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Contemporary Financial Management

Editors:  
**Sladana Benković**  
**Veljko Dmitrović**  
**Miloš Milosavljević**





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## **Contemporary Financial Management**

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**Maribor, 2023**



## Contemporary Financial Management

SLAĐANA BENKOVIĆ, VELJKO DMITROVIĆ & MILOŠ MILOSAVLJEVIĆ

**Abstract** Financial management as a scholarly field has been rapidly changing in the last few decades. This paradigm shift has been fueled by the non-precedented development of ICT technology, globalization, man-made and natural disasters and consequent crises. The aim of this book is to collect evidence on the development of financial management, both in the public and corporate sector. The book has 33 chapters, each with novel contributions to theory and practice of financial management. The book is an output of the Contemporary Financial Management Conference held in Belgrade, from 7-10 December 2022. The contributions come from various geographic regions including mainly Europe (the UK, Germany, Italy, Slovakia, Portugal, Serbia, Croatia, Montenegro, Bosnia and Herzegovina, Albania, North Macedonia), and Asia (Vietnam, and the Philippines). As for the topics – the chapters provide novel contributions to stock markets, cryptocurrencies, taxation, accounting and auditing, accounting and business intelligence, performance management and compensations, sustainable finance, financial technologies and much more. Chapters are based in various methodologies, ranging from literature reviews and theoretical conceptualizations to data science-related methodologies. The book offers valuable input for practitioners, scholars, policy makers, students and many other stakeholders interested in the ever-changing field of financial management.

**Keywords:** • finance • public finance • corporate finance • stock market • taxation • accounting • auditing

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## Revisiting the Efficiency of Performance Budgeting in OECD Countries: Lessons for Balkan Countries

MELDINA KOKOROVIĆ JUKAN & ELMAN NADŽAKOVIĆ

**Abstract** Performance budgeting (PB) is a new tool of modern public finance management reform and it is being introduced in the Balkan countries in last two decades with more or less success. Empirical research on PB practices in OECD countries shows that many of them still struggle to make effective use of performance information in budgetary decision making. To that end, this study revisits efficiency of PB in OECD countries in order to make recommendation for Balkan countries who are introducing performance budgeting. Paper investigate on efficiency of PB and its contribution to the quality of public practices in general, as well as potential challenges in implementation. OECD data on Performance budgeting survey from 2018 were used. It was concluded that PB improves efficiency of public finances but implementation process requires considerable amount of time, combination of factors, trained and educated staff, major investments in technology systems, acceptance of experimentation and failure.

**Keywords:** • performance budgeting • public finance • OECD countries

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## 1 Introduction

Performance budgeting is defined by the OECD as the systematic use of performance information to inform budget decisions, either as a direct input to budget allocation decisions or as contextual information to inform budget planning, and to install greater transparency and accountability throughout the budget process, by providing information to legislators and the public on the purposes of spending and the results achieved (OECD, 2019a). It was first introduced in the United States by the United States Secretary of Defense Robert S. McNamara in the Pentagon in the 1949. The main goal of its introduction was to improve the budgetary processes of the US government and initiative recommended that the concept of the federal budget be redesigned.

As a new tool of modern public finance management reform, performance budget aims to use performance information on public spending which are aligned with national strategies and implementing programs to inform budget decision in terms of more efficient, transparent and accountable use of public resources. In that sense, performance budgeting refers public sector funding mechanisms which use performance information to link funding to results – outputs and/or outcomes – with the aim of improving performance (Robinson, 2007).

Program budgeting remains popular and different versions of budgetary reforms under various names such as management by objectives, zero-base budgeting, program budgeting or output budgeting have been applied in USA and around the world. Nowadays, the majority of the OECD member countries apply some form of performance budgeting, but reports different levels of success in terms of achieving efficiency, transparency and better accountability. Based on evidence on implementation, USA, Australia, Finland, the Netherlands, New Zealand, and the United Kingdom are the leaders of performance budgeting.

Moreover, there are some evidences showing that performance budgeting practices contribute to lower government debt and higher GDP growth rates (Kwon, I.,2018). Therefore, it can be expected that new countries will accept some form of program budgeting as their own key to reach higher standards in public finance.

Based on the observed practices across the OECD countries, there are four different models (approaches) of performance budgeting implementation, but in practice the following three are most commonly used: presentational, performance-informed and managerial performance budgeting. Presentational performance budgeting is a model where performance information is presented with budgeting documents or other government documents, but is included as background information for the purposes of accountability and dialogue with legislators and citizens on public policy issues and government direction. Performance information does not play a significant role in decision making on allocations nor is it intended to do so. Performance information is provided parallel with the annual

budget providing transparency, but without expectation that information provided will be used in budget allocation decisions. Performance-informed budgeting is a model where performance information plays an important, but not the key a role in spending decisions; however, resources are related either to proposed future performance or to performance results in an indirect manner. There is no automatic linkage between performance and funding levels. The weight given to performance information depends on particular circumstances. Managerial performance budgeting, is a model which uses the system of performance information developed in the context of the budget process primarily as a tool of performance management and accountability at an organizational and management level, rather than primarily as a tool of resource allocation.

Empirical research on performance budgeting implementation shows that performance budgeting is increasingly prevalent in OCED counties, but many of them still struggle to make effective use of performance information in budgetary decision making (OECD, 2019b). Having that in mind, this study aims to investigate on efficiency of program budgeting use and addresses the following main research questions:

- Have performance budgeting practices contributed to the quality of public practices in OCED countries?
- What was the policy impact in terms of effectiveness of performance budgeting measured in terms of policy impact and by overall contribution of performance budgeting systems and processes to improved quality of public finances?
- What are the potential challenges/obstacles to effective implementation of performance budgeting?

The main objective of the paper is to revisit the importance of performance budgeting practices and potential obstacles to its implementation since and to provide more insight for decision makers and practitioners in Western Balkan countries where performance budgeting practices are still in the early phases of introduction, especially at the lower government levels. (eg. municipalities). In a sense, the paper contributes and re-opens the questions regarding performance budgeting efficiency since there are no significant number of most recent research on this topic.

The rest of the paper is organized as follows. Sections 2 includes literature review of previous research on efficiency of performance budgeting in selected countries. Section 3 presents the sample, variables and method used. In the fourth section the analysis and discussion of results is presented. Final part includes main conclusions and recommendations.

## 2 Literature overview

The most comprehensive research on performance budgeting practices is systematically conducted by OECD. OECD tracks progress of performance budgeting practices through Performance budgeting survey that was conducted in 2006, 2011, 2016 and 2018.

In OECDs early research from 2007, it was found that implementing performance budgeting reforms have provided number of advantages and benefits (OECD, 2007):

1. Improving the setting of objectives, performance budgeting reforms provide a mechanism that enables politicians, if they choose to use it, to clarify objectives,
2. Improving the monitoring of performance: performance information as a signaling device, key actors have tools to monitor agencies, performance and progress, with details concerning what is working and what is not working,
3. Greater emphasis on planning, the introduction of performance information has resulted in a greater emphasis on planning<sup>1</sup> in management and budgeting, and a move towards outcome focus in policy design and delivery.
4. Improving management, if properly used, performance information helps managers to implement policies and better manage programs to achieve results.
5. Improving transparency, performance budgeting reforms have improved transparency by increasing the amount of information provided to the legislature and the public on the performance and results of the public sector.
6. Informing citizens' choices, some countries provide performance information as league table that evaluates and benchmarks the provision of local services such as schools and hospitals. This provides detailed information, not just raw numbers, which can help citizens about choices (citizen can choose from among local schools and hospitals). While this information is not perfect, it can at least provide some guidance with regard to the level of performance and service provision.

In contrast to the above mentioned comprehensive surveys, there are some evidence of good practices in selected (mostly OECD) countries on performance budgeting implementation., ie. in USA (Shea, 2008), Bulgaria (Hawkesworth et al., 2009), Germany (Kelleners, 2012), European Union (Downes, 2017), Indonesia (Marsus, 2022) etc.

Evidences from United States provided mixed results on the efficiency of performance budgeting practices. United States over 45 years invest efforts to reform federal government looking for ways that would establish clearer links between outcomes and funding. Especially, over past 25 years government tried different approaches of performance systems. Although it is the cradle of performance budgeting, it still struggles with basic problems like other any other country. It is notable that still exist general reluctance of the legislature to pay attention to performance information when making budget decisions. Decentralized federal system, as constitution system also adds complexity layer to performance budgeting effort. It is very important to know that almost all-American States have tried some form of performance-based budgeting. For instance, California

implemented performance budgeting in 1982 and discarded it in 1987. New York, Oregon and South Dakota, also adopted performance budgeting, but subsequently withdrawn it. Wisconsin, adopted in 1977, repealed it in 1980, and then re-implemented it in 1997. Today, performance based budgeting is widely accepted, both by state governments and parts of the US federal government (Crain & O’Roark, 2004).

Generally, implementation did not outlive the government administrations that proposed reform. Failure demonstrated that to succeed, there must be shared commitment between budget reform and executive branch, and between the executive and legislative branches. In addition, it is difficult to implement major budget changes in a short period of time. Nevertheless, most experts agree that “While federal budget reforms have helped bring more systematic analysis into the budget process, their emphasis on performance information has had little direct impact on budget allocations.” (Office of the Legislative Auditor, State of Minnesota, 1994).

Progress of law implementation has shown numerous weaknesses. Insufficiently results-oriented measure of many agencies and programs led decision makers to help and improve program performance. Next step was Performance Improvement Initiative (PII), which aims to ensure production of maximum results. The PII gauges its success according to two measures: improved program performance and greater investment in successful programs. Shea (2008) reports that the PI Initiative is succeeding in focusing agencies’ attention on program performance. For example:

- 89% of programs established or clarified their long-term and annual performance goals to focus on the outcomes that are important to the American people.
- 82% of programs are achieving their performance goals.
- 73% of programs are measuring their efficiency, a relatively new activity for government programs.
- 70% of programs are improving efficiency annually, producing more value per dollar spent.
- 55% of programs that were initially unable to demonstrate results have improved their overall performance rating.

Yun-jie Lee and Wang (2009) claimed that United States results do not provide evidence that performance based budgeting has a significant impact on the spending growth rate. They concluded, “If performance based budgeting is designed to influence spending behaviors, efforts should be made to solicit legislative support; to involve top executives in the entire performance based budgeting process of design, implementation, and evaluation; to establish clear funding performance objectives; and to develop a culture of performance improvement.”

Compared to other international models, Downes et al. (2017) find that EU model is characterized by:

- Budget is primarily an investment-focused; emphasis is on allocation of resources of specific EU goals, avoiding duplication with national budget allocations;
- Investment programs are considered from a multi-annual perspective, and budget has a strong multi-annual character;
- Budget system is prevailing with performance information and reporting structures;
- It is legally required to abide by the principle of “sound financial management”; which means to respect the principles of economy, effectiveness and efficiency, and encompasses the need to set “SMART”<sup>2</sup> objectives.
- Performance and results are concern of different EU institutions: European Commission, European Parliament and the European Court of Audit (ECA).

Australia’s major lessons from performance budgeting reform are that it takes a considerable amount of time, it requires a combination of factors, there is a need to train and educate staff, there is a need for major investment in technology systems, there needs to be acceptance of experimentation and failure, devolved responsibility to agencies requires very good information from agencies and maybe most important is that Reform is an ongoing process. As Hawke (2016) concluded “Australia is likely to keep trying to refine its performance information arrangements rather than abandoning them.”

### 3 Research Methodology: Research Data and Methods used

For data analysis, we use descriptive inference statistics, while from conclusions regarding the efficiency and types of program budgeting model employed, we use correlations and hi-square test. Due to the fact that the total population of OECD countries is 34, we use obtained data to make general conclusions, even though the hi-squared test did not show any statistical correlations

For the purposes of this study, we use OECD International Database on Performance Budgeting from 2018. Table 1 provides information on variable used for data analysis.

**Table 1:** Description of variables

Variables and measurements	Source
Variables measuring existence of performance budgeting practices	
1. Performance budgeting practices	
Existence performance budgeting framework in place (i.e. linking budgetary allocations with information about performance, objectives and / or results)? (R27)	OECD questionnaire, 2018 Q 5
(NO=1;	
Yes, and it is compulsory for line ministries and agencies=2	
Yes, but it is compulsory only for line ministries=3	
Yes, but it is optional for both line ministries and agencies=4)	

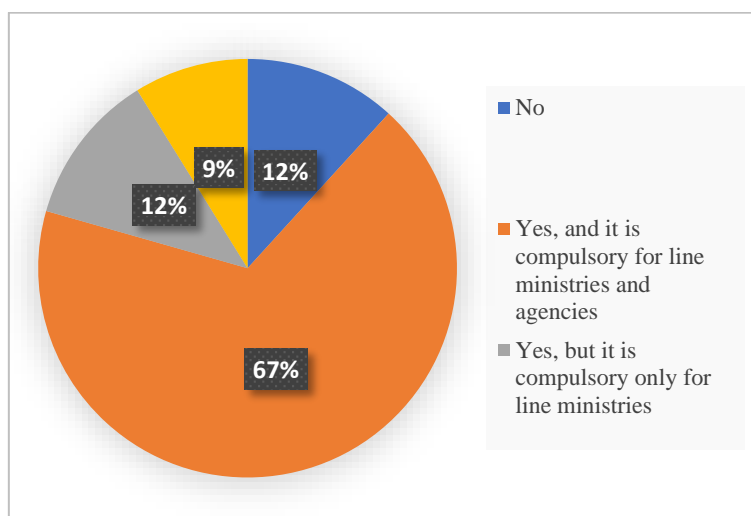
2. Performance budgeting models	
Which of the OECD performance budgeting system definitions most accurately describes the system in your country? (R28) (Managerial Performance Approach =1 Performance-Informed Approach =2 Presentational Approach =3)	OCED questionnaire, 2018 Q 5a
Variable measuring effectiveness of performance budgeting	
1. Policy impact - Relative effectiveness of the performance budgeting system in advancing the considerations to the following: Promoting transparency in policy aims and impacts Promoting accountability for the effective use of resources by public bodies Informing the allocation and prioritisation of resources by the executive Improving parliament's ability to understand and engage in discussion and debate on budget issues. Promoting a culture of performance within in the public sector Facilitating evaluation and oversight of spending effectiveness and impact Promoting budget integration and coordination to support the achievement of cross-cutting goals (not applicable=0, low=1, medium=2, high=3)	OCED questionnaire, 2018 Q 16
2. Overall contribution of performance budgeting systems and processes to improved quality of public finances Yes, quantifiable improvements Yes, non-quantifiable improvements No perceptible improvements to date (Strongly disagree=1, Somewhat disagree=2 Neither agree nor disagree=3 Somewhat agree=4 Strongly agree=5)	OCED questionnaire, 2018 Q 24
Challenges for performance budgeting implementation	
1. Potential challenges to effectively implementing performance budgeting Lack of accurate and timely data to serve as input for performance measures Poorly formulated indicators and targets that are not useful Lack of leadership/commitment in promoting performance-based approach to budgeting Gaming - whereby selection of performance targets chosen deliberately in ways that bias results Unclear how performance affects budget allocation decisions Focus on performance is not sustained once the budget has been allocated Coordination problems where the achievement of targets requires horizontal working and cooperation across central government organisations Lack of capacity/training for staff/civil servants with regards to performance measurement Lack of resources (time, staff, operating funds) to devote to performance evaluations Lack of culture of "performance" Inadequate central guidance on performance-budgeting Information overload—too much information is presented and not always clear which are most adequate for decision-making Performance budgeting procedures too bureaucratic/lengthy/complicated Lack of adequate ICT (N/A=0, Low=1, Low-medium=2, Medium=3 Medium-high=4, High=5)	OCED questionnaire, 2018 Q 25

## 4 Results and Discussion

### 4.1 Overview of performance budgeting practices in OCED countries

Based on the 2018 OECD Performance Budgeting Survey data (OECD, 2018) most of the countries (88%) have some form of performance budgeting framework in place (see figure 1), where in most of the cases (67%) is compulsory for line ministries and agencies.

**Figure 1:** Existence of performance budgeting framework in OECD countries

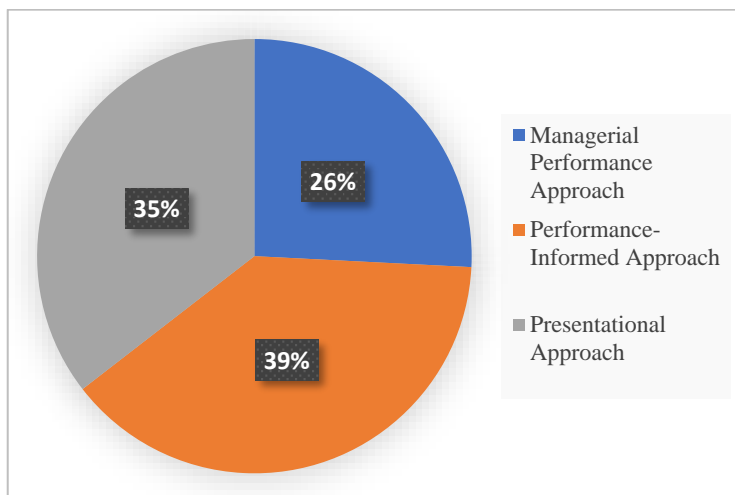


Source: (OCED, 2018), Question 5 (authors' calculation).

Furthermore, there are three types performance budgeting models used in OCED countries, namely managerial performance budgeting model, performance-informed and presentation performance budgeting model/approach (see figure below)



**Figure 2:** Types of performance budgeting model/approach used in OECD countries



Source: (OECD, 2018), Question 5.1 (authors' calculation).

Data shows that there is no one preferred type of performance budgeting model/approached being used.

## 4.2 Effectiveness of performance budgeting in OECD countries

Table 2 provides descriptive statistics on effectiveness of performance budgeting in terms of policy impact. Based on the results, it can be observed that efficiency of performance budgeting has most impact on promoting transparency in policy aims and impacts (in 50% of reporting countries), promoting accountability for the effective use of resources (in 50% of reporting countries) and promoting a culture of performance within the public sector.

On the other hand, effectiveness was not achieved in terms of improvement of parliament's ability to understand and engage in discussion and debate on budget issues. Only five countries (17,9%) reported high increase in that aspect of effectiveness. Facilitation of evaluation and overseeing on public spending, better allocation and prioritization as well as integration and coordination to support cross-cutting goals are partially achieved.

In order to examine the relation between domains of effectiveness and types of performance budgeting framework as well as between effectiveness and performance budgeting models/approaches we used correlation and Chi-squared test of independence. Both test did not show evidences of statistically significant correlation between domains of effectiveness and types of performance budgeting framework as well as between effectiveness and performance budgeting models/approaches.

**Table 2:** Effectiveness of performance budgeting (policy impact): descriptive statistics

<b>Domains of effectiveness:</b>	<b>Descriptive statistics</b>							
	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Average</i>	<i>Std. Dev.</i>	<i>Range</i>	<i>Min.</i>	<i>Max</i>
Promoting transparency in policy aims and impacts	3 (9,4%)	13 (40,6%)	<b>16 (50%)</b>	2,52	0,511	1-3	1	3
Promoting accountability for the effective use of resources by public bodies	5 (16,7%)	13 (43,3%)	<b>12 (40%)</b>	2,35	0,647	1-3	1	3
Promoting a culture of performance within in the public sector	8 (25,8%)	9 (29%)	<b>14 (45,2%)</b>	2,22	0,795	1-3	1	3
Facilitating evaluation and oversight of spending effectiveness and impact	11 (35,5%)	12 (38,7%)	8 (25,8%)	2,00	0,739	1-3	1	3
Informing the allocation and prioritisation of resources by the executive	8 (27,6%)	15 (51,7%)	6 (20,7%)	1,96	0,706	1-3	1	3
Promoting budget integration and coordination to support the achievement of cross-cutting goals	13 (48,1%)	9 (33,3%)	6 (18,5%)	1,65	0,714	1-3	1	3
Improving parliament's ability to understand and engage in discussion and debate on budget issues	7 (25%)	16 (57,1%)	5 (17,9%)	1,62	0,668	1-3	1	3

Source: (OECD, 2018), Question 16 (authors' calculation).

### 4.3 Contribution of performance budgeting to the quality of public practices

Table 3 provided insights into the contribution of performance budgeting to the quality of public practices in OECD countries. The respondents were asked to assess the contributions in terms if there were quantifiable and non-quantifiable contributions or they did not experience any improvements at all.

Based on the survey results, it can be concluded that performance budgeting is improving public practices, but those improvements seems to be non-quantifiable. Less than 13% of respondent agrees that improvements can be quantified. In contrast, more than 60% of respondent reported non-quantifiable improvements observed.

Furthermore, in order to examine the relation between quality of public practices and types of performance budgeting framework as well as quality of public practices and performance budgeting models/approaches we used correlation and Chi-squared test of independence.

Chi-squared test of independence did not show any statistically significant correlation between quality of public practices and types of performance budgeting framework. Chi-squared test of independence showed statistically significant correlation quality of public practices and performance budgeting models/approaches ( $p=0,015$ ). It is more likely that using managerial budgeting approach will yield in higher non-quantifiable improvements in the overall perception on the quality of public practices.

**Table 3:** Performance budgeting systems and processes contribution to improved quality of public finance

<i>Descriptive statistics</i>										
	<i>Strongly disagree</i>	<i>Somewhat disagree</i>	<i>Neither agree or disagree</i>	<i>Somewhat agree</i>	<i>Strongly agree</i>	<i>Average</i>	<i>Std. Dev.</i>	<i>Range</i>	<i>Min.</i>	<i>Max</i>
Quantifiable improvements	3 (9,7%)	1 (3,2%)	13 (41,9)	10 (32,3%)	4 (12,9%)	3,24	1,023	1-5	1	5
Non-quantifiable improvements	-	-	12 (38,7%)	10 (32,3%)	9 (29%)	3,83	0,805	1-5	1	5
No perceptible improvements to date	10 (34,5%)	8 (27,6%)	7 (24,1%)	4 (13,8%)	-	2,17	1,017	1-5	1	5

Source: (OECD, 2018), Question 24 (authors' calculation).

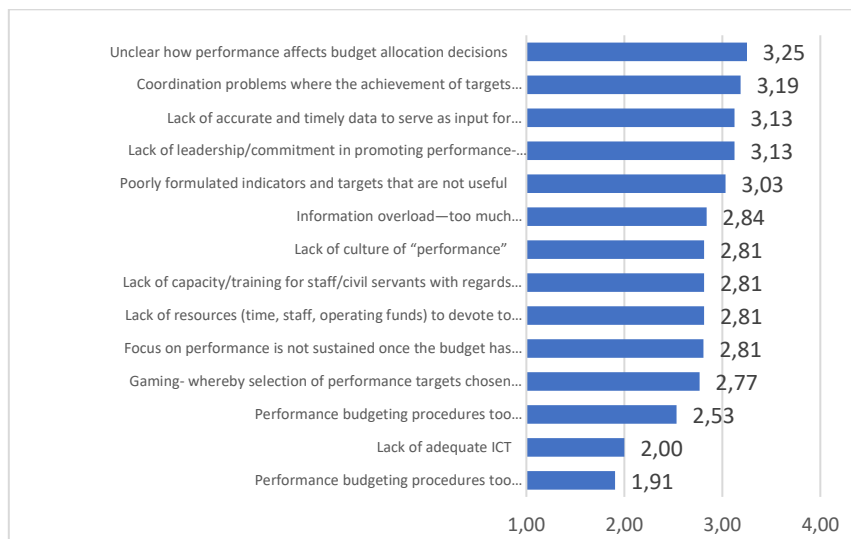
#### 4.4 Challenges to effectively implementing of performance budgeting

Key challenges to effectively implementing of performance budgeting are reported in figure 3.

In terms of the main challenges to implement performance budgeting, the most pressing ones are related to the following:

- understanding of how performance budgeting practices contribute to better decisions on budget allocation;
- crating coordination to achieve target requirement among line ministries (horizontal coordination) and between government levels (vertical coordination) and
- lack of accurately and timely data to ensure adequate implementation of the performance budget in terms of measure using for corrective actions.

The similar conclusions are reported by Marsus, 2022 in case of Indonesia.

**Figure 3:** Potential challenges to effectively implementing performance budgeting in OECD countries

Source: (OCED, 2018), Question 22 (authors' calculation).

## 5 Conclusions

Performance budgeting as the new tool for public spending is being introduced as a legal obligation across all Balkan countries. Most of the Balkan countries started with implementation of budgeting reform in the last two decades with more or less success. Being perceived as a tool for achieving “Value for Money”, accountability, transparency, efficiency and effectiveness of allocation of resources governments of all SEE countries accepted this method of budgeting. All countries, except Bosnia and Herzegovina, fully incorporated performance based budgeting into the budgeting legal system. Due to the complex political and legal structure, Bosnia and Herzegovina, only partly accepted performance budgeting system. Beside legislation, performance based budgeting reforms are still in the early development phase. Due to its importance and implication for fiscal policy and, consequently, on the lives of ordinary citizens, there was a need for understating what types of performance budgeting approaches are most commonly used, how it improves efficiency of public finance and what are the main obstacles that need to be address in order to establish functional performance budgeting model.

As most of the research show, it is not questionable that performance budgeting is the new standard for accountable, transparent and efficient way of public spending. This is confirmed through the OCED performance budgeting practices survey, which clearly shows

that introduction of any model/approach of performance budgeting will contribute to the quality of public practices.

Research confirms that introduction of performance budgeting improved budgeting process efficiency. It is showed that performance budgeting promotes (1) transparency of policies in terms of their aims and impact, (2) accountability of public bodies (ministries and government agencies where performance budgeting approach is implemented) and (3) informs decision makers on more effective budget spending. It also shows efficiency in terms of promotion of culture of performance within in the public sector in most of the OCED countries. Still, additional efforts need to be in terms of improving parliament's ability to understand and engage in discussion and debate on budget issues and especially in respect to evaluation and oversight of spending effectiveness.

In terms of overall improvements of the quality of public practices, the research showed that more than half of the respondents stated that quantifiable improvements of the quality of public practices can be observed. But still, there are some obstacles of full implementation reported by the respondent. The most pressing issues in performance budgeting practices implementation are related to the following: coordination problems to achieve target requirements among different government levels, lack of clear leadership and commitment to promote performance budgeting, and lack of accurate data to improve performance.

Implementation process of performance based budgeting is process that requires considerable amount of time, combination of factors, trained and educated staff, major investments in technology systems, acceptance of experimentation and failure and it's an ongoing process for all Balkan countries, where the evaluation of the implementation will be needed in the future.

The main limitation of this research is related to data source. We based our conclusion on the survey conducted by OCED, but we propose explaining analysis in the future research with focus on case studies and good practices of performance budgeting introduction in selected countries.

#### **Notes:**

<sup>1</sup> There is more emphasis on long-term planning through the introduction of three-to five-year strategic plans.

<sup>2</sup> Setting SMART objectives is the first step for budgeting. The SMART model is an acronym of Specific, Measurable, Attainable, Realistic and Timely that has been widely used to set objectives.

## References:

- Crain, M. W. & O’Roark, J. B. (2004) The impact of performance-based budgeting on state fiscal performance, *Economics of Governance*, 5(2), pp. 167-186, <https://doi.org/10.1007/s10101-003-0062-6>.
- Downes, R., Moretti, D. & Nico, S. (2017) Budgeting and performance in the European Union: A review by the OECD in the context of EU budget focused on results, *OECD Journal on Budgeting*, 2017/1, available at: <https://www.oecd.org/gov/budgeting/budgeting-and-performance-in-the-eu-oecd-review.pdf> (May 7, 2022).
- Hawke, L. (2016) Case studies: Australia, In: Moynihan, D. & Beazley, I. (eds.) *Toward Next Generation Performance Budgeting: Lessons from the Experiences of Seven Reforming Countries. Directions in Development* (Washington, DC: World Bank), pp. 41-54, <https://doi.org/10.1596/978-1-4648-0954-5>.
- Hawkesworth, I., Emery, R., Wehner, J. & Saenger, K. (2009) Budgeting in Bulgaria, *OECD Journal on Budgeting*, 2009/3, pp. 133-183, available at: <https://www.oecd.org/gov/budgeting/46051594.pdf> (May 7, 2022).
- Kelleners (2012) *Performance and Budget Modernization - the German Experience*, 5th Annual Meeting of Middle East and North Africa Senior Budget Officials (MENA-SBO), Tunis 2012, available at: [https://www.oecd.org/gov/budgeting/D2-AM%20-%20Roundtable%20-%20M.%20KELLENNERS%20-%20Germany%20\(English\).pdf](https://www.oecd.org/gov/budgeting/D2-AM%20-%20Roundtable%20-%20M.%20KELLENNERS%20-%20Germany%20(English).pdf) (May 7, 2022).
- Kwon, I. (2018) Performance Budgeting: Effects on Government Debt and Economic Growth, *Applied Economics Letters*, 25(6), pp. 388–392, <https://doi.org/http://www.tandfonline.com/loi/rael20>.
- OECD (2007) *Performance Budgeting in OECD Countries* (Paris: OECD).
- Marsus, S. (2022) Does The Performance-Based Budgeting Work In Indonesia?, *International Journal of Scientific & Technology Research*, 9(2), pp. 3207-3214, available at: <https://www.ijstr.org/final-print/feb2020/Does-The-Performance-based-Budgeting-Work-In-Indonesia.pdf> (December 1, 2022).
- OECD (2018) *International Database of Performance Budgeting* (Paris: OECD).
- OECD (2019a) *OECD Good Practices for Performance Budgeting* (Paris: OECD Publishing).
- OECD (2019b) *Budgeting and Public Expenditures in OECD Countries 2019* (Paris: OECD Publishing).
- Office of the Legislative Auditor, State of Minnesota. (1994) *Performance Budgeting* (Saint Paul: Program Evaluation Division).
- Robinson, M. (2007) *Performance Budgeting: linking Funding to Results* (Basingstoke, New York: Palgrave Macmillan/IMF).
- Shea, R. J. (2008) Performance Budgeting in the United States, *OECD Journal on Budgeting*, 8(1), pp. 1-13.
- Yun-jie Lee, J. & Wang, X. (2009) Assessing the Impact of Performance-Based Budgeting: A Comparative Analysis across the United States, Taiwan, and China, *Public Administration Review*, 69, pp. S60-S66, available at: <https://www.jstor.org/stable/40469073> (May 7, 2022).

## Albanian Local Authorities' Dynamics of Expenditures and the Structure of Financial Resources

NEVILA XHINDI & TEUTA XHINDI

**Abstract** Albania has undertaken two decentralization reforms in separate times in the post-communist period. The first was in the late 1990s and the second with the territorial reform of 2014. The main idea behind the territorial reform of 2014 was achieving a real decentralization after some previous not substantial efforts, to offer to the new 61 municipalities and 12 regional authorities (districts) more financial autonomy to carry out the functions devolved to them, based on the principle that national budgetary policies should ensure that local authorities are adequately funded and that they should have a wide range of income sources. The financial systems, on which resources available to local authorities are based, shall be of a sufficiently diversified and of a flexible nature, enabling them to manage the real evolution of the cost of carrying out their tasks. The purpose of this paper is to examine the dynamics and structure of financial resources as well as the expenses of the municipalities by comparing the two time periods of the implementation of the new administrative reform 2015-2018 and 2019-2021, using the Mann Whitney Wilcoxon test. It turns out that there are no statistically significant differences regarding the structure of financial resources and expenses of the municipalities in the two time periods. From the comparison of the two time periods, it is noted that capital expenditures have decreased while current expenditures have increased. This is also due to the reallocation of financial resources to facilitate the consequences of COVID 19 for Albanian taxpayers. The present paper has not only theoretical and empirical added value by focusing on the Albanian case-study seen through comparative lenses, but also policy-making relevance since it coincides with a new political and public debate on coming up with a new and consensual territorial map.

**Keywords:** • decentralization reform • financial resources • financial autonomy  
• Mann Whitney Wilcoxon test

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## 1 Introduction

In the post-communist era, Albania has implemented decentralization changes at least twice. The first occurred in the late 1990s, while the second occurred with the 2014 territorial reform. Although the objectives of the first were to bring Albania into compliance with the European Charter of Local Self-Government and the objectives of the second were to have a more effective administration of the area, the genuine decentralization of power has not occurred.

In accordance with Law 115/2015, the Albanian government consolidated 373 local authorities (municipalities and communes) into 61 municipalities in 2015. The local government system was changed as a result of the reform, with a number of constituent administrative entities (the former communes) being created as the functional component of the new local authorities (municipalities). The establishment of these considerable bodies, in the government's view, marked the beginning of a larger strategy to give democratically elected local authorities a more significant position in the nation's public administrative system.

Four goals underlie the reform of local governance and decentralization of 2014: (1) improving the effectiveness of local government structures; (2) strengthening local finances and boosting fiscal autonomy; (3) enhancing good governance; and (4) fostering sustainable local development. (Albania Council of Ministers, 2015)

The purpose of this paper is related to the second goal of the reform: "strengthening local finances and boosting fiscal autonomy".

Albanian local authorities' financial autonomy is guaranteed in the Constitution and the Law 68/2017 on the financing of local self-government. The Law states that fiscal decentralization is still a key component of the reform agenda and its goal is to give local and regional authorities more financial freedom to do the tasks assigned to them (Ministry of Finance and Economy). It is based on the idea that national budgetary strategies ought to guarantee that local governments receive appropriate funding and a variety of sources of revenue.

Stated in Law 139/2015 on local self-government, one of the fundamental principles of municipal funding is that the functions and powers granted to local self-governing authorities must always be accompanied by the financial resources required to carry them out (Instituti per Demokraci dhe Ndermjetesim).

The Ministry of Finance and the Economy in Albania has implemented reforms over the past few years that have strengthened and expanded the legal framework granting the allocation of funds to local self-government entities. This has been accompanied by a deepening of the decentralization process in terms of the usage of financial resources as



well as the skills and responsibilities that the local self-government entities undertake. As one of the primary and essential components for the strengthening of governance and local democracy, a significant emphasis has been made throughout this time on enhancing economic and financial autonomy local self-government. The improvement of local fiscal autonomy through local fiscal authority to generate revenue (service taxes and fees) and the predictability and stability of intergovernmental fiscal transfers, are key factors in enhancing local capacities for carrying out their duties and, in particular, for gathering the necessary financial resources.

This article compares the two implementation periods of the new administrative reform 2015–2018 and 2019–2021 using the Mann Whitney Wilcoxon test *in order to examine the dynamics and structure of financial resources as well as the expenses of the municipalities.*

We have compared data from two significant time periods. The following questions are posed in this paper: How did the indicators of municipalities' sources of funding performed? How did the indicators used to assess the decentralization process in terms of costs performed over the research periods of 2015–2018 and 2019–2021? Do the values of the indicators in the two time periods differ significantly?

Local authorities' own resources have essentially doubled since 2015, when the local self-government reforms began to take effect, while the funding of investments from the same source has increased fourfold, though still not to a satisfactory level.

It turns out that there are no statistically significant variations between the two time periods in the municipalities' financial resource and spending structures.

From the comparison of the two time periods, it is noted that capital expenditures have decreased while current expenditures have increased. This is also due to the reallocation of financial resources to facilitate the consequences of COVID 19 for Albanian taxpayers.

With a focus not only on the delivery of services with efficiency and effectiveness, but also its impact on the growth of the local economy, this paper will serve as an analysis regarding the financing of local units, granting the freedom of financial action to local units, or even increasing local finances. However, over this time, the organization of local finances has undergone significant qualitative changes. Despite the fact that a large share of local government units still rely heavily on national sources of funding, the amount of money they create on their own has grown, and they are using new sources as well.

## 2 Literature overview

Although there is a limited amount of literature on local finance and decentralization, political scientists, sociologists, and other researchers have been interested in these and related issues in many different countries. It is important to note that there are many opposing viewpoints in the literature about the necessity and extent of decentralization processes and the effect of fiscal decentralization on local economic development. The authors' opinions are based on their knowledge of the country's history, financial potential, fiscal capabilities, human resources, demographic trends, etc. With regard to fiscal decentralization and local economic development in particular, we have made an effort to include policy documents, research, and other publications that address these issues.

Decentralization is essentially a democratic reform that aims to give local governments more control over political, administrative, financial, and planning decisions. It aims to foster civic engagement, local people's empowerment in decision-making, and accountability and dependability: To improve resource management, resource collecting, and service delivery efficiency and effectiveness (Akai, Nobuo; Sakata. M, 2002).

Considerable effort is being made to portray municipal budget concerns as a favor or simple political will of the ruling majorities (Committee of the Regions, 2009). The economic justification for this financial mechanism has received very little consideration, particularly in light of the European Charter of Local Autonomy. Beyond the political aspects and perspectives or causes that have accompanied decentralization in former communist nations, the difficulties of local government financing are also issues of the economy and growth in general (Cini, 2007).

The decentralization of governance, particularly the fiscal one, is one of the tools that helps citizens' quality of life (Hussain, S; Moiz Hali, Sh; Ahmad, R; Iqbal, S; Iftikghar, H, 2021). The organization of monetary and financial institutions, the character of the legal system, the continuous process of economic and political reforms, and tensions resulting from ethnic, religious, or economic divisions are all part of the institutional background of fiscal decentralization (Bala, 2017).

In order to create opportunities for the financing of supported or so-called "subsidy" or subsidized functions, fiscal decentralization must first be implemented (Committee of the Regions, 2009). The foundation of any effort to reform the public sector is the establishment of an efficient and open financial management system. The key elements of financial management must also be democratic, in order to achieve true decentralization, including (a) transparent funding distribution, (b) predictable funding levels for local institutions, and (c) local decision-making autonomy in resource allocation (Toska, M; Bejko.A). The distribution of resources should be based on open formulas, as opposed to the common practice of "ad hoc" policy-driven grants.

Additionally, unlike the financial predictability common to most central mechanisms for local ones, which are the majority transfers in developing countries, the procedure should give local institutions a clear indication of how much money would be available in the cycle of multi-year planning. This enables local strategic planning, offers a budgetary ceiling that makes local planning a worthwhile activity, and gives local communities the chance to make independent judgments regarding the use of scarce resources. Thus, fiscal decentralization requires not only the transfer of financial resources and fiscal authority to local units, but they must be predictable in order to make it possible for planning to be sufficient to fulfill tasks, transparent and spending autonomously (Rodriguez-Pose, A.; A. Krojier, 2009).

One of the paradoxes that arises in the process of advancing decentralization reforms is that they are driven from above more than they should have been driven from below (Xhindi, *Regional Development: an opportunity or a challenge for the Albania joins EU*, 2010). Central governments have not been interested in giving up their functions and decentralizing them to give more competence and resources to local governments (PLGP, 2014). In actuality, this reflects policy orientation and administrative restrictions that are supported by the center the best. However, given the strong centrist heritage in post-communist nations, this is more than understandable. After the fall of communism, in many South East European countries the political reform programs were effective initiatives that were well-coordinated by international organizations and partners, and which focused political deliberation and decision-making on the development of institutions in line with European standards (Council of Europe, 12 October 2011). However, the changes in these nations overemphasized political decentralization while neglecting or even ignoring administrative and particularly fiscal decentralization (Soylu ÖB, Çakmak İ, Okur F, 2018). According to the research, this is more obvious in Albania, which we shall discuss in more detail below.

We may argue that since communism's collapse in Albania, the academic and political landscape has been actively discussing fiscal decentralization while examining and analyzing its prospects for success. In the decades that followed the collapse of the centralized, bureaucratic system, there has been an increased interest among researchers and development organizations in implementing fiscal decentralization as a key tool for fostering economic growth (Dragusha, B; Osmani, E, 2012).

### 3 Method

To empirically compare the two periods 2015-2018 and 2019-2021 regarding the dynamics and structure of financial resources as well as the expenses of the municipalities, the Man Whitney Wilcoxon test is used. Because of the restricted number of observations, since the distribution of data is very difficult to determine, the application of nonparametric tests is the only suitable option. Advantages of this nonparametric

procedure is that it does not require the assumption that the populations have a normal distribution.

The indicators that are used to assess the performance of decentralization in terms of source of financing of the municipalities, in the periods 2015-2018 and 2019-2021, are:

- Indicator A: Local revenues/Total financial resources
- Indicator B: Local revenues and shared taxes/Total of financial resources
- Indicator C: Local revenues, shared taxes and unconditional transfers/Total of financial resources.

The indicators that are used to assess the performance of decentralization in terms of expenditures of the municipalities, in the periods 2015-2018 and 2019-2021, are:

- The ratio of expenditures (total, own source and conditional) to nominal GDP, and
- The ratio of expenditures (total and own source) to general government expenditures.

The question is: Are there statistically significant differences in the values of the indicators in the two time periods?

The data about indicators used, are taken from two sources:

Local Finances Report 2021 – English (<http://financatvendore.al/pub/raporte>);

Macroeconomic and fiscal framework for the period 2021-2023, (VKM Nr 53, date 29.01.2020), Ministry of Finance and Economy (<https://financa.gov.al/kuadri-makroekonomik%20dhe%20fiskal%202/>).

Limitation: The analysis is done considering the data of all municipalities together, not classifying them by size or economic performance.

#### **4 Analyses of local authorities' dynamics of expenditures and the structure of financial resources**

The Albanian Constitution and the new Law 68/2017 on the funding of local self-government in Albania both guarantee the financial independence of local authorities. The Act states that fiscal decentralization is still a key component of the reform agenda. The objective is to give local and regional administrations more financial freedom to do the tasks assigned to them. It is based on the idea that national budgetary strategies ought to guarantee that local governments receive appropriate funding and a variety of sources of revenue. According to Article 10, local governments may receive revenue from local taxes and fees, other local sources of income, state grants, proceeds from jointly levied federal taxes and fees, local borrowing, gifts and donations, and any other local sources authorized by local legislation.

Since 2000, Albania has strategically decentralized fiscal and administrative decisions at the local level, giving local units and municipalities more authority to produce revenue

and use it for citizen services and less authority to counties (qark) (Xhindi, 2012). The indicators used to assess fiscal decentralization in Albania, as well as in Eastern and South-Eastern Europe, have been under constant review by partners and international institutions (PLGP, 2014). Fiscal decentralization performance indicators, such as local expenditure and income as a percentage of national income and local income and expenditure as a percentage of GDP, have been tracked and reported by organizations and international partners like the World Bank, USAID, UNDP, and the European Commission, among others.

Table (1) presents the distribution of all municipalities by the number of inhabitants. Approximately 73% of municipalities, with the exception of the atypical Municipality of Tirana (with an exceptionally high population), have populations that are lower than the national average (Toska, M; Bejko, A, 2018). The relative size of local budgets and the level of own source revenues per capita signal the selective effectiveness of decentralization reforms.

**Table 1:** Classification of municipalities by size (number of population)

Criteria	Group	Municipality
Up to 40,000 inhabitants	Small municipalities (43/61)	Pustec, Dropull, Libohovë, Këlcyrë, Fushë Arrëz, Delvinë, Himarë, Konispol, Tepelenë, Finiq, Përmet, Memaliaj, Poliçan, Pukë, Kolonjë, Skrapar, Selenicë, Klos, Has, Belsh, Sarandë, Tropojë, Roskovec, Mirditë, Rrogozhinë, Patos, Gramsh, Përrenjas, Vorë, Peqin, Devoll, Mallakastër, Ura Vajgurore, Cërrik, Mat, Shijak, Gjirokastrë, Vau i Dejës, Malësi e Madhe, Bulqizë, Kuçovë, Librazhd, Divjakë.
40,001 - 100,000 inhabitants	Medium-sized municipalities (11/61)	Kavajë, Maliq, Kurbin, Kukës, Krujë, Berat, Pogradec, Dibër, Lezhë, Korçë, Lushnjë
> 100,000 inhabitants	Large sized municipalities (6/61)	Kamëz, Vlorë, Fier, Shkodër, Elbasan, Durrës
557,422 inhabitants	Municipality of Tiranë (1/61)	Tiranë

Source: [www.financatvendore.al](http://www.financatvendore.al) and authors.

The method of financing local government in Albania represents a structure of intergovernmental transfers. There are two types of intergovernmental transfers: Unconditional and conditional. While the first are divided by a formula which is modified almost every year and is included in the law on the state budget, the second is a transfer which mainly covers the investments of common functions and is given according to a set of criteria (HDPC: CO-Plan; IPC, 2021).

Although their circumstances vary greatly, generally speaking, the new reforms implemented have increased towns' fiscal and budgetary autonomy. Municipalities control 75% of the revenue sources, while the federal government, through conditional or designated contributions, controls 25% of all local spending. In addition to conditional payments, there are also unconditional transfers<sup>1</sup>, which make for a substantial portion of the state's financial transfers (Ministry of Finance and Economy, 2021).

Despite several municipalities significantly raising local taxes and fees over this time, the average financial autonomy ratio—municipalities' ownership as a percentage of total resources—has not changed significantly in recent years: 25.6% in 2010, 25.2% in 2015, and 27% in 2017. The financial autonomy ratio of the 61 municipalities, as shown by a more in-depth individual analysis, ranges from 3% to 68%, indicating major disparities in the extent of reliance on the state. (Ministry of Finance and Economy, 2021).

Together with the percentage of a municipalities' own income and the percentage of central government payments in the overall local budget, local taxes serve as the foundation for local revenues that finance local services, making it a key indicator for determining local autonomy. As a result, local authorities with a large portion of local revenues in their budget and the ability to fund their required obligations have more financial freedom. A tax can only be considered entirely local if the regulating body has the ability to determine the rate "within the bounds of the law." As a result, the applicable tax legislation may establish a "band" of tax rates, within which the local authority may choose the actual tax rate (Cadoret, X; Dejonghe. C, 22 Septemeber 2021).

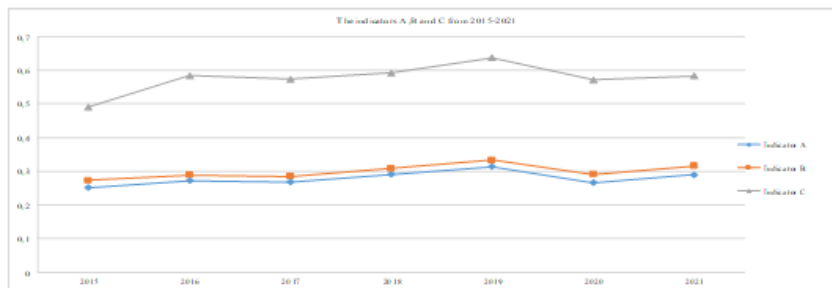
The table below contains data for the indicators about the source of financing of municipalities:

**Table 2:** The data about indicators A, B and C <sup>2</sup>

Year	Indicator A	Indicator B	Indicator C
2015	0.252	0.27	0.49
2016	0.272	0.29	0.58
2017	0.268	0.28	0.57
2018	0.291	0.31	0.59
2019	0.314	0.33	0.64
2020	0.266	0.29	0.57
2021	0.290	0.32	0.58
Average 2015-2018	0.271	0.29	0.56
Average 2019-2021	0.29	0.3136667	0.5973333
Standard deviation	0.02058179	0.0208334	0.0434741

Source: Calculation of the authors with the data taken from [www.financatvendore.al](http://www.financatvendore.al).

**Figure 1:** The presentation of indicators A, B and C, for 2015-2021 time periods



From Figure 1, we see that all three indicators have the same trend: are worsened in 2019-2020 period and are improved in 2020-2021 period.

While the vast majority of local government units rely on transfers from the central budget for larger investments, the budgets from unconditional transfers and own revenue are primarily used to finance relatively modest interventions in the local infrastructure (the vast majority being road interventions) (or other investment funds, such as the Albanian Development Fund).

But the question is: Is there a statistically significant difference in the mean values for every indicator for 2015-2018 and 2019-2021 time periods? Table 3 presents the result after performing the Man Whitney U test.

**Table 3:** The results from Man Whitney U test

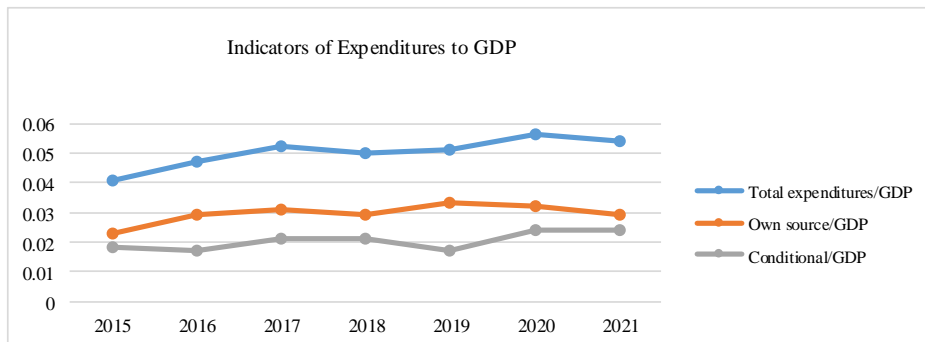
Indicator	Z value	Asymp.Sig.(2-tailed)	Result
A	-0.707	0.48	The two populations are identical
B	-1.605	0.108	The two populations are identical
C	-0.72	0.471	The two populations are identical

Based on Man Whitney U test, we conclude that: there are not statistically significant differences between mean values of each indicator in two time periods: 2015-2018 and 2019-2021.

Now, how the local government units have used the financial resources? According to the relevant literature, there are two categories of indicators that are used to assess the performance of decentralization in terms of expenditures: the ratio of expenditures (total, own source and conditional) to nominal GDP and the ratio of expenditures (total and own source) to general government expenditures.

From figure 2, we conclude that the performance of local governments increased from 2015-2017, as two indicators have increased in this period. Due to the COVID-19 pandemic, the indicator of expenditures from own funds to GDP has decreased to 3.2% in 2020 and 2.9% in 2021.

**Figure 2:** The presentation of indicators of expenditures to GDP





The average value of the indicator of expenditures with own source to GDP is 2.94% and this value is significantly below the average of the Western Balkan countries of 5.5%, South-East European countries of 6% and EU28 countries of 10.6%.

**Table 4:** The indicator used to assess the performance of LGU

	<b>Total expenditures/GDP</b>	<b>Own source/GDP</b>	<b>Conditional/GDP</b>
2015	4.1%	2.3%	1.8%
2016	4.7%	2.9%	1.7%
2017	5.2%	3.1%	2.1%
2018	5.0%	2.9%	2.1%
2019	5.1%	3.3%	1.7%
2020	5.6%	3.2%	2.4%
2021	5.4%	2.9%	2.4%

Source: Calculation of the authors with the data taken from [www.financatvendore.al](http://www.financatvendore.al).

As in the case of the indicators of the source of financing, the question is: is there a statistically significant difference in the mean values of the indicators of expenditures to GDP for 2015-2018 and 2019-2021 time periods?

The table below presents the result from the Man Whitney U test.

**Table 5:** The results from Man Whitney U test for the indicators of expenditures to GDP

<b>Indicator</b>	<b>Z value</b>	<b>Asymp.Sig.(2-tailed)</b>	<b>Result</b>
Total expenditures/GDP	-1.768	0.077	The two populations are identical
Own source/GDP	-1.468	0.142	The two populations are identical
Conditional/GDP	-0.909	0.364	The two populations are identical

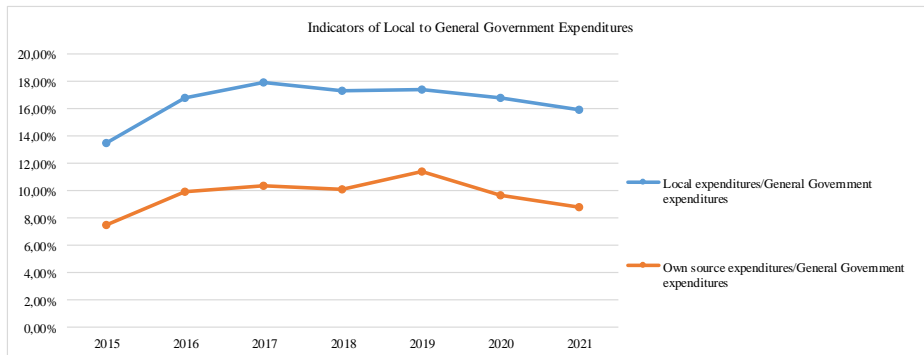
As the p values in the third column, are greater than significance level of  $\alpha=5\%$  we conclude that there aren't statistically significant differences between values of each indicator in two time periods: 2015-2018 and 2019-2021.

While, referring to the indicator of total expenditures incurred by local government, total expenditures to nominal GDP, the values have increased from 4.1% in 2015 to 5.6 % in 2020. In 2021, the total expenditures of 61 municipalities amounted to 5.4% of nominal GDP, 0.2 percentage points lower than the previous year.

**Table 6:** The other indicator used to assess the performance of LGU

	Local expenditures/General Government expenditures	Own source expenditures/General Government expenditures
2015	13.5%	7.5%
2016	16.8%	9.9%
2017	17.9%	10.3%
2018	17.3%	10.1%
2019	17.4%	11.4%
2020	16.8%	9.6%
2021	15.9%	8.8%

Source: Calculation of the authors with the data taken from [www.financatvendore.al](http://www.financatvendore.al).

**Figure 3:** The presentation of indicators of local to General Government Expenditures

How did local government units use financial resources during the 2015-2021 time period?

Table 7 presents the data about three indicators: Public investments/GDP, Investments with own sources/GDP and Total investments/GDP.

**Table 7:** The use of financial resources, the expenditures of LGU

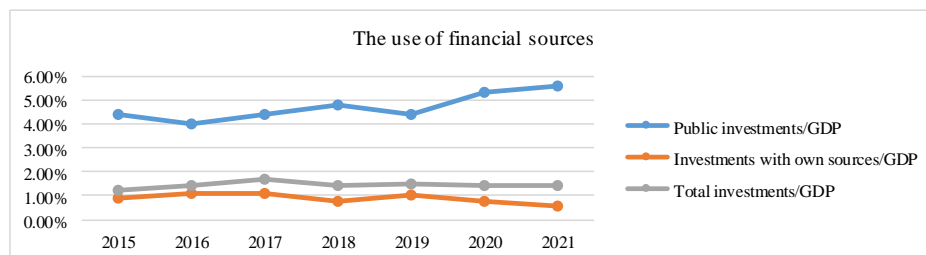
	Public investments/GDP	Investments with own sources/GDP	Total investments/GDP
2015	4.40%	0.90%	1.20%
2016	4.00%	1.10%	1.40%
2017	4.40%	1.10%	1.70%
2018	4.80%	0.80%	1.40%
2019	4.40%	1.00%	1.50%
2020	5.30%	0.80%	1.40%
2021	5.60%	0.60%	1.40%

Source: Calculation of the authors with the data taken from [www.financatvendore.al](http://www.financatvendore.al).

From Table 7, at the general government level, public investments represented 5.6% of GDP in 2021, about 0.3 percentage points more than the previous year as a result of added expenses for re-construction after the earthquake.

At the local level, investments with own sources in 2021 represented about 0.6% of the nominal GDP, decreasing with about 0.2 percentage points compared to the previous year. Total investments to GDP for the year 2021 were estimated 1.4%, the same as the year before.

**Figure 4:** The use of financial resources, the expenditures of LGU



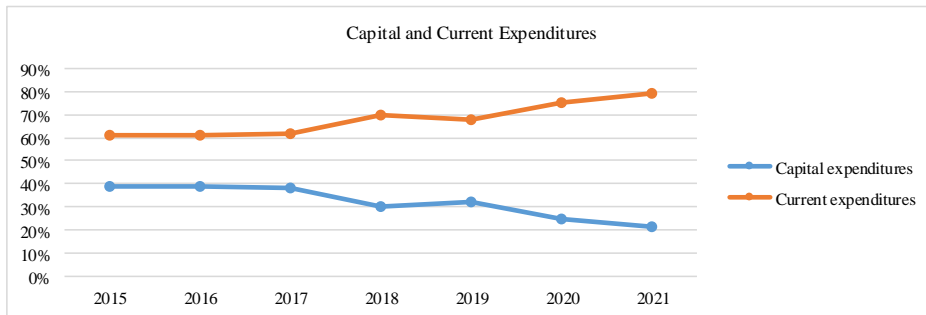
Below is the structure of expenditures for local government units and the weight of capital expenditures versus current expenditures for the period from 2015 till 2021.

**Table 8:** The structure of expenditures for LGU

	Capital expenditures	Current expenditures
2015	39%	61%
2016	39%	61%
2017	38%	62%
2018	30%	70%
2019	32%	68%
2020	25%	75%
2021	21%	79%

Source: Calculation of the authors with the data taken from Ministry of Finance and Economy.

For the period taken into consideration, the structure of expenditures is dominated by current expenditures. In 2021, the weight of capital expenditures is only 21% while the weight of current expenditures is 79%.

**Figure 5:** Capital expenditures versus current expenditures

From the figure above, we conclude that while capital expenditures have decreased from 39% to 21%, current expenditures have increased from 61% to 79%. This indicates that current expenditures (wages, social and health insurance, operating expenses, grants and interest payment) take the greater part of all expenditures.

## 5 Conclusions

The Albanian local authorities' financial autonomy is guaranteed in the Albanian Constitution and the new Law 68/2017 on the financing of local self-government, while the Law 139/2015 on local self-government sets out a number of basic principles of

municipal financing, in particular including one stating that the functions and powers delegated to local self-governing authorities shall be accompanied on each occasion by the financial resources necessary for their accomplishment. The reforms in question have also led to greater decentralization of tax-raising powers to municipalities, thus enabling them to draw up budgets where expenditure on local investments and public services is more closely tailored to meeting the needs of the local population.

In this paper, data from two important time periods were compared, 2015-2018 and 2019-2021. After performing Man Whitney U test, we conclude that there aren't statistically significant differences between values of each of the indicators that are used to assess the performance of decentralization in terms of source of financing of the municipalities as well as those of expenditures, in the periods 2015-2018 and 2019-2021.

The difficult first four years of the reform's implementation served as both a test for how well it would function and the subsequent four years, when the reform started to become more established.

In recent years there has not been any significant change in the average financial autonomy ratio (municipalities' own as a percentage of total resources). Generally speaking, the reforms carried out have served to increase municipalities' fiscal and financial autonomy, but their situation varies considerably.

Unconditional, or non-earmarked, transfers from the state budget, which municipalities are free to use as they chose, are still the main source of funding. Regardless, it appears that the financial resources available to local government, including those of the largest authorities, are still insufficient to meet all of their needs and enable them to carry out their devolved functions in a fully satisfactory manner given the significant number of powers and responsibilities transferred to municipalities in 2015 and the role they are expected to play in economic and social development.

From the two periods compared it turns out that there are no statistically significant differences in the financial resource and spending structures of the municipalities between the two time periods. It can be that current expenses have climbed while capital expenditures have dropped. This is also because financial resources were redistributed to help Albanian taxpayers deal with COVID 19's effects.

Based on the abovementioned, we draw the conclusion that Albania, despite recent improvements, appears to lack the financial resources necessary for the municipalities to effectively execute the mandated competences.

**Notes:**

<sup>1</sup> Analysis of the grant allocation formula (HDPC: CO-Plan; IPC, 2021).

The purpose of the unconditional transfer is to cover the difference between the cost of functions and the income they create during the period.

The unconditional transfer sharing formula is based on several components: The most important component which occupies 62.42% of the transfer amount is based on the number of the relative population, calculated by adding to the number of the population of Census 30% of the difference between the number of the population from civil status and that of Census. 11.7% of the transfer is allocated according to population density, including adjustment coefficients which increase the transfer amount for municipalities where population density is low as are those that include mostly rural areas. 23.46% is distributed according to the number of children in preschool education and teaching staff for them, students in public nine-year and secondary schools. 2.42% of the transfer is distributed using the weight of the budget of each municipality to the actual budget of all municipalities.

It is followed by the unconditional transfer equalization process, which takes into consideration the fiscal part, based on actual tax revenues that are shared between the government central and local related mainly to taxes such as small business tax, taxes annual used vehicle and real estate sales tax from legal persons. During this phase, local self-government units that have income for per capita below 80% of the average national income per capita, are compensated with 100% of the difference. This redistribution process takes you to units that have per capita income above 120% of the national average, 50% of the difference.

<sup>2</sup> The data analysis is based on data obtained from [www.financatvendore.al](http://www.financatvendore.al) and Ministry of Finance and Economy.

**References:**

- Aghion, P. & Howitt, P. (2009) *The Economics of Growth* (Cambridge, Massachusetts, London, England: MIT Press).
- Nobuo, A. & Sakata, M. (2002) Fiscal decentralization contributes to economic growth: evidence from state-level cross section data for United States, *Journal of Urban Economics*, 52(1), pp. 93-108.
- Albania Council of Ministers (2015) *Strategjia ndersektoriale për decentralizimin dhe qeverisjen vendore; 2015-2020* (Tirana: KM).
- Bala, A. (2017) Integration of local government through administrative-territorial reform in Albania, *Academic journal of interdisciplinary studies*, 6(2), pp. 137-140.
- Cadoret, X. & Dejonghe, C. (2021) Monitoring of the application of the European Charter of Local Self-Government in Albania, Committee on the Honouring of Obligations and Commitments by Member States of the European Charter of Local Self-Government (Monitoring Committee), *Congress of Local and Regional Authorities, 41st SESSION, Report*, CG(2021)41-14final, September 22, 2021, available at: <https://rm.coe.int/cg-2021-41-14-en-monitoring-of-the-application-of-the-european-charter/1680a42072> (September 22, 2021).
- Cali, M. & Menon, C. (2013) *Does urbanisation affect rural poverty? Evidence from Indian districts*, available at: <https://openknowledge.worldbank.org/bitstream/handle/10986/12162/wps6338.pdf?sequence=1&isAllowed=y> (September 22, 2021).
- Cini, M. (2007) *European Union Politics 2nd Edition* (Oxford: Oxford University Press).

- Committee of the Regions (2009) *White paper on multilevel governance* (Brussels: Committee of the Regions of the European Union), available at: <https://op.europa.eu/en/publication-detail/-/publication/3cba79fd-2fcd-4fc4-94b9-677bbc53916b/language-en> (June 17, 2009).
- Council of Europe (2011) *Recommendation of the Committee of Ministers to member States on the funding by Higher-level authorities of new competences for local authorities*, available at: [coe.int/cm/Pages/result\\_details.aspx?ObjectID=09000016805afc97](http://coe.int/cm/Pages/result_details.aspx?ObjectID=09000016805afc97) (September 12, 2022).
- Dragusha, B. & Osmani, E. (2012) The effects of fiscal decentralization in Albania, *Iliria International Review*, 2(1), pp. 21-34.
- HDPC, CO-Plan & IPC (2021) *Bashkitë e vogla dhe sfidat e decentralizimit: Manaxhimi financiar dhe Burimet Njerëzore* (Tirana: Human Development and Promotion Center), available at: <https://www.co-plan.org/wp-content/uploads/2022/04/Raporti-final-Bashkite-e-vogla-dhe-sfidat-e-decentralizimit-3.pdf> (November 30, 2021).
- Henderson, V. (2003) The urbanization process and economic growth: the so what question, *Journal of economic growth*, 8(1), pp. 47-71.
- Hussain, S., Moiz Hali, Sh., Ahmad, R., Iqbal, S. & Iftikghar, H. (2021) Fiscal decentralization and poverty alleviation: A case study of Pakistan, *Poverty & Public Policy*, 13(2), pp. 139-154, <https://doi.org/10.1002/pop4.304>.
- Instituti per Demokraci dhe Ndermjetesim (2015) *Matja e Ndikimit të Decentralizimit: Treguesit* (Tirane: IDM).
- Minister of State for Local government (2014) *Technical criteria for the new administrative and territorial division* (Tirana: The ministry of local affairs).
- Ministry of Finance and Economy (2021) *Raporti vjetor i monitorimit 2020. Strategjia e menaxhimit e Financave publike 2019-2022* (Tirana: MFE).
- OECD (2011) *OECD Regional Outlook 2011: Building Resilient regions for stronger economies* (OECD Publishing), <http://dx.doi.org/10.1787/9789254120983-en>.
- OECD (2011) *Making the Most of Public Investment in a Tight Fiscal Environment: Multi-level Governance Lessons from the Crisis* (Paris : OECD), <http://dx.doi.org/10.1787/9789264114470-en>.
- PLGP (2014) *Fiscal decentralization white paper up date* (Tirana: USAID Albania), available at: [https://pdf.usaid.gov/pdf\\_docs/PA00MVK5.pdf](https://pdf.usaid.gov/pdf_docs/PA00MVK5.pdf) (September 10, 2022).
- PLGP (2014) *Statistical Brief, Financat e qeverisjes vendore në prag të reformës territoriale*, available at: [https://pdf.usaid.gov/pdf\\_docs/PA00TZFV.pdf](https://pdf.usaid.gov/pdf_docs/PA00TZFV.pdf), (September 15, 2022).
- Rodriguez-Pose, A. & Krojier, A. (2009) Fiscal Decentralization and Economic Growth in Central and Eastern Europe, *Growth and Change*, 40(3), pp. 387-417.
- Romeo, L. G. (2013) *The developmental potential of local autonomy and the limits of politics-driven decentralization reforms*, available at: <http://www.locdev.org> (September 25, 2022).
- Toska, M. & Bejko, A. (2018) Territorial Administrative Reform and the Decentralization Strategy - Progress towards the Desired Objectives after a Governing Mandate, *Annual review of territorial governance in Albania*, pp. 69-83, available at: <https://www.co-plan.org/wp-content/uploads/2018/12/5.pdf> (December 21, 2018).
- World Bank (2022) *Albania and Decentralization in Transition- analytical report*, August 2004, available at: <https://www.worldbank.org/en/country/albania/overview> (October 19, 2022).
- Xhindi, N. (2010) Regional Development: an opportunity or a challenge for the Albania joins EU, *Journal of Studies on Economics & Society*, 2(2), pp. 213-223.





## The Value Relevance of Intangible Assets: Evidence from an Emerging Market Vietnam

HOANG NGUYEN & TO MINH TAN LE

**Abstract** This study aims to examine the value relevance of intangible assets and their influence on the value relevance of accounting information in Vietnamese-listed non-financial firms. Data used in the study are panel data collected from audited financial statements of 618 non-financial firms from 2015 to 2020. We test three models, including accounting information (earnings per share and book value per share) without intangible assets model, accounting information with intangible assets model, and accounting information with an interaction term of intangible assets model. Fixed-effects analyses show that intangible assets and traditional accounting measures are positively associated with stock prices. The study reveals the value relevance of earnings per share is higher for firms that own intangible assets than for firms that do not. In other words, intangible assets can improve the value relevance of accounting information.

**Keywords:** • intangible assets • value relevance • accounting information • emerging market • Vietnam

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## 1 Introduction

The purpose of financial statements is to provide useful information for decision making. Accounting information is considered useful when it shows the faithfulness and the value relevance to the market. The relevance is understood as the ability to capture and summarize information of accounting data, which is reflected in stock prices. From a valuation point of view, the higher the value relevance, the more the investment decision is based on accounting information, and therefore the greater the relationship between accounting information and firm value, the higher the quality of accounting information.

The relationship between accounting information and firm value has been an important research topic. Previous studies indicate that accounting information has a significant influence (value relevance) on firm value (Barton et al., 2010; Dunham & Grandstaff, 2022). However, this influence has declined over the years (Barth et al., 2022). Francis & Schipper (1999) suggested that this phenomenon may be due to the fact that in the context of business activities that have changed continuously over time, accounting activities have been slow to change or accounting activities have changed in the direction providing inappropriate information to the market. Lev & Zarowin (1999) argue that the decrease in the value relevance of accounting information is mainly because the accounting system does not fully reflect the changes in business activities.

Furthermore, in the era of technology and information, now companies actively implementing digital transformation and are starting to pay great attention to the value of intangible assets. Thus, the value of accounting information used in financial statements such as earnings and the book value of equity seems to be reduced. The relevance or usefulness of this financial statement information for the capital market is now limited. In that context, intangible items have changed the production process and business orientation. The economy in recent years has had a strong transition from a manufacturing economy to a service economy and an information economy in many countries. The role of intangible assets is therefore increasingly important and has a strong influence on the performance of the new economy. Consequently, the change in the influence of accounting information on firm value can be attributed to the impact of intangible items.

Intangible assets are considered as strategic assets to enhance the competitiveness of an enterprise and maintain its steady growth. The widespread adoption of new technology has made intangible assets one of the most important factors in the development and success of firms (Córcoles, 2010) and a prominent factor in valuation (Aulia et al., 2020; Çalıyurt, 2021). In developing countries such as Vietnam, intangible assets play a key role in the shift from an agricultural and industrial economy to a service and knowledge economy. The rapid rise of intangible assets raises a question about the role of intangible assets in valuation in these countries. To the extent of our knowledge, a study on the influence of intangible assets on the value relevance of accounting information in Vietnamese enterprises is not available. This paper aims to fill the gap in the literature

concerning the relation between intangible assets and value relevance by using a large sample of non-financial firms listed in Vietnam for a period of 6 years from 2015 to 2020. The purpose of this paper is to investigate whether recognized intangible assets in financial statements are value relevant and whether the assets can improve the value relevance of accounting measures in the Vietnam context.

This study has some contributions to the current literature. First, the study provides comprehensive evidence for explaining the influence of intangible assets on the value relevance in an emerging country like Vietnam, a topic that has not been addressed before. Second, this study is consistent with the point of view that intangible assets play an important role in valuation in the era of technology and information. Third, the evidence presented in this study can be useful in estimating the investments in intangible assets for investors in the Vietnam market. Fourth, the study is useful for policymakers in deciding future regulations regarding the disclosure of intangible assets and how to apply international financial reporting standards (IFRS) in Vietnam.

The remaining part of the paper is organized as follows. In Section 2, previous studies and literature are discussed, and hypotheses are developed. In Section 3, the research methodology and the data source are introduced. In Section 4, the main results and discussions are presented. In Section 5, conclusions are provided.

## **2 Literature review and hypothesis development**

The value relevance of accounting information is mainly related to the valuation function of accounting information. Since the 1960s, this topic has received much attention from researchers (Barth et al., 2022). By investigating whether accounting information is closely related to firm value, previous studies have focused on clarifying the usefulness of accounting information in valuation. These studies assess whether accounting information is a good summary measure of the events incorporated in securities price, they are value relevant because their use can provide a value of the firm that is close to its market value (Dumontier & Raffournier, 2002). Unlike event studies that focus on the market reaction to accounting disclosures over a short time interval, the association studies analyze the relationship between stock returns (stock price) and accounting data over a long period.

Ball & Brown (1968) were the first to find an empirical relationship between earnings and stock returns. Other studies have measured the strength of the association between changes in earnings and stock returns to clarify how changes in earnings summarize information incorporated in stock prices. Some studies indicate that the value relevance of accounting information increases over time (Collins et al., 1997; Francis & Schipper, 1999). However, the influence of earnings on stock prices decreases significantly over the years (Barth et al., 2022). The reduction is partly due to the increasing frequency and magnitude of the transitory revenue/cost components in earnings (Donelson et al., 2011).

In addition, the value relevance of accounting information is believed to be influenced by country factors (Al-Ani & Tawfik, 2021; Ali & Hwang, 2000; Rahman & Liu, 2021; Soderstrom & Sun, 2007). Barth et al. (2008), in a study of 21 countries, found that earnings of companies adopting International Financial Reporting Standards (IFRSs) have a greater impact on stock prices in comparison with firms applying national accounting standards.

Most of the prior results in value relevance studies are conducted in developed markets, where there is superiority in the availability of information, the ability to enforce reporting requirements from regulators, the percentage of sophisticated investors and there is sufficient competition among listed companies (Kouki, 2018; Stenheim et al., 2018). In contrast, developing markets have fewer listed companies, fewer knowledgeable investors, and less reporting requirements by regulators. This discrepancy raises questions about the relationship of accounting information to firm value in these developing countries. There is evidence that emerging markets lack the infrastructure to apply international accounting standards and, therefore accounting information has less effect on stock prices, or less value relevance (Acaranupong, 2021; Eccher & Healy, 2000). However, in some emerging countries such as China and the UAE, although the financial markets are still young and not fully aware of financial statements, accounting information is deemed relevant for the market (Alali & Foote, 2012; Chen et al., 2001). Even accounting information reported under IFRS in China was found to have more impact on stock prices (Liu & Liu, 2007). Thus, the results on the value relevance of accounting information in developing countries are inconsistent. National factors may be part of the problem.

The intangibles' value relevance is a topic that has been studied early. The studies focussing on the relevance of value estimates of intangible assets (Barth et al., 2001) have concluded that several types of intangibles are relevant to investors: capitalized software costs (Aboody & Lev, 1998), research and development (Feng et al., 2022; Zhao, 2002), patents (Hirschey et al., 1998), brands (Kallapur & Kwan, 2004), goodwill (Dahmash et al., 2009; Oliveira et al., 2010; Park & Jang, 2021), intellectual capital disclosure (Ricci et al., 2020; Solikhah et al., 2020), and advertising expenditures (Shah et al., 2009). Aboody & Lev (1998) suggest that capitalized software amounts summarize relevant information and the assets associate with market variables and future earnings. Goodwin & Ahmed (2006) indicated the indirect effect of intangibles on market values. Moreover, Ricci et al. (2020) show that stock market participants incorporate digitalization-related information into their business valuation process. Recently, by analyzing the textual content of 23,269 annual reports, Feng et al. (2022) find that descriptive R&D intensity positively affects firm value. These authors accepted that intangible assets increase the value relevance of accounting information such as earnings. In general, these studies have found that available estimates of intangible assets reliably reflect the assessed values of these assets by investors and that the items have a significant positive association with

share prices. In other words, the role of intangibles in valuation is getting important in the information technology era.

Meanwhile, few studies investigate the influence of intangible assets on the value relevance of accounting information. In a study in six emerging markets of the Gulf Cooperation Council (GCC), (Al-Ani & Tawfik, 2021) investigate the relationship between intangible assets and the value relevance of accounting information and find a positive relationship between intangible assets and earnings quality in terms of value relevance in KSA and Qatar. The finding is not found in other GCC countries. In another study, Zhao (2002) suggested that the reporting of total R&D costs increases the association of stock price with accounting earnings and book values in countries with complete R&D expensing.

In the Vietnam context, researchers have recently begun to pay attention to the value relevance of the accounting information of listed companies. Viet Ha et al. (2018) find that earnings per share and book value per share are positively associated with the stock price. Hai et al. (2015) show that the relationship between accounting data on financial statements and stock return is weak. However, in Vietnam, attempts to investigate the value relevance of intangible assets and their influence (such as R&D or all components together) on the value relevance of accounting information are very limited.

In the study, we explore whether recognized intangible assets help explain the variation of market values once the effects of traditional accounting data such as book value and earnings are controlled for. Consistent with previous studies (e.g., Oliveira et al., 2010; Ricci et al., 2020), we expect that recognized intangible assets are value relevant. Thus, our first hypothesis is:

*Hypothesis 1. Recognized intangible assets are value relevant in explaining market equity value.*

In the era of technology and information, companies increasingly appreciate the value of intangible assets. Meanwhile, investors are now paying great attention to the value of the assets. They no longer base their investment decisions on earnings and book value of the issuer's equity, but begin to use the value of intangible assets to consider for decision making. Intangible assets now play an important role for firms in the capital market and may contribute positively to the quality of accounting information. Thus, our second hypothesis is:

*Hypothesis 2. Intangible assets positively impact the value relevance of accounting information.*

### 3 Research design and data

#### 3.1 Research design

To assess the information content of accounting data, we analyze the association between accounting information and stock price in a long term. Consistent with previous studies (e.g., Collins et al., 1997), we use Ohlson's (1995) model to investigate the value relevance of accounting information, in which a firm's market value is a function of the book value of equity and earnings.

$$\text{Model 1: } \text{PRICE}_{it} = \alpha_0 + \alpha_1 \text{BVPS}_{it} + \alpha_2 \text{EPS}_{it} + \varepsilon_{it}$$

Where:  $\text{PRICE}_{it}$  is the stock price of firm  $i$  three months after the end of year  $t$ .  $\text{BVPS}_{it}$  is the book value of equity per share of firm  $i$  at the end of year  $t$ .  $\text{EPS}_{it}$  is the earnings per share of firm  $i$  at the end of year  $t$ .  $\varepsilon_{it}$  is residuals.

According to the efficient market hypothesis, if the market is efficient, when information is announced it will be immediately reflected in the price of the stock. In other words, if the market is not efficient, the information reflected in stock prices needs a certain time lag. Since the Vietnamese stock market is considered to be inefficient, in this study, we take stock prices 3 months after the end of the fiscal year. The application of this price is also to ensure that all listed companies have completed the publication of year-end financial statements.

We control for some factors in all equations to test the value relevance of accounting information to the stock price. Firm size is considered an important factor to assess the financial position of enterprises. A larger business entity is more likely to attract more capital and thus impact the firm value (share price). So, we control the Firm size (SIZE) and expect Firm size shares a positive association with the stock price. Furthermore, a business with greater leverage often entails greater financial risk. That firm is more likely to be undervalued. Therefore, we control for leverage (LEV) in the model and expect LEV is associated negatively with the stock price. We also control for operating cash flows per share (CFPS) in our models and expect firms with larger operating cash flows to have more influence on the stock price.

We examine whether changes in stock prices are explained better when intangible assets are included, in conjunction with changes in book value and earnings in model 2. We expect that intangibles are positively associated with firm values (PRICE) when EPS and BVPS are controlled for. Then, we include an interaction term of EPS with  $dIA$  (a binary variable is coded as 1 if a firm owns intangible assets and 0 otherwise) to examine whether the value relevance of accounting measure (EPS) increases when a firm owns intangible assets. Therefore, the models are as follows:

$$\text{Model 2: } \text{PRICE}_{it} = \alpha_0 + \alpha_1 \text{BVPS}_{it} + \alpha_2 \text{EPS}_{it} + \alpha_3 \text{IA}_{it} + \alpha_4 \text{SIZE}_{it} + \alpha_5 \text{LEV}_{it} + \alpha_6 \text{CFPS}_{it} + \varepsilon_{it}$$

$$\text{Model 3: } \text{PRICE}_{it} = \alpha_0 + \alpha_1 \text{BVPS}_{it} + \alpha_2 \text{EPS}_{it} + \alpha_3 \text{dIA}_{it} + \alpha_4 \text{EPS}_{it} * \text{dIA}_{it} + \alpha_5 \text{SIZE}_{it} + \alpha_6 \text{LEV}_{it} + \alpha_7 \text{CFPS}_{it} + \varepsilon_{it}$$

**Table 1:** Definition of variables in models

Name of variable	Type	Abbreviation	Calculation	Expectation
Stock price	Dependent variable	PRICE	Stock price for firm i three months after the firm's fiscal year-end	
Book value per share	Independent variable	BVPS	Book value of equity per share	+
Earnings per share	Independent variable	EPS	Earnings per share at the end of the fiscal year	+
Firm size	Independent variable	SIZE	Logarithm of total assets at the end of the year	+
Leverage	Independent variable	LEV	Total debt to total assets ratio at the end of the year	-
Operating cash flows per share	Independent variable	CFPS	Operating cash flows/ Number of shares outstanding at the end of the fiscal year	+
Intangible assets per share	Independent variable	IA	Total intangible assets per share at the end of the year/ Number of shares outstanding at the end of the fiscal year	+
Probability of intangible asset	Independent variable	dIA	1 if a firm owns intangible assets and 0 otherwise	

### 3.2 Data

We collect financial data from the Fiinpro platform. The research sample includes all 618 non-financial companies listed on the two largest stock exchanges in Vietnam - Ho Chi Minh Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX) in the period from 2015 to 2020. Finance and insurance companies are eliminated because they have different policies and regulations. With the aforementioned number of companies, we obtain 3,708 observations. However, because some data are not available in the database, the final sample for analysis includes 3,388 observations.

## 4 Empirical results and discussions

### 4.1 Descriptive statistics and correlation between variables

Table 2 indicates the descriptive statistics of the main variables used in our models. The statistics are computed after removing missing values. The mean of Earnings per share (EPS), Stock price (PRICE) and, Book value per share (BVPS) are 2.065 VND, 23.020 VND, and 17.106 VND, respectively. On average, 82% of the firms disclosed information for intangible assets in their annual financial reports.

**Table 2:** Descriptive statistics

	N	Mean	St. Dev.	Min	Median	Max
PRICE	3,388	23,020.30	24,442.60	1,700	14,900	143,413
EPS	3,388	2,065.23	2,504.61	-2,896	1,372	13,190
BVPS	3,388	17,105.77	8,294.97	5,510	14,814	55,006
LEV	3,388	0.47	0.22	0.03	0.48	0.90
CFPS	3,388	2,298.54	5,462.70	-14,453	1,714.5	23,125
SIZE	3,388	27.29	1.53	23.77	27.20	31.59
IA	3,388	895.59	1,755.71	0.00	180.17	10,845.08
dIA	3,388	0.82	0.39	0	1	1

Table 3 presents the correlation matrix. Most variables are correlated significantly at the 1 % level. As expected, earnings per share (EPS), book value per share (BVPS), and intangible assets (IA) are significantly and positively correlated with the stock price (PRICE). Moreover, leverage (LEV) has a significantly negative correlation with these main variables. We computed the variance inflation factor (VIF) to check for multicollinearity. The highest VIF was less than 5.5, indicating no significant problems with multicollinearity.



**Table 3:** Spearman & Pearson correlation matrix

	PRICE	EPS	BVPS	LEV	CFPS	SIZE	IA	dIA
PRICE		0.74***	0.57***	-0.13***	0.32***	0.22***	0.16***	0.14***
EPS	0.74***		0.69***	-0.10***	0.38***	0.16***	0.15***	0.12***
BVPS	0.62***	0.68***		-0.09***	0.32***	0.19***	0.22***	0.11***
LEV	-0.13***	-0.10***	-0.06***		-0.05**	0.33***	0.01	0.07***
CFPS	0.32***	0.38***	0.32***	-0.08***		0.07***	0.06***	0.08***
SIZE	0.17***	0.16***	0.18***	0.34***	0.08***		0.09***	0.27***
IA	0.27***	0.23***	0.27***	0.02	0.10***	0.21***		0.24***
dIA	0.18***	0.15***	0.13***	0.06***	0.09***	0.28***	0.67***	

*Notes: \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$*

## 4.2 Regression analysis and discussion

Table 4 summarizes the results of our regressions. We test three types of models corresponding to 3 columns, including Model 1: accounting information (earnings per share and book value per share) without intangible assets model, Model 2: accounting information (earnings per share and book value per share) with intangible assets model, and Model 3: accounting information (earnings per share and book value per share) with an interaction term of intangible assets model. To account for firm heterogeneity, we use panel data which allows controlling for unobservable variables. To decide between fixed or random effects, we perform a Hausman test where the null hypothesis is that the preferred model is random effects versus the alternative the fixed effects. Hausman tests (untabulated) indicate that fixed-effect approach is more appropriate. We calculate and use the consistent standard errors when presenting the regression results based on the method of Arellano (1987) to control heteroscedasticity and serial correlation.

In general, we obtain statistically significant F-statistics in all regressions, meaning that there is a significant relationship between our independent variables and the dependent variable (PRICE). All columns point out that the coefficients of EPS and BVPS are both positive and statistically significant at the 1% level. The finding suggests that both EPS and BVPS are positively related to PRICE, meaning that traditional accounting measures are positively associated with firm values. However, the magnitude of the EPS coefficient is much larger than that of BVPS, suggesting the value relevance of EPS is higher considerably. Investors seem to assess earnings as the more important information in valuing a company. As expected, in models 2 and 3, the stock price (PRICE) changes in

the same direction as firm size (SIZE) and operating cash flows (CFPS), meanwhile, it is negatively associated with leverage (LEV).

We investigate the value relevance of intangible assets in model 2 (including BVPS, EPS, and IA). In column 2, the coefficient estimate of IA ( $\beta_3 = 0.513$ ) is positive and significant at the 10% level, indicating the positive effect of intangible assets on market values. The results provide evidence that recognized intangible asset is value relevant to investors, supporting hypothesis 1. Our findings show the important role of intangible assets in market values' variability and suggest that investors consider intangible items that are reported on the balance sheet when they value securities. The result is supported by previous studies such as Oliveira et al. (2010) in the Portuguese context.

In model 3, we assess the impact of intangible assets on the value relevance of accounting measures. Our main interest in this equation is the coefficient of interaction term of EPS and the probability of a firm owning intangible assets (dIA). We do not find evidence show that the probability of a firm owning intangible assets positively impact firm value because the coefficient of dIA is insignificant. However, we find a positively significant coefficient of EPSxdIA ( $\beta_4 = 0.781$ ) at the 5% level. The result points out that when a firm owns intangible assets (i.e., dIA = 1), the total coefficient of EPS is 3.241 (i.e.,  $2.460 + 0.781$ ), meaning that the association of EPS with market value increases due to the probability of a firm has intangible items. In other words, intangible assets positively impact the value relevance of accounting information (EPS), consistent with hypothesis 2.

**Table 4:** Regression results (Fixed effects models)

<i>Dependent variable: PRICE</i>			
	(1)	(2)	(3)
BVPS	0.405*** (0.073)	0.433*** (0.077)	0.456*** (0.076)
EPS	3.159*** (0.156)	3.147*** (0.156)	2.460*** (0.320)
IA		0.513* (0.264)	
dIA			-1,507.347 (1,201.991)
EPSxdIA			0.781** (0.318)
SIZE		1,825.329** (794.900)	1,935.328** (794.477)
LEV		-8,554.698*** (2,543.474)	-8,887.486*** (2,527.861)
CFPS		0.144*** (0.038)	0.142*** (0.038)
Observations	3,388	3,388	3,388
R <sup>2</sup>	0.288	0.295	0.297
Adjusted R <sup>2</sup>	0.130	0.137	0.139
F Statistic	160.308***	105.356***	97.493***
<i>Note:</i>		*p<0.1; **p<0.05; ***p<0.01	

## 5 Conclusions

The paper investigates whether recognized intangible assets in financial statements are value relevant and whether the intangibles can improve the value relevance of accounting measures in the Vietnam context. Our analysis shows that both intangible assets and traditional accounting items such as earnings per share and book value per share are positively associated with the stock price. More importantly, we find that intangible assets can contribute positively to the value relevance of accounting information. In other words, the influence of accounting information on firm valuation is stronger for firms with intangible assets. Our findings show that investors may consider intangible assets as an important factor in valuing firms. But the influence of the assets on the value relevance of earnings per share indicates investors even base on earnings per share more in valuation when intangible assets are recognized in balance sheets. Practically, the results of this

study are expected to be able to provide an overview for issuers related to investor behavior in the Vietnam context. To investors, our findings imply paying more attention to companies with reported intangibles can be helpful in valuing a business.

Theoretically, the results are expected to be a reference and add to the literature in the discussion of the value relevance of accounting information on stock prices in an emerging country like Vietnam and the effect of the recognized value of intangible assets in the era of information technology for investors.

## References:

- Aboody, D. & Lev, B. (1998) The Value Relevance of Intangibles: The Case of Software Capitalization, *Journal of Accounting Research*, 36, pp. 161-191, <https://doi.org/10.2307/2491312>.
- Acaranupong, K. (2021) International Financial Reporting Standards Convergence and Value Relevance of Accounting Information: Evidence from ASEAN, *Asian Journal of Business and Accounting*, 14(2), pp. 31-68, <https://doi.org/10.22452/ajba.vol14no2.2>.
- Alali, F. A. & Foote, P. S. (2012) The Value Relevance of International Financial Reporting Standards: Empirical Evidence in an Emerging Market, *The International Journal of Accounting*, 47(1), pp. 85-108, <https://doi.org/10.1016/j.intacc.2011.12.005>.
- Al-Ani, M. K. & Tawfik, O. I. (2021) Effect of Intangible Assets on the Value Relevance of Accounting Information: Evidence from Emerging Markets, *The Journal of Asian Finance, Economics and Business*, 8(2), pp. 387-399, <https://doi.org/10.13106/jafeb.2021.vol8.no2.0387>.
- Ali, A. & Hwang, L.-S. (2000) Country-specific factors related to financial reporting and the value relevance of accounting data, *Journal of Accounting Research*, 38(1), pp. 1-21.
- Arellano, M. (1987) Practitioners' corner: Computing Robust Standard Errors for Within-groups Estimators, *Oxford Bulletin of Economics and Statistics*, 49(4), pp. 431-434.
- Aulia, F. P., Koeswayo, P. S. & Bede, D. (2020) Relevance of Intangible Asset, Equity Book, and Earning Value on Stock Price in Information Technology Era, *Journal of Accounting Auditing and Business*, 3(1), p. 135, <https://doi.org/10.24198/jaab.v3i1.25943>.
- Ball, R. & Brown, P. (1968) An Empirical Evaluation of Accounting Income Numbers, *Journal of Accounting Research*, 6(2), pp. 159-178, <https://doi.org/10.2307/2490232>.
- Barth, M. E., Beaver, W. H. & Landsman, W. R. (2001) The relevance of the value relevance literature for financial accounting standard setting: Another view, *Journal of Accounting and Economics*, 31(1), pp. 77-104, [https://doi.org/10.1016/S0165-4101\(01\)00019-2](https://doi.org/10.1016/S0165-4101(01)00019-2).
- Barth, M. E., Landsman, W. R. & Lang, M. H. (2008) International Accounting Standards and Accounting Quality, *Journal of Accounting Research*, 46(3), pp. 467-498, <https://doi.org/10.1111/j.1475-679X.2008.00287.x>.
- Barth, M. E., Li, K. & McClure, C. (2022) Evolution in Value Relevance of Accounting Information, *The Accounting Review*, <https://doi.org/10.2308/TAR-2019-0521>.
- Barton, J., Hansen, T. B. & Pownall, G. (2010) Which Performance Measures Do Investors Around the World Value the Most—And Why?, *The Accounting Review*, 85(3), pp. 753-789, <https://doi.org/10.2308/accr.2010.85.3.753>.
- Çaliyurt, K. T. (ed.) (2021) *Ethics and Sustainability in Accounting and Finance, Volume II* (Singapore: Springer), <https://doi.org/10.1007/978-981-15-1928-4>.

- Chen, C. J. P., Chen, S. & Su, X. (2001) Is accounting information value-relevant in the emerging Chinese stock market?, *Journal of International Accounting, Auditing and Taxation*, 10(1), pp. 1–22, [https://doi.org/10.1016/S1061-9518\(01\)00033-7](https://doi.org/10.1016/S1061-9518(01)00033-7).
- Collins, D. W., Maydew, E. L. & Weiss, I. S. (1997) Changes in the value-relevance of earnings and book values over the past forty years, *Journal of Accounting and Economics*, 24(1), pp. 39–67, [https://doi.org/10.1016/S0165-4101\(97\)00015-3](https://doi.org/10.1016/S0165-4101(97)00015-3).
- Córcoles, Y. R. (2010) Towards the convergence of accounting treatment for intangible assets, *Intangible Capital*, 6(2), p. 2, <https://doi.org/10.3926/ic.161>.
- Dahmash, F. N., Durand, R. B. & Watson, J. (2009) The value relevance and reliability of reported goodwill and identifiable intangible assets, *The British Accounting Review*, 41(2), pp. 120–137, <https://doi.org/10.1016/j.bar.2009.03.002>.
- Donelson, D. C., Jennings, R. & McInnis, J. (2011) Changes over Time in the Revenue-Expense Relation: Accounting or Economics?, *Accounting Review*, 86(3), pp. 945–974, <https://doi.org/10.2308/accr.00000046>.
- Dumontier, P. & Raffournier, B. (2002) Accounting and capital markets: A survey of the European evidence, *European Accounting Review*, 11(1), pp. 119–151, <https://doi.org/10.1080/09638180220124761>.
- Dunham, L. M. & Grandstaff, J. L. (2022) The Value Relevance of Earnings, Book Values, and Other Accounting Information and the Role of Economic Conditions in Value Relevance: A Literature Review, *Accounting Perspectives*, 21(2), pp. 237–272, <https://doi.org/10.1111/1911-3838.12280>.
- Eccher, E. A. & Healy, P. M. (2000) The Role of International Accounting Standards in Transitional Economies: A Study of the People's Republic of China, *SSRN Electronic Journal*, <https://doi.org/10.2139/ssrn.233598>.
- Feng, C., Fay, S. & Kashmiri, S. (2022) The value relevance of descriptive R&D intensity, *Journal of Business Research*, 139, pp. 1394–1407, <https://doi.org/10.1016/j.jbusres.2021.10.033>.
- Francis, J. & Schipper, K. (1999) Have Financial Statements Lost Their Relevance?, *Journal of Accounting Research*, 37(2), p. 319, <https://doi.org/10.2307/2491412>.
- Goodwin, J. & Ahmed, K. (2006) Longitudinal value relevance of earnings and intangible assets: Evidence from Australian firms, *Journal of International Accounting, Auditing and Taxation*, 15(1), pp. 72–91, <https://doi.org/10.1016/j.intaccaudtax.2006.01.005>.
- Hai, T. T. T., Diem, N. N. & Binh, H. Q. (2015) The Relationship between Accounting Information Reported In Financial Statements And Stock Returns—Empirical Evidence From Vietnam, *International Journal of Accounting and Financial Reporting*, 1(1), p. 229, <https://doi.org/10.5296/ijaf.v5i1.7473>.
- Hirschey, M., Richardson, V. J. & Scholz, S. W. (1998) Value Relevance of Nonfinancial Information: The Case of Patent Data, *SSRN Electronic Journal*, <https://doi.org/10.2139/ssrn.63589>.
- Kallapur, S. & Kwan, S. Y. S. (2004) The Value Relevance and Reliability of Brand Assets Recognized by U.K. Firms, *The Accounting Review*, 79(1), pp. 151–172, <https://doi.org/10.2308/accr.2004.79.1.151>.
- Kouki, A. (2018) IFRS and value relevance: A comparison approach before and after IFRS conversion in the European countries, *Journal of Applied Accounting Research*, 19(1), pp. 60–80, <https://doi.org/10.1108/JAAR-05-2015-0041>.
- Lev, B. & Zarowin, P. (1999) The Boundaries of Financial Reporting and How to Extend Them, *Journal of Accounting Research*, 37(2), p. 353, <https://doi.org/10.2307/2491413>.

- Liu, J. & Liu, C. (2007) Value Relevance of Accounting Information in Different Stock Market Segments: The Case of Chinese A-, B-, and H-Shares, *Journal of International Accounting Research*, 6(2), pp. 55–81, <https://doi.org/10.2308/jiar.2007.6.2.55>.
- Ohlson, J. A. (1995) Earnings, Book Values, and Dividends in Equity Valuation, *Contemporary Accounting Research*, 11(2), pp. 661–687, <https://doi.org/10.1111/j.1911-3846.1995.tb00461.x>.
- Oliveira, L., Rodrigues, L. L. & Craig, R. (2010) Intangible assets and value relevance: Evidence from the Portuguese stock exchange, *The British Accounting Review*, 42(4), pp. 241–252, <https://doi.org/10.1016/j.bar.2010.08.001>.
- Park, K. & Jang, S. (2021) A study of value-relevance and reliability of intangible assets: What do we know from the restaurant industry?, *Journal of Hospitality and Tourism Management*, 47, pp. 104–113, <https://doi.org/10.1016/j.jhtm.2021.03.002>.
- Rahman, J. & Liu, R. (2021) Value relevance of accounting information and stock price reaction: Empirical evidence from China, *Journal of Accounting and Management Information Systems*, 20(1), pp. 5–27, <https://doi.org/10.24818/jamis.2021.01001>.
- Ricci, F., Scafarto, V., Ferri, S. & Tron, A. (2020) Value relevance of digitalization: The moderating role of corporate sustainability. An empirical study of Italian listed companies, *Journal of Cleaner Production*, 276, <https://doi.org/10.1016/j.jclepro.2020.123282>.
- Shah, S. Z. A., Stark, A. W. & Akbar, S. (2009) The value relevance of major media advertising expenditures: Some U.K. evidence, *The International Journal of Accounting*, 44(2), pp. 187–206, <https://doi.org/10.1016/j.intacc.2009.03.004>.
- Soderstrom, N. S. & Sun, K. J. (2007) IFRS Adoption and Accounting Quality: A Review, *European Accounting Review*, 16(4), pp. 675–702, <https://doi.org/10.1080/09638180701706732>.
- Solikhah, B., Wahyudin, A. & Rahmayanti, A. A. W. (2020) The Extent of Intellectual Capital Disclosure and Corporate Governance Mechanism to Increase Market Value, *The Journal of Asian Finance, Economics and Business*, 7(10), pp. 119–128, <https://doi.org/10.13106/jafeb.2020.vol7.no10.119>.
- Stenheim, T., Beckman, A. N., Valltoft Olsen, C. & Madsen, D. Ø. (2018) The Value Relevance of Alternative Performance Measures: Evidence from the Oslo Stock Exchange, *Journal of Governance and Regulation*, 7(4), pp. 27–41, [https://doi.org/10.22495/jgr\\_v7\\_i4\\_p4](https://doi.org/10.22495/jgr_v7_i4_p4).
- Viet Ha, H. T., Hung, D. N. & Dung, T. M. (2018) Impact of Accounting Data on Stock Prices: The Case of Vietnam, *International Journal of Accounting and Financial Reporting*, 8(1), p. 140, <https://doi.org/10.5296/ijaf.v8i1.12671>.
- Zhao, R. (2002) Relative Value Relevance of R&D Reporting: An International Comparison, *Journal of International Financial Management & Accounting*, 13(2), pp. 153–174, <https://doi.org/10.1111/1467-646X.00082>.

## The Impact of the Application of Business Intelligence Tools on the Company's Performance

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**Abstract** Business intelligence (BI) has become very popular in the business environment because of its ability to transform huge amount of data into relevant information, important for decision making. Based on the sample of 52 small to large companies from the Republic of Serbia we tested the impact of BI implementation on company's performance. The research shows that foreign owned companies have higher level of the BI tools implementation than the domestic owned. The main obstacle to the higher level of the BI tools implementation is the lack of skilled and qualified staff. Companies that use BI tools have better performances than companies that use only financial statements data for decision making. The implementation of BI has the strongest impact on the level of company profits related to other partial components of the performance.

**Keywords:** • business intelligence • performance indicator • profit

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## 1 Introduction

Performance monitoring requirements are increasing over time in the global business environment. Large business systems cannot monitor performance and make business decisions based on information exported from the company's ERP system due to its incompleteness and volume. Excel has a limited ability to import data from the accounting system. This gap is covered by development of Business Intelligence that is defined as an integrated set of tools and technologies that are used to collect, analyze, and make data available (Reinschmidt & Francoise, 2000). The former system of recording business transactions has been replaced by a modern one, which includes an automatic recording of business transactions. Information technologies (IT) are improved on a daily level. This is the reason why key topics such as: "supply chain management," "information system" and "information technology" have been interesting for research in the last twenty-five years (Chao et al., 2019). Companies have to adapt very fast to new trends and to apply innovative technologies if they want to retain their market share and competitive advantage (Perdana et al., 2022). This is one of the most important reasons for applying BI. Certainly, working with historical data is often highlighted as the main barrier to making timely and relevant business decisions. Therefore, a distinction should be made between Business Intelligence and Performance Management (PM). BI uses data collection to analyze and evaluate historical data, while PM uses data collection to evaluate and improve the process and methodologies of an organization (Leveleleven, 2019). First of all, accurate and up-to-date data is a prerequisite. The aim of the paper is to research whether a higher degree of application of BI tools has a positive effect on the performance of companies. Also, we will take into account the degree of application of BI tools depending on the ownership structure of the companies. Adequate BI solutions require large investments that are often not available to smaller companies. Also, we will research the most common reasons why BI tools are not applied in certain companies or are not applied to a sufficient extent. The research was conducted on the basis of questionnaire distributed to small, medium and large companies operating in the Republic of Serbia.

## 2 Literature review

Business Intelligence has become significantly important in the last twenty years (Chen et al., 2012:1165). BI tools can be applied in various industries and professions. Appelbaum et al. (2017) have suggested a framework based on BI which can be used in the Management Accounting. Su et. al. (2020) have explained the application of BI technologies in the gaming industry. Business Analytics (BA) also has its application in the retail sector. As a result of the application of BA, the performances of companies have improved (Ramanathan et al., 2017). Business Intelligence tools can also be applied in the construction industry. It is important for engineers to know the degree of completion of the project. Therefore, it is necessary to monitor data from various sectors. The applied BI system in the construction management enables greater reliability of the decisions



made, as well as a reduction in errors and input consumption (Rodrigues et al., 2022). The benefits of using BI tools are numerous: shortening the time required for reporting, availability of timely and relevant information needed for making business decisions, segment reporting, and preparation of consolidated financial reports. The benefits that companies can accomplish from the implementation of the BI system depend on how effectively the system is used (Trieu et al., 2022: 645). Before using, it is necessary to adequately implement the BI system. In that part, cooperation between programmers, managers, accountants and other professionals who will use BI tools is very important. Numerous authors have concluded that the critical success factors for implementing Business Intelligence Systems are: adequate management support and commitment, compatibility with organizational goals, adequate BI infrastructure, and the existence of a clear vision (Purvis et. al., 2001; Yeoh & Popovič, 2016; Paradza & Daramola, 2021; Fu et al., 2022 ). Critical success factors are also led predominantly by “soft” factors such as organizational culture, behavior, and leadership (Dijkstra, 2022). Having on mind rapid technological changes, accounting and finance experts will increasingly be required to improve their IT competencies (Sun et al. 2020). One of the most important obstacles to the adequate implementation of BI and performance monitoring is the absence of standardized key performance indicators (Vallurupalli & Bose, 2018). When a company doesn't have strictly and in advance defined KPI, employees won't be able to measure them. Comparison between industries is also impossible. In the research conducted by Trieu et al. (2022), 433 respondents out of the total of 437, have said that they are making business decisions relying on the data collected from the BI system. Because of that, it is very important that the data entered in the BI system is correct. Otherwise, information based on that data is useless and leads to wrong business decision.

As we previously said, BI tools can be applied in various sectors. The sales department should monitor the achievement of the defined sales volume, the procurement department should monitor the stock level production should follow consumer requirements. Recording of business transactions by accountants has to be accurate so that the finance sector can monitor the achieved business results. Special attention in professional literature is devoted to the impact of the application of BI analytics on the performance of companies such as impact on: revenues, profit, reduction in different types of costs, such as salary costs, inventory costs, administrative costs, production costs (Akter et al., 2016; Rajnoha et al., 2016; Ramanathan et al., 2017; Torres et al., 2018; Aydiner et al., 2019; Yiu et al., 2021). Companies prepare Cost benefit analyses and expect that the benefits of implementing new technologies will exceed the cost of their implementation, manifested in the hardware and software investment, cost and time of training of employees, etc. Regardless of the accomplished performances, discussing both positive and negative is of the great importance to the success of Business Analytics (Kerklaan, 2022). In the research conducted by (Aydiner et al. (2019), the implementation of business analytics positively affected business process performance and firm performance. BA adoption has also had a positive effects on profitability, risk reduction, organizational performance, financial performance, market performance (Elbashir et al.,

2008; Rajnoha et al. 2016; Maroufkhani et al., 2020; Yiu et al., 2021). Implementation of Business analytics in the supply chain has also had positive effects on performance (Trkman et al., 2010). Companies with a more mature level of BI tools implementation have better performance (Bach et. al., 2018). The most common used control variables in the research are: the company's size, age, industry, experience, IT capital accessibility (Aydiner et al., 2019; Maroufkhani et al., 2020; Paradza & Daramola, 2021). When we are talking about a company's size, it can be measured by different criteria: the number of employees, total revenues, and value of total assets. Regardless of the applied criteria, the common is that larger companies have greater financial strength and can invest more in BI tools. Small and medium-sized companies have no sufficient internal expertise, and because of that new technology adoption is more difficult (Asiaei & Rahim, 2019). Therefore, Maroufkhani et al. (2020) have suggested outsourcing of Business Data Analytics implementation as an option. Another advantage of the creation and development of BI tools is the development of new jobs. Modern technological changes are gradually transforming the economy and the society, creating new ways of working (Njegomir et al., 2021:1797). When demand for some new profession, usually related to the IT, emerges and increases, the supply of competent and enough qualified employees on the labour market is usually insufficient, which push their salaries up.

### 3 Research

We have opted to use the questionnaire method to study the extent to which BI tools are implemented in Serbian companies as well as to examine the relations between certain firm characteristics and the level of BI tools implementation. A broad range of tools and concepts can be applied. Regardless of the applied tools companies can derive positive effects. In the research are included all BI tools. In this regard, we have developed the questionnaire that consists of two broad parts – first, stating the main and general firm characteristics and second, examining the BI tools implementation. The questionnaire was originally made in Serbian language. The structure of the questionnaire was based on a previous research by numerous authors (Akter et al., 2016; Ramanathan et al., 2017; Aydiner et al., 2019; Yiu et al., 2021). The questions in the questionnaire are primarily focused on impact on performance such as: level of profit, increase in revenues from the goods sold, reduction in production costs, reduction in inventory holding costs, improvement in competitive position. Respondents marked the level of agreement with the listed statements described above related to the effects of the application of BI tools on the performance using scales from 1 to 5 where 1 indicates "strongly disagree" and 5 "strongly agree". The sampling frame was formed randomly. Financial information is usually analyzed in the financial sector. Because of that the questionnaire was primary sent to Financial Controllers, Analysts, Financial directors etc. The positions of the respondents are described in table 1. The questionnaire was sent to 150 companies and received 52 feedbacks, thus making the response rate of 34,67%. The questionnaire is distributed in the September 2022.

The sampled company must have no more than one response, so 52 respondents are employed in 52 different companies. The sample structure is presented in Table 1 and shows that most of the respondents are employed as controllers in their companies. In addition, the vast majority of the sampled companies are large and majority foreign owned. The questionnaire was sent to the companies who organized financial department. At the moment of sampling, the size of the company and ownership structure were unknown. The industry structure of the sampled companies is highly diversified, though more than twenty percent of the sampled companies primarily operate in food and beverages industry.

H1: Majority foreign owned companies have a higher level of the BI tools implementation than the majority domestic owned companies.

H2: Level of the BI tools implementation positively impacts company performance.

**Table 1:** Sample structure

<i><b>Panel A. Position of the respondent in the company<sup>a</sup></b></i>	
Controlling	29
Finance	21
Planning and Analysis	8
Other	6
<i><b>Panel B. Size of the respondent's company</b></i>	
Small	4
Medium	13
Large	35
Total	52
<i><b>Panel C. Ownership structure of the respondent's company</b></i>	
Majority domestic owned	18
Majority foreign owned	34
Total	52
<i><b>Panel D. Main industry of the respondent's company</b></i>	
Automotive	2
Construction and real estate	6
Food and beverages	11
Information systems	5
Investments, banking and finance	6
Pharmacy	1
Textile industry	2
Trade	5
Transport, telecommunication and media	5
Other	9
<b>Total</b>	<b>52</b>

Note: <sup>a</sup> denotes question with more than one answer permitted.

The first research hypothesis is tested by comparing the level of the BI tools implemented between majority domestic owned and majority foreign owned companies. In this regard, we have employed statistical tests for independent groups to test the significance of the difference in the level of the BI tools implementation between two groups of companies. We have firstly examined whether the distribution of the level of the BI tools implementation follows the normal distribution curve and employed parametric statistical test if this assumption holds or nonparametric test on the contrary.

The second research hypothesis is tested using the multiple regression analysis to examine the impact of the level of the BI tools implementation (BI) on the change in company performance after the BI tools implementation (PERF) in general. A specific period in performance monitoring was not observed, but whether the application of BI tools leads to improvements in listed performance. PERF is tracked with the six answers of the respondents, as they had to assess the change in company profits, sales, market share, reduction of costs of holding inventory, reduction of production costs, and competitive position, (Aker et al. 2016, Ramanathan et al. 2017, Aydiner et al., 2019) on the Likert scale, with 1 representing the slightest improvement and 5 representing the largest improvement. Variable PERF is calculated as a sum of the answers on each of the six questions, there having a minimum possible value of 5 and a maximum possible value of 30.

Since company size and ownership structure may influence the company performance (Greenaway et al., 2014), we have controlled the impact of the BI on PERF for the variations in company size (SIZE; 1 for small company; 2 for medium company and 3 for large company) and ownership type (OWN, 0 for majority domestic owned and 1 for majority foreign owned company). Therefore, for the company  $i$ , the following regression model may be developed:

$$PERF_i = \alpha + \beta_1 BI_i + \beta_2 SIZE_i + \beta_3 OWN_i + \varepsilon_i \quad (1)$$

## 4 Discussion

### 4.1 The extent of the BI tools implementation

We begin the presentation of the results with an analysis of the extent to which BI tools are implemented in sampled companies. We have asked respondents to assess the level of BI tools implementation, with 1 representing the lowest level and 5 the highest level of BI tools implementation. The results for this question are presented in Table 2.

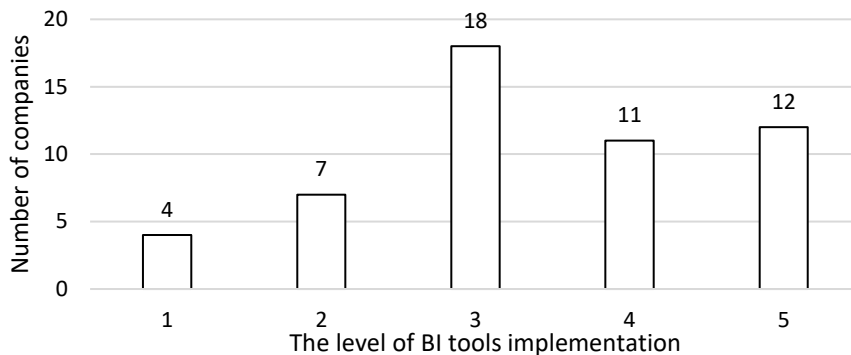
**Table 2:** The level of BI tools implementation

Arithmetic mean	3.38
Median	3.00
Minimum	1.00
Maximum	5.00
Standard deviation	1.21

Data from Table 2 shows that arithmetic mean of the level of the BI tools implementation is only 3.38, thus being only slightly higher than the average level of the implementation. In addition, arithmetic mean is higher than median, indicating that there are more companies with higher levels of the implementation than the companies with lower levels.

This is confirmed in Figure 1, showing that twelve companies assess the highest level of the BI tools' implementation, while only four companies assess the lowest level. Further, most of the companies (18 from 52, or around 35%) assess the level of the BI tools' implementation as moderate. Relatively low standard deviation (compared to the arithmetic mean) implies that the sampled levels of BI tools implementation are relatively clustered around the arithmetic mean.

**Figure 1:** Distribution of sampled companies by the level of BI tools implementation



We have also analyzed the environment of the BI tools implementation in the sampled companies. In this regard, we have analyzed the obstacles for the higher implementation of the BI tools and current practices of the implementation. The results are presented in Table 3. It is worth noting that most of the respondents argued that lack of the skilled and qualified staff is the main obstacle for the higher level of the BI tools' implementation, though many respondents (9 from 52) identified other obstacles not offered in the questionnaire (such as lack of the software solutions like data warehousing solutions, or lack of necessity of the BI for maintaining company operations). The important share of respondents also did not give any answer on such obstacles, which may imply that they are yet to identify the obstacles. This may represent a particular problem for the richer BI tools implementation. In addition, slightly more than half of the respondents answered that the KPIs are tracked on the monthly basis, though the portion of the respondents that track the KPIs on a daily basis is also large. Further, more than seventy percent of the respondents (37 from 52) argue that available BI solutions in Serbia are well fitted to the needs of their companies. The rest of the 15 respondents stated that available BI solutions in Serbia are not adapted to the needs of the company. The reason for that is the difference between financial statements in European countries and countries from other continents. Because of the numerous companies which are mainly foreign owned, the applied BI solution is primarily adjusted to the foreign companies.

**Table 3:** The environment of the BI tools implementation

<i>Panel A. Obstacles for the higher level of BI tools implementation</i>	
Lack of the funds	7
Lack of the staff	13
Lack of the top management support	5
Inadequate organizational structure	9
Other	9
No response	9
Total	52
<i>Panel B. How often the KPIs are tracked?</i>	
Daily	16
Weekly	7
Monthly	27
Yearly	2
Total	52
<i>Panel C. Available BI solutions in Serbia are adapted to the needs of the company</i>	
Yes	37
No	15

#### 4.2 Ownership structure and the BI tools implementation

We have compared the assessed levels of the BI tools implementation in majority domestic owned and majority foreign owned sampled companies. Results of the comparison are presented in Table 4. Both arithmetic mean and median of the level of BI tools implementation are higher in the majority of foreign owned companies. In addition, only three of sampled 18 majority domestic owned companies assessed the level of the BI tools implementation as the highest. On the other hand, as much as nine of sampled 34 majority foreign owned companies assessed this level as the highest.

**Table 4:** The comparison in the level of BI tools implementation between domestic and foreign owned companies

	<i>Majority domestic owned</i>	<i>Majority foreign owned</i>
Arithmetic mean	2.78	3.71
Median	3.00	4.00
Minimum	1.00	1.00
Maximum	5.00	5.00
Standard deviation	1.26	1.06
Number of companies	18	34

To examine the statistical significance of the difference in the level of the BI tools implementation between majority domestic owned and majority foreign owned companies, we have conducted statistical test for independent samples. However, we have

firstly tested whether the distribution of the assessed level of the BI tools' implementation follows the normal distribution. We have relied on Shapiro-Wilk test instead of Kolmogorov-Smirnov test of normality due to the relatively small sample size. In fact, both tests of normality showed that the distribution of the analyzed variable does not follow the normal distribution. Therefore, we have opted to use the nonparametric Mann-Whitney test as the better alternative than parametric Independent Samples t-test.

The results of the Mann-Whitney test are presented in Table 5, showing that the difference between majority domestic owned and majority foreign owned companies in the level of the BI tools implementation is statistically significant. In other words, the difference significant at the 1% level shows that majority foreign owned companies have higher level of the BI tools' implementation than the majority domestic owned. Therefore, the first research hypothesis cannot be rejected.

**Table 5:** Results of the Mann-Whitney test

Mann-Whitney U	172.000
Z-statistic	-2.667
p-value	***0.008

Note: Statistically significant at the level of 10% (\*), 5% (\*\*) and 1% (\*\*\*).

It is widely known that BI tools have origins in most developed countries of the world (Hassan, 2019). On the other side, foreign direct investments in Serbia primarily come from developed European countries, such as The Netherlands, Austria or Germany. Leading Investors by Value (%) are Germany, USA, Italy, France, Austria, China, etc. (Ras, 2022). Regarding this, it could be expected that Serbian subsidiaries of multinational companies whose headquarters are located in above mentioned countries, invest more in BI tools implementation. Such multinational companies have the know-how for the BI tools implementation and may transfer it to the subsidiaries in developing countries.

Although it is often assumed that benefits of the BI tools adoption exceed the costs of it (Puklavec et al., 2018), the costs of BI tools may be an important obstacle for its implementation. In this regard, it is rational to assume that multinational companies have more funds to finance (sometimes highly expensive) BI tools implementation. Such foreign funds may be distributed to the subsidiaries of multinational companies in order to implement BI tools compatible with the tools implemented in parent companies. Companies may adopt a free (demo) version of the BI tool, but free software has a limited data storages and limited possibilities for reporting. Therefore, the free version of BI tools could only satisfy the information needs of micro and small companies. Medium and large-sized companies realize huge investments in data integration, consolidation of data and reporting. Some of the free versions are: Birt, ClicData, Jedox, Microsoft Power BI etc.



### 4.3 BI tools implementation and company performance

Table 6 presents the descriptive statistics for the change in company performance after the BI tools implementation. Both arithmetic mean and median are only at the moderate level of the increase in company performance, implying that there is a significant room for improvement in both BI tools implementation and company performance. We have also tracked each performance component separately – the change in profits (PERF1), sales (PERF2), market share (PERF3), reduction of costs of holding inventory (PERF4), reduction of production costs (PERF5) and competitive position (PERF6). The results indicate that PERF1 has the highest arithmetic mean, meaning that profits are the component mostly increased after the implementation of the BI tools.

**Table 6:** Descriptive statistics for PERF and its components

<i>Variable</i>	<i>PERF</i>	<i>PERF1</i>	<i>PERF2</i>	<i>PERF3</i>	<i>PERF4</i>	<i>PERF5</i>	<i>PERF6</i>
Arithmetic mean	17.06	3.02	2.98	2.81	2.60	2.65	3.00
Median	18.00	3.00	3.00	3.00	3.00	3.00	3.00
Minimum	6.00	1.00	1.00	1.00	1.00	1.00	1.00
Maximum	30.00	5.00	5.00	5.00	5.00	5.00	5.00
Standard deviation	6.32	1.21	1.21	1.16	1.26	1.34	1.12

Figure 2 shows the scatter diagram, analyzing the relationship between the level of the BI tools implementation and the change in the company performance. In other words, such diagram shows the estimates of the simple Ordinary Least Squares regression. A positive trendline shows that the companies with higher level of the BI tools implementation experienced larger increase in the performance. However, it is necessary to include control variables to reach a more reliable conclusion. Therefore, we have run the multiple regression analysis.

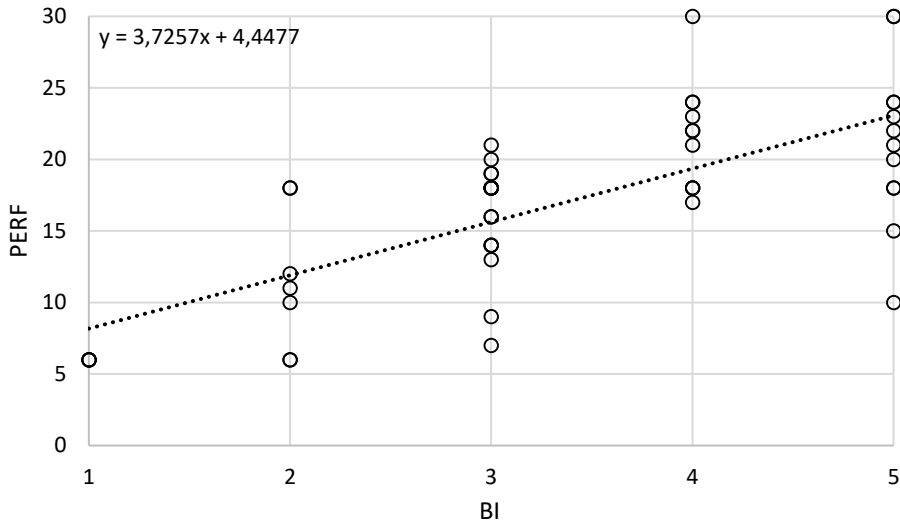
**Figure 2:** The relation between the level of BI tools implementation and the change in company performance

Table 7 reports the regression analysis results. It may be concluded that the implementation of the BI tools leads to the significant change in a company performance. As the level of the BI tools implementation is higher, the change in a company performance is significantly higher, with the results significant at the 1% level. Therefore, the second research hypothesis cannot be rejected. Research results are robust to some changes in the research model. We have eliminated observations with low level of the BI tools implementations, leaving in the sample only 41 observations that assessed the level with at least 3 on the scale from one to five. However, the impact of the employed independent variables remains the same, though the adjusted  $R^2$  lowers to the 0.209. Research results for such modified research sample are not tabulated due to the reasons of space.

**Table 7:** Regression estimates

<i>Variable</i>	<i>Beta coefficient</i>	<i>t-statistic</i>	<i>p-value</i>
Constant	1.031	0.372	0.712
BI	3.231	5.678	***0.000
SIZE	1.543	1.509	0.138
OWN	1.660	1.202	0.235
Adjusted R <sup>2</sup>	0.516		
F-value	***19.147		
Observations	52		

Note: Statistically significant at the level of 10% (\*), 5% (\*\*) and 1% (\*\*\*).

Research results dominantly confirm theoretical assumptions about the positive impact of the BI tools on the company performance. Therefore, it may be concluded that implemented BI tools in Serbian companies facilitate more accurate, timely and data-driven decision-making process. In addition, the implementation of the BI tools improves organizational efficiency. Although its implementation may be costly, it is obvious that BI tools enable valuable benefits for Serbian companies. In other words, companies that use BI tools have better performance than companies that use only financial statements data, as pointed out in some previous research (Rajnoha et al., 2016, Akter et al. 2016, Torres et al., 2018, Aydiner et al., 2019). Business intelligence tools vary in robustness, integration capabilities, ease of use (from a technical perspective), and pricing (Gilliam. H, 2022). Some of the most commonly used BI tools are Sap Business Objects, Datapine, MicroStrategy, Microsoft Power BI, Oracle BI etc. Companies with limited financial potential cannot afford expensive software. It has to be noticed that implementation and use of BI tools in the decision-making process is still the privilege of companies that have financial capacity and budget for this type of investment. Previous research about BI tools implementation in the Republic of Serbia is limited. There is not enough empirical data about the industries within companies perceive the importance of implementing BI tools. There is no transparent data about cost benefit analysis of implementing BI tools, as well as there is no deep analysis of key enabling factors important for higher level of implemented BI tools in the companies operating in Serbia. The positive effects of BI implementation are explained in the example of tolling system. The effects of applying BI technology primarily include time savings in evaluating and analyzing performances, improvement in business processes (Radivojevic et al., 2015: 52).

We have also run the regression analysis with partial components of company performance (PERF1, PERF2, PERF3, PERF4, PERF5 and PERF6) as dependent variables. Therefore, we have estimated six additional regression models and their results are reported in Table 8. Since the beta coefficient for the impact of the level of BI tools implementation on company performance is the strongest in the first additional regression model, it may be concluded that the implementation of BI has the strongest impact on the level of company profits related to other partial components of the performance.

**Table 8:** Additional regression estimates

<i>Variable</i>	<i>Dependent: PERF1</i>			<i>Dependent: PERF2</i>		
	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>
Constant	0.639	1.067	0.291	0.364	0.610	0.545
BI	0.639	5.212	***0.000	0.614	5.022	***0.000
SIZE	0.080	0.365	0.717	0.199	0.908	0.368
OWN	0.012	0.041	0.968	0.035	0.116	0.908
Adjusted R <sup>2</sup>	0.390			0.395		
F-value	***11.867			***12.087		
Observations	52			52		
<i>Variable</i>	<i>Dependent: PERF3</i>			<i>Dependent: PERF4</i>		
	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>
Constant	0.021	0.037	0.970	-0.056	-0.085	0.932
BI	0.523	4.517	***0.000	0.420	3.099	***0.003
SIZE	0.351	1.689	*0.098	0.342	1.404	0.167
OWN	0.158	0.564	0.576	0.528	1.606	0.115
Adjusted R <sup>2</sup>	0.401			0.308		
F-value	***12.397			***8.554		
Observations	52			52		
<i>Variable</i>	<i>Dependent: PERF5</i>			<i>Dependent: PERF6</i>		
	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>	<b>Beta coeff.</b>	<b>t-statistic</b>	<b>p-value</b>
Constant	0.087	0.128	0.899	-0.022	-0.043	0.966
BI	0.546	3.935	***0.000	0.489	4.638	***0.000
SIZE	0.117	0.470	0.641	0.453	2.391	**0.021
OWN	0.636	1.889	*0.065	0.290	1.134	0.262
Adjusted R <sup>2</sup>	0.363			0.472		
F-value	***10.673			***16.172		
Observations	52			52		

Note: Statistically significant at the level of 10% (\*), 5% (\*\*) and 1% (\*\*\*).

## 5 Conclusions

The goal of this paper was to analyze the impact of BI implementation on a company's performance. It is concluded that the majority of foreign owned companies have higher level of the BI tools implementation. The companies with higher level of the BI tools implementation have higher increase in the performance. The strongest impact of BI implementation refers to the level of company profits. Although is expected that the main obstacle to the higher level of BI implementation is a lack of resources, 25 % of the respondents said that the main reason is a lack of qualified staff. One of the suggestions to companies might be to organize workshops and enable their employees to get additional knowledge and improve their competence in the field of data analysis, reporting, etc. Also, companies should not wait until the end of the year to analyze financial results. Of the total of 52 respondents, 27 have said that they analyze performance on a monthly basis and 16 respondents analyze performance daily.

One of the limitations of our study is it that is based on a relatively small sample. Also, limited variables were tested. The level of BI implementation could be expanded to different sectors. The impact of an accountant's year of experience, accounting knowledge and competencies could be tested as moderating variables. That is very important because accountants play a fundamental role in supplementing data to Power BI when we are talking about accounting data. In the construction sector that might be engineers. The fundamental role depends on the type of sector or type of information that we need to analyze. That will be the direction of further research.

### References:

- Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R. & Childe, S. J. (2016) How to improve firm performance using big data analytics capability and business strategy alignment?, *International Journal of Production Economics*, 182, pp. 113–131, <https://doi.org/10.1016/j.ijpe.2016.08.018>.
- Appelbaum, D., Kogan, A., Vasarhelyi, M. & Yan, Z. (2017) Impact of business analytics and enterprise systems on managerial accounting, *International Journal of Accounting Information Systems*, 25, pp. 29–44, <http://dx.doi.org/10.1016/j.accinf.2017.03.003>.
- Asiaei, A. & Ab. Rahim, N. Z. (2019) A multifaceted framework for adoption of cloud computing in Malaysian SMEs, *Journal of Science and Technology Policy Management*, 10(3), pp. 708–750, <https://doi.org/10.1108/JSTPM-05-2018-0053>.
- Aydiner, A. S., Tatogly, E., Bayraktar, E., Zaim, S. & Delen, D. (2019) Business analytics and firm performance: The mediating role of business process performance, *Journal of Business Research*, 96, pp. 228–237, <https://doi.org/10.1016/j.jbusres.2018.11.028>.
- Bach, M.P., Jaklič, J. & Vugec, D.S. (2018) Understanding impact of business intelligence to organizational performance using cluster analysis: does culture matter, *International Journal of Information Systems and Project Management*, 6(3), pp. 63–86, <https://doi.org/10.12821/ijispm060304>.
- Chao, W., Longfeng, Z., Andre L.M. V. & Ming, K., L. (2019) The evolution of Industrial Management & Data Systems over the past 25 years a bibliometric overview, *Industrial Management & Data Systems*, 119(1), pp. 2–34, <https://doi.org/10.1108/IMDS-11-2018-0506>.
- Chen, H., Chiang, R.H.L. & Storey, V.C. (2012) Business Intelligence and Impact: From Big Data to Big Impact, *MIS Quarterly*, 36( 4), pp. 1165–1188, <https://doi.org/10.2307/41703503>.
- Dijkstra, E. (2022) *Blunder 1: Purchasing hundreds of licenses before deciding what to do with them*, available at: <https://www.passionned.com/7-blunders-business-analytics/> (October 6, 2022).
- Elbashir, M.Z., Collier, P.A. & Davern, M.J. (2008) Measuring the effects of business intelligence systems: The relationship between business process and organizational performance, *International Journal of Accounting Information Systems*, 9(3), pp. 135–153, <https://doi.org/10.1016/j.accinf.2008.03.001>.
- Fu, H.-P., Chang, T.-H., Teng, Y.-H., Liu, C.-H. & Chuang, H.-C. (2022) Critical Factors Considered by Companies to Introduce Business Intelligence Systems, *Axioms*, 11(7), p. 338, <https://doi.org/10.3390/axioms11070338>.
- Gilliam, E. H. (2022) *Top 15 Business Intelligence Tools in 2022: An Overview*, available at: <https://mopinion.com/business-intelligence-bi-tools-overview/> (November 15, 2022).

- Greenaway, D., Guariglia, A. & Yu, Z. (2014) The More the Better? Foreign Ownership and Corporate Performance in China, *The European Journal of Finance*, 20(7-9), pp. 681-702, <https://doi.org/10.1080/1351847X.2012.671785>.
- Hassan, N. (2019) The Origins of Business Analytics and Implications for the Information Systems Field, *Journal of Business Analytics*, 2(2), pp. 118-133, <https://doi.org/10.1080/2573234X.2019.1693912>.
- Kerklaan, L. (2022) *Not connecting Business Analytics to continuous improvement*, available at: <https://www.passionned.com/7-blunders-business-analytics/> (November 16, 2022).
- LevelEleven (2019) *Business Intelligence vs. Performance Management*, available at: <https://leveleven.com/2019/11/business-intelligence-vs-performance-management/> (September 12, 2022).
- Maroufkhani, P., Tseng, M.-L., Iranmanesh, M., Ismail, W.K.W. & Khalid, H. (2020) Big data analytics adoption: Determinants and performances among small to medium-sized enterprises, *International Journal of Information Management*, 54, <https://doi.org/10.1016/j.ijinfomgt.2020.102190>.
- Njegomir, V., Demko-Rihter, J. & Bojanić, T. (2021) Disruptive Technologies in the Operation of Insurance Industry, *Tehnički vjesnik*, 28(5), pp. 1797-1805, <https://doi.org/10.17559/TV-20200922132555>.
- Paradza, D. & Daramola, O. (2021) Business Intelligence and Business Value in Organisations: A Systematic Literature Review, *Sustainability*, 13(20), <https://doi.org/10.3390/su132011382>.
- Perdana, A., Hoon Lee, H., Koh, S. & Arisandi, D. (2022) Data analytics in small and mid-size enterprises: Enablers and inhibitors for business value and firm performance, *International Journal of Accounting Information Systems*, 44, <https://doi.org/10.1016/j.accinf.2021.100547>.
- Puklavac, B., Oliveira, T. & Popović, A. (2018) Understanding the Determinants of Business Intelligence System Adoption Strategies: An Empirical Study of SMEs, *Industrial Management & Data Systems*, 118(1), pp. 236-261, <https://doi.org/10.1108/IMDS-05-2017-0170>.
- Purvis, R. L., Sambamurthy, V. & Zmud, R. W. (2001) The Assimilation of Knowledge Platforms in Organizations: An Empirical Investigation, *Organization Science*, 12(2), pp. 117-135, <https://ezproxy.nb.rs:2213/stable/3086051>.
- Rajnoha, R., Štefko, R., Merkova, M. & Dobrović, J. (2016) Business Intelligence as a Key Information and Knowledge Tool for Strategic Business Performance, *E&M Ekonomie a Management*, 19(1), pp. 183-203, <https://doi.org/10.15240/tul/001/2016-1-013>.
- Ramanathan, R., Philpott, E., Duan, Y. & Cao, G. (2017) Adoption of business analytics and impact on performance: A qualitative study in retail, *Production Planning and Control*, 28(11-12), pp. 985-998, <https://doi.org/10.1080/09537287.2017.1336800>.
- Radivojevic, G., Lazic, B. & Sormaz, G. (2015) Effects Of Business Intelligence Application In Tolling System, *International Journal for Traffic and Transport Engineering*, 5(1), pp. 45 – 53, [http://dx.doi.org/10.7708/ijtte.2015.5\(1\).06](http://dx.doi.org/10.7708/ijtte.2015.5(1).06).
- Razvojna agencija Srbije (2022) *Vodeći Investitori po broju projekata (%)*, available at: <https://ras.gov.rs/uspesne-price> (November 16, 2022).
- Reinschmidt, J., & Francoise, A. (2000) *Business Intelligence certification guide* (San Jose, CA: IBM, International Technical Support Organization).
- Rodrigues, F., Alves, A.D. & Matos, R. (2022) Construction Management Supported by BIM and a Business Intelligence Tool, *Energies*, 15(9), <https://doi.org/10.3390/en15093412>.
- Su, Y., Backlund, P. & Engstrom, H. (2020) Business Intelligence Challenges for Independent Game Publishing, *International Journal of Computer Games Technology*, pp. 1-8, <https://doi.org/10.1155/2020/5395187>.

- Sun, H., Rabbani, M.R., Sial, MS., Yu, S., Filipe J.A. & Cherian, J. (2020) Identifying Big Data's Opportunities, Challenges, and Implications in Finance, *Mathematics*, 8(10), pp. 2 – 20, <https://doi.org/10.3390/math8101738>.
- Torres, R., Sidorova, A. & Jones, M.C. (2018) Enabling firm performance through business intelligence and analytics: A dynamic capabilities perspective, *Information & Management*, 55(7), pp. 822–839, <https://doi.org/10.1016/j.im.2018.03.010>.
- Trieu, V. H., Jones, A., Green, P. & Cockcroft, S. (2022) Applying And Extending The Theory Of Effective Use in a Business Intelligence Context, *MIS Quarterly*, 46(1), pp. 645-678, <https://doi.org/10.25300/MISQ/2022/14880>.
- Trkman, P., McCormack, K., Valadares de Oliveira, M.P. & Bronzo, L.M. (2010) The impact of business analytics on supply chain performance, *Decision Support Systems*, 49(3), pp. 318–327, <https://doi.org/10.1016/j.dss.2010.03.007>.
- Vallurupalli, V. & Bose, I. (2018) Business intelligence for performance measurement: A case - based analysis, *Decision Support Systems*, 111, pp. 72-85, <https://doi.org/10.1016/j.dss.2018.05.002>.
- Yeoh, W. & Popović, A. (2016) Extending the Understanding of Critical Success Factors for Implementing Business Intelligence Systems, *Journal of the Association For Information Science and Technology*, 67(1), pp. 134-147, <https://doi.org/10.1002/asi.23366>.
- Yiu, D. L. M., Yeung, A. C. L. & Cheng, E. T. C. (2021) The impact of business intelligence systems on profitability and risks of firms, *International Journal of Production Research*, 59(13), pp. 3951-3974, <https://doi.org/10.1080/00207543.2020.1756506>.





## Employees' Perception of the Performance Evaluation Process Elements: Evidence from Banking Industry

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**Abstract** In this study, we argue that evaluation system elements, more precisely performance measures and managers' biases, fairness perception, pay transparency, and incentive types, have important consequences for employees' performance. Since managers have limited time for performance evaluation, performance information is usually incomplete and includes subjectivity. This leads to performance evaluation biases, more precisely to centrality and leniency biases. Additionally, we argue that employees' fairness perception is very important not only for the evaluation process but also for their satisfaction. Moreover, a growing body of literature emphasizes the role of pay transparency in the performance evaluation process. Finally, the study analyses how important it is for employees to receive rewards they value and expect. We developed a survey where we collect data from one bank in Serbia. Most employees think that branch managers use subjective performance evaluation, but that their evaluations are fair. However, results show that centrality and leniency biases exist and there is still room for improvement.

**Keywords:** • performance evaluation • pay transparency • fairness perception • centrality and leniency biases

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## 1 Introduction

Compensation systems send a message to employees that their output and performance are valued by the organization (Hoffman and Rogelberg, 1998). In addition, it helps managers to build a long-term relationship with employees. Compensation system literature is tightly linked to managers' discretion over compensation. On the one hand pay transparency results in more accurate and comprehensive performance evaluation and potentially employees' higher productive effort. On other hand, previous research shows that pay transparency can be detrimental to employees' productivity if employees do not perceive managers' allocation decisions as fair (see Ittner et al., 2003). In this research, we focus on employees' perception of pay transparency. Therefore, this study contributes to a better understanding of how employees from banking industry in Serbia perceive pay transparency.

Additionally, the study examines the effects of subjective performance evaluation and managers' performance evaluation biases. It is important to understand how managers make allocation decisions and what can be expected from employees after evaluations. More precisely, we focus on centrality and leniency biases (Prendergast, 1999; Bol, 2011). The study extends the current literature by focusing on employees' satisfaction with the bonus determination.

We argue that employees' fairness perception is very important not only for the evaluation process but also for their satisfaction and reactions to work. One of the objectives of this study is to analyze employees' fairness perception of the performance evaluation process, their ratings, and rewards. Bol, Kramer and Maas (2016) point out that accurate information and transparency about performance evaluation outcomes lead to better evaluation judgments and more objective reward decisions. Consequently, the study analyses how important it is for employees to receive rewards they value and expect. Therefore, employees' preferences for different types of incentives, such as explicit or implicit, might result in employees' better performance.

To address the above questions, we examine the compensation policy of one large international bank in Serbia. In the banking industry managers usually have to follow standards when evaluating their employees, but they still have freedom in assigning performance ratings.

The results show that majority of employees think that their managers rely on objective information when judging their performance and prefer implicit incentives (e.g. promotion to a higher level). However, employees report that they believe that their managers use personal judgment when judging their performance. Moreover, employees perceive managers' decisions on performance evaluation scores as transparent, and generally they think that their bonus is fair compared to other colleagues. Collectively, our results suggest that branch managers follow performance evaluation procedure which

is based on objective criteria, but also subjectivity is inevitable part. Generally, managers' evaluations are perceived as fair and match what employees deserve. Although employees are generally satisfied with the results of the evaluation process and the rewards they received based on it, centrality and leniency biases exist and have a significant influence on employees' satisfaction.

This study makes several contributions to the literature that examines the performance evaluation process. In addition, the study gives insights from the banking industry. More precisely, results contribute to the prior literature on subjective performance evaluations and show how compensation system design depends on the managers' subjectivity and can be perceived differently by employees. Moreover, our results contribute to a better understanding of compensation systems designed to promote transparency and fairness in practice.

By illustrating the elements of the performance evaluation process and their potential consequences for employees' performance, our study contributes to the literature that examines compensation policies.

The next sections of this paper are structured as follows. In the section "literature review" we discuss prior literature on this topic. Section "Research" presents the design of the empirical survey. The section "Results and Discussion" presents the results regarding the employees' perception of the performance evaluation elements. Finally, the section "Conclusion" shows an overview of findings, the study's limitations, and directions for future research.

## **2 Literature overview**

Evaluation of employees can be determined objectively (by comparing actual performance to targets), subjectively (evaluation decisions are made by managers), and a combination of both approaches (Bol, 2008; Murphy, 2000). Numerous performance measurement systems include both objective measures and subjective evaluations (Bol and Smith, 2011).

Subjective performance evaluation allows including noncontractible information to analyze actions and efforts that objective measures are not able to capture (Bol and Smith, 2011). Fehr and Schmidt (2000) provide evidence that managers have a strong preference for less complete contracts. Fairness concerns explain this preference, especially when fair managers provide strong implicit incentives through incomplete contracts. Since managers have limited time for performance evaluation, performance information is usually incomplete and includes subjectivity (Bol, 2011). This leads to performance evaluation biases, more precisely to centrality and leniency biases (Bol 2011; Moers 2005). Centrality bias is a tendency to compress employees' performance ratings, resulting in less variance in ratings. Leniency bias is the tendency to inflate employees'

performance ratings (Bol, 2011). Moers (2005) argues that managers provide more lenient and compressed ratings when subjectively assessing performance. Generally, the performance evaluation process is time-consuming - managers need to invest time and effort in gathering information on employee performance. When employees can observe each other's ratings and performance, satisfaction with evaluations will depend on how their own ratings and rewards compare to those of their peers (Greenberg et al., 2007). Although sometimes it is inconsistent with the organization's interests, managers will provide ratings that satisfy their employees. There are several reasons for such managers' behavior. If employees are not satisfied with the ratings, they will confront and decrease their effort. This will affect managers' compensation and/or promotion opportunities. Additionally, confrontations are psychologically painful and time-consuming (Bol et al., 2016). Moreover, research shows that most employees think that their own performance is above the average (Alicke and Govorun, 2005). The rating strategies result in compressed ratings - ratings are concentrated above the average of the rating scale. Potential risks are that a company will have a culture of mediocrity, where high performers are less motivated. This might influence the attraction, development and retention of talents (Bol, 2011). When pay transparency does not exist managers are less concerned about the dissatisfaction of the best employees. However, when pay transparency exists they have to confront weaker employees and focus on fair distribution. This means that pay transparency might help managers to make fair rating decisions.

Voußem et al. (2016) argue that subjectivity increases fairness perceptions when the overall focus on subjective measures is relatively low. However, subjectivity decreases fairness perceptions when the overall focus on subjective measures is relatively high. Perceived fairness is defined as organizational justice that consists of procedural, distributive and informational justice (Sudin, 2011). Literature on organizational justice differentiates between the fairness related to the outcomes employees perceive (distributive fairness), the decision-making process related to the outcomes (procedural fairness), and the behavior of managers and employees (interactional fairness). Fairness perceptions are very important for organizations because of its relationship with employees' job satisfaction and organizational commitment (Sudin, 2011). Krekel et al. (2019) find out that employees' satisfaction with their company increases not only employees but also business (e.g. unit level) profitability.

Brickley et al. (2003) state that an optimally designed incentive system makes a strong link between organizational architecture and strategy. Although incentives are perceived as a good motivator, there is empirical and practical evidence that incentives lead to a decrease in intrinsic motivation (Fehr and Falk, 2002). Moreover, incentives sometimes might foster unethical (Brickley, Smith, and Zimmerman, 2003) or counterproductive (Wang, 2017) behaviour. Incentives can be monetary or non-monetary and serve to signal future direction for employees. Moreover, managers use incentives to show what they expect from their employees and often count on employees' reciprocal behaviour. It has been shown that monetary incentives more efficiently motivate cooperation between

employees. For example, Haesebrouck et al. (2021) argue that knowledge-sharing behaviour is motivated by anticipated rewards. Results are different, since also negative or no effects are found (Bock et al., 2005; Lin, 2007). Nevertheless, the theory of reciprocity suggests that employees are willing to invest at a higher effort level when their managers behave fair and kindly (Maas and Yin, 2022). Providing incentives is a very important and very often a game-changing factor (Lazear, 2018).

Pay transparency is a controversial but understudied topic (Stofberg et al., 2022). Pay transparency might be defined as the extent to which employees know each other's pay level. Also, pay transparency is a multidimensional construct that includes several forms such as pay process; pay outcome transparency; and pay communication restriction (Arnold et al., 2018, Stofberg et al., 2022). Hartmann and Slepničar (2012) provide evidence that the relationship between pay justice and managers' intrinsic motivation is moderated by pay transparency. Pay transparency as a relatively new way of doing business requires companies to train managers in evaluating employees, making decisions on incentives, and communicating directly with employees (Friedman, 2014). Moreover, it is understudied how pay transparency influences employees turnover and their satisfaction (Smit & Montag-Smit, 2018). There are studies that look at pay transparency in laboratory settings (Belogolovsky and Bamberger, 2014), studies that use public data (Hill et al., 2017), and recent studies that focus on the theoretical level - how to measure pay transparency and how to analyse its consequences for the organization (Smit & Montag-Smit, 2018). The potential benefits of pay transparency are reduced inequality in pay, improved motivation, better performance, a higher level of fairness, and improved labor market efficiency. However, there are some potential risks too (Zenger, 2016). Being aware of pay inequalities employees might become less motivated, less willing to give their best, and less satisfied with their pay. One of the risks is that pay transparency might negatively impact employees' trust. Moriarty (2018) points out that organizations should protect employees' privacy and keep their information in a sensitive manner. The way how employees perceive pay transparency largely depends on their personalities and contextual factors. LaViers (2019) shows that when pay dispersion exists transparency decreases employees' total productivity. Additionally, she points out that it is more likely that employees will engage in negative reciprocity.

### 3 Research

For addressing the research questions, we require a setting that enables us to study the perceived effectiveness of a compensation system at the business unit level. Data sets about compensation systems are often not publicly available and formal compensation systems differ between organizations. We, therefore, developed a survey where we collect data from various branches of one large international bank in Serbia. All branches are subject to the same compensation system, where employees are evaluated on a set of similar targets.

Yet, the branch managers still have discretion in assigning the performance ratings of their employees. More precisely, at the end of each year, managers are asked to evaluate their employees and give them a rating for their performance (the final rating is based on three criteria: Job requirements, Operational Objectives, and Professional/Behavioral Development Objectives). Ratings could range from 1 to 3 (1 stands for below expectations; 2 stands for average performance; and 3 stands for above expectations). In doing so, they should follow a pre-defined distribution (Berger et al. 2013; Chattopadhyay, 2019; Blume et al., 2009; Stewart et al., 2010; Grote, 2005). Specifically, bank managers should have about 25% of employees rated below expectations, 50% of employees should be rated in line with the expectations and around 25% should receive an above the expectations rating. While the manager cannot directly influence the compensation system, ratings are informative for the final allocation of the bonus to an employee.

The sample includes employees from 24 branches in five big cities in Serbia. Most of the branches are from Belgrade, but we chose different municipalities of the city in order to have a balanced sample size. A total of 121 respondents had filled out the questionnaire. There were 22.3% of male and 77.7% of female respondents. On average they were 37 years old ( $M=37.71$ ,  $SD=6.696$ ). Table 1 presents the distribution of employees' level of education. The approximate length of their bank working experience was 9 to 10 years ( $M=9.84$ ,  $SD=5.067$ ).

**Table 1:** Distribution of employees' level of education

Level of education	Percentage
High school	16.8
College	23.5
Bachelor	49.6
Master	10.1

#### 4 Results and Discussion

As discussed above, the main topic of this research is the performance evaluation process of the bank employees. The research encompasses 40 questions regarding the employees' performance evaluation, divided into three parts which were further molded into performance evaluation elements: pay transparency, performance evaluations and managers' biases, fairness perception, and incentive types.

Table 2 presents the vast results of the conducted research regarding the employees' perception of the performance evaluation elements.

**Table 2:** Performance evaluation elements – Promotions, incentives, and performance measures

Item	Yes	No	Neutral
I prefer recognition for the hard work being done (e.g. reward for the best employee).	82.5	2.5	15
I prefer implicit incentives such as promotion to the next higher job level.	85.2	0.9	13.9
Promotions in my branch are largely based on favouritism.	10.2	64.4	25.4
My branch manager tries to pick the best candidate for the next level job.	76.1	3.5	20.5
When judging my performance, my branch manager uses his (her) personal judgment of my performance.	48.7	21.8	29.4
When judging my performance, my branch manager relies on objective information from the information system.	81.5	4.2	14.3

Regarding the recognition for the hard work being done, such as a reward for the best employee or similar incentive, 82% of the respondents do prefer recognition for the hard work, less than 3% of them do not, while 15% are neutral about that matter. There are 85% of the employees that prefer implicit incentives such as promotion to a higher position, while 14% are neutral and less than 1% do not prefer such an incentive. Promotions are seen as largely based on favoritism by 10% of the respondents, while 65% do not believe that this is the case, and 25% are neutral on the matter.

We also analyzed the opinion of the bank employees regarding their managers' actions. When it comes to picking the right man for the job, 76% of the employees believe that their branch manager tries to pick the best candidate for the next level position. Less than 4% do not believe that this is the case, while 20% are neutral. More than 80% have an opinion that their managers rely on objective information when judging their performance, less than 5% do not agree, while less than 15% are neutral. Nevertheless, slightly less than half of the employees believe that their managers use personal judgment when judging their performance. About 30% are neutral regarding this matter, while a bit more than 20% do not believe that this is the case.

Further analysis of the respondents' perception of performance evaluation elements is given in Table 3.

**Table 3:** Performance evaluation elements – fairness and biases

Item	Yes	No	Neutral
I am very satisfied with the way in which my bonus was determined.	58.8	14	27.2
I am very satisfied with the bonus amount that my manager gave to me.	56.4	16.4	27.3
I think that the bonus amount I have received in 2016 matches completely what I deserved.	47.4	19.3	33.3
I think that the bonus amount I have received in 2016 is fair in comparison to my colleagues.	45.1	13.2	41.6
My branch manager evaluates all employees almost equally (there is no big difference between employees' bonuses).	33.3	27.9	38.7
There is a large pay spread between low performers and high performers in a given job.	17.3	34.5	48.2
Usually almost all my colleagues are evaluated above the average.	10.8	36	53.2
My branch manager uses discretion in determining performance evaluation scores.	29.1	37.3	33.6

Less satisfying results pertain to fairness and the biases of the bonuses and rewards. Less than 60% of the employees are satisfied with the way that the bonus was determined and 14% of them are not, while 27% are neutral regarding the matter. Even fewer of them were satisfied with the bonus amount, while 16% were not and still 27% neutral.

Less than half of the respondents believe that the bonus amount matches what they deserve and almost 20% do not agree, while 33% are neutral. Even less, 45% think that the bonus they gained is a fair bonus compared to their colleagues. Still, only 13% are not satisfied with this comparison, while more than 40% do not compare their bonus with their colleagues. This is also evident from the next item from Table 3, because almost 40% are neutral regarding the matter if their manager evaluates all employees equally. But almost 30% do not think that they are treated equally and only 33% think that they are. Almost half of the respondents are neutral regarding the pay spread between low performers and high performers, while 35% think that the pay spread is not large and 17% think the opposite. More than half are neutral when it comes to the matter of their colleagues being evaluated above the average, 36% think that this is not the case and only 10% are distrustful about the matter.

Branch managers are not trusted with discretion in determining performance evaluation scores in almost 40% of cases. In contrast, about 30% are fine with this matter and 33% are neutral. Table 4 presents the summary results regarding the performance evaluation.



**Table 4:** Summary results regarding the performance evaluation

Item	Below expectations	In line with expectations	Above expectations
Overall evaluation	12.9	65.6	21.5
Appraisal of job requirements	3.2	79.6	17.2
Appraisal of Operational Objectives	9.7	60.2	30.1
Appraisal of Professional Development Objectives	6.5	63.4	30.1

Overall, 65% consider that the evaluation is in line with the expectations. In contrast, 13% are unsatisfied claiming that the evaluation is below expectations, while more than 20% even consider that it is above expectations. Even 80% believe that the appraisal of job requirements is in line with expectations, a bit less than 20% consider them to be above expectations, and only 3% think that they are below expectations. When it comes to operational objectives, 60% think that the appraisal is in line with expectations, and moreover, 30% are satisfied with this matter considering it above expectations. Less than 10% are unsatisfied, considering the appraisal of objectives is below expectations. Even less, about 6% are dissatisfied with the appraisal of professional/behavioral development objectives, marking it as below expectations. On the other hand, almost 65% believe that they are in line with the expectations and even 30% that they are above expectations.

Statistical analysis of the results is given in the following paragraphs of the chapter. Crosstabs Chi-Square analysis is used to determine the relationship between the overall mark of the employees and some of their specific attitudes. Table 5 presents the crosstabs of the overall mark of the employees versus the satisfaction with the bonus amount provided by the managers.

**Table 5:** Crosstabs - overall mark vs. satisfaction with the bonus amount

	No	Neutral	Yes
<b>Below expectations</b>	41.7%	50.0%	8.3%
<b>In line with expectations</b>	18.5%	24.1%	57.4%
<b>Above expectations</b>	5.0%	5.0%	90.0%

To examine the relationship between the overall mark of the employees and the satisfaction with the bonus amount provided by the managers, we used crosstabs and the Likelihood Ratio correction of the Chi-Square test, considering that we had more than 20% of crosstabs cells with the expected value less than 5. The value of the Likelihood Ratio test was 23.412, with a significance  $p < 0.001$ . Since the significance was less than 0.05, we conclude that there is a relationship between the overall mark and satisfaction with the bonus amount. From table 5 we can conclude that 90% of the employees, who were satisfied with the bonus amount, had the overall mark above expectations. A bit less than 60% of the employees, who were satisfied with the bonus amount, had an overall

mark in line with expectations. On the other hand, 50% of the employees, who were marked below expectations were neutral about the bonus amount, and more than 40% of them were not satisfied with the bonus amount. The crosstabs indicate the existence of the described relationship.

Table 6 further shows the crosstabs of the overall mark of the employees versus the satisfaction with the way that bonus was determined.

**Table 6:** Crosstabs - overall mark vs. satisfaction with the bonus determination

	No	Neutral	Yes
<b>Below expectations</b>	41.7%	41.7%	16.7%
<b>In line with expectations</b>	12.5%	21.4%	66.1%
<b>Above expectations</b>	5.0%	15.0%	80.0%

Same as previous, Likelihood Ratio test was used. The value of the Likelihood Ratio test was 14.745, with a significance  $p < 0.001$ . Since the significance was less than 0.05, we conclude that there is a relationship between the overall mark and satisfaction with the way that the bonus was determined. From table 6 we can conclude that 80% of the employees, who were satisfied with the bonus determination, had an overall mark above expectations, and more than 65% of them, had the overall mark in line with expectations. On the other hand, more than 40% of the employees, who were marked below expectations were both, neutral and not satisfied with the bonus determination.

Table 7 presents the crosstabs of the overall mark of the employees versus the belief of the employees that they have received the deserved bonus amount.

**Table 7:** Crosstabs - overall mark vs. deserved bonus amount

	No	Neutral	Yes
<b>Below expectations</b>	41.7%	41.7%	16.7%
<b>In line with expectations</b>	24.6%	29.8%	45.6%
<b>Above expectations</b>	0.0%	15.0%	85.0%

The value of the Likelihood Ratio test was 20.696, with significance  $p < 0.001$ . Since the significance was less than 0.05, we conclude that there is a relationship between the overall mark and the belief of the employees that they have received the deserved bonus amount. Indeed, from table 7 we can note that 85% of the employees, who believed that they have received the deserved bonus amount, had an overall mark above expectations. More than 45% of them, had an overall mark in line with expectations. Tables also show that none of the employees whose performance was above expectations believed that they had received a different than deserved amount of bonus. On the other hand, again, more than 40% of the employees, who were marked below expectations were both, neutral and

not persuaded that the amount of the bonus that they received was what they actually deserved.

## 5 Conclusions

This study analyses evaluation system elements, more precisely pay transparency, subjective performance evaluations and managers' biases, fairness perception, and incentive types, and their important consequences on employees' satisfaction and performance. Commonly, our findings testify that, when it comes to promotions, incentives, and performance measures, employees are mostly satisfied with the treatment and the actions of their managers. For the matter of fairness and biases, they again are mostly satisfied but in a less percentage than the above. When it comes to comparing themselves to their colleagues, employees are quite neutral in a large percentage. Our findings also show that the overall mark is associated with satisfaction with the bonus amount provided by the managers and the way that bonus was determined, as well as with the belief of the employees that they have received the deserved bonus amount. Employees who were generally satisfied with the bonus amount and the bonus determination mostly had an overall mark in a line and even more frequently above expectations. These employees also believed that they had received the deserved bonus amount. Employees who had an overall mark below expectations were often neutral and not satisfied with the bonus determination. We argue that our findings indicate that the evaluation system elements have important consequences for employees' satisfaction and performance.

Limitations to this study offer additional opportunities for future research. The ability to generalize the results is limited since data are collected only from one bank. Moreover, we obtained information for only one year. Probably extending time-series data from several organizations would overcome these limitations.

Moreover, the performance evaluation process could be a strategic choice of the managers, and also this decision would likely be influenced by other management accounting decisions or practices. Future research can examine how the performance evaluation process affects employees' motivation and willingness for cooperation.

## References:

- Alicke, M. D., & Govorun, O. (2005) The better-than-average effect, *The self in social judgment*, 1, pp. 85-106.
- Arnold, A. & Fulmer, I. S. (2018) Pay transparency, In: Perkins, S. J. (ed.) *The Routledge companion to reward management* (London: Routledge), pp. 87-96.
- Belogolovsky, E. & Bamberger, P. A. (2014) Signaling in secret: Pay for performance and the incentive and sorting effects of pay secrecy, *Academy of Management Journal*, 57(6), pp. 1706-1733.

- Berger, J., Harbring, C. & Sliwka, D. (2013) Performance appraisals and the impact of forced distribution—an experimental investigation, *Management Science*, 59(1), pp. 54-68.
- Blume, B. D., Baldwin, T. T. & Rubin, R. S. (2009) Reactions to different types of forced distribution performance evaluation systems, *Journal of Business and Psychology*, 24(1), pp. 77-91.
- Bock, G. W. & Kim, Y. G. (2002) Breaking the myths of rewards: An exploratory study of attitudes about knowledge sharing, *Information Resources Management Journal (IRMJ)*, 15(2), pp. 14-21.
- Bol, J. C. (2008) Subjectivity in compensation contracting, *Journal of Accounting Literature*, 27, pp. 1-32.
- Bol, J. C. & Smith, S. D. (2011) Spillover effects in subjective performance evaluation: Bias and the asymmetric influence of controllability, *The Accounting Review*, 86(4), pp. 1213-1230.
- Bol, J. C., Kramer, S. & Maas, V. S. (2016) How control system design affects performance evaluation compression: The role of information accuracy and outcome transparency, *Accounting, Organizations and Society*, 51, pp. 64-73.
- Brickley, J. A., Smith, C. W. & Zimmerman, J. L. (2003) Corporate governance, ethics, and organizational architecture, *Journal of Applied Corporate Finance*, 15(3), pp. 34-45.
- Chattopadhyay, R. (2019) Impact of forced distribution system of performance evaluation on organizational citizenship behaviour, *Global Business Review*, 20(3), pp. 826-837.
- Chun, J. S., Brockner, J. & De Cremer, D. (2018) How temporal and social comparisons in performance evaluation affect fairness perceptions, *Organizational Behavior and Human Decision Processes*, 145, pp. 1-15.
- Colquitt, J. A., Greenberg, J. & Zapata-Phelan, C. P. (2013) What is organizational justice? A historical overview, In: Greenberg, J. & Colquitt, J. A. (eds.) *Handbook of organizational justice* (New York: Psychology Press), pp. 3-56.
- Fehr, E. & Falk, A. (2002) Psychological foundations of incentives, *European economic review*, 46(4-5), pp. 687-724.
- Fehr, E. & Schmidt, K. M. (2000) Fairness, incentives, and contractual choices, *European Economic Review*, 44(4-6), pp. 1057-1068.
- Friedman, D. S. (2014) Pay transparency: The new way of doing business, *Compensation & Benefits Review*, 46(5-6), pp. 292-294.
- Greenberg, J., Ashton-James, C. E. & Ashkanasy, N. M. (2007) Social comparison processes in organizations, *Organizational behavior and Human decision processes*, 102(1), pp. 22-41.
- Grote, R. C. (2005) *Forced ranking: Making performance management work* (Boston, MA: Harvard Business School Press).
- Haesebrouck, K., Van den Abbeele, A. & Williamson, M. G. (2021) Building trust through knowledge sharing: Implications for incentive system design, *Accounting, organizations and society*, 93, <https://doi.org/10.1016/j.aos.2021.101241>.
- Hartmann, F. & Slapničar, S. (2012) Pay fairness and intrinsic motivation: the role of pay transparency, *The International journal of human resource management*, 23(20), pp. 4283-4300.
- Hill, A. D., Aime, F. & Ridge, J. W. (2017) 10 years of data on baseball teams shows when pay transparency backfires, *Harvard Business Review*, available at: <https://hbr.org/2017/05/10-years-of-data-on-baseball-teams-shows-when-pay-transparency-backfires> (January 29, 2023).
- Hoffman, J. R. & Rogelberg, S. G. (1998) A guide to team incentive systems, *Team Performance Management: An International Journal*, 4(1), pp. 23-32.
- Ittner, C. D., Larcker, D. F. & Meyer, M. W. (2003) Subjectivity and the weighting of performance measures: Evidence from a balanced scorecard, *The accounting review*, 78(3), pp. 725-758.

- Krekel, C., Ward, G. & De Neve, J. E. (2019) Employee wellbeing, productivity, and firm performance, *Saïd Business School WP*, 2019-4, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3356581](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3356581) (January 29, 2023).
- LaViers, L. (2019) The Effect of Pay Transparency on Narcissists: Can Personality Type Predict Reciprocity?, *SSRN* 3487157, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3487157](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3487157) (January 29, 2023).
- Lazear, E. P. (2018) Compensation and incentives in the workplace, *Journal of Economic Perspectives*, 32(3), pp. 195-214.
- Lin, H. F. & Lee, G. G. (2004) Perceptions of senior managers toward knowledge-sharing behaviour, *Management decision*, 42(1), pp. 108-125.
- Maas, V. S. & Yin, H. (2022) Finding partners in crime? How transparency about managers' behavior affects employee collusion, *Accounting, Organizations and Society*, 96, <https://doi.org/10.1016/j.aos.2021.101293>.
- Moriarty, J. (2018) Against pay secrecy, *Journal of Applied Philosophy*, 35(4), pp. 689-704.
- Murphy, K. J. (2000) Performance standards in incentive contracts, *Journal of Accounting and Economics*, 30(3), pp. 245-278.
- Prendergast, C. (1999) The provision of incentives in firms, *Journal of economic literature*, 37(1), pp. 7-63.
- Smit, B. W. & Montag-Smit, T. (2018) The role of pay secrecy policies and employee secrecy preferences in shaping job attitudes, *Human Resource Management Journal*, 28(2), pp. 304-324.
- Stewart, S. M., Gruys, M. L. & Storm, M. (2010) Forced distribution performance evaluation systems: Advantages, disadvantages and keys to implementation, *Journal of Management & Organization*, 16(1), pp. 168-179.
- Stofberg, R., Mabaso, C. M. & Bussin, M. H. (2022) Employee responses to pay transparency, *SA Journal of Industrial Psychology*, 48(1), pp. 1-12.
- Sudin, S. (2011) Fairness of and satisfaction with performance appraisal process, *Journal of Global Management*, 2(1), pp. 66-83.
- Voußem, L., Kramer, S. & Schäffer, U. (2016) Fairness perceptions of annual bonus payments: The effects of subjective performance measures and the achievement of bonus targets, *Management Accounting Research*, 30, pp. 32-46.
- Wang, L. W. (2017) Recognizing the best: The productive and counterproductive effects of relative performance recognition, *Contemporary Accounting Research*, 34(2), pp. 966-990.
- Zenger, T. (2016) The case against pay transparency, *Harvard Business Review*, available at: <https://hbr.org/2016/09/the-case-against-pay-transparency> (January 29, 2023).



## Audit Market Concentration: Some Evidence from the Republic of North Macedonia

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**Abstract** Audit market concentration has been thoroughly researched both globally and regionally. According to previous studies, the audit market is often dominated by the Big Four at the EU level, while in the region, the concentration is lower, indicating that it has oligopolistic features. This paper analyzes and measures the concentration of the audit market in Republic of North Macedonia, through Herfindahl-Hirschman index - HHI and concentration ratio - CR4, based on three independent variables: audit-related revenue, number of clients and number of employees. The research covers the period from 2014 to 2021 and it is concluded that at the beginning of the analyzed period (2014-2017), according to audit-related revenue, the audit market in Republic of North Macedonia had the characteristics of an oligopoly, but today it is nonconcentrated market and ranges from perfect competition to oligopoly. In terms of the number of employees and the number of clients, the results from our research show that audit market in Republic of North Macedonia is not concentrated.

**Keywords:** • audit market • concentration • big four • audit firms • Republic of North Macedonia

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## 1 Introduction

Concentration is 'the combined market share of leading firms and indicates the degree of oligopoly' (Schaen & Maijoor, 1997). It is calculated by a formula with the market share as an independent variable. The bigger the size of the suppliers and the smaller their presence on the market, the higher the concentration level. Strong concentration indicates oligopoly. Low concentration points out that the market is divided equally under a big number of suppliers.

Audit market concentration has been widely researched, both globally and regionally, and there is evidence of market concentration in Serbia, Croatia, Slovenia, etc. However, in Republic of North Macedonia this market is not much researched and we believe that this paper is the only one that determines the concentration of audit firms in the country.

The concentration of different service or product markets is measured using several statistical methods, such as the Herfindahl-Hirschman index (HHI), Concentration ratios (CR<sub>n</sub>), Gini coefficient, Linda index, Hannah-Kay index, Hall Tideman index etc. In our paper to measure the concentration of the audit market we use the Herfindahl-Hirschman index (HHI) and Concentration ratio (CR<sub>4</sub>).

The purpose of this paper is to determine whether the audit market in Republic of North Macedonia is concentrated, or whether it is a case of perfect competition or an oligopoly. Through an analysis of the market for the period from 2014 to 2021 and already established indices, the paper provides an answer as to whether the audit market in Republic of North Macedonia is concentrated in terms of audit related revenues, the number of employees in the audit firms and the number of clients.

The paper is composed of several parts as follows: Introduction, Literature Review, Audit Market Concentration Measures, Audit Market Concentration Analysis in Republic of North Macedonia, Results and Discussion, and finally a Conclusion summarizing the results obtained from the research.

## 2 Literature overview

The audit market concentration globally and regionally has been extensively researched. In general, the market, depending on the number of participants, i.e. competitors in a certain area, as well as their market share, can range from perfect competition to monopoly. In the literature (Garcia, Kutlu & Sickles, 2019; Hall et al., 1986, and Verma, 2022), for perfect competition it is stated that a small concentration of certain firms is required, which would lead the market of those services to be objectively divided between the concerned firms. But, if the market is dominated by a small number of certain firms that are concentrated, then it is an oligopoly, and in the case if only one firm is dominant then it is a monopoly.



Many authors (Le Vourc'h & Morand, 2011; Mijić et al., 2014, and Mališ & Brozović, 2015) emphasize the oligopolistic nature of the audit services market in Europe and the region, with the dominance of the firms that are part of the Big Four. Also, most scholars agree that the level of audit concentration in most European countries is very high (Mališ & Brozović, 2015). The latest CFO (2022) article continues to highlight the dominance of the Big Four, indicating that the audit market is most concentrated among the population of large accelerated filers, that are publicly held organizations with a worldwide public float of \$700 million or more. According to them, The Big Four audit 88% of the large accelerated filers. Ernst & Young audits more than a quarter (28.4%) of them, with Deloitte (21.4%) in second place, according to Audit Analytics data, followed by PwC and KPMG (CFO, 2022). Boone (2011) states that oligopolistic dominance of the audit market by the Big 4 fosters complacency among auditors resulting in a more lenient and less skeptical approach to audits and lowers service quality.

According to Le Vourc'h & Morand (2011) in Europe, 19 Member States are highly concentrated with a Herfindahl-Hirschmann Index (HH Index) above 2000, while only two states are moderately concentrated with an HH Index between 1000 and 2000 (i.e. France and Greece). The EU average for the HH Index is 3094. This fact is also supported with some reports by the European Commission (2010, 2021), which state persistent high concentration, as the Big Four still dominate the Public Interest Entities' statutory audit market in most Member States and where the market share measured by revenue and audit fees exceeds even 90%.

Indyk (2019) examines mandatory audit rotation and audit market concentration in Poland and comes to the conclusion that the biggest capital groups tend to appoint audit firm from the Big Four, and if they change firm, they choose another audit firm from the Big Four. The high number of short-term tenures (up to five years) suggests that Big Four firms have strong bargaining power and they benefit more from the rotation of the clients rather than from their retention. According to estimates by Gerakos and Syverson (2015), mandated rotation after ten years would result in losses to consumer surplus of about \$2.7 billion, and rotation after four years would cause losses of \$4.7–5.0 billion. A relationship with a client that is too long may cause anticipation of the outcome rather than unbiased assessment. Rotating audits might thereby guarantee "the new look" and a more analytical approach. Long ago, Hoyle (1978) made the case that requiring audit rotation would make audit firms more competitive because they would have to constantly work to recruit new clients. According to Italian experience, regular rotations may result in cheaper audit fees, which could bolster the case for more competition in the audit market (Ewelt-Knauer et al., 2012).

The opponents of mandatory audit rotation also offer empirical proof that auditors were not even subjected to the requirement for rotation (Carrera et al. 2007). Mandatory audit rotation may further increase market concentration because big businesses typically select

one of the Big Four auditors when changing audit firms. Experience from South Korea implies that market competition will decline rather than grow (Ewelt-Knauer et al., 2012).

Willekens et al. (2020) discover that, even though industry leadership is not significantly correlated with audit quality, the favorable link between market share distance and audit quality only persists when the incumbent auditor is a market leader. These results imply that rather than industry specialization per se, audit quality is positively impacted by a market leader's industry market share supremacy over its competitors. In China, a study on the relationship between audit market concentration and audit quality with an empirical study has been done, with which Minghui and Zhenggang (2003) stated that the concentration and audit quality presents a u-function relationship in China's audit market, and point out it necessary to construct "oligopoly" to enhance the audit quality and international competitiveness of Certified Public Accountants and the listed company in China. Song (2021) demonstrate that audit quality declines as audit market concentration rises, and that this inverse relationship between audit market concentration and audit quality only changes when audit committees include certified accountants, other accounting experts like chief financial officers and controllers, or finance experts (excluding finance professors).

Furthermore, the audit market concentration is researched from different aspects by determining several independent variables that could have impact on it. Mijić et al. (2014) with their research analyze the market of audit services in Serbia through the operating revenues of the audit firms, net earnings, the number of employees and the number of clients and reveal that the audit market in Serbia is oligopolistic when market share is measured by operating revenue of audit firms and that the "Big Four" audit firms have a dominant position in the audit market in Serbia. When other measures of market concentration are taken into consideration, such as net earnings, number of employees and number of audit clients, the "Big Four" is not so dominant (Mijić et al., 2014). Furthermore, Mališ and Brozović (2015) in addition to those variables consider the concentration through the total assets and revenues of audit clients and conclude that the audit market in Croatia for listed companies is moderately to highly concentrated, with a decrease in the five-year period (i.e., 2013 compared to 2008). The paper of Zaman Groff and Salihović (2016) is also significant, with which they make an analysis of concentration in the audit services market in Slovenia and point out high concentration of the Big Four audit firms for the segment of listed companies (4-year CR<sub>4</sub> average 70,2%, 4-year average HHI 1.842,1), but on the other hand, the market is unconcentrated for the segment of non-listed companies (4-year CR<sub>4</sub> average 42 %, 4-year average HHI 703,6).

The research on the audit market concentration is very broad and has existed since almost 30 years ago until today. Some older papers (Loft & Sjoefors, 1993, and Lenz & Bauer, 2004) demonstrated high ratios of audit market concentration. Also, many authors analyze and offer empirical evidence on the correlation of the audit market concentration with the audit fees (Eshelman & Lawson, 2017; Huang et al., 2016; Feldman, 2006, and

Pearson & Trompeter, 1994). All these authors have proven the positive relation between audit market concentration and audit fees. Gunna et al. (2019) indicate that audit fees charged to relatively complex clients are higher when the audit market is more heavily concentrated within the Big Four group of auditors.

The audit market concentration has also been examined from the aspect of audit quality. In a significant study by Francis et al. (2012) in which they examine the audit market concentration in 42 countries, conclude that both Big Four audits and non-Big Four audits are of higher quality in those countries where the Big Four conduct a higher percentage of total audits. These results suggest that Big Four dominance, by itself, does not harm audit quality. An interesting conclusion is reached by Van Raak et al. (2019) who state that market concentration can have a net beneficial effect on quality in the large-client segment, as it helps audit firms to achieve economies of scale in audit technology and resources. Their research proves that competition can be improved by facilitating client mobility rather than by reducing market concentration.

### 3 Audit Market Concentration Measures

Measuring the levels of audit concentration was the subject of many studies done by regulators and individual researchers (Mališ & Brozović, 2015). Commonly used measures of concentration, but also recommended from The Organisation for Economic Co-operation and Development (1993), are the following two methods:

- Herfindahl-Hirschman Index (HHI) and
- Concentration ratio (CR<sub>n</sub>)

The first one, The Herfindahl-Hirschman Index (HHI) represents an index that measures the market concentration of an industry (CFI, 2020). The Herfindahl-Hirschman Index is the sum of squares of the market shares of all audit firms:

$$HHI = \sum_{i=1}^n (MS_i)^2$$

where:  $S_i$  is the market share of the firm  $i$  in the market,  $n$  is the number of firms.

Owing to squaring market shares, the HHI is dominated by large audit firms and only significantly influenced by small carriers. It rates from  $1/n$  (in case of minimal concentration and equal share of all suppliers) to 10,000 (which indicates a complete concentration). The European legislation uses the HH Index to assess horizontal mergers and thus isolates three ranges of post-merger HH Index levels (Le Vourc'h & Morand, 2011):

1. non concentrated markets if the HH Index is below 1000,
2. moderately concentrated markets if the HH Index is between 1000 and 2000, and

### 3. highly concentrated markets if the HH Index is above 2000

The second one, Concentration ratio (CR<sub>n</sub>) refers to the ratio of the market shares of a particular company in relation to the entire market size (The Business Professor, 2022). This ratio also measures the size of a company or firm in comparison to the size of the whole market.

$$CR_n = \sum_{i=1}^n S_i$$

where:  $n$  is the number of firms,  $S_i$  is the market share.

Concentration ratios range from 0 to 100 percent. Audit market concentration is mostly measured by concentration ratio CR<sub>4</sub>, since there are four largest audit firms ("Big Four"). The following scale can be used for interpretation of CR<sub>4</sub> (Le Vourc'h & Morand, 2011):

1. 0% - means perfect competition (no concentration).
2. between 0% to 50% - this category ranges from perfect competition to oligopoly (low concentration).
3. between 50% and 80% - an industry in this range is likely an oligopoly (medium concentration).
4. between 80% and 100% - this category ranges from highly concentrated oligopoly to monopoly (high concentration)
5. 100% means an extremely concentrated oligopoly (total concentration).

Various independent variables can be used in HHI and CR<sub>n</sub> methods. Based on the literature and research on the concentration of the audit market in the countries of the region, in our research as independent variables have been included: revenues from audit services, the number of employees, and the number of clients.

## 4 Audit Market Concentration Analysis in Republic of North Macedonia

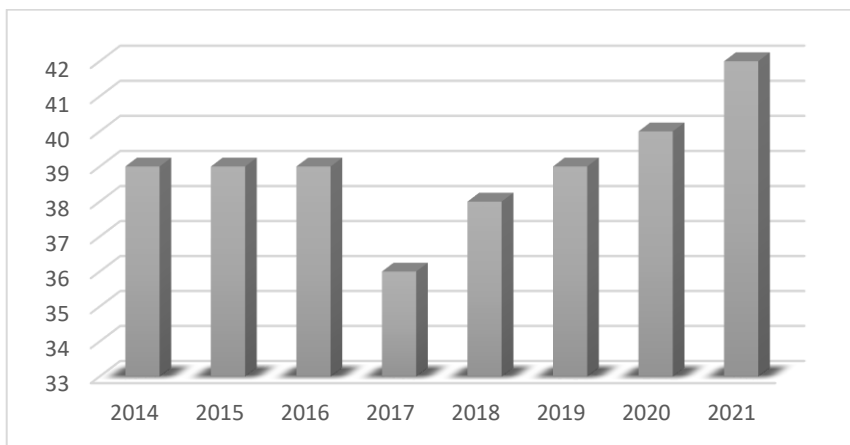
The Government of North Macedonia, at the suggestion of the Minister of Finance, in order to promote and oversight audits, established the Council for Advancement of Oversight of the Audit of the Republic of North Macedonia (herein after: CAO), as an independent and autonomous regulatory body with public authorizations established in Audit Law (Official Gazette, 2010). According to the CAO (2022) latest updated data in October 2022 in Republic of North Macedonia there are: 28 Licensed Audit Firms and 13 Licensed Certified Auditors - Sole Proprietor and 228 Licensed Certified Auditors.

The values contribute to the achievement of the goals of the CAO, appreciating that this is achieved by strengthening the internal organization and increasing the efficiency and effectiveness in the audit work. The role that CAO has for the development of domestic

audit practice is indisputable, as well as the role in establishing cooperation with foreign and international organizations.

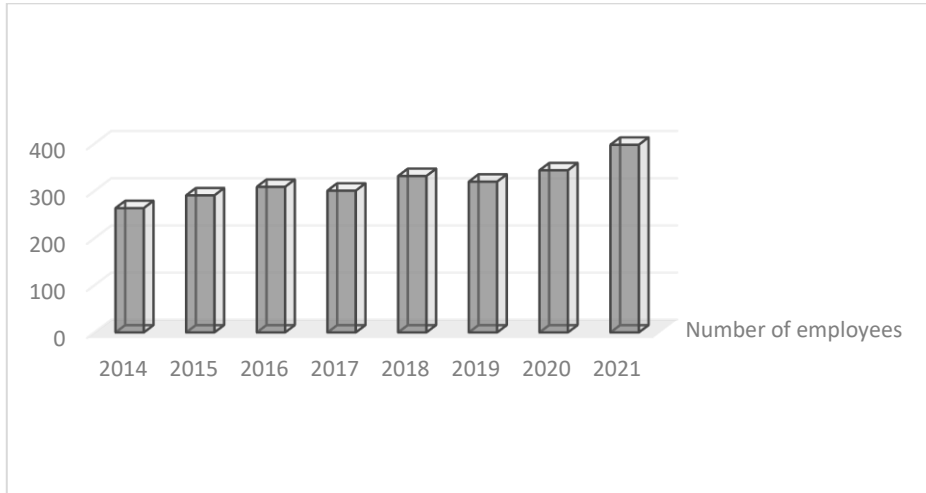
The audit market in Republic of North Macedonia begins to be regulated by the Law on Audit, originally adopted in 1997, and then a new Law on Audit was adopted in 2010. According to the available information and Transparency Reports published by the CAO, figure 1 gives the number of audit firms in Republic of North Macedonia from 2019 to 2021.

**Figure 1:** Number of Audit Firms in Republic of North Macedonia (2014 – 2021)



It can be noted that there is a positive trend from 2017 till 2021, that is, the number of audit firms is growing. The increase in the number of audit firms is reflected in the increase in the number of employees (see figure 2).

**Figure 2:** Number of employees in the audit firms in Republic of North Macedonia (2014 – 2021)



The number of employees in 2014 is the smallest and amounts to 264 employees in audit firms, while in 2021 that number is the largest and amounts to 398 employees.

The analysis of the audit market in Republic North Macedonia is measured by the Herfindahl-Hirschman Index and concentration ratio  $CR_4$  in the 2014 to 2021 year. Independent variables in the research through which the concentration is measured are: Audit-related revenue, Number of employees and Number of clients.

The analysis of the concentration of the audit market should provide an answer to the following research question:

- *Is the audit market in Republic of North Macedonia concentrated?*

**Table 1:** Audit-related revenue, Number of Employees and Number of Clients of “Big Four, International Network and Domestic Audit Firms in Republic of North Macedonia (2014 – 2021)

Independent Variables	2014	2015	2016	2017	2018	2019	2020	2021
<i>Audit-related revenue (in EUR)</i>								
Big Four	2,109,303	2,525,704	2,415,769	2,451,187	2,402,846	2,431,399	2,627,203	2,449,691
International Network	987,083	1,065,368	1,176,484	1,325,949	1,407,342	1,495,431	1,414,830	1,459,691
Other (domestic) audit firm	1,053,671	1,172,838	1,221,279	1,213,523	1,375,654	1,539,528	1,661,953	1,926,634
<b>Total audit-related revenue</b>	4,150,057	4,763,909	4,813,532	4,990,659	5,185,842	5,466,358	5,703,986	5,836,016
<i>Number of clients</i>								
Big Four	167	205	189	202	189	202	180	157
International Network	281	294	350	389	360	379	370	247
Other (domestic) audit firm	594	763	714	732	809	833	891	975
<b>Total number of clients</b>	1042	1262	1253	1323	1358	1414	1441	1379

<i>Number of employees</i>								
Big Four	90	103	114	111	111	104	119	131
International Network	80	91	95	94	111	109	117	123
Other (domestic) audit firm	94	97	100	96	110	107	108	144
<b>Total number of employees</b>	264	291	309	301	332	320	344	398

Table 1 presents the values of the independent variables for the observed period. The data are provided by the transparency reports published on the CAO's website, and according to the research needs, they are divided into three groups: Big Four, International Network and Other (Domestic) audit firms.

## 5 Results and Discussion

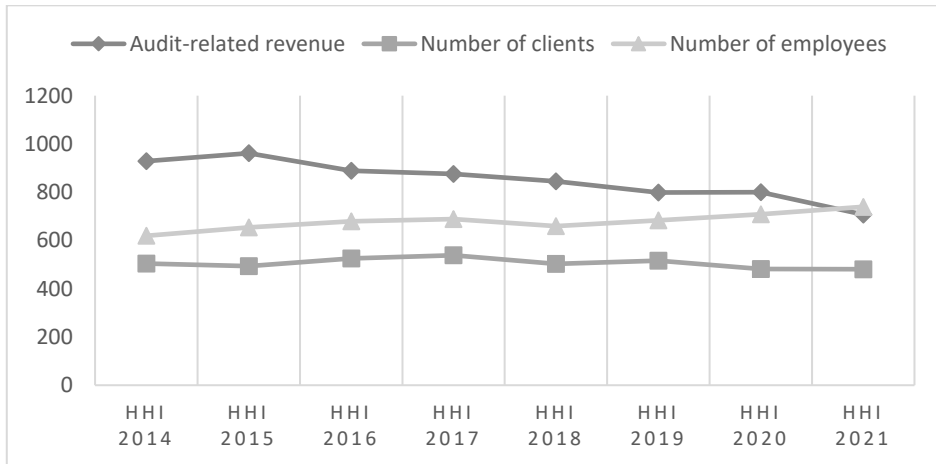
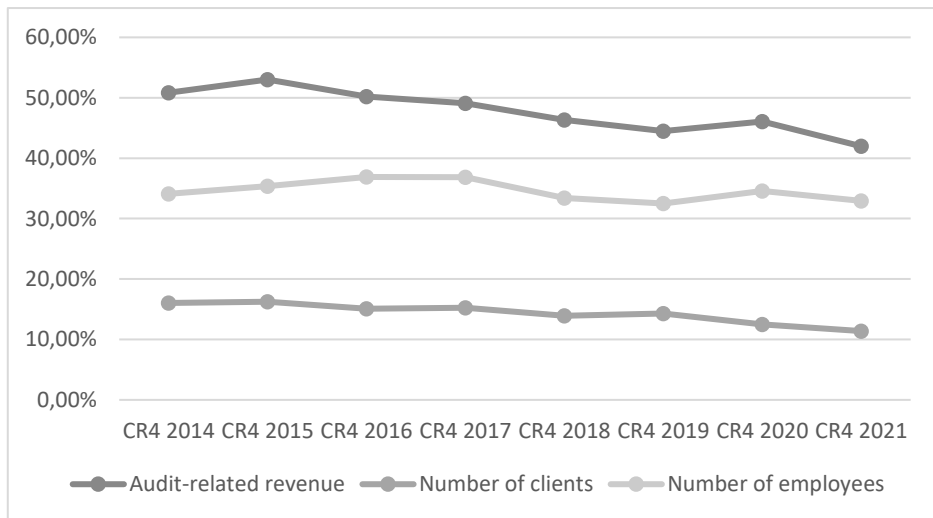
The obtained results of the measurement with the two indices (HHI and CR<sub>4</sub>) are given in extended.



**Table 2:** Concentration of Audit Market in Republic of North Macedonia (2014 – 2021)

Audit Market Concentration Indices	Independent Variables		
	Audit-related revenue	Number of clients	Number of employees
HHI 2014	928	504	619
HHI 2015	961	494	654
HHI 2016	888	525	679
HHI 2017	876	538	688
HHI 2018	845	503	659
HHI 2019	799	517	683
HHI 2020	800	482	709
HHI 2021	707	481	739
CR <sub>4</sub> 2014	50.83%	16.03%	34.09%
CR <sub>4</sub> 2015	53.02%	16.24%	35.40%
CR <sub>4</sub> 2016	50.19%	15.08%	36.89%
CR <sub>4</sub> 2017	49.12%	15.27%	36.88%
CR <sub>4</sub> 2018	46.33%	13.92%	33.43%
CR <sub>4</sub> 2019	44.48%	14.29%	32.50%
CR <sub>4</sub> 2020	46.06%	12.49%	34.59%
CR <sub>4</sub> 2021	41.98%	11.39%	32.91%

Measurement of market concentration according to audit related revenue by concentration ratio CR<sub>4</sub> indicated that the audit market in Republic of North Macedonia in the 2014-2017 period was moderately concentrated and that it had the characteristics of an oligopoly (see figure 4). From 2017 to 2021, the percentage of CR<sub>4</sub> already falls below 50%, which means that the concentration is decreasing. According to the HHI, in the entire analyzed period, the audit services market according to this independent variable is not concentrated, that is, it represents perfect competition. This is due to the fact that in Republic of North Macedonia, as a relatively small market, there are a large number of audit firms (in 2021 a total of 41), which comprise the firms of the Big Four, audit firms from the International Network and domestic audit firms.

**Figure 3:** HHI according to audit-related revenue, number of clients and number of employees (2014-2021)**Figure 4:** CR4 Index according to audit-related revenue, number of clients and number of employees (2014-2021)

For the other two independent variables, the number of employees and the number of clients, and according to the two indexes HHI and CR<sub>4</sub> in the entire analyzed period

(2014-2021), the audit market in Republic of North Macedonia is not concentrated and has the characteristics that range from perfect competition to oligopoly (see table 2, figures 3 and 4). From the analysis, it can be noted that the number of employees divided into the three categories (Big Four, International Network and Domestic Audit Firms) is relatively the same in each category, while in the number of clients, the largest number of clients belong to the category of domestic audit firms, and the smallest number to the Big Four. The result is logical and can be pointed out is that Big Four audit firms earn the most for an audit engagement, where they have the highest amount of revenue and the lowest number of clients, due to the size of the client. From a practical point of view, this is shown through the increasing number of newly opened auditing companies, as well as the larger number of authorized auditors compared to previous years. The existence of competition in the audit market is a good indicator and a challenge that must constantly keep auditors awake in their continuous improvement in order to carry out the highest quality, most effective, and most efficient audit possible.

## 6 Conclusions

This research contributes to increase the existing literature in the field of audit markets, especially for Republic of North Macedonia. With a detailed analysis of the concentration of the audit market in Republic of North Macedonia, through defined independent variables related to audit-related revenue, number of employees and number of clients, the results in the paper indicate that from the aspect of audit-related revenue the audit market in Republic of North Macedonia from 2014 to 2017 was medium concentrated, but in terms of the number of employees and the number of clients, the audit market is non concentrated, that is, it ranges from perfect competition to oligopoly.

Further research could elaborate the concentration of audit firms for the segment of listed companies or in the segment of non-listed companies in Republic of North Macedonia. There is also room for research on the concentration in the audit market, whether it affects audit fees and quality of statutory audits provided in Republic of North Macedonia. An international study, comparing concentration levels, audit fees and audit quality in different countries could serve as a high quality platform for audit market concentration related policy recommendations.

## References:

- Boone, J. P., Khurana, K. I., and Raman, K. K., (2011) Audit Market Concentration and Auditor Tolerance for Earnings Management, *Contemporary Accounting Research*, 29(4), pp. 1171-1203, <https://doi.org/10.1111/j.1911-3846.2011.01144.x>.
- Carrera, N., Gómez-Aguilar, N., Humphrey, C. & Ruiz-Barbadillo, E. (2007) Mandatory audit firm rotation in Spain: A policy that was never applied, *Accounting, Auditing & Accountability Journal*, 20(5), pp. 671-701, <https://doi.org/10.1108/09513570710779009>.

- CFI (2020) *Herfindahl-Hirschman Index (HHI)*, available at: <https://corporatefinanceinstitute.com/resources/knowledge/finance/herfindahl-hirschman> (October 24, 2022).
- CFO (2022) *The Big Four Continue to Dominate Auditing: Weekly Stat*, available at: <https://www.cfo.com/accounting-tax/auditing/2022/06/auditing-big-four-market-share-sec-registrants-accounting/#:~:text=The%20Big%20Four%20audit%2088> (November 12, 2022).
- Eshelman, J.D. & B.P. Lawson. (2017) Audit market structure and audit pricing, *Accounting Horizons*, 31(1), pp. 57-81, <https://doi.org/https://doi.org/10.2308/acch-51603>.
- European Commission (2010) *Green Paper – Audit Policy: Lessons from the crisis*, available at: [http://ec.europa.eu/internal\\_market/consultations/docs/2010/audit/green\\_paper\\_audit\\_en.pdf](http://ec.europa.eu/internal_market/consultations/docs/2010/audit/green_paper_audit_en.pdf) (November 3, 2022).
- European Commission (2021) *Report from the Commission to the European Parliament, the Council, the European Central Bank and the European systemic risk board*, available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0029&rid=2> (October 25, 2022).
- Ewelt-Knauer, C., Gold, A. & Pott, C. (2012) *What do we know about mandatory audit firm rotation?* (Institute of Chartered Accountants of Scotland), available at: [https://assets.publishing.service.gov.uk/media/5329dbc1ed915d0e5d0000c1/icas\\_mafr\\_report.pdf](https://assets.publishing.service.gov.uk/media/5329dbc1ed915d0e5d0000c1/icas_mafr_report.pdf) (October 29, 2022).
- Feldman, E. R. (2006) A basic quantification of the competitive implications of the demise of Arthur Andersen, *Review of Industrial Organization*, 29(3), pp. 193–212, <https://doi.org/10.1007/s11151-006-9117-5>.
- Francis, R. J., Michas, N. P. & Seavey, E. S. (2012) Does Audit Market Concentration Harm the Quality of Audited Earnings? Evidence from Audit Markets in 42 Countries\*, *Contemporary Accounting Research*, 30(1), pp. 325-355, <https://doi.org/10.1111/j.1911-3846.2012.01156.x>.
- Garcia, D., Kutlu, L. & Sickles, R. C. (2019) Market Structures in Production Economics, In: Ray, S. C., Chambers, R. G. & Kumbhakar, S. C. (eds.) *Handbook of Production Economics* (New York: Springer), vol 1, pp. 1-48.
- Gerakos J. & Syverson C. (2015) Competition in the audit market: Policy implications, *Journal of Accounting Research*, 53(4), pp. 725-775, <https://doi.org/10.1111/1475-679X.12087>.
- Gunna, L. J., Kawadab, S. B. & Michas, N. P. (2019) Audit market concentration, audit fees, and audit quality: A cross-country analysis of complex audit clients, *Journal of Accounting and Public Policy*, 38(6), <https://10.1016/j.jaccpubpol.2019.106693>.
- Hall, E. R., Blanchard J. O. & Hubbard, R. G. (1986), Market Structure and Macroeconomic Fluctuations, *Brookings Papers on Economic Activity*, 1986(2), pp. 285-338, <https://doi.org/10.2307/2534476>.
- Hoyle, J. (1978) Mandatory auditor rotation : The arguments and an alternative, *Journal of Accountancy*, 145(5), pp. 69-78.
- Huang, T.-C., Chang, H. & Chiou, J.-R. (2016) Audit Market Concentration, Audit Fees, and Audit Quality: Evidence from China, *Auditing: A Journal of Practice and Theory*, 35(2), pp. 121-145, <https://doi.org/10.2308/ajpt-51299>.
- Indyk, M. (2019) Mandatory audit rotation and audit market concentration - evidence from Poland, *Economic and Business Review*, 5(19), pp. 90-111, <https://10.18559/ebrev.2019.4.5>.
- Le Vourc'h, J. & Morand, P. (2011) *Study on the Effects of the Implementation of the Acquis on Statutory Audits of Annual and Consolidated Accounts Including the Consequences on the Audit Market* (Paris: European Commission).
- Lenz, H. & Bauer, M. (2004) Pruefungs- und Beratungshonorare von Abschlusspruefern deutscher boersennotierter Aktiengesellschaften, *Die Wirtschaftspruefung*, 57(12), pp. 985-998.

- Loft, A. & Sjoefors, A. (1993) Audit concentration in Sweden and Denmark, In: Artsberg, K., Loft, A. & Yard, S. (eds.) *Accounting Research in Lund* (Lund: University Press), pp. 155-175.
- Mijić, K., Jakšić D. & Vuković, B. (2014) Concentration of the audit market: Evidence from Serbia, *Economic Themes*, 52(1), pp. 115-126, <https://10.1515/ethemes-2014-0008>.
- Minghui, L. & Zhenggang, X. (2003) The Empirical Analysis of China's audit market concentration and audit the quality, *Journal of Accounting Research*, 7, pp 37-41.
- Official Gazette (2010) *Audit Law*, 158/10, 135/11, available at: <https://finance.gov.mk/wp-content/uploads/2009/05/Audit-law.pdf> (September 19, 2022).
- Organisation for Economic Co-operation and Development (1993) *Glossary of Industrial Organization Economics and Competition Law* (Europe: OECD), available at: <https://www.oecd.org/regreform/sectors/2376087.pdf> (September 12, 2022).
- Pearson, T. & Trompeter, G. (1994) Competition in the market for audit services: The effect of supplier concentration on audit fees, *Contemporary Accounting Research*, 11(1), pp. 115-135.
- Schaen, M. & Maijoor, S. (1997) The Structure of the Belgian Audit Market, *International Journal of Auditing*, 1(2), pp. 151-162, <http://dx.doi.org/10.1111/1099-1123.00019>.
- Sever Mališ, S. & Brozović, M. (2015) Audit Market Concentration – Evidence from Croatia, *Ekonomski Vjesnik/ECoviews*, 28(2/2015), pp. 339-356.
- Song, B. (2021) The Relation of Audit Quality to Audit Market Concentration and the Composition of Audit Committee Financial Expertise, *Academy of Accounting and Financial Studies Journal*, 25(6).
- The Business Professor (2022) *Concentration Ratio – Explained*, available at: [https://thebusinessprofessor.com/en\\_US/economic-analysis-monetary-policy/concentration-ratio-definition](https://thebusinessprofessor.com/en_US/economic-analysis-monetary-policy/concentration-ratio-definition) (November 4, 2022).
- Van Raak, J., Peek, E., Meuwissen, R. & Schelleman, C. (2019) The effect of audit market structure on audit quality and audit pricing in the private-client market, *Journal of Business Finance & Accounting*, 47(3-4), pp. 456-488, <https://10.1111/jbfa.12414>.
- Verma, E. (2022) *Market Structure: Definition, Types, Features and Fluctiations*, available at: <https://www.simplilearn.com/market-structures-rar188-article#:~:text=Market%20structure%20refers%20to%20the,monopolistic%20markets%2C%20and%20monopolistic%20competition> (October 7, 2022).
- Willekens, S., Dekeyser, S., Bruynseels, L. & Numan, W. (2020) Auditor Market Power and Audit Quality Revisited: Effects of Market Concentration, Market Share Distance, and Leadership, *Journal of Accounting, Auditing and Finance*, 38(1), <https://doi.org/10.1177/0148558X209662>.
- Zaman Groff, M. & Salihović, A. (2016) Audit market concentration for the segments of listed and non-listed auditees in Slovenia, *Journal of Economics and Business*, 19/2016(1), pp. 31-49.



## Non-financial Reporting Analysis: Does EU Membership Affect the Disclosure of Non-financial Information in Blue-Chip Companies?

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& IVAN DIONISIJEV

**Abstract** Non-financial reporting, as a relatively new concept, has been intensively developed in the last few decades, primarily voluntarily, as a need to provide stakeholders with an insight into business-related issues that are of broader social importance. It is becoming necessary and increasingly important for all participants in today's socio-economic environment. This paper presents qualitative and quantitative research on the disclosure of non-financial information on social responsibility in 40 listed companies from selected Balkan countries for the period from 2019 to 2021, to determine whether and how EU membership affects the scope of non-financial reporting. The results of the conducted statistical tests indicate that companies from EU countries disclose in more detail and for more segments compared to companies from non-EU countries. The transposition of the directive into law, i.e. mandatory non-financial reporting is one of the key factors for the disclosure of companies' ESG activities.

**Keywords:** • non-financial reporting • EU membership • social responsibility • ESG

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## 1 Introduction

Participants in the capital markets increasingly emphasize the value of non-financial information. To promote accountability and incorporate non-financial factors in ratings, rules, and covenants, investors, regulators, and banks are seeking greater consistency (Deloitte, 2021). This impetus is due to the increased worldwide attention being paid to issues like climate change, diversity and inclusiveness, and the Covid-19 crisis. Companies must address all current issues in the context of the international economy's ongoing evolution in order to secure the long-term success of their operations, which necessitates a solid stakeholder connection (Ștefănescu et al., 2021). Since the most recent financial crisis, businesses have been more accountable to and transparent with their stakeholders (Manes-Rossi, et al., 2018). As a result, one of the biggest problems for businesses is producing integrated, succinct, and unambiguous reporting. To analyze a company's past and future performance, stakeholders now need more information than the standard financial reporting model can provide (Flower, 2015). The release of non-financial disclosure reports is a strategic move that significantly enhances an organization's ability to communicate with its stakeholders. The growth of self-initiated charitable initiatives and social responsibility as one of the most talked-about subjects in the world today are crucial for the long-term success of businesses. By enhancing the company's entire corporate image and reputation, corporate social responsibility (CSR) helps businesses compete more effectively, consolidate markets, and build stakeholder trust (Gardiner et al., 2003; Worcester, 2009). In other words, CSR is a type of marketing and strategic action (McWilliams et al., 2006). Environmental, Social, and Governance principles (ESG) refer to a set of environmental, social, and governance factors that companies consider when managing their business and presenting their organization's image to the public (Damjanović, 2021). Investors also consider these factors when investing, in terms of the risks, impacts, and opportunities that these factors bring. In the past, the reporting of non-financial data was generally on a voluntary basis, but today with the increasing interest of stakeholders in this type of information, the efforts for a certain standardization and regulation of this type of reporting by companies are also increasing. The disclosure of non-financial information (NFI) has been strongly encouraged in Europe by several recent initiatives. Therefore, Public Interest Entities in Europe are required to publish a "Non-financial report" addressing environmental and social matters, respect for human rights, and the fight against corruption (EU, 2014) and its adaptation to the specific characteristics of each Member State (Sierra-Garcia, et al., 2018). The EU Directive establishes minimal legislative standards for non-financial reporting (NFR) and makes it mandatory to unify and improve economic, social, and environmental reporting throughout the European States (La Torre et al., 2020). By the end of 2016, the provisions of the EU Directive had been incorporated into the national laws of the Member States, so companies subject to this Directive are required to report NFI beginning January 1, 2017, by preparing a non-financial report or a consolidated non-financial report that should contain information relating to at least the minimum



information required by the EU Directive elements (Ștefănescu et al., 2021). As EU member states, Croatia and Slovenia have implemented the provisions of the Directive in their national legislation. On the other hand, in North Macedonia, there is no legal regulation in this area, but only a certain guide, recommendations, etc., while in Serbia NFR is voluntary for 2019 and 2020, and mandatory starting from 2021.

In that regard, the purpose of this paper is to determine the difference in the scope of NFR between countries that are members of the EU and countries that are not members of the EU. More specifically, this paper analyzes the NFR of the aforementioned countries through a detailed content analysis of the reports published by 40 blue-chip companies that are part of the national stock market indexes, and they are a suitable representative for each country individually. The paper first presents a theoretical overview of the actuality and increasing importance of NFR for social responsibility, then presents the methodology used in the research and shows the results of the qualitative and quantitative analysis of several segments of NFR, such as the content of the non-financial disclosure report according to all listed key performance indicators (KPIs) in the EU directive, the title of the report used by the companies, the type and the length of the report on NFI. Finally, a summary of the obtained results was made, through which we give a conclusion about the differences and the way companies from the selected countries report on NFI.

## 2 Literature overview

The trend of sharing NFI makes sustainability reports increasingly utilized in providing stakeholders with financial and non-financial information relating to an organization's relationship with its physical and social surroundings (Hackston & Milne, 1996). Among the most well-known and accepted non-financial reporting frameworks are the International Integrated Reporting Framework (IIRF), the Global Reporting Initiative (GRI) and the standards adopted by the Sustainability Accounting Standards Board (SASB). In 2014, the European Union enacted a non-financial reporting Directive (2014/95/EU), also called the Non-Financial Reporting Directive (NFRD), which obliges public interest companies to disclose certain information about how they operate and manage social and environmental challenges (Faccia et al., 2021). According to the directive, policies, actions, and outcomes relating to their effects on the environment, employees, society, human rights, and corruption must be reported. In 2017, the European Commission published Guidelines on non-financial reporting (methodology for reporting non-financial information) to help companies how to publish information about their activities that affect the improvement of conditions in society, employees, anti-corruption, etc. (EU Commission, 2017). However, these guidelines are not mandatory and companies may decide to use other international, European, or national policies for NFR, from which it follows that there is still no single standardized reporting format. There are varying perspectives on the importance of establishing a legal framework for revealing NFI in annual reports or transparency reports that reflect the company's role in

improving society (Mies & Neergaard, 2020). Some argue that legislation improves NFR, while others argue that the voluntary nature of NFR is critical (Romolini et al., 2012). If the regulation is examined from two distinct angles, namely strict regulation or total voluntariness, both positive and negative outcomes are revealed. Because the laws typically provide standard rules for all organizations within the jurisdiction or categories designated by law, tight government regulation places all businesses under the mandatory scope (Jackson et al., 2020). With greater transparency, there will be less information asymmetry between businesses and stakeholders, according to these standards. The growth of standardization and regulation, such as EMAS or ISO 14000 and AA1000 reports, as well as the expansion of the disclosure domain of social responsibility reports, led to an increase in the quality and amount of published data in the company's reports (Vukić et al., 2018). The EU Directive's goal must be achieved and put into practice. However, there are several practical obstacles in the way (La Torre, et al., 2020). Social duty should be carried out voluntarily rather than because it is required, otherwise, the purpose of the deeds will be lost and the laws may be followed but inadvertently. According to Dave (2017), if a corporation chooses not to be socially responsible, its stakeholders will alter their opinions of it and penalize its actions. The practical application of NFR initiatives reveals the mindset and character of the organization and those in charge of determining the kind of environment they want to live and work in. The sleigh or reward from society will always be contingent upon how well businesses behave and conduct themselves. One of the main drivers and motivators for firms to actively participate in the advancement of society is competition and reputation among stakeholders (Yu et al., 2017). Companies in industrialized nations exhibit significantly more initiative and social responsibility than their counterparts in poor or developing nations (Ali et al., 2017). Non-financial disclosure reports fall under various titles, headings, and categories of reporting, such as integrated reports, social responsibility reports, sustainability reports, corporate social responsibility reports, non-financial information reports, and others (Stolowy, 2018).

In accordance with the findings of KPMG's (2022) survey on Environmental, Social, and Governance (ESG) reporting, 83 % of the respondents (246 financial reporting executives from private and public sector entities, from different sector affiliations) believe that a focus on ESG will improve their business. However, only 30% report on their ESG commitments and have initiated a clear strategy to implement them. According to Johari & Komathy (2019), Europe had the greatest rate of sustainability disclosure at over 49%, followed by Asia at 15%, North America at 14%, Latin America at 12%, Oceania at 6%, and Africa at 4%. Growth companies and index constituents in the United States are less likely to report non-financial data, whereas firms in the European market stock indexes that operate in environmentally sensitive industries, have high capital intensity, and have better financial results are more likely to do so (Stolowy & Paugam, 2018).

Venturelli et al. (2019) compare the quality of NFR in the UK and Italy before the introduction of the EU Directive. Based on the content analysis of 343 large listed firms' mandated and voluntary disclosures, they find that the UK is more compliant with the NFR required by the EU Directive than Italy. The literature shows that a content analysis approach and a binary scoring method of NFI disclosure have been used in many studies to identify the characteristics and scope of NFR related to a company's ESG activities (Khan, 2010; Fatma & Rahman, 2014; Nyarku & Hinson, 2017; Matuszak et al., 2019; Levkov & Palamidovska-Sterjadovska, 2019; Trpeska et al., 2021).

Many large Macedonian companies, according to Msrík and Kostovski (2015), do not address CSR matters in their annual reports, so NFR is left up to the discretion of the companies, their management, and their perception of the need to update the key stakeholders and the most appropriate method to do so. Trpeska et al. (2021) in the conducted research on the disclosure of NFI at 14 banks that are actively working in North Macedonia for the period from 2017 to 2019 indicate that the banks mostly disclose information about the activities related to the improvement of the local community, followed by activities for environmental protection, employee matters, and least of all for customers. On the path to EU accession, North Macedonia needs to align national regulation and market practices with the new EU sustainability framework and raise awareness among companies for quality NFI disclosure. To encourage the adoption of solid corporate governance standards and to increase the level of ESG disclosure, the Macedonian Stock Exchange (MSE) published two important documents that should be taken into account, that is the new "Corporate Governance Code", published in October 2021, and the "Guide to ESG Reporting", published in January 2022 (MSE, 2022).

Hanić (2021) reveals that the majority of Serbian banks publish their environmental policies (74%), the environmental initiatives they have done with the community (51%), and the effectiveness of their water, energy, and paper usage (48%). Even though the results show an increase in environmental disclosure practices across all Serbian banks, the reports do not follow a set format. Although there is no unified record since 2008 it is estimated that by 2021, on a voluntary basis, twenty large companies in Serbia had the practice of issuing sustainability reports (Damnjanović, 2021). In October 2019, the new Law on Accounting<sup>1</sup> was adopted in Serbia, which entered into force on January 1, 2020. The new law defines Articles 37 and 38 relating to NFR, which obligate large public interest companies with over 500 employees to prepare and publish a non-financial report as part of the annual report. According to Article 64, companies must start publishing the non-financial report on December 31, 2021, i.e. for the current year 2021, and it should include all NFR segments as the information necessary to understand the development, business results, and position of the legal entity, as and the results of activities related to environmental protection, social and employee matters, respect for human rights, the fight against corruption and bribery, which are following the EU directive. In September 2021, the "Handbook for companies – Step by step to the non-financial report" was published,

which provides insight into the context important for the development of NFR, mandatory NFR in the European Union and Serbia, and provides recommendations for improvement in this area (Smart Kolektiv, 2021).

According to Remlein & Roška's (2020) analysis for the period 2010-2018, it can be seen that Croatian companies listed on the Zagreb Stock Exchange and part of the CROBEX index present some information on expenditures for environmental protection, investments in local society and improving the working conditions. There is a slight but positive trend of NFI disclosure in the analyzed period. The authors state that none of the companies used the term "Socially Responsible Investments" for their CSR activities. Croatian public relations specialists, that were part of a survey, found a favorable correlation between CSR and a company's reputation, as well as a positive relationship between CSR and business performance (Božić, et al., 2021). A review of the non-financial reports of six Croatian corporations revealed that employees are viewed as important stakeholders because the corporations' strategies give particular attention to the development of long-term relationships, lifelong learning, gender equality, zero tolerance for discrimination, and equal opportunities (Bartolović & Vučemilović, 2019). On January 1, 2017, the 2014/95/EU directive has been transposed into the Croatian Accounting Act, where companies of public interest with over 500 employees are required to disclose NFI in any form of non-financial disclosures (annual reports, sustainability reports, social reports, environmental reports or others) (Peršić & Lahorka, 2018).

Slovenian banks reported on CSR activities before new EU legislation (Directive 2014/95/EU) and national legislation requiring NFR were adopted (Beloglavec, 2020). According to (Kukanja & Planinc, 2018) research on CSR practices in small and medium-sized tourism firms in Slovenia, the most important CSR dimension is the Environmental dimension. The 2014/95/EU directive has also been transposed into The Companies Act (ZGD-1) and EC Accounting Directive (2013/34/EU) in Slovenia, where NFR of ESG activities is mandatory for large listed companies registering 500 and more employees.

### 3 Research Methodology

We conducted a content analysis to determine the level and trends of NFR in 40 listed companies from four Balkan countries, of which two EU member countries: Slovenia and Croatia, and two non-EU countries: North Macedonia and Serbia. In the research, we analyzed the top 10 blue-chip companies in each country that are part of the national stock market index, i.e. the companies that are representative and through which the capital market movement can be seen. The sample used for this research is composed of 40 companies analyzed for the period from 2019 to 2021, i.e. 120 observations. For 20 companies, NFR is mandatory according to the EU directive (Croatia and Slovenia), while for 20 companies, NFR is voluntary, although there are national guidelines that

illustrate and recommend the use of international best practices in this area (North Macedonia and Serbia). For the 10 analyzed companies from Serbia, NFR is voluntary for 2019 and 2020, but for 2021 it is mandatory according to the new national accounting law. Secondary data was taken from 120 audited consolidated annual reports published by each company. In addition to annual reports, all additional separate reports on NFI (if any) and official websites (tabs and sub-tabs dedicated to NFI) were also analyzed.

We used the binary scoring method to generate the non-financial disclosure score. A disclosure point is awarded if a company provides qualitative NFI, an additional point is if this information is supplemented with quantitative information. If a separate section in the report is dedicated to the following segments: (1) environment, (2) social and employee matters, (3) human rights, (4) anticorruption and bribery, and (5) other matters, an additional point is rewarded for each relevant segment referred to by the EU Guidelines on NFR (EU Commission, 2017). Table 1 below shows the methodology used in arriving at the disclosure score.

**Table 1:** Research Methodology for generating non-financial disclosure points

Description	“Yes” Max points	“No” Min points
<b><u>1. Non-financial data availability</u></b> (Whether published in financial statements, annual reports, or as a separate section of the official website)		
- Qualitative Non-financial Information exists	1	0
- Quantitative Non-financial Information exists	1	0
<b><u>2. Non-financial reporting referring to the environment?</u></b> (Company’s environmental concern, pollution prevention and control, energy conservation, direct and indirect atmospheric emissions, waste management, development of green products and services, etc.)	1	0
<b><u>3. Non-financial reporting referring to social and employee matters?</u></b> (Employment issues, diversity issues, health and safety at work, human capital management, consumer relations, impacts on vulnerable consumers, community relations, etc.)	1	0
<b><u>4. Non-financial reporting referring to human rights?</u></b> (Company’s commitment to respecting human rights – the rights of children, women, indigenous people, persons with disabilities, victims of trafficking in human beings, the rights of workers, etc.)	1	0
<b><u>5. Non-financial reporting referring to anticorruption and bribery?</u></b> (Company’s anti-corruption policies, procedures and standards, internal control processes, use of whistleblowing mechanisms, etc.)	1	0
<b><u>6. Non-financial reporting referring to other matters?</u></b> (Supply chains, conflict minerals, etc. )	1	0
<b><u>Total points per company for 1 year</u></b>	<b><u>7</u></b>	<b><u>0</u></b>
<b><u>Total points for the observed period of 3 years (2019-2021)</u></b>	<b><u>21</u></b>	<b><u>0</u></b>

After the data was collected and the non-financial disclosure score was calculated, we performed several statistical tests using SPSS software to conduct an in-depth analysis of the NFR in the analyzed countries.

We used Descriptive and Comparative Analysis to summarize the basic characteristics of NFR by country and year, the title of the report, the type and presentation of the non-financial disclosure report, and the number of pages dedicated to NFR. All mentioned aspects were analyzed in detail and summarized in separate sub-sections.

In order to see if there is a significant correlation between EU membership and the scope of NFR in the analyzed companies from respective countries, we used a nonparametric test, the Multivariate Kruskal-Wallis test to elaborate the following set of research questions (RQ):

- RQ1 = Is EU membership related with disclosing non-financial information?*  
*RQ2 = Is EU membership related with the title of the non-financial disclosure report?*  
*RQ3= Is EU membership related with the type of the non-financial disclosure report?*  
*RQ4 = Is EU membership related with the length of the non-financial disclosure report?*

To answer *RQ1*, the generated score for non-financial disclosure is taken into account for EU and non-EU countries. For the *RQ2*, the different titles of the non-financial disclosure reports were used as variables, i.e. the frequency of the titles used by the companies from the respective country. For the *RQ3*, the different ways in which NFI is published were taken as variables, that is, whether the report is integrated into the Annual Reports, whether there is an individual NFI report or whether there is information available only on the official websites. The frequency of publication method was used for statistical testing. For the *RQ4*, the length of the NFI reports, expressed through the number of pages, was used as a variable. The independent variable (factor) is EU membership, where for the purposes of statistical testing EU member states (Croatia and Slovenia) were coded with 1, while non-EU countries (North Macedonia and Serbia) were coded with 0.

The independent variable (factor) and all dependent variables (response) used in the research are shown in table 2.

**Table 2:** Variables for statistical testing

<b>Independent variable (factor): EU membership</b>			
<b><i>RQ1</i> dependent variables:</b>	<b><i>RQ2</i> dependent variables:</b>	<b><i>RQ3</i> dependent variables:</b>	<b><i>RQ4</i> dependent variables:</b>
1) Qualitative data; 2) Quantitative data; 3) Environment; 4) Social & Employee; 5) Human rights; 6) Anticorruption and bribery; 7) Other matters	1) Corporate Social Responsibility/ Social Responsibility; 2) Sustainability Report; 3) Non-financial Report; 4) Committed to Society; 5) Environmental Protection; 6) Responsible Business; 7) Specific names for specific segments	1) Part of Annual Report; 2) Individual Report; 3) Only as a tab of Official Website; 4) None	1) Number of pages dedicated to non-financial information

First, a detailed qualitative and quantitative analysis was performed to elaborate the NFR and then statistical testing was conducted.

## 4 Results and Discussion

Companies from four Balkan countries were included in the research, in order to draw a parallel in NFR on social responsibility and derive appropriate recommendations for improving and standardizing the non-financial reports.

**Table 3:** Sample used in the research

	<b>Stock Exchange</b>	<b>INDEX</b>	<b>EU Membership</b>	<b>No of companies</b>
MKD	Macedonian Stock Exchange	MBI10	Non EU	10
SRB	Belgrade Stock Exchange	BELEX15	Non EU	10
HR	Zagreb Stock Exchange	CROBEX10	EU	10
SLO	Ljubljana Stock Exchange	SBITOP	EU	10
<u>Total</u>				<u>40</u>

Table 3 summarizes the basic characteristics of the database for companies representative of the analyzed countries. MBI10, CROBEX10, and SBITOP stock market indexes as of 31.12.2021 consist of 10 blue-chip companies, while the BELEX15 index was composed of 15 companies, but for research purposes, the first 10 listed companies according to market capitalization were taken, for consistency in the analysis.

A more detailed overview of the affiliation by sector of the analyzed companies is presented in table 4.

**Table 4:** Companies' sector affiliation

		<b>MKD</b>	<b>SRB</b>	<b>HR</b>	<b>SLO</b>	<b>Total</b>	
<b>Financial Sector</b>	Banks	5	0	0	1	<u>6</u>	<u>10</u>
	Insurance	0	1	1	2	<u>4</u>	
<b>Real Business Sector</b>	Pharmacy	1	0	0	2	<u>3</u>	<u>30</u>
	Telecommunications	1	0	2	1	<u>4</u>	
	Oil and Gas	1	2	0	1	<u>4</u>	
	Hospitality and Tourism	1	0	2	0	<u>3</u>	
	Manufacturing	0	3	3	2	<u>8</u>	
	Engineering and Construction	1	1	0	0	<u>2</u>	
	Airport	0	1	0	0	<u>1</u>	
	Energetics	0	2	1	0	<u>3</u>	
	Transport and logistics	0	0	1	1	<u>2</u>	
<u>Total</u>		<u>10</u>	<u>10</u>	<u>10</u>	<u>10</u>	<u>40</u>	



It can be seen that a total of 10 companies are part of the financial sector, of which 6 are banks and 4 are insurance companies, while 30 companies are part of real business sector, most of which belong to the manufacturing business.

#### 4.1 Non-financial disclosure points

We performed the scoring so that the company received 1 point for the disclosure of relevant information according to the analyzed segments, regardless of whether they were structured in a separate paragraph or part of the report with a specific title.

All annual and financial reports, official websites and links related to the selected companies were searched in detail manually, and the following results were obtained (see table 5 and table 6):

**Table 5 :** Descriptive statistics for analyzed companies in respective countries (minimum; maximum; average; median and total score)

	MKD			SRB			CRO			SLO		
	'19	'20	'21	'19	'20	'21	'19	'20	'21	'19	'20	'21
Minimum score per company (points)	0	0	0	0	2	2	0	0	0	0	6	7
Maximum score per company (points)	5	6	6	7	7	7	7	7	7	7	7	7
<b>Average score per company (points)</b>	<b>3</b>	<b>3,2</b>	<b>3,1</b>	<b>2,7</b>	<b>3,1</b>	<b>3,7</b>	<b>6,1</b>	<b>6,1</b>	<b>6,1</b>	<b>5,5</b>	<b>6,9</b>	<b>7</b>
<b>Median score (points)</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2,5</b>	<b>2,5</b>	<b>3,5</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>7</b>
% of maximum disclosure score	43%	46%	44%	39%	44%	53%	87%	87%	87%	79%	99%	100%

Table 5 presents the basic descriptive characteristics of the non-financial disclosure score. It can be seen that there is a big difference in the average, median and total scores for the respective countries, where Croatia and Slovenia have almost double the score compared to North Macedonia and Serbia. For the entire analyzed period, a company from North Macedonia has an average score of 3,1 points on an annual basis, a company from Serbia 3,2 points, a company from Croatia 6,1 points, and a company from Slovenia 6,5 points out of a maximum of 7 points. For the analyzed period, only in Serbia, there is an increase in the median score in 2021. The result is due to the adoption of mandatory NFR. According to the literature and the previous practice of NFR after its legal adoption, a certain period is needed for its full adaptation and accordingly, in the next years, companies are expected to increase the degree of NFR.

Table 6 presents the analysis of the non-financial disclosure scores through the representation rate for each segment separately according to which the scoring was performed.

**Table 6:** Non-financial disclosure score analysis

		MKD	SRB	HR	SLO	<u>Total score/max points (120 points)</u>
<b>Non-financial data availability</b>	Qualitative data	90%	93%	90%	93%	<b>92%</b>
	Quantitative data	20%	20%	90%	93%	<b>56%</b>
<b>Non-financial reporting referring to:</b>	Environment	50%	93%	90%	93%	<b>82%</b>
	Social & Employee matters	90%	53%	90%	93%	<b>82%</b>
	Human rights	10%	17%	80%	93%	<b>50%</b>
	Anticorruption and bribery	10%	17%	80%	93%	<b>50%</b>
	Other matters	40%	23%	90%	87%	<b>60%</b>
<b>Total non-financial disclosure score/max score (210 points)</b>		<b>44%</b>	<b>45%</b>	<b>87%</b>	<b>92%</b>	<b>67%*</b>

\*The total NFR rate in relation to the maximum number of points (840 p.)

The maximum scoring points for 10 analyzed companies in each country for the relevant period is 210 (10 companies x 21 points). The maximum scoring points for each type of disclosed data by all analyzed companies for the relevant period is 120 (4 countries x 30 points). The total maximum score is 840 if all analyzed companies in the four respective countries for the period 2019-2021 completely met the guidelines and criteria of the EU directive on NFR. From the obtained results it can be seen that the companies from Slovenia have the highest number of non-financial disclosure points, followed by companies from Croatia and then Serbia, and North Macedonia. The non-financial disclosure rate in these countries is 67% in relation to the maximum number of possible points. Seen in more detail from the perspective of EU countries (420 points) and non-EU countries (420 points), the non-financial disclosure rates are 90% and 45%, respectively.

The biggest differences in NFR result from non-EU countries not disclosing enough financial (quantitative) data about their activities related to social responsibility. A common feature is that most companies report on matters related to the environment, social impact, and employees. However, in addition to the fact that non-EU countries do not disclose financial data, they also do not have separate segments in their reports that refer to human rights, anticorruption and bribery, and other matters such as the supply

chain, cooperation with domestic, smaller companies, and the like. The results clearly show that companies from EU countries, in our case Croatia and Slovenia, have better and more detailed NFI disclosure.

#### 4.2 Non-financial disclosure score through years

From the conducted analysis on non-financial disclosure score for the period from 2019 to 2021, the results show that companies from Slovenia and Serbia see positive growth, while companies from Croatia and North Macedonia maintain the same level of NFR (see Figure 1).

**Figure 1:** Non-financial disclosure score through years

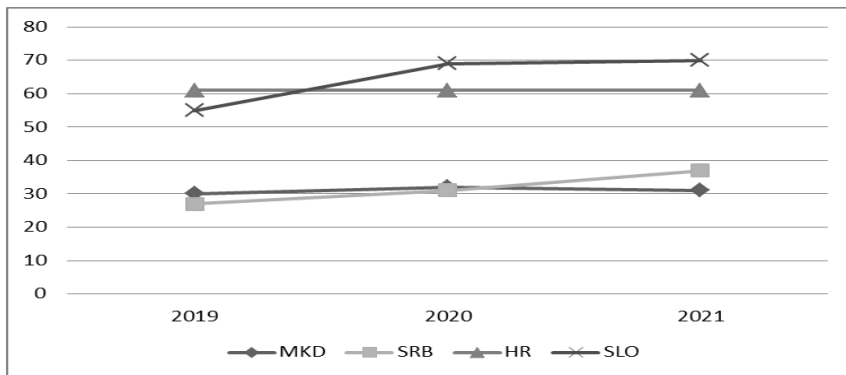


Figure 1 shows the non-financial disclosure points throughout the years for the analyzed period, from which it is clearly seen that there is a big difference in the scores between the analyzed companies from respective EU countries and non-EU countries.

#### 4.3 Non-financial report title

In addition to generating non-financial disclosure points, through content analysis we analyzed in detail the way companies present information and the format in which they disclose it. It is worth noting that companies have not yet standardized the title of the separate or integrated report in which they present NFI. Table 7 presents the titles of the reports used by the companies.

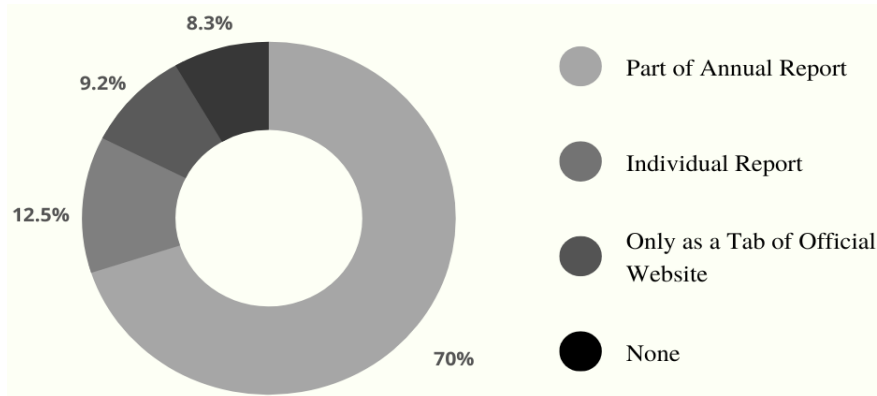
**Table 7:** Non-financial report titles

Report Title	<i>Total</i>	%	MKD	SRB	HR	SLO
<b>Corporate Social Responsibility/Social Responsibility</b>	<b><u>35</u></b>	29%	19	6	9	1
<b>Sustainability Report</b>	<b><u>34</u></b>	28%	3	2	7	22
<b>Non-financial Report</b>	<b><u>15</u></b>	13%	0	1	9	5
<b>Committed to society</b>	<b><u>2</u></b>	2%	2	0	0	0
<b>Environmental protection</b>	<b><u>15</u></b>	13%	0	15	0	0
<b>Responsible business</b>	<b><u>2</u></b>	2%	0	0	2	0
<b>Specific names for specific segments</b>	<b><u>7</u></b>	6%	3	4	0	0
<b>None (no NFR)</b>	<b><u>10</u></b>	8%	3	2	3	2
<b>Total Reports (10 companies x 3 years)</b>	<b><u>120</u></b>	100%	30	30	30	30

The most commonly used titles of the non-financial disclosure report are "Corporate Social Responsibility" or "Social Responsibility" and "Sustainability Report". It can be noted that there are oscillations in each country and there is no unique or standardized title used by companies. However, it can be pointed out that in North Macedonia the most commonly used title is "Corporate Social Responsibility", in Serbia "Environmental Protection", in Croatia "Corporate Social Responsibility" and "Non-financial Report", while in Slovenia "Sustainability Report". Specific names for specific segments refer to unstructured information that is disclosed in annual reports, i.e. the companies have disclosed information in different segments and under different headings/subheadings. From the results, it can be seen that only companies from non-EU countries have unstructured NFI related to social responsibility in their reports.

#### 4.4 Presentation of non-financial disclosure report

In terms of the way the non-financial disclosure report is presented, wheatear as: 1) integrated into the company's Annual Report, 2) individual report or 3) information available only through a special tab on the official website, the results show that as many as 70% of companies insert the information in separate sections as part of the Annual Report (see Figure 2).

**Figure 2:** Presentation of non-financial disclosure report

Individual reports on NFR are most frequently used in Croatia (4 companies), followed by Slovenia and North Macedonia (1 company), while in Serbia none of the analyzed companies has a separate report. From Figure 2 it can be seen that 8.3% of the analyzed companies have no NFR at all, one company each from North Macedonia and Croatia for the period 2019-2021 and two companies each from Serbia and Slovenia only in 2019.

#### 4.5 Length of the non-financial disclosure report

The length of the NFR was analyzed through the number of pages used by the companies to present the relevant information. Table 8 shows the total number of pages dedicated to NFR throughout the analyzed period.

**Table 8:** Length of the non-financial disclosure report

	MKD			SRB			CRO			SLO		
Year	'19	'20	'21	'19	'20	'21	'19	'20	'21	'19	'20	'21
Minimum no. of pages	1	1	1	1	1	1	7	10	8	2	3	20
Maximum no. of pages	22	19	20	16	16	16	102	80	83	114	134	112
Average no. of pages	4,1	3,7	3,8	2,5	2,9	3,6	49,9	49,9	52,7	24,6	41,8	46,9

As previously stated, for companies that have not disclosed NFI, or a total of 10 reports for the analyzed period in the sample, the data are excluded from the presented analysis of report length. It is clearly seen that there is a big difference in the length of the non-financial disclosure report between companies from EU countries and non-EU countries. Slovenia observes the greatest growth in terms of commitment to NFR, where companies

increasingly place importance on the disclosure of their undertaken ESG activities. Although companies from Slovenia have the largest number of non-financial disclosure points and the length of the non-financial disclosure report is increasing, we can notice that during these three years, companies in Croatia give the most importance to NFR and disclose their ESG activities in the most detail, where a large part of the annual reports is dedicated to this type of reporting. We also analyzed the average number of pages for NFR in the three years observed period and it turns out that a company from North Macedonia annually devotes 4 pages, a company from Serbia 3 pages, a company from Croatia 51 pages and, a company from Slovenia 38 pages.

The length of the report was analyzed in terms of the number of pages, where it is significant to note that not always one page has the same number of characters, ie. companies also include images, graphics, etc. It represents a limitation in the analysis, but a large part of the companies publish their annual documents in pdf-picture format, from which we were prevented from measuring the length of the report through another variable.

#### **4.6 Multivariate Kruskal-Wallis test**

We conducted a nonparametric test, the Multivariate Kruskal-Wallis test to elaborate the all four set research questions separately, where the detailed results obtained by SPSS software are shown in the appendix. Table 9 summarizes the obtained results of the statistical testing, where the dependent variables that are affected by EU membership ( $p < 0,05$ ) are marked with (X).

**Table 9:** Summary of the results of statistical testing

<i><b>RQ1</b></i>	<i><b>RQ2</b></i>	<i><b>RQ3</b></i>	<i><b>RQ4</b></i>
<i><b>Is EU membership related with disclosing NFI?</b></i>	<i><b>Is EU membership related with the title of the non-financial report?</b></i>	<i><b>Is EU membership related with the type of the non-financial report?</b></i>	<i><b>Is EU membership related with the length of the non-financial report?</b></i>
Appendix A-1, A-2	Appendix B-1, B-2	Appendix C-1, C-2	Appendix D-1, D-2
1) Qualitative data	1) Corporate Social Responsibility/ Social Responsibility	1) Part of Annual Report	1) Number of pages dedicated to NFI <u>(X)</u>
2) Quantitative data <u>(X)</u>	2) Sustainability Report <u>(X)</u>	2) Individual Report <u>(X)</u>	
3) Environment <u>(X)</u>	3) Non-financial Report <u>(X)</u>	3) Only as a tab of Official Website <u>(X)</u>	
4) Social & Employee <u>(X)</u>	4) Committed to Society	4) None	
5) Human rights <u>(X)</u>	5) Environmental Protection		
6) Anticorruption and bribery <u>(X)</u>	6) Responsible Business		
7) Other matters <u>(X)</u>	7) Specific names for specific segments <u>(X)</u>		

Appendices A-1 and A-2 refer to RQ1, from which it can be seen that from the analysis of 120 observations on the impact of EU membership on the scope of NFR expressed through the individual social responsibility segments, there is an impact on six out of seven specified variables. The results for RQ1 are expected and logical considering the fact that the EU directive has been transposed into law in EU countries, while it has not been in non-EU countries (NFR is mandatory in Serbia starting from 2021). Mandatory NFR is a key factor for compliance of NFR with good international practices that are presented through the EU directive and the Guide of the European Commission. It is important to note that EU membership does not affect the disclosure of qualitative information on the social responsibility of companies, because regardless of whether it is mandatory or voluntary, companies recognize the importance of NFR and disclose NFI in their reports. However, EU membership affects the scope and detail of the disclosed NFI, which makes it clear that almost all companies from EU countries follow all legally specified standards and practices.

For the statistical testing of RQ2 and RQ3, 12 observations were used in the statistical test because the variables were grouped according to frequency during the year (4 countries x 3 years). The results of the analysis of the RQ2, i.e. whether EU membership affects the title of the non-financial report, are shown in appendices B-1 and B-2. The general conclusion is that there is still no single, specified title that is used by all

companies. However, we can state that there is an impact of EU membership on three of the seven titles used by the analyzed companies. The title "Sustainability Report" is more often used by companies in EU countries (29 reports) compared to companies from non-EU countries (5 reports). The title "Non-financial Report" is also more often used in companies from EU countries (14 reports) compared to companies from non-EU countries (1 report). The category Specific names for specific segments, which referred to unstructured information that is disclosed in annual reports, that is, in different sections and under different headings/subheadings, exist only in the companies from non-EU countries (7 reports).

Appendices C-1 and C-2 refer to the results obtained for examining RQ3, whether EU membership affects how NFI are disclosed, i.e. the format in which they are displayed. The most common form of disclosure of NFI about social responsibility is through supplementing the annual report with separate sections and subsections, usually near the end of the report, after the disclosed financial information. EU membership affects two forms of NFR. Companies from EU countries prepare more individual reports that are fully dedicated to NFR (12 reports) compared to companies from non-EU countries (3 reports). All companies from Slovenia and Croatia disclose NFI as part of the Annual Reports or in an individual report, while among the non-EU countries, there are two companies each from North Macedonia and Serbia that have disclosed NFI only on the official websites.

The statistical results of the analysis for the impact of EU membership on the length of the non-financial report (RQ4) are presented in appendices D-1 and D-2. The result is expected and very clear, which through the previously presented analysis indicated the strong relation between EU membership and the length of the non-financial disclosure report. Namely, companies from EU countries provide much more detailed and complete non-financial reports compared to companies from non-EU countries.

## 5 Conclusions

In the modern socio-economic environment, business sustainability is becoming an increasingly important topic, both for the organizations themselves and various stakeholders. Considering the complex social challenges and the increasingly emphasized need to preserve the environment, there is a need to disclose NFI related to the company's ESG activities, which are essential for obtaining a complete picture of the company's operations and impact.

The results of our research show that there is a difference in the disclosure of NFI between companies in EU countries and non-EU countries. Although there are small deviations among the analyzed companies from Croatia and Slovenia, their compliance with the EU directive is high, while companies from North Macedonia and Serbia should devote more



importance to NFR and strive for greater compliance with the good international practices and guidelines of EU directive. We believe that EU membership which is expressed through the transposition of the EU Directive into national laws is one of the key factors for the respective differences. The biggest differences consist in the fact that companies from non-EU countries do not disclose financial data about the undertaken activities related to the socio-economic environment, and do not disclose information related to human rights, anticorruption and bribery, and other matters related to supply chain, conflict minerals, etc. It is important to note that even in the segments where there is adequate disclosure of NFI, there is still a big difference in the length of the text, i.e. the detail of the information compared to companies from EU countries. The research shows that companies from non-EU countries are aware of the importance of NFR and there is a belief that in the coming years, company management will strive for greater compliance with the guidelines set in the EU directive and that NFR will become an inevitable segment of annual reporting. EU membership, as an independent variable that we used in the research, was expected and logical to affect the scope of NFR because the separate segments listed in the EU directive were used as standards (dependent variables for RQ1). However, in the survey, we also covered other elements of the NFR that are not strictly specified and mandatory for companies regardless of whether they are EU members or not. We can state that EU membership has a certain impact on the rest of the analyzed matters: the title of the report, the method of disclosure, and the length of the report.

In the research, we used a sample of 40 companies, of which for 20 companies NFR is mandatory, and for 20 companies it is voluntary (in Serbia, NFR is mandatory from 2021). The biggest limitation in the research comes from the sample itself, because the recommendations of the EU directive, which were transposed into the accounting laws of the respective countries, were used as standards for a "good" NFR. This paper contributes to the literature on the relevant matter, which is increasingly important and popular. Of the analyzed non-EU countries, Serbia, although not yet a member state of the EU, has already transposed the EU Directive into law, while North Macedonia has not yet. This research provides a good foundation and approach to NFR analysis that contributes to a field that is still under-researched. In June 2022 The Council and European Parliament reached a provisional political agreement, i.e. proposal on the corporate sustainability reporting directive (CSRD). The CSRD amends the 2014 NFRD and introduces more detailed reporting requirements through which EU rules on NFR will apply to all large companies and all companies listed on regulated markets. One of the other significant improvements that have been recommended is that NFR will need to be certified by an accredited independent auditor or certifier. If the proposal is adopted, it will enter into force gradually, starting in 2024. Our recommendation and goal are to encourage more research in the field and to do in-depth research that would use a sample of more countries where NFR is mandatory in order to obtain results if, and where there are deviations from the guidelines given in the EU directive. One of the possible reasons for deviation from the standards that should be investigated is whether there is control and penalties if the

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companies do not meet the prescribed standards. In addition, countries, where the NFR is on a voluntary basis, should be researched and compared to identify good practices and make recommendations for greater standardization and unification in the NFR.

#### Notes:

<sup>1</sup> Law on Accounting ("Official Gazette of RS", no. 73/2019 and 44/2021 - other law).

#### References:

- Ali, W., Frynas, J. G. & Mahmood, Z. (2017) Determinants of Corporate Social Responsibility (CSR) Disclosure in Developed and Developing Countries: A Literature Review, *Corporate Social Responsibility and Environmental Management*, 24(4), pp. 273-294, <https://doi.org/10.1002/csr.1410>.
- Bartolović, V. & Vučemilović, V. (2019) Corporate Social Responsibility and Human Resource Management in the Republic of Croatia, *Conference Proceedings of the 9th International Scientific Conference "Tourism, Innovations and Entrepreneurship – TIE 2019"* (Pula: Juraj Dobrila University of Pula, Faculty of Economics and Tourism), pp. 301-317.
- Beloglavec, T. S. (2020) CSR Reporting and ethics in Slovenian banking system, In: Grima, S., Özen, E., Boz, H. & Saçkes, E. (eds.) *Proceeding Book of the Iv. International Applied Social Sciences Congress (C-IASOS)* (Turkey: İzmir Kavram Vocational School), pp. 191-200.
- Božić, B., Stanić K. M. & Jurišić, J. (2021) The Relationship Between Corporate Social Responsibility, Corporate Reputation, And Business Performance, *Interdisciplinary Description of Complex Systems*, 19(2), pp. 281-294, <https://doi.org/10.7906/indecs.19.2.7>.
- Damnjanović, S. (2021) *Handbook for companies – Step by Step to the Non-financial Report* (Belgrade, Serbia: Smart kolektiv), available at: [http://smartkolektiv.org/wp-content/uploads/2021/12/Prirucnik\\_Korak-po-korak-do-nefinansijskog-izvestaja.pdf](http://smartkolektiv.org/wp-content/uploads/2021/12/Prirucnik_Korak-po-korak-do-nefinansijskog-izvestaja.pdf) (October 1, 2022).
- Deloitte (2021) *Reporting of non-financial information*, available at: <https://www2.deloitte.com/content/dam/Deloitte/be/Documents/audit/DT-BE-reporting-of-non-financial-info.pdf> (September 16, 2022).
- EU (2014) *Directive 2014/95/EU of The European Parliament And Of The Council of 22 October 2014 - amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups* (The European Parliament And The Council Of The European Union), available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0095&from=EN> (September 11, 2022).
- EU Commission (2017) *Guidelines on non-financial reporting (methodology for reporting non-financial information)* (Official Journal of the European Union - EUROPEAN COMMISSION), available at: [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC0705\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC0705(01)&from=EN) (September 20, 2022).
- Faccia, A., Manni, F. & Capitanio, F. (2021) Mandatory ESG Reporting and XBRL Taxonomies Combination: ESG Ratings and Income Statement, a Sustainable Value-Added Disclosure, *Sustainability*, 13(6), p. 8876, <https://doi.org/10.3390/su13168876>.

- Fatma, M. & Rahman, Z. (2014) Building a corporate identity using corporate social responsibility: a website based study of Indian banks, *Social Responsibility Journal*, 10(4), pp. 591-601, <https://doi.org/10.1108/SRJ-01-2013-0002>.
- Flower, J. (2015) The international integrated reporting council: A story of failure, *Critical Perspectives on Accounting*, 27(1), pp. 1-17, <https://doi.org/10.1016/j.cpa.2014.07.002>.
- Gardiner, L., Rubbens, C. & Bonfiglioli, E. (2003) Research: Big business, big responsibilities, *Corporate Governance*, 3(3), pp. 67-77, <https://doi.org/10.1108/14720700310483451>.
- Hackston, D. & Milne, M. (1996) Some determinants of social and environmental disclosures in New Zealand, *Accounting, Auditing & Accountability Journal*, 9(1), pp. 77-108, <https://doi.org/10.1108/09513579610109987>.
- Hanić, A. (2021) Environmental disclosure practice in the Serbian banking sector, *Management: Journal of Contemporary Management Issues*, 26(2), pp. 115-144, <https://doi.org/10.30924/mjcmi.26.2.7>.
- Jackson G., Bartosch J., Avetisyan E., Kinderman D. & Knudsen S. J. (2020) Mandatory Non-financial Disclosure and Its Influence on CSR: An International Comparison, *Journal of Business Ethics*, 162(2), pp. 323-342, <https://doi.org/10.1007/s10551-019-04200-0>.
- Johari, J. & Komathy (2019) Sustainability reporting and firm performance: Evidence in Malaysia, *International Journal of Accounting, Finance and Business*, 4(17), pp. 1-7.
- Khan, H.Z. (2010) The Effect of Corporate Governance Elements on Corporate Social Responsibility (CSR) Reporting: Empirical Evidence from Private Commercial Banks of Bangladesh, *International Journal of Law and Management*, 52(2), pp. 82-109, <https://doi.org/10.1108/17542431011029406>.
- KPMG (2022) *The ESG journey to assurance*, available at: <https://assets.kpmg/content/dam/kpmg/sg/pdf/2022/09/the-esg-journey-to-assurance.pdf> (September 22, 2022).
- Kukanja, M. & Planinc, T. (2018) Corporate Social Responsibility Practices in Small And Medium Sized Tourism Enterprises: The Case of Slovenia, *Geographical Review*, 39(1), pp. 67-87.
- La Torre, M., Sabelfeld, S., Blomkvist, M. & Dumay, J. (2020) Rebuilding trust: sustainability and non-financial reporting and the European Union regulation, *Meditari Accountancy Research*, 28(5), pp. 701-725, <https://doi.org/10.1108/MEDAR-06-2020-0914>.
- Levkov, N. & Palamidovska-Sterjadovska, N. (2019) Corporate Social Responsibility Communication in Western Balkans Banking Industry: A Comparative Study, *Management Research and Practice*, 11(3), pp. 18-30.
- Manes-Rossi, F., Tiron-Tudor, A., Nicolò, G. & Zanellato, G. (2018) Ensuring more sustainable reporting in Europe using non-financial disclosure – De facto and de jure evidence, *Sustainability*, 10(4), p. 1162, <https://doi.org/10.3390/su10041162>.
- Matuszak, L., Róžańska, E. & Macuda, M. (2019) The impact of corporate governance characteristics on banks' corporate social responsibility disclosure: Evidence from Poland, *Journal of Accounting in Emerging Economies*, 9(1), pp. 75-102, <https://doi.org/10.1108/JAEE-04-2017-0040>.
- McWilliams, A., Siegel, D. & Wright, P. (2006) Corporate Social Responsibility: Strategic Implications, *Journal of Management Studies*, 43(1), pp. 1-18, <https://doi.org/10.1111/j.1467-6486.2006.00580.x>.
- Mies, A. & Neergaard, P. (2020) Quality of CSR Reporting: Mandatory or Voluntary Reporting?, *Governance and Sustainability (Developments in Corporate Governance and Responsibility)*, 15), (Bingley: Emerald Publishing Limited), pp. 205-234, <https://doi.org/10.1108/S2043-052320200000015012>.

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- Mrsik, J & Kostovski, N. (2015) Environmental and Social Responsibility Reporting. Do Macedonian companies disclose those information and how?, *Timisoara Journal of Economics and Business*, 8(2), pp. 220-231, <https://doi.org/10.1515/tjeb-2015-0016>.
- MSE (2022) *Guide to ESG Reporting*, available at: <https://www.mse.mk/Repository/%D0%9A%D0%BE%D0%B4%D0%B5%D0%BA%D1%81/Vodic%20ESG%20izvestivanje.pdf> (September 21, 2022).
- Nyarku, K. M. & Hinson, R. E. (2017) Corporate Social Responsibility Reporting of Banks Operating in Ghana, *African Journal of Business Ethics*, 11(2), pp. 19-36, <https://doi.org/10.15249/11-2-146>.
- Peršić, M. & Lahorka, H. (2018) Exploring the quality of social information disclosed in non-financial reports of Croatian companies, *Economic Research-Ekonomska Istraživanja*, 31(1), pp. 2024-2043, <https://doi.org/10.1080/1331677X.2018.1480968>.
- Remlein, M. & Roška, V. (2020) The disclosure of investments related to CSR in the management report. Evidence from non-financial listed companies in Poland and Croatia, *Zeszyty Teoretyczne Rachunkowości*, 109(165), pp. 85-104, <http://dx.doi.org/10.5604/01.3001.0014.4343>.
- Romolini, A., Fissi, S. & Gori, E. (2012) Scoring CSR reporting in listed companies - evidence from Italian best practices, *Corporate Social Responsibility and Environmental Management*, 21(2), pp. 65-81, <https://doi.org/10.1002/csr.1299>.
- Sierra-Garcia, L., Garcia-Benau, M. A. & Bollas-Araya, H. M. (2018) Empirical Analysis of Non-Financial Reporting by Spanish Companies, *Administrative Sciences*, 8(3), p. 29, <https://doi.org/10.3390/admsci8030029>.
- Smart Kolektiv (2021) *Handbook for Companies – Step by Step to the Non-Financial Report*, available at: <https://smartkolektiv.org/en/news/handbook-for-companies-step-by-step-to-the-non-financial-report> (October 1, 2022).
- Ștefănescu, C. A., Tiron-Tudor, A. & Moise, E. M. M. (2021) EU Non-Financial Reporting Research – Insights, Gaps, Patterns And Future Agenda, *Journal of Business Economics and Management*, 22(1), pp. 257-276, <https://doi.org/10.3846/jbem.2020.13479>.
- Stolowy, H. & Paugam, L. (2018) The Expansion of Non-financial Reporting: an Exploratory Study, *Accounting and Business Research*, 48(5), pp. 525-548, <https://doi.org/10.1080/00014788.2018.1470141>.
- Trpeska, M., Tocev, T., Dionisijev, I. & Malchev, B. (2021) Banks' Corporate Social Responsibility (CSR) Disclosure and Their Role in the Betterment of Society In The Republic Of North Macedonia, *Facta Universitatis Series: Economics And Organization*, 18(4) Special Issue, pp. 325-339, <https://doi.org/10.22190/FUEO210628023T>.
- Venturelli, A., Caputo, F., Leopizzi, R. & Pizzi, S. (2019) The State of Art of Corporate Social Disclosure Before the Introduction of Non-Financial Reporting Directive: A Cross Country Analysis, *Social Responsibility Journal*, 15(4), pp. 409-423, <https://doi.org/10.1108/SRJ-12-2017-0275>.
- Vukić, N. M., Vuković, R. & Calace, D. (2018) Non-Financial Reporting as a New Trend in Sustainability Accounting, *Journal of Accounting and Management*, 7(2), pp. 13-26.
- Worcester, R. (2009) Reflections on corporate reputations, *Management Decision*, 47(4), pp. 573-589, <https://doi.org/10.1108/00251740910959422>.
- Yu, H. C., Kuo, L. & Kao, M. F. (2017) The relationship between CSR disclosure and competitive advantage, *Sustainability Accounting, Management and Policy Journal*, 8(5), pp. 547-570, <https://doi.org/10.1108/SAMPJ-11-2016-0086>.

## Appendix:

### Appendix A-1: RQ1 analysis = Correlation between EU membership and disclosing NFI

Ranks			
	EU_membership	N	Mean Rank
Qualitative_data	0	60	60,50
	1	60	60,50
	Total	120	
Quantitative_data	0	60	39,00
	1	60	82,00
	Total	120	
Environmental	0	60	54,50
	1	60	66,50
	Total	120	
Social_employee	0	60	54,50
	1	60	66,50
	Total	120	
Human_rights	0	60	38,50
	1	60	82,50
	Total	120	
Anticorruption_bribery	0	60	38,50
	1	60	82,50
	Total	120	
Other	0	60	43,50
	1	60	77,50
	Total	120	

### Appendix A-2: RQ1 analysis = Correlation between EU membership and disclosing NFI

Test Statistics <sup>a,b</sup>							
	Qualitative_data	Quantitative_data	Environmental	Social_employee	Human_rights	Anticorruption_bribery	Other
Chi-Square	,000	61,963	7,948	7,948	63,996	63,996	39,804
df	1	1	1	1	1	1	1
Asymp. Sig.	1,000	,000*	,005*	,005*	,000*	,000*	,000*

a. Kruskal Wallis Test

b. Grouping Variable: EU\_membership

**Appendix B-1:** RQ2 analysis = Correlation between EU membership and the title of NFR

Ranks			
	Eu_membership	N	Mean Rank
Corporate_social_responsibility	0	6	8,00
	1	6	5,00
	Total	12	
Sustainability_report	0	6	3,50
	1	6	9,50
	Total	12	
Non_financial_report	0	6	3,58
	1	6	9,42
	Total	12	
Committed_to_society	0	6	7,50
	1	6	5,50
	Total	12	
Environmental_protection	0	6	8,00
	1	6	5,00
	Total	12	
Responsible_business	0	6	5,50
	1	6	7,50
	Total	12	
Specific_names	0	6	9,50
	1	6	3,50
	Total	12	

**Appendix B-2:** RQ2 analysis = Correlation between EU membership and the title of NFR

Test Statistics <sup>a,b</sup>							
	Corporate_soci- al_ responsibility	Sustainability_ _report	Non_financial_ _report	Committed_ to_society	Environmental_ - protection	Responsible_ business	Specific_ names
Chi-Square	2,152	8,966	8,638	2,200	3,578	2,200	10,286
df	1	1	1	1	1	1	1
Asymp. Sig.	,142	,003*	,003*	,138	,059	,138	,001*

a. Kruskal Wallis Test

b. Grouping Variable: Eu\_membership

**Appendix C-1:** RQ3 analysis = Correlation between EU membership and the type of NFR

Ranks			
	EU_membership	N	Mean Rank
Part_of_annual_report	,0	6	6,00
	1,0	6	7,00
	Total	12	
Individual_report	,0	6	4,25
	1,0	6	8,75
	Total	12	
Only_on_Web	,0	6	9,50
	1,0	6	3,50
	Total	12	
None	,0	6	6,50
	1,0	6	6,50
	Total	12	

**Appendix C-2:** RQ3 analysis = Correlation between EU membership and the type of NFR

Test Statistics <sup>a,b</sup>				
	Part_of_annual_report	Individual_report	Only_on_Web	None
Chi-Square	,253	5,411	10,286	,000
df	1	1	1	1
Asymp. Sig.	,615	,020*	,001*	1,000

a. Kruskal Wallis Test

b. Grouping Variable: EU\_membership

**Appendix D-1:** RQ4 analysis = Correlation between EU membership and the length of NFR

Ranks			
	EU_membership	N	Mean Rank
Report_length	0	60	37,21
	1	60	83,79
	Total	120	

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**Appendix D-2:** RQ4 analysis = Correlation between EU membership and the length of NFR

Test Statistics <sup>a,b</sup>	
	Report_length
Chi-Square	54,584
df	1
Asymp. Sig.	,000*

a. Kruskal Wallis Test

b. Grouping Variable: EU\_membership



## Impact of the Dividend Policy and Related Corporate Governance Mechanisms on Agency Costs

IVANA ĐUNDEK KOKOTEC, TIHANA GRBAC & MARINA KLAČMER ČALOPA

**Abstract** The paper's primary goal is to identify the role of the dividend policy and related corporate governance mechanisms in reducing agency problem between management (agent) or large controlling shareholders and minority shareholders (principal). Another important goal of the research paper is approximating the agency costs. The turnover coefficient of total assets approximates this measure for the work. The agency costs are specific for joint-stock companies, and it results from the agency problem (when agents do not represent the best interests of principals), and it is not possible to measure it directly. Namely, the agency costs and the possibility of their reduction are linked to the legal protection of investors (principals) and the specifics of the joint-stock company's. Therefore, additional knowledge is essential in solving the agency problem in the insufficiently researched developing countries. Based on the results of the empirical research carried out as part of this paper, the significant role of dividend policy in explaining changes in the agency costs has been confirmed, which is in line with the majority of research carried out so far.

**Keywords:** • dividend • policy • agency costs • agency theory • corporate governance mechanisms • Zagreb stock exchange

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## 1 Introduction

The primary goal of every company, that is, a joint-stock company, is to increase the capital of its owners or shareholders, which is achieved by increasing the company's value. If it operates successfully, it realizes a profit or profit that can be distributed to shareholders in the form of dividends or reinvested in internal capital, that is, saved in the form of retained earnings. On the one hand, shareholders expect dividend payments. On the other hand, the company needs additional capital, which is the easiest and fastest to obtain precisely from the realized profit. Based on the above, joint stock companies are faced with the challenge of deciding on dividend policy as one of the most important financial decisions.

Shareholders' expectations regarding the dividend payments largely depend on the characteristics of the financial system itself, that is, the country in which the joint-stock company operates. La Porta et al. (2000), Tipurić et al. (2007) and Džidić (2016) state that companies operating in countries with a monistic or Anglo-Saxon system of corporate governance are characterized by strong investor protection, capital market development and a dispersed ownership structure. On the other hand, in countries with a dualistic or continental system of corporate governance, investor protection is present to a lesser extent, capital markets are underdeveloped or shallow, and the ownership structure is relatively concentrated (La Porta et al. , 2000; Tipurić et al., 2007; Džidić, 2016, pp. 99-100). Namely, in joint-stock companies with a concentrated ownership structure, which is typical for the Republic of Croatia, managers are usually under the direct supervision of large shareholders, and dividends serve to a greater extent as a means of expropriating small shareholders rather than controlling managers. It is expected that such companies will advocate a dividend policy to a lesser extent, in contrast to companies with an Anglo-Saxon corporate governance system. In this way, the agency problem, that is, the conflict between the described interest groups, which arises based on their different goals concerning the company's operations, is directly reflected in the dividend policy (Kožul, 2012, pp. 77-78). Due to the occurrence of the described conflict, the agency costs arises, which represents the lost value of one of the parties in the contractual relationship defined in this way (Orsag, 2015, p. 61). The informational impact of dividends is also associated with the agency problem in such a way that a change in dividends due to information asymmetry can lead to a change in stock prices (Kožul, 2012, p. 71).

According to Cerović et al. (2011), agency costs are associated with significant problems in running a company that arise from the separation of ownership functions and control over a joint-stock company. They consist of all tangible and intangible assets that the principal uses to control the agent's behavior with the aim of optimal use of invested capital. Orsag (2015, p. 61) adds that the agency cost occurs due to the appearance of a conflict of interest through the lost value of some interest groups in the described principal-agent relationship. Jensen and Meckling (1976), Easterbrook (1984) and Kožul

(2012, p. 77) describe the agency cost as the sum of monitoring costs, compensation of the interests of the contracting parties in the principal-agent relationship and residual loss. Suppose the agency cost is viewed as the lost value due to the agent's actions. In that case, it represents an opportunity cost that does not arise directly based on actual payments but by making decisions by managers that do not follow the interests of the owners of the joint-stock company. Such an indirect agency cost can be avoided by monitoring and controlling the manager and continuously conducting actions between the two interest groups (Orsag, 2015, p. 61). Jensen and Meckling (1976) and Kožul (2012, p. 77) describe the indirect agency cost as a residual loss and equate it with the reduction of the principal's wealth due to the agent's decisions against the principal's interests. On the other hand, the direct agency costs arise precisely to avoid opportunity costs, which lead to additional costs. They refer to the already mentioned costs of monitoring and controlling agents, the costs of gathering information necessary to implement monitoring and control, the costs of compensation to agents and other compensations that motivate agents to work in the principal's best interest (Orsag, 2015, p. 61). The agency cost varies between joint stock companies and depends on many internal and external factors. The most important internal factors are the managers' preferences, which conflict with the owners' interests. They relate to reputation, prestige and freedom in the management of the company and the incentives of the owners with which they try to control managerial behavior. External factors refer to the company's market position, characteristics of the managerial market, and pressure from investors and creditors. Therefore, since measuring the agency cost directly is impossible, it is most often calculated based on cost efficiency. This method considers the manager's ability to control costs and generate profits. A less common but more precise method of measuring the agency cost is profit efficiency as a way of calculating the agency cost that also considers external factors such as prices on the market in which the company operates (Cerović et al., 2011). Approximate measures of the agent's cost, which are most often used in previous research in the field of agency problem, will be described in more detail in the empirical part of the paper, which identifies the agency cost as a dependent variable of this empirical research.

Important mechanisms of corporate governance, which play a significant role in mitigating agency costs and reducing the possibility of promoting managerial interests to the detriment of shareholders, are considered to be the reduction of cash flow to managers through dividend payments and the independence of the supervisory board, which enhances the supervision of managerial activities. The announcement of dividend payments can also serve as a positive signal about future investments and development of the joint-stock company, which leads to the continuation of such a dividend policy. Additionally, higher amounts of dividends are associated with an increase in low-cost external financing of joint-stock companies through the reduction of agent conflicts and the improvement of the process of obtaining information (Hamdan, 2018; Yakubu et al., 2022). Easterbrook (1984) is one of the first theorists who tried to define dividend policy in the context of agency problem between managers and external investors (La Porta et al., 2000). In his work, he mentioned the division of the economic literature on dividend

policy into that which assumes managers are perfect investors' agents. The reasons for paying dividends are sought to be examined. That which assumes the opposite, i.e., considers managers to be imperfect agents and investigates ways of harmonizing their interests with the interests of investors. Also, he explained that the primary goal of any dividend policy is to minimize the sum of capital, agent costs and tax costs (Easterbrook, 1984).

The dividend payments are most often negatively related to the agency costs. If a joint-stock company pays dividends, it creates value for its shareholders, which results in the management's efficient use of the company's assets, which can limit agency costs. A significant negative correlation is also expected concerning dividend yield and earnings per share, where earnings per share is a more stable indicator than dividend yield since it is based on market values, so the conditions of uncertainty occurring in the market should be considered. According to Kožul (2012), previous research on dividends as a signal of future cash flow was mainly based on the assumption that a change in dividends, due to information asymmetry, can lead to a change in stock prices, thus directly connecting the informational impact of dividends to the agency problem. It is expected that joint-stock companies with a concentrated ownership structure will pay lower dividends than companies with a dispersed ownership structure for the reason that controlling shareholders can then more easily get income from their investments in shares (Kožul, 2012, pp. 71, 78). Furthermore, as a rule, profitability has a negative relationship on the agency costs. At the same time, debt ratio, the size of the supervisory board, and the size of the company can, under certain conditions, limit and increase agency costs. In his research paper Jensen (1986) also recognized the optimal size of the company and the payment of cash to shareholders as potential agency problem.

Concerning the described subject and problem, the empirical research carried out as part of this paper examines the role of the dividend policy and related corporate governance mechanisms in limiting or intensifying agency conflicts between management or large controlling shareholders on the one hand and minority shareholders on the other side. Such conflicts result in agents' costs and are closely related to the legal protection of shareholders and the environment and specifics of the joint-stock company's country. As part of numerous types of research, it has been proven that the dividend policy has a significant role in changing agency costs and increasing the value of a joint-stock company. It is considered a possible solution for mitigating the problems of agents arising from the company's business activities. However, the research results did not offer a unique answer to the question of which dividend policy concept the company should apply under the given conditions. Following the above, the impact of eight variables that have so far proved to be significant for describing the dividend policy (dividend payment, dividend yield, earnings per share, concentration of ownership, debt ratio, profitability, size of the supervisory board, size of the company) with the dependent variable will be examined the agency costs, which aims to expand knowledge in the research of that area

of economics, and for which panel regression analysis will be used. Based on the described problem, the research questions of these paper were defined:

- RQ1: Is the dividend policy significant for the explained change in the agency costs?
- RQ2: Do the dividend policy measures (dividend payment, dividend yield, earnings per share) have a negative impact on the agency costs?
- RQ3: Does the ownership concentration have a negative impact on the agency costs?
- RQ4: Does debt ratio have a negative impact on the agency costs?
- RQ5: Does profitability have a negative impact on the agency costs?
- RQ6: Does the size of the supervisory board have a positive influence on the agency costs?
- RQ7: Does the size of the company have a negative impact on the agency costs?

In accordance with defined objectives and research questions, one main and eight auxiliary hypotheses were formulated as follows:

- H1: Dividend policy is significant for explaining agency costs changes.*
  - H1.1: The dividend payments have a negative impact on the agency costs.*
  - H1.2: Dividend yield has a negative impact on the agency costs.*
  - H1.3: Earnings per share have a negative impact on the agency costs.*
  - H1.4: Ownership concentration has a negative impact on the agency costs.*
  - H1.5: Debt ratio has a negative impact on the agency costs.*
  - H1.6: Return on assets has a negative impact on the agency costs.*
  - H1.7: The board size has a positive impact on the agency costs.*
  - H1.8: Company size has a negative impact on the agency costs.*

## 2 Literature overview

Research on the analyzed issue mainly focuses on examining the influence of agency costs on dividend policy as one of its factors. In contrast, a smaller number of research studies examine the reverse relationship. Although the development of the capital market has recently stimulated research in developing countries, most of the research has been carried out in developed countries. In any case, dividend policy remains one of the under-researched issues in corporate finance. In the continuation of the sub-chapter, an overview of the most significant global and Croatian research on the described issue is presented.

La Porta et al. (2000) surveyed more than 4,000 corporations from 33 different countries in the world to identify the role of dividend policy "in the world of agency problem between corporate insiders and outsiders" (La Porta et al., 2000, p. 4). For research, they were guided by the idea that dividend policy can significantly solve agency problems. Namely, when dividends are not paid to outsiders or external shareholders, the insiders, i.e., the company's management, can use the described earnings for personal use and direct it too unprofitable projects. The consequence of the above is reflected in the fact that external shareholders prefer the payment of dividends concerning retained earnings, thereby depriving the management of the possibility of inefficient use of the company's

assets. In addition, the dividend payment leads to the company's need to go to the capital market to obtain external means of financing, which allows external investors to exercise some control over insiders. As part of the research, the authors mentioned above take into account the legal protection of investors, which varies in different countries and is linked to the seriousness of the agency problem, which directly reflects the dividend policy on the agency problem. More precisely, they showed that the dividend policy results from effective real protection of investors, which improves the payment of dividends to small shareholders. Additionally, it has been proven that companies operating in countries with better legal protection against outsiders generally pay higher dividends to their shareholders (La Porta et al., 2000).

Hardjopranoto (2006) researched a sample of manufacturing joint-stock companies listed on the Indonesian Jakarta Stock Exchange (JSX) from 1994 to 2004, trying to investigate the relationship between debt policy, dividends and managerial ownership. The results showed, among other things, that managerial ownership does not significantly reduce agents' costs (Hardjopranoto, 2006). So, even though companies implement a specific dividend policy, it does not significantly reduce agency costs, which is supported by the proven statistically insignificant negative impact of dividend policy on agency costs. The obtained results follow the concept that dividends are not linked to an increase in the company's value, and the decision on their payment may depend on the tax burden and methods of taxation of investors (Iskandar et al., 2021).

Hamdan (2018) conducted a study that included 237 companies from member countries of the Gulf Cooperation Council (GCC) from 2003 to 2015. The research examined the moderating role of supervisory board independence in dividend policy and agency costs. The results showed that the companies of the four GCC member countries (Bahrain, Oman, Saudi Arabia and the United Arab Emirates) practice paying dividends to reduce free cash flow, consequently leading to a reduction in agency costs. Also, a positive influence of supervisory board independence was observed in the relationship between dividend policy and agents' costs. Namely, it has been proven that the payment of cash dividends and the independence of the company's board lead to a reduction in the agency costs, which was expected given the fact that the research was conducted in developing markets where, due to weak investor protection, the dividend payment policy seeks to mitigate agency problems and limit the described costs (Hamdan, 2018).

Hailin and Jingxu (2019) investigated the impact of a mandatory dividend policy on a sample of Chinese joint-stock companies whose shares were traded on two Chinese stock exchanges, the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE), in the period from 2007 to 2017. The results of the research showed that the mandatory dividend policy that has existed in China for the past ten years significantly inhibits agents' costs. It has been found that it has a significant impact on limiting the costs of agents in the case of companies that pay out larger amounts of dividends. In

contrast, this impact is absent in companies with smaller dividends and small and medium-sized supervisory boards (Hailin & Jingxu, 2019).

Subsequently, Iskandar et al. (2021) analyzed ten manufacturing joint-stock companies listed on the IDX from 2014 to 2018, investigating the impact of managerial ownership, debt policy and dividend policy on agency costs and the value of the observed joint-stock companies. A panel regression analysis of the data did not prove a statistically significant influence of the dividend policy on the agency costs nor on the value of the company. On the other hand, the results indicated a statistically significant and positive correlation between borrowing policy and company value and agents' costs. Additionally, a statistically significant indirect influence of managerial ownership and borrowing policy on the company's value was observed through the agency costs, an intervening variable in the model thus set (Iskandar et al., 2021).

Kim et al. (2021) investigated the relationship between information asymmetry and dividend policy in the emerging Korean market. The research was conducted on a sample of 1,238 companies listed on KOSDAQ and the Korea Exchange (KRX) from 2002 to 2010. The results indicated a negative relationship between information asymmetry and dividend policy, which is particularly strong when companies encounter obstacles when collecting external capital, such as high systemic risk, financial constraints and low liquidity of shares (Kim et al., 2021).

Related to research on dividend policy and agency problem in European countries, Mitton (2004) investigated the relationship between corporate governance and dividend policy in a total of 365 companies from 19 countries, including those in Europe. The results showed that joint-stock companies with a better corporate governance system pay out dividends to a greater extent, which can be explained in the context of agency theory (Mitton, 1994). Furthermore, Tekin (2020) investigates the impact of company size and the financial crisis on the payment of cash dividends, analyzing companies from 18 European countries from 2001 to 2017. The research results showed that smaller companies with greater information asymmetry pay lower dividends than larger companies, especially in conditions of uncertainty when agency costs are high, and investment opportunities are low (Tekin, 2020). Furthermore, Bena and Hanousek (2006) investigated Czech joint stock companies from 1996 to 2003. The results showed that joint-stock companies with a majority shareholder pay out dividends to a lesser extent and have a lower target dividend payout ratio, in contrast to companies with at least one minority shareholder. The above reflects the importance of substantial minority shareholders in the creation of dividend policy, especially in developing countries characterized by weak legal protection of shareholders and insufficiently developed corporate governance practices (Bena & Hanousek, 2006; Kožul, 2012, p. 137).

Companies in the Republic of Croatia have been exceptionally poorly researched in dividend policy and agents' costs, and only a small number of studies dealing with the

described issue can be found. Tipurić, Hruška and Aleksić (2007) analyzed the concentration of ownership in 2007 on a sample of a total of 211 Croatian public joint-stock companies. The results favor the highly concentrated ownership structure in the Republic of Croatia, which, as the authors explain, ensures a level of control that enables direct influence on management and reduces agency costs between management and owners. On the other hand, such a concentrated ownership structure leads to the problem of protecting minority shareholders concerning large controlling shareholders who are interested in realizing their benefits, further deepening the conflict between the abovementioned interests (Tipurić et al., 2007).

Kožul (2010) examined the relationship between ownership concentration and dividend policy for 2007 on a sample of 212 companies listed on the Regulated Market of the Zagreb Stock Exchange (ZSE). The research results indicated a high concentration of ownership characteristic of Croatian companies. Furthermore, a correlation between the concentration of ownership and the payment of dividends has been proven in such a way that companies with a higher concentration of ownership pay out dividends to a lesser extent, while those with a low concentration of ownership structure practice the payment of dividends. The proven influence of ownership concentration on the decision on the dividend policy of Croatian companies is directly related to the agency problem and the protection of the rights of small shareholders in relation to a large controlling shareholder (Kožul, 2010).

Cerović et al. (2011) analyzed companies with low ownership concentration in the Republic of Croatia, examining the influence of ownership and capital structure on the movement of agency costs in 2008. Limiting factors of the research are the small number of companies in the sample and the calculation of agency costs for only one observed year. The research additionally dealt with the issue of approximating the dependent variable agency costs, considering that the agency costs cannot be directly measured. It has been proven that they are more pronounced in Croatian companies with a low concentration, that is, a more dispersed ownership structure. The correlation between the agency costs and the company's leverage turned out to be negative, following the agency theory of Jensen and Meckling from 1976 (Cerović et al., 2011).

Klačmer Čalopa et al. (2020) researched a sample of 109 large Croatian companies that operated in the manufacturing industry and wholesale and retail trade, specifically in the repair of motor vehicles and motorcycles, in the period from 2014 to 2018. The research first tried to examine the influence of the size of the supervisory board and the concentration of ownership, debt financing, and the company's growth rate on agency costs, which are approximated by the turnover ratio of total assets. Applying a regression panel data analysis, a statistically significant and negative influence of the size of the supervisory board, debt financing and growth rate on the costs of the agent of the sample company was proven. At the same time, it is absent in ownership concentration (Klačmer Čalopa et al., 2020).



### 3 Research

The initial research sample included all joint-stock companies based in the Republic of Croatia whose shares were actively traded on the Zagreb Stock Exchange from January 1, 2015, to December 31, 2021. The initial research sample included a total of 106 shares, from which the shares of those companies that met one or more criteria below were excluded from further analysis:

1. the issuing company belongs to sector K (Financial and insurance activities) and differs from non-financial companies due to its specific balance sheet structure
2. the issuing company did not operate continuously within the defined period
3. the issuer's shares are not ordinary
4. the issuer's shares are not listed on the Zagreb Stock Exchange, or securities were executed within the defined period
5. the issuer's shares were not continuously listed on the Zagreb Stock Exchange within the defined period.

Considering the selection criteria, the final research sample includes 52 joint-stock companies. Table 1 below shows the variables of the conducted empirical research. According to available research that dealt with agency theory and agency problems, the two most commonly used approximations of agency costs are below. The dependent variable of this research that cannot be directly measured:

1. ratio of sales revenue and total assets of the joint-stock company  $i$  in year  $t$ , according to Ang et al. (2000), Singh and Davidson (2003), Hamdan (2018), Klačmer Čalopa et al. (2020), Huu Nguyen et al. (2020);
2. the ratio of operating costs and income from the sale of a joint-stock company in year  $t$ , according to Ang et al. (2000), Cerović et al. (2011), Hailin and Jingxu (2019), Chamidah and Asandimitra (2017).

Cerović et al. (2011) state that the first approximation represents an auxiliary ratio for the direct costs of agents and indicates the extent to which the managers who manage the company successfully control operating costs and how much funds are spent on their interests. The second approximation refers to lost income due to a lack of ability, failure to invest, or bad investment decisions by managers (Cerović et al., 2011). Taking into account the previously described agency cost measures and the availability of data on joint-stock companies from the sample, the first form of approximation was used for this paper. The dependent variable agency costs is therefore calculated as the ratio of sales revenue to the total assets of the joint-stock company ( $i$ ) in the year ( $t$ ). The measure mentioned above of asset utilization is called the total asset turnover ratio or, for short, asset turnover, and it measures the effectiveness of asset management practices. A high turnover of assets shows a large amount of sales and cash flow generated for a given level of assets, from which it follows that the management, i.e., the joint-stock company, uses the assets effectively, thereby creating value for its owners or shareholders. On the other

hand, if the asset turnover is low, it can be concluded that the management uses the assets in ventures that do not generate cash flow, consequently leading to a decrease in the value of the joint stock company. Following what has been described, if the financial indicator of asset turnover by which the dependent variable is approximated is higher, the agency costs will be lower and vice versa. Joint-stock companies with greater information asymmetry between management and shareholders will have lower asset turnover rates, creating less value for their shareholders than companies with less apparent agent conflicts (Singh & Davidson, 2003; Cerović et al., 2011; Hamdan, 2018).

The first independent variable that describes the dividend policy is dividend payments. It is approximated as a binomial or dummy variable, meaning it can take the value 1 or 0. The variable would take the value of 1 if the joint-stock company paid dividends during the year; otherwise, it takes the value of 0. Only regular dividend payments were taken into account. Hardjopranoto (2006), Bena & Hanousek (2006) and Kožul (2011) used such a measure of dividend policy in their research.

The following independent variable that describes the dividend policy is the dividend yield. Based on the research conducted by Hamdan (2018), Nusaputra and Basana (2020) and Kim et al. (2021), the dividend yield was measured by the percentage of dividends paid per share and the market price per share of the joint-stock company (i) in the year (t). In doing so, only ordinary shares of the analyzed companies from the sample were included in the calculation. The market price was determined as the last market price on the year's last trading day. If the joint-stock company did not pay dividends in the observed year, the dividend yield is 0%.

According to Kožul (2012), the lack of dividend yield is the sensitivity to changes in share prices and based on the idea that Croatian companies with a highly concentrated ownership structure generally do not pay dividends, a third independent variable, earnings per share, was defined and used in their research by Nusaputra and Basana (2020) examining the correlation between agency costs and dividend policy. According to Žager et al. (2017, p. 55-56), earnings per share is a financial indicator of investment that compares the profit of the period, that is, the net profit after interest and taxes, and the number of ordinary shares of the observed joint-stock company (i) in the year (t). It is expressed in monetary units. More precisely, this empirical research shows how many Croatian kuna (HRK) profits or dividends are realized per share of the company.

The control variable ownership concentration was measured by the percentage share of ownership of the largest shareholder of the joint-stock company (i) in the year (t), taking into account their unique relationships. Following the above, groups of institutional investors (pension funds, investment funds, insurance companies) were viewed as jointly owned, that is, as one majority shareholder. This approximated variable was used in the research by Ang et al. (2000), Tipurić et al. (2007), Kožul (2011) and Kim et al. (2021).

Furthermore, following the research conducted by Ang et al. (2000), Singh and Davidson (2003), Bena & Hanousek (2006), Cerović et al. (2011), Chamidah and Asandimitra (2017), Hamdan (2018), Hailin and Jingxu (2019), Klačmer Čalopa et al. (2020), Nusaputra and Basana (2020), Tekin (2020) and Kim et al. (2021) defined the control variable leverage measured by the debt ratio. The indicated indicator compares the total liabilities and assets of the joint-stock company (i) in the year (t). According to Žager et al. (2017, p. 48-49), the debt ratio reflects the company's capital structure. It indicates its static debt, i.e., how much of the joint stock company's assets are financed from other people's capital or liabilities.

According to the works of authors Mitton (2004), Bena & Hanousek (2006), Cerović et al. (2011), Hailin and Jingxu (2019), Huu Nguyen et al. (2020) and Kim et al. (2021), the following control variable, profitability, measured return on assets, was defined. The indicator compares the period's profit and the joint-stock company's total assets (i) in the year (t). It represents the percentage of the total assets that the company's shareholders will earn. According to Žager et al. (2017, p. 52-53), return on total assets is one of the financial indicators of profitability that indicates the success of the joint-stock company's operations and the rate of return that the company achieved concerning the total assets.

The following control variable is board size. Taking into account the research of Singh and Davidson (2003), Chamidah and Asandimitra (2017), Klačmer Čalopa et al. (2020) and Huu Nguyen et al. (2020), was measured by the number of members of the supervisory board of the joint-stock company (i) in the year (t). In the absence of a company's supervisory board, for comparability with other years and entities, as already described at the beginning of this subchapter, information on the number of board members was used.

The last control variable, company size, was measured as the natural logarithm of the total assets of the joint-stock company (i) in the year (t). Mitton (2004), Hamdan (2018), Tekin (2020) and Huu Nguyen et al. used such an approximation of the mentioned variable in research in the field of dividend policy and agency costs. (2020).

The method used for this empirical research is panel regression analysis. Specifically, a static model of panel data whose spatial dimension consists of 52 joint-stock companies from the sample, and the time dimension refers to the finally defined period from 2015 to 2021. Furthermore, a fixed-effect model was used after diagnostic tests to determine that such a model was the most suitable for analysis for this empirical research. Based on the defined hypotheses and selected research variables and taking into account the theoretical assumptions of the static panel data model with a fixed effect, an econometric model was defined to test the impact of the dividend policy on the agency costs as follows:

$$TA_{i,t} = \alpha_{i,t} + \beta_1 * DIV_{i,t} + \beta_2 * DY_{i,t} + \beta_3 * EPS_{i,t} + \beta_4 * KV_{i,t} + \beta_5 * VNO_{i,t} + \beta_6 * ROA_{i,t} + \beta_7 * KZ_{i,t} + \beta_8 * VP_{i,t} + \varepsilon_{i,t}$$

Where is:

$TA_{i,t}$  – Total asset turnover ratio of a joint-stock companies (i) in time (t)

$DIV_{i,t}$  – Dividend payments of a joint-stock companies (i) in time (t)

$DY_{i,t}$  – Dividend yield of a joint-stock companies (i) in time (t)

$EPS_{i,t}$  – Earnings per share of a joint-stock companies (i) in time (t)

$KV_{i,t}$  – Ownership concentration of a joint-stock companies (i) in time (t)

$VNO_{i,t}$  – Bord size of a joint-stock companies (i) in time (t)

$ROA_{i,t}$  – Return on assets of a joint-stock companies (i) in time (t)

$KZ_{i,t}$  – Debt ratio of a joint-stock companies (i) in time (t)

$VP_{i,t}$  – Size of a joint-stock companies (i) in time (t)

$i = 1, \dots, 52; t = 1, \dots, 7.$

#### 4 Discussion

Based on the results of the panel regression analysis shown in table 2, it is evident that the payment of dividends has a negative, statistically significant impact on the agency costs at a significance level of 5%. In other words, if the company pays dividends, it will have a higher turnover of assets and a lower agent cost. Earnings per share of the observed joint-stock companies also have the expected, statistically significant and negative impact on the agency costs at a significance level of 10%. In addition, leverage and profitability have a significant and positive relationship with the asset turnover of the analyzed companies and negatively affect the agency costs. Contrary to expectations, dividend yield shows a significant negative relationship with asset turnover, implying its positive impact on agency cost at the 5% significance level. Namely, if the dividend yield of a joint-stock company is higher, it does not use its assets efficiently enough, and the agency costs is higher. The size of the company also significantly and positively correlates with the agency costs, while for the variable's concentration of ownership and size of the supervisory board, no statistically significant influence on the agency costs was identified.

In accordance with the previously described results, the main hypothesis is accepted, according to which all three dividend policy measures (dividend payment, earnings per share, dividend yield) have a statistically significant influence on the agency costs. More precisely, it is confirmed that dividend policy is significant for explaining changes in agent cost. Such results are consistent with previous research (Hamdan, 2018; Hailin & Jingxu, 2019; Nusaputra & Basana, 2020; Kim et al., 2021; La Porta et al., 2000; Mitton, 2004; Kožul, 2010), which showed that dividend policy significantly correlates with agency costs, mainly contributing to their reduction. Other results in Table 3 show that the sub-hypotheses according to which leverage and profitability have a negative impact on the agency costs are supported. Accordingly, a positive relationship between

profitability and asset turnover and its negative impact on the agency costs was confirmed, per the assumptions of the agency theory and the research conducted by Cerović et al. (2011) and Huu Nguyen et al. (2020). The theory can also explain that a higher level of profitability leads to a higher cash flow for the payment of dividends, as stated by Nusaputra and Basana (2020) and Kim et al. (2021), which then reduces agency problems and agency costs. Leverage is also in a significant and positive relationship with asset turnover. More precisely, a higher level of leverage leads to a reduction in agency costs in accordance with the analyzed research (Ang et al., 2000; Cerović et al.; Chamidah & Asandimitra, 2017; Hamdan, 2018; Huu Nguyen et al., 2020). The explanation is found in the fact that a lower level of leverage allows management greater freedom in decision-making and the selection of less risky solutions, consequently reducing the agency costs.

Furthermore, the sub-hypotheses assuming a negative relationship between ownership concentration, the size of the supervisory relationship and the size of the company with agency cost are not supported. The concentration of ownership has a negative but statistically insignificant relationship with the agency costs in accordance with the results of some previous research (Hardjopranoto, 2006; Klačmer Čalopa et al., 2020; Iskandar et al., 2021). Given that numerous studies have proven a significant correlation between the mentioned variables (Ang et al., 2000; Singh & Davidson, 2003; Kožul, 2010; Cerović et al., 2011; Hamdan, 2018; Nusaputra & Basana, 2020), the explanation is found in the different characteristics of the examined markets and the high concentration of ownership of the analyzed Indonesian and Croatian joint-stock companies, compared to research conducted in the area of developed countries. The size of the supervisory board also did not show a significant impact concerning the agency costs, which can be explained by the smaller average number of members of the supervisory board of the analyzed joint-stock companies, where such an impact is absent. This is by the results of research conducted by Chamidah and Asandimitra (2017) and Hailin and Jingxu (2019), while there is no link with the claim that supervisory boards of companies increase the level of agency costs and are therefore less efficient (Singh & Davidson, 2003; Huu Nguyen et al., 2020; Klačmer Čalopa et al., 2020). Regarding the size of the company, its significant positive influence on the agency costs was proven, which is contrary to expectations and in line with research conducted by Mitton (2004), Hamdan (2018) and Nusaputra and Basana (2020). The reason for this is found in the insufficient example of appropriate mechanisms for monitoring management behavior, and the way assets are used (Hamdan, 2018), where the similarity with Indonesian companies is visible. Additionally, as the sample includes large joint-stock companies listed on the Zagreb Stock Exchange, they have easier access to financial resources and greater investment opportunities that improve their cash flow and business performance.

The previously analyzed results must be viewed in the context of the limitations of implementing this empirical research. They relate primarily to the characteristics of the balanced sample in which specific non-financial companies were selected, more precisely, joint-stock companies that operated continuously and whose ordinary shares

were continuously listed on the Zagreb Stock Exchange in a defined period from 2015 to 2021. Additional limitations relate to the instability of the market and the reduction of investment activities caused by the coronavirus pandemic in the second half of the observed period, the impossibility of directly measuring the agency costs, which is approximated by the turnover of total assets, and the collection of data on joint-stock companies from several different sources, given the unavailability of all necessary data in as part of the annual financial statements. The last limiting factor is related to the problem of transparency and weak legal protection of investors in Croatia.

## 5 Conclusions

The results of the conducted statistical analysis confirmed the main hypothesis that the dividend policy of the observed joint-stock companies is significant for explaining changes in agency costs. Therefore, the dividend policy plays a significant role in mitigating the conflict between management or large controlling shareholders and minority shareholders, consequently reducing agents' costs, which is consistent with the assumptions of agency theory. Joint-stock companies in the Republic of Croatia are characterized by a continental corporate governance system with a highly concentrated ownership structure where management is under the direct supervision of large controlling shareholders. In addition, the problem of the weak legal protection of minority shareholders in relation to large controlling shareholders who seek to achieve their interests, primarily in establishing control over the company, based on which the agency costs arise, is expressed. Thus, the agency problem is directly related to the dividend policy, which is confirmed by research examining the differences in dividend policy depending on investor protection. Precisely because of the diversity of the market, the results of this research conducted in developing countries, characterized by insufficient adoption of corporate governance mechanisms, differ from those in countries with an Anglo-Saxon corporate governance system. Furthermore, the analysis showed that it is essential to implement a stable dividend policy because investors can perceive constant changes as a negative signal about the future operations of companies, especially in conditions of uncertainty and market instability. The informational impact of dividends is thus directly connected to the agency problem in such a way that a change in dividends due to information asymmetry leads to the variability of stock prices by the signaling theory. Additional results showed that, in addition to the dividend policy, the increase in leverage and profitability also leads to a decrease in the agency costs. At the same time, the influence of the other analyzed variables was not identified.

**References:**

- Ang, J. S., Cole, R. A. & Wuh Lin, J. (2000) Agency costs and ownership structure, *Journal of Finance*, 55(1), pp. 81–106, <https://doi.org/10.1111/0022-1082.00201>.
- Bena, J. & Hanousek, J. (2006) Rent extraction by large shareholders: Evidence using dividend policy in the Czech Republic, *Financial Markets Group, Discussion paper*, 556, pp. 1-38, available at: <http://eprints.lse.ac.uk/24510> (September 9, 2022).
- Cerović, Lj., Zaninović, V. & Dukić, N. (2011) Utjecaj vlasničke i kapitalne strukture na kretanje agencijskih troškova: studija slučaja vlasnički nisko koncentriranih poduzeća Republike Hrvatske, *Ekonomski misao i praksa*, 20(2), pp. 419-442, available at: <https://hrcak.srce.hr/75566> (September 9, 2022).
- Chamidah, N. & Asandimitra, N. (2017) The determinant of agency cost in Indonesia, *International Journal of Economic Research*, 14(1), pp. 449-463, available at: <https://www.researchgate.net/publication/315996908> (October 28, 2022).
- Džidić, A. (2016) *Utjecaj razvoja tržišta kapitala na politiku dividendi* [Doktorska disertacija] (Split: Ekonomski fakultet, Sveučilište u Splitu), available at: <https://dr.nsk.hr/islandora/object/efst:1762> (October 5, 2022).
- Hailin, Q. & Jingxu, Z. (2019) Can Mandatory Dividend Policy Reduce the Agency Cost of Listed Companies? Model Analysis and Empirical Test in China, *Copernican Journal of Finance & Accounting*, 8(1), pp. 59-100, <http://dx.doi.org/10.12775/CJFA.2019.003>.
- Hamdan, M. A. (2018) Dividend policy, agency costs and board independence, *International Journal of Critical Accounting*, 10(1), pp. 42-58, <https://www.researchgate.net/publication/324170132>.
- Hardjopranoto, W. (2006) Interdependent Analysis of Leverage, Dividend and Managerial Ownership Policies: Agencies Perspectives, *Gadjah Mada International Journal of Bussines*, 8(2), pp. 179-199, <https://doi.org/10.22146/gamaijb.5619>.
- Huu Nguyen, A., Thuy Doan, D. & Ha Nguyen, L. (2020) Corporate Governance and Agency Cost: Empirical Evidence from Vietnam, *Journal of Risk and Financial Management*, 13(103), pp. 1-15, available at: <https://ideas.repec.org/a/gam/jjrfmx/v13y2020i5p103-d360580.html> (October 5, 2022).
- Iskandar, Santoso, B. & Suryani, E. (2021) The Influence Of Managerial Ownership, Debt Policy, Dividend Policy On Agency Costs And Its Implications On Company Value (Studies on Manufacturing Companies Listed on the IDX for the 2014-2018 Period), *International Journal of Innovative Science, Engineering & Technology*, 8(9), pp. 367-379, available at: <http://eprints.unram.ac.id/id/eprint/26928> (September 9, 2022).
- Jensen, M. (1986) Agency costs of free cash flow, corporate finance, and takeovers, *American Economic Review*, 76(2), pp. 323–29.
- Jensen, M. C. & Meckling, W. H. (1976) Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure, *Journal of Financial Economics*, 3(4), pp. 305-360, [https://doi.org/10.1016/0304-405X\(76\)90026-X](https://doi.org/10.1016/0304-405X(76)90026-X).
- Kim, S., Jung, J-y. & Cho, S-w. (2021) Does Information Asymmetry Affect Dividend Policy? Analysis Using Market Microstructure Variables, *Sustainability*, 13(7), pp. 1-19, <https://doi.org/10.3390/su13073627>.
- Klačmer Čalopa, M., Đundek Kokotec, I. & Kokot, K. (2020) Utjecaj veličine nadzornog odbora i koncentracije vlasništva na troškove agenta: Analiza poduzeća u Republici Hrvatskoj, *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, 38(2), pp. 521-535, available at: <https://hrcak.srce.hr/clanak/362813> (September 9, 2022).

- Kožul, A. (2010) Utjecaj koncentracije vlasništva na politiku dividendi, *Zbornik II. Međunarodne konferencije "Vallis Aurea" / Katalinić, Branko* (Požega-Beč: Veleučilište u Požegi i DAAAM International Vienna), pp. 615-621, available at: <https://www.bib.irb.hr/518048?rad=518048> (October 5, 2022).
- Kožul, A. (2012) *Faktori oblikovanja politike dividendi* [Doktorska disertacija] (Zagreb: Ekonomski fakultet, Sveučilište u Zagrebu).
- La Porta, R., Lopez-de-Silanes, F., Shleifer, A. & Vishny., R. (2000) Agency problems and dividend policies around the world, *Journal of Finance*, 55(1), pp. 1-33, <https://doi.org/10.1111/0022-1082.00199>.
- Mitton, T. (2004) Corporate governance and dividend policy in emerging markets, *Emerging Markets Review*, 5(4), pp. 409-426, <https://doi.org/10.1016/j.ememar.2004.05.003>.
- Nusaputra, F. & Basana, S. R. (2020) The effect of agency costs, ownership structure, signaling, investment opportunities, size, financial leverage, and profitability on dividend policy of companies listed in Indonesian stock exchange, *International Journal of Financial and Investment Studies (IJFIS)*, 1(2), pp. 109-120, <https://doi.org/10.9744/ijfis.1.2.109-120>.
- Orsag, S. (2015) *Poslovne financije* (Zagreb: Avantis, HUFA).
- Singh, M. & Davidson III, W. N. (2003) Agency costs, ownership structure and corporate governance mechanisms, *Journal of Banking & Finance*, 27(5), pp. 793-816, [https://doi.org/10.1016/S0378-4266\(01\)00260-6](https://doi.org/10.1016/S0378-4266(01)00260-6).
- Tekin, H. (2020) Firm size and dividend policy of European firms: evidence from financial crises, *Marmara Journal on European Studies*, 28(1), pp. 109-121, available at: <https://dergipark.org.tr/en/pub/maruaad/issue/57737/823669> (October 28, 2022).
- Tipurić, D., Hruška, D. & Aleksić, A. (2007) Corporate Governance and Ownership Concentration in Croatia, *The Business Review*, Cambridge, 7(1), pp. 207-211, available at: <https://www.bib.irb.hr/475859?rad=475859> (September 9, 2022).
- Tipurić, D. (ed.) (2008) *Korporativno upravljanje* (Zagreb: SINERGIJA).
- Yakubu, I. N., Kapusuzoglu, A. & Ceylan, N. B. (2022) The Effect of Corporate Governance on Firm Dividend Policy: Evidence from Ghana, *The Journal of Accounting and Finance*, 94, pp. 223-238, available at: <https://www.researchgate.net/publication/360159779> (October 28, 2022).
- Žager, K., Mamić Sačer, I., Sever Mališ, S., Ježovita, A. & Žager, L. (2017) *Analiza financijskih izvještaja* (3. izmj. i dopunj. izd.) (Zagreb: Hrvatska zajednica računovođa i financijskih djelatnika).



**Appendix:****Table 1:** Selected research variables

Name	Label	Approximation	Expected impact
<b>Dependent variable</b>			
Agency Costs	TA	sales revenue / total assets	negative (-)
<b>Independent and controlling variables</b>			
Dividend payments	DIV	One or zero	negative (-)
Dividend yield	DY	Dividends paid per share / market price per share (%)	negative (-)
Earnings per share	EPS	Net profit / number of equity shares	negative (-)
Ownership concentration	KV	Share of ownership of the largest shareholder of the joint-stock company (i) in the year (t) (%)	negative (-)
Debt ratio	KZ	Total liabilities / total assets	negative (-)
Return on assets	ROA	Net profit / the joint-stock company's total assets (i) in the year (t)	negative (-)
Board size	VNO	Number of members of the supervisory board in the year (t).	positive (+)
Company size	VP	Ln (total assets)	negative (-)

Source: Created by the authors based on the literature analysis.

**Table 2:** Results of the static panel analysis

Dependent variable Agency costs (TA) (i,t)	Coefficient	p-value
<b>Independent variable</b>		
Intercept ( $\alpha_{i,t}$ )	1.896226	0.0061
Dividend payments (DIV)	0.056252	0.0554*
Dividend yield (DY)	-0.015847	0.0051*
Earnings per share (EPS)	0.000064	0.1821**
Ownership concentration (KV)	0.001222	0.2554
Debt ratio (KZ)	0.098172	0.1657**
Return on assets (ROA)	0.001761	0.0220*
Board size (VNO)	-0.007057	0.4204
Company size (VP)	-0.065602	0.0467*
F-test		0.0000
Hausman test		0.0078
LM test		/
Selected model		FE
No. of observations (N)		364

\*significant at the 5% level; \*\*significant at the 10% level.

Source: Created by the authors in EViews.

**Table 3:** Results of research sub-hypotheses testing

Research sub-hypothesis	Description	Impact	Compliance with expectation
H <sub>1.1</sub>	The dividend payments have a negative impact on the agency costs.	statistically significant, negative	yes
H <sub>1.2</sub>	Dividend yield has a negative impact on the agency costs.	statistically significant, negative	no
H <sub>1.3</sub>	Earnings per share have a negative impact on the agency costs.	statistically significant, negative	yes
H <sub>1.4</sub>	Ownership concentration has a negative impact on the agency costs.	statistically insignificant, negative	no
H <sub>1.5</sub>	Debt ratio has a negative impact on the agency costs.	statistically significant, negative	yes
H <sub>1.6</sub>	Return on assets has a negative impact on the agency costs.	statistically significant, negative	yes
H <sub>1.5</sub>	The board size has a positive impact on the agency costs.	statistically insignificant, negative	no
H <sub>1.8</sub>	Firm size has a negative impact on the agency costs.	statistically significant, positive	no

Source: Created by the authors.



## Financing Policies of Innovative Italian SMEs: Who Finances Business Innovation?

ALESSANDRO GENNARO

**Abstract** Financial constraints are among the causes of the innovative gap that characterized Italian SMEs in the last decades, and that contributed to stagnant productivity and a low growth rate. Despite the relevance of the problem, relatively few studies have indagated the innovative gap of firms in Italy just focusing on their financing issues. Therefore, the paper analyses the financing policies of Italian innovative young firms. The aim is twofold: to observe the main sources of capital and verify whether the capital structure of innovative firms is conditioned by their life cycle and innovativeness; to identify the firm-specific factors influencing the choices of financing sources. A sample of 1289 Italian startups and SMEs, identified among those registered in the appropriate section of the Italian "business register", has been analyzed. A two-step regression analysis has been performed to assess the influence of several firm-specific factors on corporate financing policies. The evidence indicates that the level and composition of debt vary with the innovation degree of the firms considered. The high variability of the financial structure ratios does not allow a univocal interpretation of the influence of the business life cycle; this is also due to the impact of other firm-specific factors on corporate funding policies. The results of the research allow some early insights into the ability of Italian young innovative companies to adapt their capital structure to the evolving conditions of the business.

**Keywords:** • innovative firms • SMEs • financing policies • capital structure • business life cycle

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## 1 Introduction

There's no doubt of the importance of innovation in helping businesses navigate their way out of the pandemic crisis. Most businesses have had to adapt, quickly seizing new opportunities in order to survive. This is what innovation is all about: a change in products or processes that adds value for entrepreneurs and stakeholders. It will certainly play a significant role in getting businesses back to growth and value creation. In a post-pandemic economy, the search for competitiveness brings a rethinking of business strategies and policies, which should be mainly based on the ability to innovate. The latter requires advanced knowledge, continuous renewal of know-how, highly qualified human resources, and structural R&D activities (Subramaniam & Youndt, 2005; Paoloni et al., 2020). In other terms, innovation at the same time requires and generates a strong intellectual capital (Gennaro et al, 2019). Moreover, innovation and flexibility are strictly required for firms to be reactive and resilient in turbulent markets (and in times of crisis), their knowledge and networks represent strategic components of their business model and value proposition system (Buenechea-Elberdin et al., 2017). Indeed, the vitality, strength, and resilience of a business model depend on the company's ability to innovate by generating distinctive knowledge resources and adapting them to the dynamics of the competitive environment (Cabrilo and Dahms, 2018).

Institutional debate, mainly in countries like Italy where economic growth is a problem to face, is increasing. In recent decades, Authorities (Consob, Bank of Italy, etc.), universities and research centers (Mediobanca, Prometeia, etc.) have addressed the problems of the competitiveness and growth of Italian SMEs. Policymakers have considered these problems by often placing them at the center of their economic policy choices. Since the early 90s, the Italian economic and industrial system has faced relevant changes due to the globalization of trade, the EU integration process, and the ITC development. More recently, other important factors of change have been added, such as digital innovation, environmental and social sustainability of business activities, and circular economy. New business opportunities and business models arose, and new business risks arose as well. That increased competitive pressure for SMEs and shifted their balances between internal or external growth, economies of scale or scope, transaction costs or agglomeration economies. With the outbreak of the pandemic crisis, global value chains showed their fragility, and membership in international supply and production networks, which in the 2000s was considered a key strategic driver for business development, was called into question.

Several issues limit the ability of Italian small and medium-sized enterprises to innovate. Low level of entrepreneurship, poor managerial culture, and lack of well-defined innovation processes are among the main reasons. Alongside these, certainly, there are financing problems (European Commission, 2019 and 2022; OECD, 2021). The financial needs for innovation are evident: building and regenerating intellectual capital require investments, which call for adequate sources of capital.

The financing policies of Italian non-financial SMEs have been observed in several research from the Bank of Italy, which outline the peculiarities of their capital structures, and the effectiveness of public measures devoted to fostering access to financial markets (equity side or debt side). De Socio e Russo (2016) found that in the run-up to the financial crisis Italian firms significantly increased their debt in absolute terms and in relation to equity. The positive gap in firms' leverage between Italy and other euro-area countries has widened in recent years, despite the outstanding debt of Italian firms has decreased since 2011. Authors document the magnitude of this gap using both aggregate macro data and firm-level information: controlling for several firm-specific characteristics (i.e. age, profitability, asset tangibility, asset liquidity, turnover growth), they find that the leverage of Italian firms is about 10% higher than in other euro area countries. Differences are systematically larger among micro and small firms. In the period before the financial crisis, as a result of low-interest rates and abundant liquidity, Italian non-financial corporations increased their financial debt considerably, particularly their debt levels with banks.

The condition of low capitalization and low financial independence of Italian small and medium-sized enterprises highlights financial problems that might worsen when companies have innovative business models. New or young enterprises, despite their high technological content and strong growth potential, may suffer limits in accessing capital markets, rationing in bank credit, financial constraints, etc. However, startups and innovative SMEs represent an important factor in the innovation and development of the country and are considered one of the key points of Italian economic policy. With legislative decrees no. 179/2012 and 3/2015 Italian government defined innovative startups and innovative SMEs and introduced some specific measures to support these companies to support them during their life cycle (birth, growth, maturity). With these regulatory interventions, the Italian policymakers intend to develop a dynamic and competitive "innovation ecosystem", to create new opportunities for doing business and encourage employment and promote sustainable growth strategies. To achieve the status of innovative firms, Italian startups and SMEs must have the following objective [Table 1] and subjective [Table 2] requirements.

**Table 1:** Objective requirements for innovative young Italian companies

<b>OBJECTIVE REQUIREMENTS</b>	<b>INNOVATIVE STARTUPS</b> (Legislative Decree n. 179/2012)	<b>INNOVATIVE SMEs</b> (Legislative Decree n. 3/2015)
• <i>new company or established for no more than 5 years</i>	✓	
• <i>resident in Italy, or in another country of the European Economic Area but with a production site or branch in Italy</i>	✓	✓
• <i>annual turnover of less than 5 million euros</i>	✓	
• <i>not listed on a regulated market</i>	✓	✓
• <i>no dividend payout</i>	✓	
• <i>exclusive or prevalent corporate purpose the development, production and commerce of a product or service with a high technological value</i>	✓	
• <i>not be the result of a merger or spin-off</i>	✓	
• <i>latest financial statements certified by an independent auditor</i>		✓

Source: Authors' elaboration.

**Table 2:** Subjective requirements for innovative young Italian companies

<b>SUBJECTIVE REQUIREMENTS</b>	<b>INNOVATIVE STARTUPS</b> (Legislative Decree n. 179/2012) <u>at least 1 of the following subjective requirements</u>	<b>INNOVATIVE SMEs</b> (Legislative Decree n. 3/2015) <u>at least 2 of the following subjective requirements</u>
• <i>R&amp;D and innovation expenses</i>	at least 15% of the higher value between cost and total value of production	at least 3% of the higher value between turnover and cost of production
• <i>Qualified personnel</i>	at least 1/5 PhDs, PhD students or researchers, or at least 1/3 with master's degrees	at least 1/3 PhDs, PhD students or researchers, or at least 2/3 with master's degrees
• <i>Intellectual property</i>	ownership or licensing of at least one patent or one registered software	ownership or licensing of at least one patent or one registered software

Source: Authors' elaboration.

Innovative startups, after entering the special section of the "Business register" dedicated to innovative firms, can enjoy tax and financial benefits within 5 years of their establishment. Since Italian policymakers consider innovative SMEs as the second evolutionary stage of the innovative startups mature and ready for the consolidated growth phase, startups can transform themselves into SMEs without losing the benefits.



Through fiscal and financial incentives, Italian policymakers have attempted to create an ecosystem favorable to the birth and consolidation of innovative companies. The focus of our research is the financial policies and financing choices of Italian companies recognized as innovative in accordance with the aforementioned legislative decrees. Our study, therefore, attempts to provide some first answers to the following research questions:

- *RQ1* Does the financial structure of Italian innovative companies depend on the stage of their life cycle and on their degree of innovation?
- *RQ2* What are the firm-specific factors, among those already identified and investigated in the literature, that most influence the financial choices of innovative companies?

The paper is organized as follows. The literature review on intellectual capital disclosure and measurement is presented in Section 2. Sample, dataset, and methodology are presented in Section 3, while in Section 4 evidence is shown and results are also analyzed and discussed in detail. Section 5 presents final remarks on the results, limitations of the research, and future implementations.

## 2 Literature overview

Since the fundamental work of Modigliani and Miller (1958), financial literature has been discussing if financing policies affect the firm's value, if an optimal capital structure does exist, and what variables can affect the financing choices of companies, which result in sub-optimal capital structure and no-maximized corporate value (Myers, 1984). Scholars and practitioners studied and tried to explain several phenomena that affect the firms' financial management like financing lacks or constraints, external financing preferences, and debt overhang, just to name a few.

Based on the well-known revised "M&M propositions" (Modigliani and Miller, 1963), the conceptual model called "Trade-off Theory" (ToT) was built and tested. It specifically focuses on the link between capital structure, insolvency risk, and corporate value, considering disruption costs and default costs related to financial debt (Copeland et al. 2005). The ToT affirms the existence of an optimal financial structure reachable by balancing advantages (tax savings) and disadvantages of financial debt (bankruptcy costs; agency costs). The tax shield makes convenient the increase of debt until a further increase would lead to a rising in default probability and related costs which result in a reduction in the firm value. Limits of the TOM for practical uses are several. The identification of an optimal structure requires an estimation of the default probability, related costs, and methods to be considered in the firm valuation process.

From this theoretical model various lines of research have been derived which aim to investigate the following aspects: dynamics of the financial structure and adjustment

costs; firm-specific factors that contribute to defining the optimal financial structure or condition its realization; impacts of the business life cycle and business innovation on financing policies; relationships between governance structures, ownership structures, and financial structure.

Optimal leverage tends to vary over the lifecycle of a company (birth, growth, maturity, and decline). Each phase is characterized by different levels of financial distress, insolvency risk, and recovery probability, and therefore influences financing policies and changes in the capital structure of a firm (Koh et al. 2015). The relationship between optimal capital structure and cash flow risk has also been explored. Several studies focused on the role of systematic risk, finding that firms with riskier assets choose a lower net leverage, given their higher expected financing costs; less risky firms, with lower expected financing costs, optimally choose to issue more debt to exploit a tax advantage (Palazzo 2019). Other studies focused on the role of operating leverage as a risk factor, finding that firms with lower levels of operating cash flow have a positive and significant relationship between cash flow risk and debt levels, while firms with higher levels of operating cash flow have no significant relationship between cash flow risk and debt levels (Harris and Roark 2018).

Financial studies paid a specific attention to this kind of issue when referring to SMEs. The issue of SME financing is well known and under massive investigation for decades (Cressy and Olofsson, 1997; Beck and Demirguc-Kunt, 2006; Berger and Udell, 2006; Ebiringa, 2011). There is no doubt that access to finance is of crucial importance for the growth and profitability of SMEs, through its role in facilitating the creation of new businesses and nurturing the innovation process. Several studies have discussed that SMEs are financially more constrained than large firms and are less likely to have access to formal finance. There is a general consensus that financial markets do not function well when it comes to small and medium firms; the main reasons for market failures considered in financial literature are information asymmetries and external benefits (eg. spillovers), that are more relevant for SMEs' than for large enterprises.

Al-Zoubi et al (2018) analyzed the relationship between business cycles, financial cycles and capital structure. They find evidence that firms' leverage is both persistent and cyclical, a result supported by the trade-off, pecking order, and market timing capital structure theories. Although market timing theory research supports persistence, previous literature dictates that the trade-off and pecking order theories may predict either persistent or mean reverting leverage. In addition, the Authors examine whether firms change their capital structure as a result of business and financial cycles. Since financial cycles last longer than business cycles, financial cycles should have a long-term effect on leverage.

The presence of market failures (informational issues and externalities) implies that the size and the number of SMEs tend to be not optimal, with respect to what would be an

efficient market organization and a competitive firm's dimension in dynamic and innovative industries. Indeed, limited access of SMEs to the capital market could represent a serious impediment to their expansion strategies and investment (also in R&D) policies. In the framework of market failures, financial literature deeply analyzed the factors that matter in the determination of the availability and the cost of capital resources, and of the financing policies of SMEs. A significant part of the literature has focused on the intrinsic characteristics of SMEs, such as size, age, ownership and governance structures, and management team (Abdulsaleh and Worthington, 2013). In this field, specific attention is paid to the role of age (Kieschnick and Moussawi, 2018), and to the dynamics of the determinants of SMEs capital structure across their lifecycle (Matias and Serrasueiro, 2017; Martinez Cillero et al., 2019). Other studies have focused on the economic environment's impacts (Xia et al., 2019), searching for context elements able to affect the financial decisions of SMEs, not only related to credit policies of banks or sector dynamics, but also to the supply-chain network (Song et al., 2016) and tax regulation. Relatively poor is the literature that considers the relationships between the financial policies of SMEs and financial innovation; in this context, an interesting line of studies has investigated the impacts of securitization operations (Casey and O'Toole, 2014; Kaya and Masetti, 2019).

### 3 Research

The aim of the research is to verify whether financing policies of Italian innovative companies are influenced by their business life cycle and innovativeness degree. We focused on young and small or medium-sized enterprises because, unlike large companies, they encounter greater constraints in accessing some sources of finance, that the public intervention aims to remove.

The relationship between financing choices and business life cycle has been analyzed through the capital structures of a sample of young innovative companies of different ages, being the firm's age equal to the number of years since the start of the business activity. We have considered the age of a firm as an objective indicator of its life-cycle stage. Indeed, without specific information, different indicators (e.g., revenue growth rate, breakeven point of EBITDA, etc.) would have led to classification or comparison problems. This research approach has led to the cross-sectional analysis illustrated below, which makes it possible to compare the capital structure that the sampled innovative companies had at the end of 2021. The use of cross-sectional data certainly limits the possibility to control for time-variation in firm-specific variables but has the advantage that the analysis is not influenced by time variations in macroeconomic or context variables, which could affect the financial choices of companies in different ways depending on the age.

To build an adequate sample a clear definition of an innovative company is required. Available definitions in managerial literature converge on the concept of business

innovation as the ability to design new products and processes or to implement new business models that allow a firm to strengthen its competitiveness generating value for its stakeholder. This definition includes various forms of innovation, for which the criteria for identifying innovative companies may be different and may require information that is often not available in the case of unlisted SMEs. Therefore, we have considered the criteria envisaged by the aforementioned Decrees to define and identify a sample of Italian innovative companies. Therefore, the startups and SMEs registered in the special section of the Italian "Business Register" created for innovative firms were analyzed. From the website (<https://startup.registroimprese.it/isin/home>) it is possible to download the list of registered startups and SMEs and obtain information on the headquarters, sector, size, and innovativeness requirements. As of September 30, 2022, there are 14.716 innovative startups and 2.372 innovative SMEs registered in this Register, an increase compared to the first quarter of 2022. Considering only incorporated companies (joint-stock and limited liability companies), and excluding firms in liquidation or with incomplete data, we identified 14.989 innovative firms, representing our study's reference population. For these companies, information is available on the age, the subjective requirements [Table 3], the amount of equity [Table 4], and the belonging sector [Table 5].

**Table 3:** Innovative Italian companies at July 1, 2022 – Age and innovation requirements

AGE (years)	INNOVATION REQUIREMENTS			Total	
	1	2	3		
less than 3	6.136	272	51	6.459	43,09%
3	2.148	157	24	2.329	15,54%
4	1.808	131	25	1.964	13,10%
5	1.407	173	32	1.612	10,75%
6	464	231	22	717	4,78%
7	96	238	42	376	2,51%
8	14	256	34	304	2,03%
9	4	183	28	215	1,43%
10	1	120	25	146	0,97%
more than 10	7	712	148	867	5,78%
<b>Total</b>	<b>12.085</b>	<b>2.473</b>	<b>431</b>	<b>14.989</b>	<b>100,00%</b>
	80,63%	16,50%	2,88%		

Source: Authors' elaboration.

**Table 4:** Innovative Italian companies at July 1, 2022 – Age and equity

AGE (years)	EQUITY								Total	
	≤ 10 k/€	≥ 50 k/€	≤ 100 k/€	≥ 250 k/€	≥ 500 k/€	≤ 1 mln/€	≥ 2,5 mln/€	> 2,5 mln/€		
less than 3	4,097	1,506	350	270	124	57	32	23	6,459	43,09%
3	1,289	590	173	127	79	33	29	9	2,329	15,54%
4	1,046	539	134	110	55	40	26	13	1,963	13,10%
5	787	444	148	98	56	37	27	15	1,612	10,76%
6	318	214	62	54	32	18	11	8	717	4,78%
7	109	126	36	40	25	16	12	12	376	2,51%
8	78	103	35	38	28	11	5	6	304	2,03%
9	48	79	21	24	10	12	16	5	215	1,43%
10	28	47	21	19	11	9	6	5	146	0,97%
more than 10	94	219	166	144	75	68	57	44	867	5,78%
<b>Total</b>	<b>7.894</b>	<b>3.867</b>	<b>1.146</b>	<b>924</b>	<b>495</b>	<b>301</b>	<b>221</b>	<b>140</b>	<b>14.988</b>	<b>100,00%</b>
	52,67%	25,80%	7,65%	6,16%	3,30%	2,01%	1,47%	0,93%		

Source: Authors' elaboration.

**Table 5:** Innovative Italian companies at July 1, 2022 – Age and sectors

AGE (years)	SECTORS					Total	
	SERVICES	INDUSTRY/H ANDICRAFT	COMMERCE	TOURISM	AGRICULTURE/ FISHING		
less than 3	5.231	925	211	45	47	6.459	43,09%
3	1.826	380	80	21	22	2.329	15,54%
4	1.537	341	63	13	10	1.964	13,10%
5	1.207	300	65	23	17	1.612	10,75%
6	534	141	33	4	5	717	4,78%
7	278	69	27	1	1	376	2,51%
8	229	59	12	3	1	304	2,03%
9	155	46	14	-	-	215	1,43%
10	105	31	8	2	-	146	0,97%
more than 10	600	216	49	1	1	867	5,78%
<b>Total</b>	<b>11.702</b>	<b>2.508</b>	<b>562</b>	<b>113</b>	<b>104</b>	<b>14.989</b>	<b>100,00%</b>
	78,07%	16,73%	3,75%	0,75%	0,69%		

Source: Authors' elaboration.

We used the subjective requirements indicated by the Italian Decrees to assess the degree of innovation of the companies examined: the number of possessed requirements is a proxy of the innovativeness degree of a firm. Companies that have 3 requirements are considered very innovative; those that have 2 are considered on average innovative; those that have only 1 are considered less innovative. The latter category is most of the reference population and tends to correspond to smaller companies in the start-up stage.

For each company included in our reference population, we downloaded from the database AIDA (Bureau van Dijk)<sup>1</sup> the accounting data and the financial ratios of the last available financial statement (fiscal year 2021 or, in few cases, 2020). Unfortunately, the accounting data of just 3792 companies was available, ie 25% of the total of firms reported in the section of Business Register for innovative startups and SMEs. This did not make it possible to extend our analysis to the entire population of young Italian innovative firms. To answer our research questions, for companies with available data,

we collected 7 accounting indicators of capital structure [Table 6], 7 accounting indicators of solvency, profitability, intangibility, and size [Table 7], and 3 variables expressing the ownership structure of firms [Table 8].

**Table 6:** Capital structure indicators

Firm characteristic	Variables	Financial ratios
Capital Structure	Financial leverage	$\frac{\text{financial debt}}{\text{net worth}}$
	Net Financial leverage	$\frac{\text{net financial position}}{\text{net worth}}$
	Equity to debt ratio	$\frac{\text{net worth}}{\text{total debt}}$
	Financial independence	$\frac{\text{net worth}}{\text{total assets}}$
	Debt maturity	$\frac{\text{short} - \text{term debt}}{\text{total debt}}$
	Bank debt incidence	$\frac{\text{bank debt}}{\text{revenues}}$
	Equity magnitude	$\frac{\text{equity}}{\text{net worth}}$

Source: Authors' elaboration.

**Table 7:** Firm-specific indicators for solvency, profitability, intangibility and size

Firm characteristics	Variables	Financial ratios
Solvency	Current ratio	$\frac{\text{current assets}}{\text{current liabilities}}$
	Debt Coverage Ratio	$\frac{\text{financial debt}}{\text{ebitda}}$
Profitability	Ebitda Margin	$\frac{\text{ebitda}}{\text{revenues}}$
	Return on Assets (ROA)	$\frac{\text{ebit}}{\text{net assets}}$
Intangibility	Intangible asset	$\frac{\text{intangible assets}}{\text{total assets}}$
Size	Capital invested	<i>Total assets</i>
	Turnover	<i>Operating revenues</i>

Source: Authors' elaboration.

**Table 8:** Variables for ownership structure

Firm characteristics	Variables	Specifications
Ownership structure	Equity Concentration	<i>Number of Shareholders</i>
	Type of First Shareholder	<ul style="list-style-type: none"> <li>- <i>Natural person or member of the entrepreneurial family</i></li> <li>- <i>Insurance</i></li> <li>- <i>Banks</i></li> <li>- <i>Pension or mutual funds</i></li> <li>- <i>Hedge funds</i></li> <li>- <i>Private capital funds (venture capital or private equity)</i></li> <li>- <i>Non-financial corporations</i></li> <li>- <i>Financial companies</i></li> <li>- <i>Others</i></li> </ul>
	Control of First Shareholder	<i>percentage of ownership of first shareholder/quotaholder</i>

Source: Authors' elaboration.

Among the indicators of capital structure composition, we included the ratio between equity capital and net worth. Since the latter includes reserves deriving from non-monetary revaluations and retained earnings, the incidence of the company equity reflects the ability of a firm to raise capital from external sources.

Excluding companies with missing data or incomplete information on the ownership structure, we obtained a sample of 1.289 innovative companies, both startups and SMEs. Our sample, therefore, contains all the young innovative Italian companies reported in the specific section of the Business Register, whose accounting data are complete and available in the AIDA database. It represents an adequate portion of the reference population (8.60%), but its composition is different from that of the entire population since the lack of some accounting data in AIDA, especially those of smaller and younger companies [Table 9 and Table 10]. Since this lack, any sampling technique would have led to a much smaller sample.

**Table 9:** Sample of innovative Italian companies – Age and innovation requirements

AGE (years)	INNOVATION REQUIREMENTS			Total	% of population
	1	2	3		
less than 3	45	7	2	54	0,84%
3	85	20	1	106	4,55%
4	95	31	3	129	6,57%
5	78	40	3	121	7,51%
6	26	64	7	97	13,53%
7	4	67	10	81	21,54%
8	2	71	7	80	26,32%
9	-	65	7	72	33,49%
10	-	40	10	50	34,25%
more than 10	2	426	71	499	57,55%
<b>Total</b>	<b>337</b>	<b>831</b>	<b>121</b>	<b>1.289</b>	<b>8,60%</b>
% of population	2,79%	33,60%	28,07%		8,60%

Source: Authors' elaboration.



**Table 10:** Sample of innovative Italian companies – Age and sectors

AGE (years)	SECTORS					Total	% of population
	SERVICES	INDUSTRY/H ANDICRAFT	COMMERCE	TOURISM	AGRICULTURE/FISHING		
less than 3	35	14	4	1	-	54	0,84%
3	67	30	7	2	-	106	4,55%
4	81	37	10	1	-	129	6,57%
5	83	28	9	1	-	121	7,51%
6	69	20	7	1	-	97	13,53%
7	53	20	7	1	-	81	21,54%
8	49	23	6	2	-	80	26,32%
9	46	20	6	-	-	72	33,49%
10	33	11	5	1	-	50	34,25%
more than 10	322	143	33	1	-	499	57,55%
<b>Total</b>	<b>838</b>	<b>346</b>	<b>94</b>	<b>11</b>	<b>-</b>	<b>1.289</b>	<b>8,60%</b>
% of population	7,16%	13,80%	16,73%	9,73%	0,00%	8,60%	

Source: Authors' elaboration.

The following tables provide the main statistics relating to the age, innovativeness, capital structure [Table 11], ownership features, and other firm-specific indicators [Table 12] of the firms included in the sample.

**Table 11:** Statistics of age, innovativeness, and capital structure of innovative firms in the sample

DESCRIPTIVE STATISTICS	AGE	INNOVATION REQUIREMENTS	FIN.DEBT on NET WORTH	NFP on NET WORTH	NET WORTH on TOT.ASSET	NET WORTH on TOT.DEBT	St DEBT on TOT.DEBT	BANK DEBT on REVENUES	EQUITY on NET WORTH
Mean	11,44	1,83	1,44	0,63	34,99	1,12	0,73	23,80	0,22
Standard error	0,28	0,02	0,15	0,11	0,62	0,05	0,01	0,67	0,01
Median	8,00	2,00	0,46	0,04	33,49	0,61	0,74	17,17	0,08
Most frequent value	4,00	2,00	0,00	n.a.	37,30	0,24	1,00	0,00	n.a.
Standard Deviation	9,91	0,57	5,29	4,03	22,29	1,82	0,22	24,20	0,48
Sample Variance	98,14	0,33	27,96	16,28	496,73	3,32	0,05	585,83	0,23
Curtois	9,15	-0,19	132,09	94,44	-0,06	57,62	-0,67	0,26	109,20
Asimmetry	2,35	0,01	9,78	7,80	0,21	5,87	-0,47	1,02	4,87
Range	95,00	2,00	121,06	85,23	139,86	28,41	0,93	99,35	14,26
Minimum	1,00	1,00	-26,78	-24,33	-43,35	-0,78	0,07	0,00	-5,97
Maximum	96,00	3,00	94,28	60,90	96,51	27,63	1,00	99,35	8,29
Count	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00
Confidence level of Mean (95%)	0,541	0,031	0,289	0,220	1,218	0,100	0,012	1,323	0,026

Source: Authors' elaboration.

**Table 12:** Statistics of solvency, profitability, intangibility, size, and ownership structure of innovative firms in the sample

DESCRIPTIVE STATISTICS	CURRENT ratio	FIN.DEBT/EBIT DA ratio	EBITDA on REVENUES (%)	RETURN ON ASSET (%)	INT.ASSET on TOT.ASSET	LN(Tot.Asset)	LN(Revenues)	N° of SH	TYPE of FSH (dummy)*	Control of FSH (dummy)**
Mean	2,04	3,01	5,23	3,64	0,17	15,02	14,72	11,33	0,54	0,58
Standard error	0,04	1,00	1,41	0,50	0,01	0,03	0,03	1,16	0,01	0,01
Median	1,55	1,06	10,18	3,95	0,12	14,86	14,51	3,00	1,00	1,00
Most frequent value	1,04	0,00	7,53	2,26	0,00	n.a.	n.a.	2,00	1,00	1,00
Standard Deviation	1,57	35,78	50,58	18,08	0,18	1,13	1,12	41,58	0,50	0,49
Sample Variance	2,48	1280,53	2557,97	326,97	0,03	1,28	1,26	1728,81	0,25	0,24
Curtosis	5,03	351,67	123,91	9,84	1,30	-0,14	0,56	126,24	-1,98	-1,88
Asimmetry	2,03	14,99	-9,45	-1,56	1,29	0,50	0,49	10,16	-0,15	-0,35
Range	9,65	1160,11	1095,29	233,03	0,89	6,92	8,85	684,00	1,00	1,00
Minimum	0,11	-335,98	-808,15	-152,98	0,00	12,17	9,62	0,00	0,00	0,00
Maximum	9,76	824,13	287,14	80,05	0,89	19,10	18,46	684,00	1,00	1,00
Count	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00	1289,00
Confidence level of Mean (95%)	0,086	1,955	2,764	0,988	0,010	0,062	0,061	2,272	0,027	0,027

Source: Authors' elaboration.

Preliminarily, grouping the sampled companies by age and innovativeness, the distribution of the average value and the standard deviation of the capital structure ratios was examined. Through a simple graphic analysis, the trends of these financial ratios were identified and studied, to evaluate their significance and degree of representativeness of the entire reference population. We then proceeded with the regression analysis.

It is a common approach for multi-country studies to perform analysis on both pooled data and data from individual countries (Antoniou et al., 2008; Fan et al., 2012). This methodology enables the researcher to determine the impacts of firm-specific factors by assessing the significance of country effects on corporate financing policies. In our research, we applied this approach by performing a two-stage analysis to find out the drivers that impacts on financing choices of Italian innovative firms.

In the first stage, data on the entire sample are considered, and regression analysis is performed with pooled data from all sectors to detect the effects of life cycle and innovativeness on corporate financing policies. Therefore, the leverage is regressed just over the age and innovation requirement as the independent variables and dummies for sectors represent just control variables, as specified below:

$$LEV_i = \beta_0 + \beta_1 \cdot AGE_i + \beta_2 \cdot IR_i + \beta_3 \cdot D_i + \varepsilon_i \quad [3.1]$$

where  $LEV_i$  is a measure of the level of debt of firm  $i$ ,  $AGE_i$  is the number of years from its incorporation,  $IR_i$  is the number of innovative requirements a firm has,  $D_i$  is a vector of sector dummies,  $\varepsilon_i$  is the error term. Subsequently, the regression analysis was carried out by adding, consistent with the ToT, financial ratios and ownership variables:

$$LEV_i = \beta_0 + \beta_1 \cdot AGE_i + \beta_2 \cdot IR_i + \beta_3 \cdot AR_i + \beta_4 \cdot OS_i + \varepsilon_i \quad [3.2]$$

where  $AR_i$  is a vector of firm-specific variables related to solvency, profitability, intangibility, and size,  $OS_i$  is a vector of firm-specific variables related to the ownership features. All these variables have been already defined and specified above. In this stage, the analysis has been carried out on both pooled data of the entire sample and data of sub-samples composed of firms of individual sectors. It is necessary also to specify that to perform the regression analysis:

- the natural logarithm of the dimensional indicators (total assets, total revenues) was used;
- variables relating to the ownership structure have been transformed into dummy variables as follows [Table 13].

**Table 13:** Dummies for ownership structure information

Firm characteristics	Variables	Dummy
Ownership structure	Type of First Shareholder (dummy)	<i>1 if the first shareholder (with the highest percentage of ownership) is a natural person or a member of the entrepreneurial family; 0 if the first shareholder is of another type (financial, company, trust, fund, etc.)</i>
	Control of First Shareholder (dummy)	<i>1 if the first shareholder is the controlling shareholder (percentage of ownership &gt; 50,1%; 0 if the first shareholder is not the controlling shareholder (percentage of ownership more &lt; 50,1%)</i>

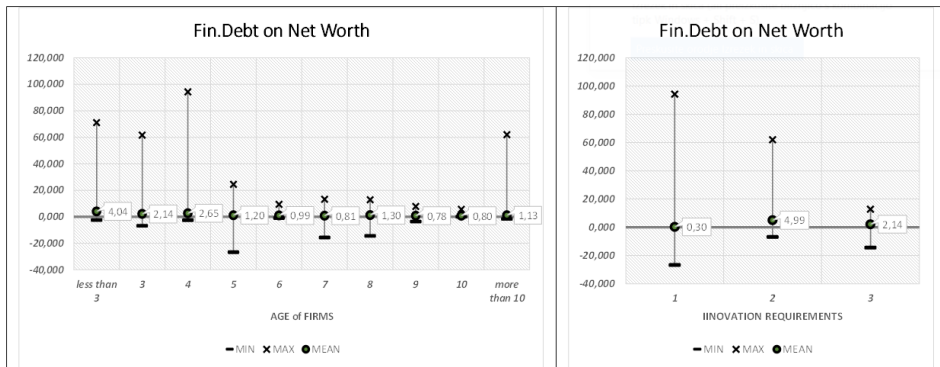
Source: Authors' elaboration.

## 4 Discussion

By observing the mean values of the capital structure ratios by age and innovativeness groups, it can be seen that level and composition of debt vary along with the life cycle and the degree of innovation. However, the variations in the capital structure among the groups show different dynamics depending on the observed financial ratio.

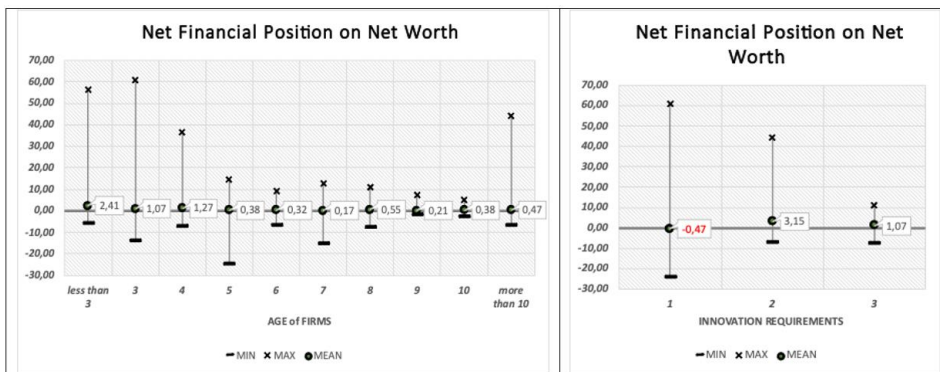
The ratio between financial debt and net worth decreases with the age of the companies: the average value of this financial ratio goes from 4.04 for firms with less than 3 years, to 0.8 for firms with more than 9 years. Not considering outliers, a clear deleveraging trend could be observed.

The same indicator seems sensitive to the degree of innovation, although a clear and univocal trend is not observable. In fact, its average value first increases from 0.3 to 4.99 and then decreases to 2.14 [Figure 1].

**Figure 1:** Financial leverage by age and innovation requirement of firms

Source: Authors' elaboration.

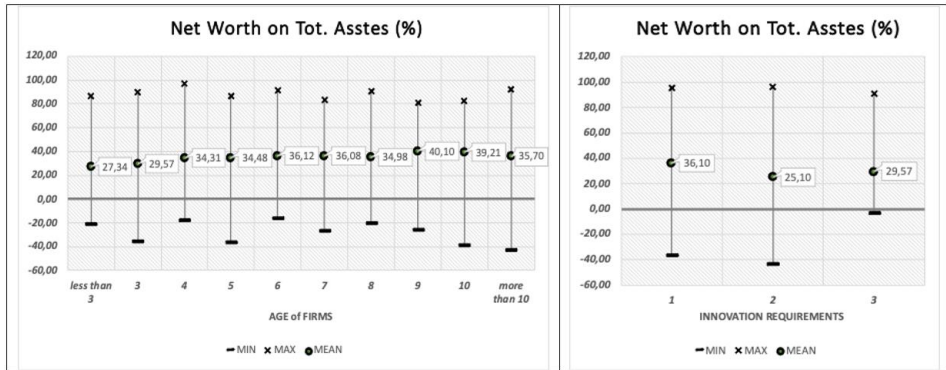
As expected, similar evidence arises from observing the dynamics of the net financial position on net worth [Figure 2].

**Figure 2:** Net financial leverage by age and innovation requirement of firms

Source: Authors' elaboration.

The firms' financial independence, measured as net worth over total assets, shows, on average, values that tend to increase with the age of the sampled companies. So, it appears to follow an evolution consistent with that of financial leverage [Figure 3].

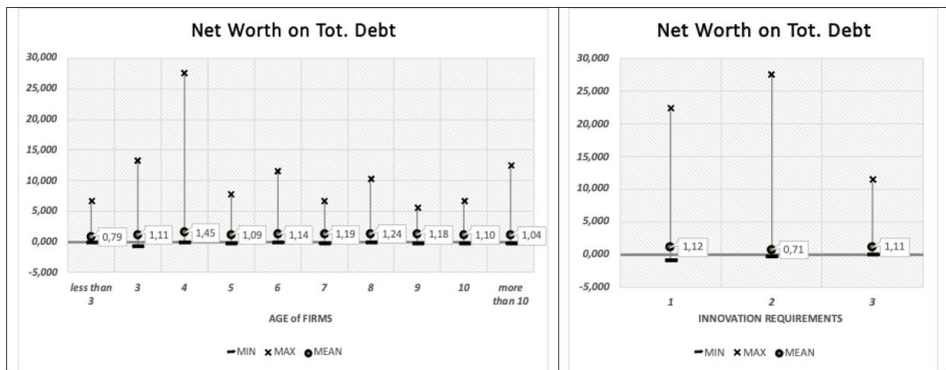
**Figure 3: Financial independence by age and innovation requirement of firms**



Source: Authors' elaboration.

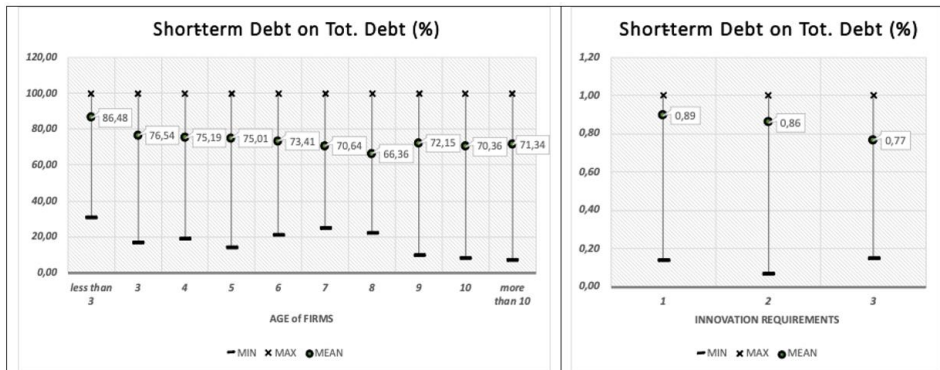
Considering its trade payables and fiscal debt as well as its financial exposure, it is not possible to identify clear relationships between capital structure, age, and degree of innovation for the sampled firms. The ratio of net worth to total debt initially increases and then decreases, showing relevant swings [Figure 4].

**Figure 4: Financial strength by age and innovation requirement of firms**



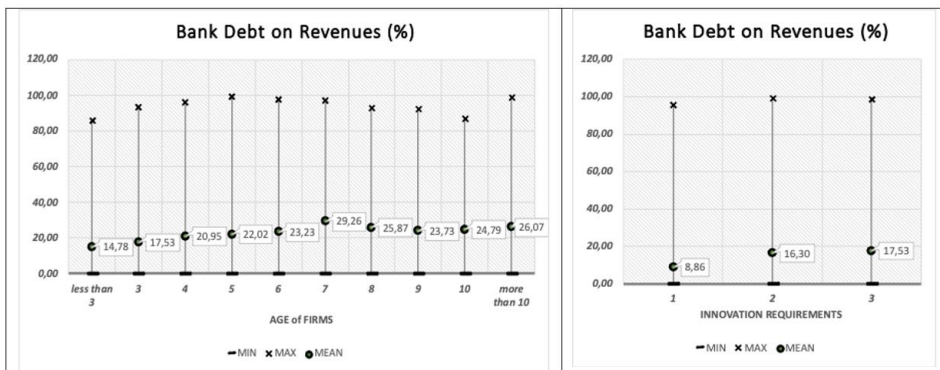
Source: Authors' elaboration.

Average values and ranges of the ratio of short-term debt to total debt clearly show that sampled firms tend to consolidate their debt exposure during their life cycle. It seems that this consolidation trend is also due to, or linked to, the degree of innovation [Figure 5].

**Figure 5: Short-term debt relevance by age and innovation requirement of firms**

Source: Authors' elaboration.

Observing the exposure to the banking system, it emerges that bank loans increase with the age and the innovation requirements of the sampled companies [Figure 6]. This evidence is consistent with the financial literature. Indeed, the observed trend is probably due to the fact that, during the life cycle, firms increase information disclosure allowing banks to better understand their asset quality, competitive positioning, and corporate profitability.

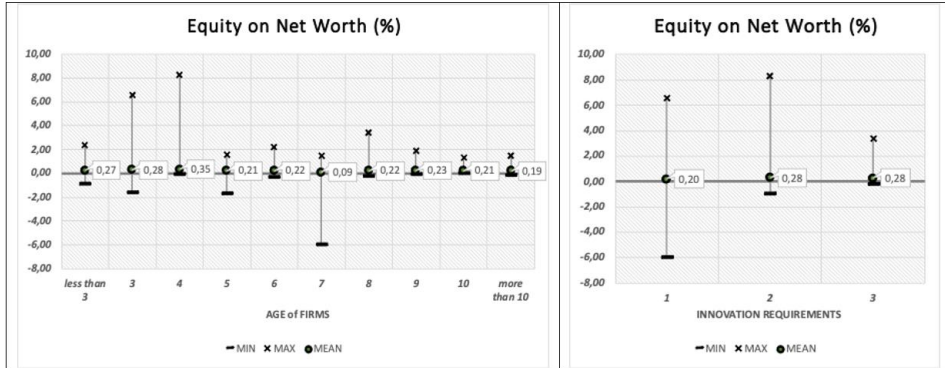
**Figure 6: Bank loans relevance by age and innovation requirement of firms**

Source: Authors' elaboration.

The incidence of equity on net worth does not show any evidence that could suggest a link between the ability to attract capital, life cycle, and degree of innovation [Figure 7]. It is necessary to consider that the consolidation of the competitive position and profitability of innovative companies during their life cycle, by increasing their self-

financing capacity, could not make evident, through the sample averages, any capital increase subscribed by external investors.

**Figure 7: Equity capital relevance by age and innovation requirement of firms**



Source: Authors' elaboration.

Since the variance of previous accounting ratios is high in all classes of age or innovation requirements, the observed means and trends require further analysis to be correctly and carefully interpreted. In fact, the high variability and wide variation ranges of some ratios leave doubts about the effective ability of sampled innovative companies to increase their financial independence strengthening their "equity shoulders" and reducing their short-term exposure during the life cycle. This makes it difficult to draw general conclusions about the financial behavior of young Italian innovative firms. Unfortunately, as we have already clarified, the AIDA database does not contain the financial statements of 75% of the companies reported in the Business Register; therefore, it doesn't allow us to carry out a complete analysis of the entire reference population.

To overcome this problem and verify the significance of the previous empirical evidence, we performed a statistic test using the *Student's t-distribution* (*t*-test) to estimate the margin of error of mean financial ratios. Assuming a confidence level of 99%, we observed that the margins of error of net worth/total assets, short-term debt/total debt, and bank loans/revenues allow us to consider the average values and trends of these ratios representative of the entire population [Table 14].

**Table 14:** Margins of error

SUB_SAMPLE	CAPITAL STRUCTURE RATIOS	FIN.DEBT on NET WORTH	NFP on NET WORTH	NET WORTH on TOT.ASSET	NET WORTH on TOT.DEBT	St DEBT on TOT.DEBT	BANK DEBT on REVENUES	EQUITY on NET WORTH
Age	mean	4,036	2,413	27,340	0,791	0,865	14,784	0,266
Less than 3y	std.dev.	12,37	10,45	23,56	1,38	0,17	22,92	0,43
N. of firms	Margin of error*	4,497	3,801	8,566	0,501	0,061	8,332	0,158
54	margin of error on mean (%)	111,41%	157,52%	31,33%	63,43%	7,08%	56,36%	59,38%
Age	mean	2,139	1,072	29,565	1,113	0,765	17,530	0,277
3 years	std.dev.	7,66	6,94	26,99	2,12	0,25	22,20	0,77
N. of firms	Margin of error*	1,953	1,768	6,876	0,540	0,063	5,658	0,196
106	margin of error on mean (%)	91,28%	164,85%	23,26%	48,50%	8,22%	32,28%	70,56%
Age	mean	2,646	1,268	34,309	1,452	0,752	20,953	0,347
4 years	std.dev.	9,54	5,16	24,60	3,60	0,22	24,08	0,81
N. of firms	Margin of error*	2,197	1,188	5,663	0,828	0,050	5,545	0,187
129	margin of error on mean (%)	83,02%	93,68%	16,51%	57,05%	6,61%	26,46%	54,05%
Age	mean	1,198	0,376	34,484	1,093	0,750	22,021	0,213
5 years	std.dev.	4,14	3,42	25,20	1,51	0,23	25,61	0,35
N. of firms	Margin of error*	0,984	0,813	5,996	0,359	0,054	6,093	0,083
121	margin of error on mean (%)	82,13%	216,40%	17,39%	32,84%	7,26%	27,67%	38,76%
Age	mean	0,986	0,321	36,118	1,140	0,734	23,229	0,219
6 years	std.dev.	1,64	1,93	22,58	1,67	0,22	25,08	0,40
N. of firms	Margin of error*	0,438	0,516	6,025	0,445	0,059	6,693	0,106
97	margin of error on mean (%)	44,40%	160,64%	16,68%	39,03%	8,07%	28,81%	48,53%
Age	mean	0,808	0,172	36,084	1,194	0,706	29,258	0,093
7 years	std.dev.	2,96	2,72	24,83	1,53	0,22	27,93	0,74
N. of firms	Margin of error*	0,866	0,797	7,281	0,447	0,064	8,190	0,218
81	margin of error on mean (%)	107,23%	463,39%	20,18%	37,45%	9,07%	27,99%	235,03%
Age	mean	1,305	0,552	34,978	1,244	0,664	25,866	0,216
8 years	std.dev.	3,09	2,13	23,83	1,97	0,22	24,36	0,46
N. of firms	Margin of error*	0,913	0,630	7,031	0,582	0,066	7,187	0,136
80	margin of error on mean (%)	69,99%	114,10%	20,10%	46,75%	9,93%	27,79%	63,05%
Age	mean	0,780	0,207	40,102	1,180	0,722	23,725	0,228
9 years	std.dev.	1,40	1,34	21,82	1,15	0,22	23,44	0,38
N. of firms	Margin of error*	0,438	0,417	6,807	0,360	0,068	7,313	0,119
72	margin of error on mean (%)	56,09%	201,32%	16,97%	30,50%	9,47%	30,82%	52,05%
Age	mean	0,795	0,381	39,207	1,095	0,704	24,794	0,209
10 years	std.dev.	1,16	1,04	20,97	1,20	0,23	24,61	0,35
N. of firms	Margin of error*	0,441	0,396	7,947	0,456	0,089	9,329	0,132
50	margin of error on mean (%)	55,39%	103,85%	20,27%	41,61%	12,59%	37,63%	62,82%
Age	mean	1,131	0,472	35,705	1,038	0,713	26,072	0,195
more than 10y	std.dev.	3,28	2,66	18,59	1,29	0,22	23,21	0,25
N. of firms	Margin of error*	0,379	0,307	2,152	0,149	0,025	2,686	0,029
499	margin of error on mean (%)	33,54%	65,13%	6,03%	14,39%	3,52%	10,30%	14,73%

\*Confidence level 99%

Source: Authors' elaboration.

Limits of the previous outcomes require completing the analysis by applying the regression models.

The following correlation matrix shows modest levels of correlation between the capital structure ratios, age, and innovativeness of the companies in the sample [Table 15a]. It is noted that the age of the examined companies has low levels of correlation with all the financial ratios, except for the incidence of bank loans. On the contrary, the degree of innovation has more relevant correlations with almost all capital structure ratios. The same matrix also shows the degree of correlation between the capital structure indices and firm-specific variables representing the solvency, profitability, intangibility, size, and ownership structure of the sampled companies. Financial structure indices have relevant correlations only with the current ratio, intangibility, and size when measured in terms of



total assets. The relationships between capital structure and other accounting ratios are controversial and unclear. As we expected, the number of shareholders has a significant positive correlation with the level of financial independence, while other aspects of the ownership structure do not seem to be significantly influencing the financing policies of sampled firms.

**Table 15a:** Correlation matrix

	FIN.DEBT on NET WORTH	NFP on NET WORTH	NET WORTH on TOT.ASSET	NET WORTH on TOT.DEBT	St DEBT on TOT.DEBT	BANK DEBT on REVENUES	EQUITY on NET WORTH
FIN.DEBT on NET WORTH	100,00%						
NFP on NET WORTH	88,17%	100,00%					
NET WORTH on TOT.ASSET	-26,37%	-24,13%	100,00%				
NET WORTH on TOT.DEBT	-13,39%	-12,42%	71,66%	100,00%			
St DEBT on TOT.DEBT	-6,46%	-10,86%	17,17%	22,10%	100,00%		
BANK DEBT on REVENUES	15,34%	23,53%	-23,40%	24,35%	59,82%	100,00%	
EQUITY on NET WORTH	26,60%	31,46%	-14,41%	-8,39%	-7,53%	11,17%	100,00%
AGE	-6,14%	-4,01%	4,83%	-0,92%	-7,36%	10,93%	-3,49%
INNOVATION REQUIREMENTS	10,66%	-8,05%	13,02%	3,95%	14,29%	11,53%	-2,96%
CURRENT ratio	-12,90%	-15,28%	57,88%	63,26%	-12,36%	-17,78%	-13,62%
FIN.DEBT/EBITDA ratio	3,72%	-0,08%	-1,86%	-2,47%	-2,49%	4,67%	-1,38%
EBITDA on REVENUES (%)	1,09%	1,98%	-3,18%	11,52%	1,18%	-1,74%	-0,95%
RETURN ON ASSET (%)	-1,16%	-1,69%	16,76%	3,43%	13,96%	17,69%	-2,56%
INT.ASSET on TOT.ASSET	-5,16%	0,71%	8,69%	11,95%	-15,55%	23,19%	5,16%
LN(Tot.Asset)	0,19%	2,91%	12,39%	8,58%	17,06%	24,53%	-2,17%
LN(Revenues)	0,58%	1,59%	-3,99%	-8,41%	-3,89%	-1,20%	-2,90%
N° of SH	-2,10%	-1,92%	12,00%	10,87%	-1,82%	0,96%	-1,91%
TYPE of FSH (dummy)	5,95%	6,14%	-5,95%	-7,02%	0,97%	1,92%	-9,61%
Control of FSH (dummy)	-4,48%	-3,54%	-6,29%	0,51%	5,81%	-5,08%	3,99%

Source: Authors' elaboration.

A second correlation matrix shows that the analysis is not affected by regressor collinearity problems [Table 15b].

**Table 15b:** Correlation matrix – multi-collinearity

	AGE	INNOVATION REQUIREMENTS	CURRENT ratio	FIN.DEBT/EBITDA ratio	EBITDA on REVENUES (%)	RETURN ON ASSET (%)	INT.ASSET on TOT.ASSET	LN (Tot.Asset)	LN (Revenues)	N° of SH	TYPE of FSH (dummy)	Control of FSH (dummy)
AGE	100,00%											
INNOVATION REQUIREMENTS	40,03%	100,00%										
CURRENT ratio	3,35%	13,03%	100,00%									
FIN.DEBT/EBITDA ratio	2,49%	2,66%	-2,63%	100,00%								
EBITDA on REVENUES (%)	10,58%	-0,90%	-1,72%	0,67%	100,00%							
RETURN ON ASSET (%)	8,19%	-2,45%	13,01%	-0,05%	49,12%	100,00%						
INT.ASSET on TOT.ASSET	12,62%	4,96%	17,26%	2,37%	13,40%	30,36%	100,00%					
LN(Tot. Asset)	39,16%	32,35%	-1,20%	-1,27%	-5,44%	9,42%	8,61%	100,00%				
LN(Revenues)	37,22%	23,39%	-9,32%	-2,96%	16,50%	8,94%	15,99%	77,06%	100,00%			
N° of SH	-5,95%	-1,82%	1,13%	-1,10%	-8,45%	22,07%	15,38%	2,87%	1,14%	100,00%		
TYPE of FSH (dummy)	4,87%	-4,63%	-2,28%	5,60%	9,63%	13,08%	10,66%	21,47%	13,12%	-1,07%	100,00%	
Control of FSH (dummy)	2,28%	0,10%	-1,53%	-0,86%	4,00%	11,78%	-2,38%	-2,68%	-1,86%	16,99%	18,56%	100,00%

Source: Authors' elaboration.

We then tested the theoretical explanatory models of the financial behavior of the sampled innovative firms through OLS regressions. First, we applied 3.1 to verify whether life cycle and innovativeness significantly influence financial structure choices. We used dummy variables to test the significance of the model and control for sectors in which the companies operate [Table 16]. The degree of innovation has negative and significant coefficients when the financial structure is expressed by financial leverage or by net financial leverage, while it has a positive and significant coefficient when considering financial independence. Sector belonging seems to explain the choices of capital structure just if we focus on the net financial leverage and the financial independence level.

**Table 16:** Regression statistics for capital structure choices

ENTIRE SAMPLE				FIRM-SPECIFIC VARIABLE											
REGRESSION STATISTICS				FINANCIAL DEBT on EQUITY				NET FINANCIAL POSITION on EQUITY				NET WORTH on TOTAL ASSET			
R multiple				13,81%				16,35%				19,06%			
R2				1,91%				2,67%				3,63%			
R2 adjusted				1,45%				2,22%				3,18%			
Standard Error				524,72%				398,78%				2192,13%			
Observations				1.289				1.289				1.289			
VARIANCE ANALYSES				df	SS	MS		df	SS	MS		df	SS	MS	
Regression				6,0	686	114,4		6,0	560	93,4		6,0	23.245	3.874,2	
Residual				1.283,0	35.325	27,5		1.283,0	20.403	15,9		1.283,0	616.539	480,5	
Total				1.289,0	36.011			1.289,0	20.963			1.289,0	639.784		
F - Test				4,985	***			7,046	***			9,674	***		
VARIABLES ANALYSES				Coeff.	P-values	Std. Er.		Coeff.	P-values	Std. Er.		Coeff.	P-values	Std. Er.	
Intercept				3,121	***	0,724		1,661	***	0,550		26,185	***	0,803	
AGE				- 0,019	n.s.	0,016		- 0,012	n.s.	0,012		0,025	n.s.	0,004	
INNOVATION REQUIREMENTS				- 0,844	***	0,280		- 0,469	**	0,212		4,793	***	0,089	
COMMERCE				-	n.a.	-		-	n.a.	-		-	n.a.	0,039	
SERVICES				- 0,215	n.a.	0,571		- 0,413	n.a.	0,434		1,739	n.a.	0,002	
INDUSTRY				0,827	n.s.	0,613		0,909	*	0,466		4,717	*	0,001	
TOURISM				- 0,139	n.s.	1,673		- 0,489	n.s.	1,272		- 14,720	**	0,005	

Significance level: \*  $p < 0,1$ ; \*\*  $p < 0,5$ ; \*\*\*  $p < 0,01$ 

Source: Authors' elaboration.

The regression analysis confirms that the innovativeness degree pushes the consolidation of the debt exposure, and positively affects the possibility of accessing bank credit. It is also confirmed that the business life cycle does not influence the choices of financing forms [Table 17].

**Table 17:** Regression statistics for capital structure composition

ENTIRE SAMPLE				FIRM-SPECIFIC VARIABLE								
REGRESSION STATISTICS				SHORT-TERM DEBT on TOTAL DEBT			BANK DEBT on REVENUES			EQUITY on NET WORTH		
R multiple				20,48%			25,56%			6,89%		
R2				4,19%			6,53%			0,47%		
R2 adjusted				3,74%			6,09%			0,01%		
Standard Error				21,84%			2344,53%			48,14%		
Observations				1.289			1.289			1.289		
VARIANCE ANALYSES				df	SS	MS	df	SS	MS	df	SS	MS
Regression				6,0	3	0,4	6,0	49.306	8.217,6	6,0	1	0,2
Residual				1.283,0	61	0,0	1.283,0	705.240	549,7	1.283,0	297	0,2
Total				1.289,0	64		1.289,0	754.545		1.289,0	299	
F - Test				11,234	***		17,940	***		1,223	n.s.	
VARIABLES ANALYSES				Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.
Intercept				0,816	***	0,030	12,243	***	3,233	0,214	***	0,066
AGE				- 0,000	n.s.	0,001	0,117	n.s.	0,073	- 0,002	n.s.	0,001
INNOVATION REQUIREMENTS				- 0,056	***	0,012	4,254	***	1,249	- 0,012	n.s.	0,026
COMMERCE				-	n.a.	-	-	n.a.	-	-	n.a.	-
SERVICES				0,039	n.a.	0,024	- 0,892	n.a.	2,551	0,041	n.a.	0,052
INDUSTRY				- 0,028	n.s.	0,026	10,532	***	2,738	0,088	n.s.	0,056
TOURISM				- 0,130	*	0,070	20,695	***	7,477	- 0,082	n.s.	0,154

Significance level: \*  $p < 0,1$ ; \*\*  $p < 0,5$ ; \*\*\*  $p < 0,01$ 

Source: Authors' elaboration.

The model we used has a low explanatory capacity even though it is statistically significant for all the capital structure ratios. The reported R<sup>2</sup>s are very low (always below 4%, except for bank loans on revenues ratio), which indicates poor specification of the model applied in the first step of regression analysis. To overcome this problem, we improved the model 3.1 by including selected financial variables to control for solvency, intangibility, profitability, size, and ownership characteristics of the sampled firms. Then, we applied the regression model 3.2 to control for firm-specific variables other than life cycle and innovativeness and to verify whether they might significantly influence financial structure choices. We didn't use dummy variables to control for sectors because we applied the regression model 3.2 to sub-samples representing the sectors in which observed firms operate.

Considering the financial leverage [Table 18] or the net financial leverage [Table 19] as independent variables, regression analysis indicates that theoretical models are poorly

explanatory of financial structure choices. Only for the "Commerce" sub-sample, the model shows a satisfying explanatory capacity. The life cycle is never a significant variable in the regression model; the innovativeness degree negatively affects the financial exposure having a negative coefficient for all samples, statistically significant for almost all sub-samples. Among the control variables, the current ratio always presents a negative and statistically significant coefficient, while the relevance and influences of intangibility and size are uncertain.

**Table 18:** Regression statistics for financial leverage

INDEPENDENT VARIABLE	FINANCIAL DEBT ON NET WORTH											
REGRESSION STATISTICS	SAMPLE INNOVATIVE FIRMS			SUB-SAMPLE "SERVICES"			SUB-SAMPLE "INDUSTRY"			SUB-SAMPLE "COMMERCE"		
R multiple	20,45%			17,78%			25,70%			52,26%		
R2	4,18%			3,16%			6,60%			27,31%		
R2 adjusted	3,28%			1,75%			3,24%			16,54%		
Standard Error	520,02%			506,06%			602,13%			300,37%		
Observations	1.289			838			346			94		
VARIANCE ANALYSES	df	SS	MS	df	SS	MS	df	SS	MS	df	SS	MS
Regression	12,0	1.506,2	125,5	12,0	690,1	57,5	12,0	853,8	71,2	12,0	274,6	22,9
Residual	1.276,0	34.505,2	27,0	825,0	21.128,2	25,6	333,0	12.073,4	36,3	81,0	730,8	9,0
Total	1.288,0	36.011,4		837,0	21.818,2		345,0	12.927,2		93,0	1.005,4	
F - Test	4,642	***		2,245	**		1,963	*		2,536	**	
VARIABLES ANALYSES	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.
Intercept	0,622	n.s.	2,341	0,853	n.s.	2,880	5,063	n.s.	5,543	5,186	n.s.	4,597
AGE	0,034	*	0,017	0,026	n.s.	0,025	0,039	n.s.	0,030	0,029	n.s.	0,041
INNOVATION REQUIREMENTS	0,759	**	0,287	0,428	n.s.	0,356	1,467	*	0,614	1,231	n.s.	0,796
CURRENT ratio	0,446	***	0,098	0,362	***	0,112	0,593	*	0,266	0,482	n.s.	0,342
FIN.DEBT/EBITDA ratio	0,005	n.s.	0,004	0,005	n.s.	0,004	0,008	n.s.	0,016	0,240	***	0,063
EBITDA on REVENUES (%)	0,003	n.s.	0,003	0,003	n.s.	0,004	0,003	n.s.	0,009	0,057	n.s.	0,037
RETURN ON ASSET (%)	0,006	n.s.	0,010	0,007	n.s.	0,011	0,021	n.s.	0,032	0,025	n.s.	0,030
INT.ASSET on TOT.ASSET	2,797	***	0,918	2,682	*	1,086	3,127	n.s.	2,367	1,204	n.s.	2,186
LN(Tot.Asset)	0,585	*	0,235	0,680	*	0,278	0,298	n.s.	0,653	0,528	n.s.	0,512
LN(Revenues)	0,329	n.s.	0,234	0,390	n.s.	0,278	0,202	n.s.	0,664	0,538	n.s.	0,491
N° of SH	0,003	n.s.	0,004	0,005	n.s.	0,007	0,002	n.s.	0,011	0,002	n.s.	0,003
TYPE of FSH (dummy)	0,579	n.s.	0,311	0,541	n.s.	0,377	0,540	n.s.	0,726	0,822	n.s.	0,684
Control of FSH (dummy)	0,397	n.s.	0,307	0,505	n.s.	0,375	0,191	n.s.	0,680	1,533	*	0,730

P-Value: n.s. >5%; \* <5%; \*\* <1%; \*\*\* <0,5%

Source: Authors' elaboration.

**Table 19:** Regression statistics for net financial leverage

INDEPENDENT VARIABLE	NET FINANCIAL POSITION on NET WORTH											
REGRESSION STATISTICS	SAMPLE INNOVATIVE FIRMS			SUB-SAMPLE "SERVICES"			SUB-SAMPLE "INDUSTRY"			SUB-SAMPLE "COMMERCE"		
R multiple	19,90%			17,97%			24,46%			56,92%		
R <sup>2</sup>	3,96%			3,23%			5,98%			32,40%		
R <sup>2</sup> adjusted	3,06%			1,82%			2,59%			22,38%		
Standard Error	397,22%			318,80%			555,54%			280,58%		
Observations	1.289			838			346			94		
VARIANCE ANALYSES	df	SS	MS	df	SS	MS	df	SS	MS	df	SS	MS
Regression	12,0	830,4	69,2	12,0	279,9	23,3	12,0	653,8	54,5	12,0	305,6	25,5
Residual	1.276,0	20.133,0	15,8	825,0	8.384,6	10,2	333,0	10.277,1	30,9	81,0	637,7	7,9
Total	1.288,0	20.963,4		837,0	8.664,6		345,0	10.931,0		93,0	943,2	
F - Test	4,386	***		2,295	**		1,765	n.s.		3,235	***	
VARIABLES ANALYSES	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.
Intercept	- 1,146	n.s.	1,788	- 2,849	n.s.	1,814	4,486	n.s.	5,114	5,121	n.s.	4,294
AGE	- 0,019	n.s.	0,013	- 0,006	n.s.	0,016	- 0,031	n.s.	0,028	- 0,019	n.s.	0,038
INNOVATION REQUIREMENTS	- 0,465	*	0,219	- 0,044	n.s.	0,224	- 1,234	*	0,567	- 1,806	*	0,744
CURRENT ratio	- 0,387	***	0,075	- 0,244	***	0,071	- 0,605	*	0,246	- 0,411	n.s.	0,320
FIN. DEBT/EBITDA ratio	- 0,001	n.s.	0,003	- 0,001	n.s.	0,003	- 0,005	n.s.	0,015	- 0,265	***	0,059
EBITDA on REVENUES (%)	0,003	n.s.	0,003	0,002	n.s.	0,002	0,004	n.s.	0,009	0,056	n.s.	0,034
RETURN ON ASSET (%)	- 0,003	n.s.	0,008	- 0,002	n.s.	0,007	- 0,017	n.s.	0,029	- 0,025	n.s.	0,028
INT.ASSET on TOT.ASSET	- 0,810	n.s.	0,701	0,019	n.s.	0,684	- 1,930	n.s.	2,184	- 0,998	n.s.	2,042
LN(Tot.Asset)	0,532	***	0,180	0,491	**	0,175	0,417	n.s.	0,603	- 0,145	n.s.	0,478
LN(Revenues)	- 0,295	n.s.	0,179	- 0,244	n.s.	0,175	- 0,364	n.s.	0,612	0,172	n.s.	0,459
N° of SH	- 0,002	n.s.	0,003	- 0,004	n.s.	0,004	- 0,004	n.s.	0,010	- 0,001	n.s.	0,003
TYPE of FSH (dummy)	0,550	*	0,237	0,450	n.s.	0,238	0,441	n.s.	0,670	- 1,105	n.s.	0,639
Control of FSH (dummy)	- 0,214	n.s.	0,234	- 0,239	n.s.	0,236	- 0,270	n.s.	0,627	- 1,476	*	0,682

P-Value: n.s. &gt;5%; \* &lt;5%; \*\* &lt;1%; \*\*\* &lt;0,5%

Source: Authors' elaboration.

The financial independence (net worth on total assets) of the sampled firms is not influenced by age and innovativeness, while it is positively and significantly influenced by the current ratio, operating profitability, company size (when measured in terms of assets), and the number of shareholders [Table 20]. The regression analysis highlights that the growth in turnover as well as in operating margin has a reductive effect on the degree of financial independence.

**Table 20:** Regression statistics for financial independence

INDEPENDENT VARIABLE	NET WORTH on TOTAL ASSET											
	SAMPLE INNOVATIVE FIRMS			SUB-SAMPLE "SERVICES"			SUB-SAMPLE "INDUSTRY"			SUB-SAMPLE "COMMERCE"		
REGRESSION STATISTICS												
R multiple	66,70%			66,41%			73,30%			68,18%		
R <sup>2</sup>	44,48%			44,11%			53,73%			46,49%		
R <sup>2</sup> adjusted	43,96%			43,29%			52,07%			38,56%		
Standard Error	1668,39%			1681,90%			1484,32%			1717,66%		
Observations	1.289			838			346			94		
VARIANCE ANALYSES	df	SS	MS	df	SS	MS	df	SS	MS	df	SS	MS
Regression	12,0	284.606	23.717,2	12,0	184.153	15.346,1	12,0	85.211	7.100,9	12,0	20.764	1.730,3
Residual	1.276,0	355.178	278,4	825,0	233.375	282,9	333,0	73.367	220,3	81,0	23.898	295,0
Total	1.288,0	639.784		837,0	417.528		345,0	158.577		93,0	44.662	
F - Test	85,206	***		54,250	***		32,230	***		5,865	***	
VARIABLES ANALYSES	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.
Intercept	- 7,586	n.s.	7,509	7,023	n.s.	9,570	- 43,674	***	13,663	- 0,067	n.s.	26,289
AGE	0,027	n.s.	0,056	- 0,133	n.s.	0,085	0,109	n.s.	0,075	0,130	n.s.	0,232
INNOVATION REQUIREMENTS	0,416	n.s.	0,919	- 0,444	n.s.	1,183	3,448	*	1,515	1,293	n.s.	4,553
CURRENT ratio	7,864	***	0,315	7,606	***	0,373	9,059	***	0,656	3,682	n.s.	1,958
FIN.DEBT/EBITDA ratio	- 0,005	n.s.	0,013	- 0,004	n.s.	0,014	- 0,021	n.s.	0,040	- 0,505	n.s.	0,362
EBITDA on REVENUES (%)	- 0,030	**	0,011	- 0,035	**	0,012	- 0,010	n.s.	0,023	0,257	n.s.	0,209
RETURN ON ASSET (%)	0,322	***	0,032	0,311	***	0,038	0,435	***	0,078	0,132	n.s.	0,170
INT.ASSET on TOT.ASSET	21,811	***	2,945	20,529	***	3,608	29,401	***	5,835	7,712	n.s.	12,499
LN(Tot.Asset)	5,079	***	0,755	4,902	***	0,924	5,375	***	1,610	10,654	***	2,926
LN(Revenues)	- 3,668	***	0,751	- 4,254	***	0,923	- 2,312	n.s.	1,636	- 8,854	***	2,809
N° of SH	0,066	***	0,012	0,067	***	0,022	0,051	n.s.	0,026	0,077	***	0,020
TYPE of FSH (dummy)	- 1,516	n.s.	0,997	- 0,801	n.s.	1,254	- 1,037	n.s.	1,791	- 4,145	n.s.	3,910
Control of FSH (dummy)	- 2,738	**	0,985	- 2,396	n.s.	1,247	- 2,004	n.s.	1,676	- 4,745	n.s.	4,174

P-Value: n.s. &gt;5%; \* &lt;5%; \*\* &lt;1%; \*\*\* &lt;0,5%

Source: Authors' elaboration.

The financial strength (net worth on total debt) of the sampled firms is sensitive to the same firm-specific variables that influence corporate financial independence already considered and discussed above [Table 21].

**Table 21:** Regression statistics for financial independence

INDEPENDENT VARIABLE	NET WORTH on TOTAL DEBT											
	SAMPLE INNOVATIVE FIRMS			SUB-SAMPLE "SERVICES"			SUB-SAMPLE "INDUSTRY"			SUB-SAMPLE "COMMERCE"		
REGRESSION STATISTICS												
R multiple	66,70%			70,55%			75,26%			79,00%		
R2	44,48%			49,77%			56,64%			62,40%		
R2 adjusted	43,96%			49,04%			55,08%			56,83%		
Standard Error	1668,39%			144,26%			87,22%			101,87%		
Observations	1.289			838			346			94		
VARIANCE ANALYSES	df	SS	MS	df	SS	MS	df	SS	MS	df	SS	MS
Regression	12,0	2.082	173,5	12,0	1.701	141,8	12,0	331	27,6	12,0	140	11,6
Residual	1.276,0	2.200	1,7	825,0	1.717	2,1	333,0	253	0,8	81,0	84	1,0
Total	1.288,0	4.282		837,0	3.418		345,0	584		93,0	224	
F - Test	100,663 ***			68,125 ***			36,247 ***			11,204 ***		
VARIABLES ANALYSES	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.	Coeff.	P-values	Std. Er.
Intercept	- 2,294	***	0,591	- 2,278	**	0,821	- 2,288	***	0,803	- 0,568	n.s.	1,559
AGE	0,001	n.s.	0,004	- 0,011	n.s.	0,007	0,002	n.s.	0,004	0,040	***	0,014
INNOVATION REQUIREMENTS	- 0,290	***	0,072	- 0,376	***	0,101	- 0,010	n.s.	0,089	- 0,129	n.s.	0,270
CURRENT ratio	0,761	***	0,025	0,809	***	0,032	0,700	***	0,039	0,272	*	0,116
FIN.DEBT/EBITDA ratio	- 0,000	n.s.	0,001	- 0,001	n.s.	0,001	0,000	n.s.	0,002	- 0,037	n.s.	0,021
EBITDA on REVENUES (%)	- 0,003	***	0,001	- 0,004	***	0,001	0,001	n.s.	0,001	0,012	n.s.	0,012
RETURN ON ASSET (%)	0,010	***	0,003	0,010	***	0,003	0,005	n.s.	0,005	0,014	n.s.	0,010
INT.ASSET on TOT.ASSET	2,081	***	0,232	2,654	***	0,309	0,982	***	0,343	0,959	n.s.	0,741
LN(Tot.Asset)	0,308	***	0,059	0,342	***	0,079	0,246	**	0,095	0,209	n.s.	0,174
LN(Revenues)	- 0,185	***	0,059	- 0,220	**	0,079	- 0,124	n.s.	0,096	- 0,155	n.s.	0,167
N° of SH	0,004	***	0,001	- 0,001	n.s.	0,002	0,000	n.s.	0,002	0,008	***	0,001
TYPE of FSH (dummy)	- 0,033	n.s.	0,078	- 0,008	n.s.	0,108	- 0,037	n.s.	0,105	- 0,358	n.s.	0,232
Control of FSH (dummy)	0,101	n.s.	0,077	0,183	n.s.	0,107	- 0,067	n.s.	0,098	- 0,255	n.s.	0,248

P-Value: n.s. &gt;5%; \* &lt;5%; \*\* &lt;1%; \*\*\* &lt;0,5%

Source: Authors' elaboration.

The adjusted R2 for the regression model 3.2 is about 44% for the accounting ratios representing the sampled firms' financial strength and financial independence, which indicates a good specification of the model.

## 5 Conclusions

The paper shows the first results of a research project that focuses on the capital structure of young innovative companies in order to identify and study issues and constraints that affect the financing policies of these companies. This paper focuses on the financial behaviour of Italian innovative startups and SMEs, defined as companies with high technological content and strong growth potential. The research design and methodological approach of this paper reflect the Italian regulatory framework, which provides specific requirements for identifying innovative firms and defines fiscal and



financial benefits they can access. A sample of 1289 Italian startups and SMEs has been analyzed, identified among those reported in the appropriate section of the Italian Business Register.

We observe that level and composition of debt vary with the age of the sampled firms and the innovation subjective requirement they have.

However, not all accounting ratios provide clear insights. Considering the financial independence of sampled firms, we observed that equity finances just under 30% of total assets up to the third year of life, around 35% in the following 5 years, and about 40% from the ninth year onwards. Similarly, considering the bank exposure, it can be seen that bank loans grow with the age of the companies sampled. They represent less than 20% of revenues up to the third year of life, range between 23% and 25% in the following 5 years, and stabilize at around 25% from the ninth year onwards. These dynamics are representative of the financial behavior of the entire reference population of young Italian innovative firms. Thus, the importance of shareholders and banks in supporting corporate growth and consolidation is clear.

However, the regression analysis demonstrates that the life cycle has a low explanatory power of the financing policies of the sampled firms. Only by adding variables related to firm-specific characteristics (solvency, profitability, intangibility, size, ownership structure) the regression model becomes statistically significant showing a good explanatory power. Again, the relevance of their outcomes depends on the financial ratio and, often, on the sector. Consistent with the financial literature, size, profitability, and solvency are relevant drivers for financial structure choices. Financial independence and strength increase with size, short-term financial equilibrium (current ratio), and operating profitability (ROA). Coherently, the operating margin (EBITDA margin) has a positive relationship with the indebtedness of innovative firms. As for the ownership structure, while the number of shareholders improves strength and financial independence, curiously the type of shareholder and the type of control are not relevant factors.

This results and here represent only the first step of a research path that still requires further analysis and in-depth analysis. The main limitation of this paper lies in the extent of the dataset. This study focuses on a sample that represents about 8% of the reference population, and accounting or ownership structure data are relative just to the last available fiscal years (2020 or 2021). The available dataset reflects the effects of the pandemic outbreak of Covid-19, and does not allow for time-series or panel analysis. The extension of the number of companies and the fiscal years under observation will allow to isolate the effects of exogenous systemic or sectoral shocks, and to validate the results here presented with broader and more in-depth analyzes. Furthermore, the robustness of our results will have to be verified using alternative definitions and criteria to identify young innovative companies.

Despite the limitations highlighted above, in our opinion, the research has different aspects of originality and offers first significant insights. To our knowledge, despite the number of previous studies on the relevance of capital structure, relatively few researchers have analyzed the financial life-cycle of innovative startups and SMEs, using several alternative accounting ratios to study its capital structure. This paper provides exploratory but interesting evidence about the financial behavior of Italian innovative firms. Such analysis allows for assessing the effectiveness of Italian public policies to incentivize and support corporate innovation, which is a key factor of competitiveness in a “knowledge open economy”.

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### Notes:

<sup>1</sup> The data base AIDA is part of the Bureau van Dijk (<https://www.bvdinfo.com/>) solutions thought for several type of organizations (also Academic institutions) that need accounting, governance and operating information about companies and financial institutions. Specifically, Aida contains comprehensive information on Italian companies, with up to ten years of history, with reference to: accounting data from financial statements, debt and credit detail, financial ratios and operating indicators, rating, activity codes and description (ATECO; SIC, NACE), employees, local units, share values for listed companies, shareholders and equity investments, etc.

### References:

- Abdulsaleh, A.M., Worthington, A.C. (2013) Small and Medium-Sized Enterprises Financing: A Review of Literature, *International Journal of Business and Management*, 8(14), pp. 36-54, <http://dx.doi.org/10.5539/ijbm.v8n14p36>.
- Antoniou, A., Guney, Y., Paudyal, K. (2008) The Determinants of Capital Structure: Capital Market-Oriented versus Bank-Oriented Institutions, *Journal of Financial and Quantitative Analysis*, 43(1), pp. 59-92, <https://doi.org/10.1017/S0022109000002751>.
- Al-Zoubi, H.A., O’Sullivan, J.A. & Alwathnani, A.M. (2018) Business cycles, financial cycles and capital structure, *Annals of Finance volume*, 14, pp. 105–123, <https://doi.org/10.1007/s10436-017-0306-z>.
- Beck, T. & Demirguc-Kunt, A. (2006) Small and Medium-size Enterprises: Access to finance as a growth constraint, *Journal of Banking & Finance*, 30(11), pp. 2931-2943, <https://doi.org/10.1016/j.jbankfin.2006.05.009>.
- Berger, A.N. & Udell, G.F. (2006) A More Complete Conceptual Framework for SME Finance, *Journal of Banking and Finance*, 30(11), pp. 2945-2966, <https://doi.org/10.1016/j.jbankfin.2006.05.008>.

- Carpenter, R.E. & Petersen, B.C. (2002) Is the Growth of Small Firms Constrained by Internal Finance?, *Review of Economics and Statistics*, 84(2), pp. 298-309, <https://www.jstor.org/stable/3211778>.
- Casey, E & O'Toole, C. (2014) Bank Lending Constraints and Alternative Financing during the Financial Crisis: Evidence from European SMEs, *Journal of Corporate Governance*, 27, pp. 173-193, <https://doi.org/10.1016/j.jcorpfin.2014.05.001>.
- Copeland, T.E., Weston, J.F. & Shastri, K (2005) *Financial Theory and Corporate Policy* (Boston: Pearson Addison Wesley).
- Cressy, R. & Olofsson, C. (1997) European SME Financing: An Overview, *Small Business Economics*, 9(2), pp. 87-96.
- Czerwonka, L. & Jaworski, J. (2021) Capital structure determinants of small and medium-sized enterprises: evidence from Central and Eastern Europe, *Journal of Small Business and Enterprise Development*, 28(2), pp. 277-297.
- De Socio, A. & Finaldi Russo, P. (2016) The debt of Italian non financial firms: an international comparison, *Questioni di Economia e Finanza – Banca d'Italia*, No. 308, available at: <https://www.bancaditalia.it/publicazioni/qef/2016-0308/index.html?com.dotmarketing.htmlpage.language=1&dotcache=refresh> (September 2, 2022).
- Ebiringa, O.T. (2011) Synthesis of Literature on Small & Medium Enterprise (SME) Start-up Financing, *International Journal of Economic Research*, 2(1), (pp. 85-95).
- European Commission (2020) *2019 SBA Fact Sheet – Italy*, available at: [https://single-market-economy.ec.europa.eu/smes\\_en](https://single-market-economy.ec.europa.eu/smes_en) (September 15, 2022).
- European Commission (2022) *SME Performance Review 2021/2022 – Italy country sheet*, available at: <https://ec.europa.eu/docsroom/documents/50693> (September 15, 2022).
- Fan, J.P.H., Titman, S. & Twite G. (2011) An International Comparison of Capital Structure and Debt Maturity Choices, *Journal of Financial and Quantitative Analysis*, 47(1), pp. 23-56, <https://doi.org/10.1017/S0022109011000597>
- Giaretta, E. & Chesini, G. (2021) The determinants of debt financing: The case of fintech start-ups, *Journal of Innovation & Knowledge*, 6(4), pp. 268-279.
- Hernandez-Canovas, G. & Koeter-Kant, J. (2011) SME financing in Europe: Cross-country determinants of bank loan maturity, *International Small Business Journal*, 29(5), pp 489-507.
- Huyghebaert, N. & Van De Gucht, L.M. (2007) The determinants of financial structure: New insights from business start-ups, *European Financial Management*, 13(1), pp. 101-133, <https://doi.org/10.1111/j.1468-036X.2006.00287.x>.
- Huynh, K.P., Paligorova, T. & Petrunia, R. (2018) Debt financing in private and public firms, *Annals of Finance*, 14, pp. 465–487, <https://doi.org/10.1007/s10436-018-0323-6>.
- Kaya, O. & Masetti, O. (2019) Small and Medium-Sized Enterprise Financing and Securitization: Firm-level Evidence from the Euro Area, *Economic Inquiry*, 57(1), pp. 391-409.
- Kieschnick, R. & Moussawi, R. (2018) Firm age, corporate governance, and capital structure choices, *Journal of Corporate Finance*, 48(C), pp. 597-614.
- Martinez Cillero, M., Lawless, M. & O'Toole, C. (2019) The determinants of SME capital structure across the lifecycle, *ESRI Working Paper*, No. 614 (Dublin: The Economic and Social Research Institute (ESRI)), pp. 1-41.
- Matias, F. & Serrasqueiro, Z. (2017) Are there reliable determinant factors of capital structure decisions? Empirical study of SMEs in different regions of Portugal, *Research in International Business and Finance*, 40(C), pp. 19-33.
- Modigliani, F. & Miller, M.H. (1958) The cost of capital, corporate finance, and the theory of investment, *American Economic Review*, 48(3), pp. 261-297.

- Modigliani, F. & Miller, M.H. (1963) Corporate income taxes and the cost of capital: A correction, *American Economic Review*, 53(3), pp. 433-443.
- Myers, S.C. (1977) Determinants of corporate borrowing, *Journal of Financial Economics*, 5(2), pp. 147-175.
- Myers, S.C. (1984) The capital structure puzzle, *Journal of Finance*, 39(3), pp. 574-592.
- OECD (2018) *Financing SMEs and Entrepreneurs 2018: An OECD Scoreboard*, available at: <https://www.oecd.org/cfe/smes/Highlights-Financing-SMEs-and-Entrepreneurs-2018.pdf> (October 25, 2022).
- OECD (2021) *Raising Skills in SMEs in the Digital Transformation: A Review of Policy Instruments in Italy*, available at <https://www.oecd.org/els/emp/skills-and-work/adult-learning/> (October 25, 2022).
- Tirelli, M. (2021) On the optimal investment finance of small businesses, *Small Business Economics*, 56(4), pp. 1639-1665.
- Udell, G. (2015) Issues in SME Access to Finance, *European Economy – banks, regulation and the real sector*, (2), pp. 61-74, <https://doi.org/10.1007/s11187-019-00283-1>.
- Villamil, A.P. (2010) The Modigliani-Miller theorem and entrepreneurial firms: an overview, *Strategic Change*, 19(1-2), pp. 3-7.
- Lefebvre, V. (2021) Zero-debt capital structure and the firm life cycle: empirical evidence from privately held SMEs, *Venture Capital, An International Journal of Entrepreneurial Finance*, 23(4), pp. 371-387, <https://doi.org/10.1080/13691066.2021.2001700>.
- Xia, L., Zhang, W. & Han, A.Q. (2019) Research on the Impact of Financial Ecological Environment on SMEs Financing, *Ekoloji*, 28(107), pp. 3383-3391.

## Determinants of Investors' Satisfaction at Industrial Zones in the Central Region of Vietnam

XUAN HUNG PHAM

**Abstract** Industrial zones (IZs) play an important role in the development of Vietnam during the last decades. This study analyzes the factors affecting the level of investor's satisfaction at IZs in the central region of Vietnam based on the data collected from 343 managers/directors who are investing at the IZs in the three selected provinces of the central region of Vietnam namely Quang Binh, Quang Tri and Thua Thien Hue. By employing PLS-SEM approach to analyse data, the results of this study revealed that four factors that influence the investors' satisfaction in IZs are arranged sequentially, from high to low as follows: infrastructure system of IZs; responsiveness of local government; preferential policies and operating cost. The result implicates that in order to improve the satisfaction of investors, local government should focus on the development of infrastructure system in IZs and pay more attention on the interaction between investors and local authorities.

**Keywords:** • industrial zones • satisfaction of investors • PLS-SEM • central Vietnam

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## 1 Introduction

Industrial Zones (IZs) are areas developed to attract, support and provide facilities for industries. IZs play an important role in the development of Vietnam during the last decades. The establishment of IZs contributed to the economic restructuring, created jobs and developed supporting industries in many provinces in Vietnam. In the central region of Vietnam, the formation and development of IZs has contributed to the rapid increase of Foreign Direct Investment (FDI) and became the important factor influencing the GDP growth, tax increase and infrastructure development. According to the Vietnamese Ministry of Investment and Planning, since the first IZ established in 1991, the number of IZs in Vietnam has increased to 397 in 2021. The development of IZs in Vietnam have attracted 21,875 projects with the 340 billion USD registered capital. Of which, the number of FDI projects is 10,975 with 230.1 billion USD registered capital (Ministry of Investment and Planning, 2022). Because of the importance of attracting investment in IZs, many researchers and governmental authorities were interested in studying on the satisfaction of investors in IZs (Cu, Hoang, & Le, 2020).

The central region of Vietnam has a total population of nearly 25 million people, accounting for nearly  $\frac{1}{4}$  of Vietnam population. During the last two decades, there are many IZs established in this region. In 2021, the total registered capital at IZs in this region reached 16,140 billion VND and 8,785 million USD, creating jobs for more than 90,000 workers (General Statistics Office, 2022). Due to a high competition among regions in attracting investment, the improvement investors' satisfaction at IZs will subsequently increase the number of potential investors in the future. On the other hand, when the local government and management board of IZs fail to understand the factors influencing investors' satisfaction may result in a decline in number of new projects

Although several research has been carried out regarding the investment attraction in IZs in Vietnam (N. T. T. Ha, Ha, Duc, & Thang, 2016; Ho & Trung, 2011; Huong & Dung, 2019; Lan & Viet, 2018), less attention has been paid to examine factors influencing investors' satisfaction at IZs in the central region of Vietnam. Therefore, this study seeks to identify critical factors that impact on the satisfaction of investors when they do their business at IZs in the study site.

The paper is organized as following, in the next section, the literature review and hypothesis development are explained. Then, the research method is described, and followed by the research results and discussions. Finally, the conclusion and limitations of the research are clarified for future studies.

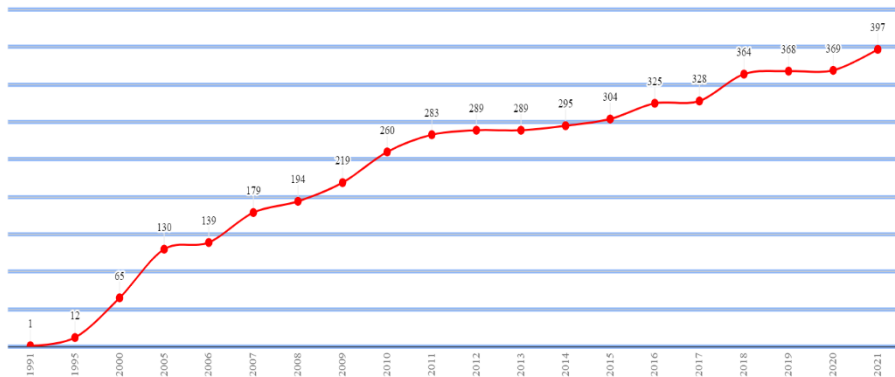
## 2 Literature review

### 2.1 The development of industrial zones in Vietnam and the study site

Industrial zones are locations that are earmarked by the government for the production of industrial goods. In industrial zones, enterprises produce industrial products, export and have incentives for business that set up there. As can be seen in the Figure 1, the number of industrial zones in Vietnam continues to rise during the last 30 years. As of December 2021, there were 397 industrial zones with 122.900 ha established in Vietnam. The occupancy rate in these IZs is 52.5 % and IZs have created 4.07 billion jobs (Ministry of Investment and Planning, 2022). The IZs in Vietnam are spread out across the country, and are concentrated within three administrative regions – the Northern, Central and Southern regions.

As Vietnam continues to attract FDI, IZs have been improving their infrastructure to meet international standards. Improvements include higher quality of factory buildings and warehouses, sufficient sources of electricity and water, building wastewater treatment plants and garbage disposals, fire prevention systems, telecommunications, logistic services, and internal roads. Besides, the Vietnam government has implemented many preferential policies to attract new investors such as reducing the land rental fee for new investors; improving the process to obtain investment certificate.

**Figure 1:** Number of IZs in Vietnam in the period 1991 – 2021

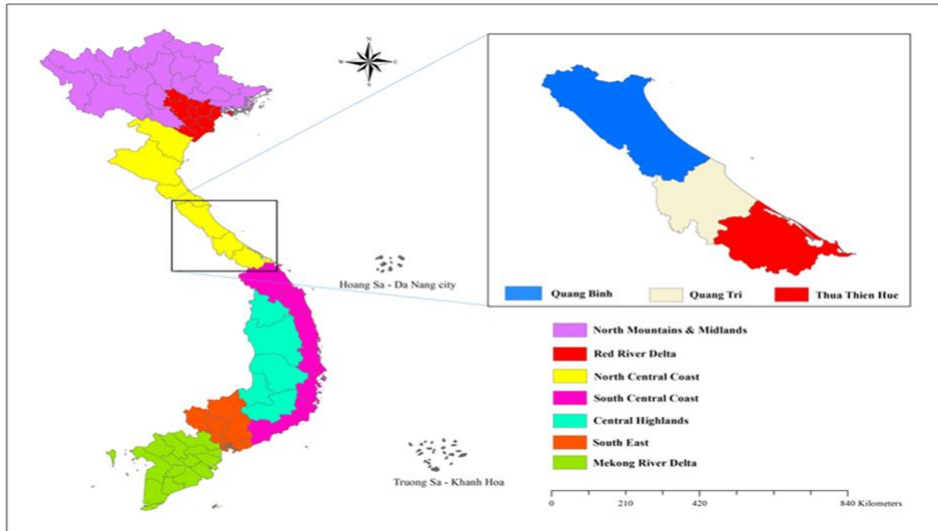


Source: Ministry of Investment and Planning.

Quang Binh, Quang Tri and Thua Thien Hue are three provinces in the central region selected for this study. During recent years the numbers of IZs has been increased rapidly in these provinces because it has location advantages. All three provinces are located near National Highways (Number 1A) that connect with Dong Hoi and Phu Bai airports, Chan

May and Gianh sea ports, and rail stations. Thus, it is easy to travel between Vietnam, Laos and Thailand.

**Figure 2:** Map of Vietnam and the study site



Thua Thien Hue has an area of more than 5,000km<sup>2</sup> and a population of 1.2 million people. The province has a well-developed infrastructure system which include the Chan May deep sea port; the National Highway (Number 1A), and the Phu Bai airport. Thua Thien Hue is also a part of the East-West Economic Corridor linking Laos, Thailand, Myanmar and Vietnam, which facilitates a connection among Asia countries.

Quang Tri province is located in the central of region of Vietnam. It is surrounded by the Thua Thien Hue and the Quang Binh province. The province has a boarder with Savannakhet Province, Lao PRD, to the West, so it is easy to set up the connection with Lao PRD and Thailand.

Quang Binh is located in the North of the central region and the closest point from Vietnam to Lao PRD with a length of nearly 250km. The province has a convenient transportation system with national railways, Dong Hoi airports and Gianh deep-water ports. The province has the direct road to the Cha Lo international border gate with Lao PRD.



## 2.2 Factors influencing the satisfaction of investors in the IZs

The satisfaction of investor at IZs is a measure of the extent to which the investors are satisfied with the conditions or service they received from IZs. Previous studies indicate that investor satisfaction is the important factor for investment attraction because if investors are satisfied with the services and condition provided by local authorities and the management board of IZs, they will continue to invest more money in the future (Huong & Dung, 2019). From perspectives of local government, the understanding perceptions of investors' satisfaction may enable local government authorities to identify the issues of conditions or services they need to improve at IZs.

Several studies refer to the satisfaction of investors in IZs and its influencing factors. Ho and Trung (2011) studied the satisfaction of investors when they established their business at IZs in Vietnam. The research indicated that there were eight groups of factors with thirty-eight observed variables including physical infrastructure, working environment, human resources, fees, investment advantages, local brands, public services and governmental policy for investment. The results of this research also shown that the factors that have the greatest impact on investor satisfaction are governmental policy for investors, physical infrastructure, and quality of labour respectively. Similarly, M. Nguyen (2010) utilised the statistical method to investigate the different views of attracting foreign direct investment in Vietnam and concluded that the development of technical infrastructure is the most important factor, followed by incentives of local government for investors and operation costs and potential market. Geographic location and social infrastructure did not affect the selection of location. Huong and Dung (2019) point out the factors affecting the investors' satisfaction at IZs in Binh Dinh province, including the development of IZs infrastructure facilities, advantages of investment industry, support of local government relating to the decision-making process and cost advantage. According to T. D. Nguyen (2009), the factors affecting investors' satisfaction in Tien Giang province including basic business infrastructure (electricity, water system, schools,); local government support (e.g. public services, investment incentives) and quality of life.

Tocar (2018) reviewed the determinants of FDI follow and found that there were eleven categories of FDI determinants. Of these factors, infrastructure facilities, institutional – political factors, corporate tax rate had positive influence in investors' selection of investment places.

*Infrastructure system:* Infrastructure system, such as communication facilities, energy supply and transportation determine production and transaction costs, thus it influences the satisfaction of investors in IZs. Infrastructure factors are often mentioned in literature, although referring to different aspects. For instance, the stability of electrical system is important for production, thus it influence positively on the investors' decision (Kok & Ersoy, 2009). The study carried out by Khachoo and Khan (2012) show that there was a

significantly positive relationship between electric system and FDI inflows. In addition, the other infrastructure facilities such as water system supply, the sufficient areas of land for building factories was very important for investors because it impacts on the cost of investors. Thus, the relationship between infrastructure system and investors' satisfaction could be described as following:

*H1: Infrastructure system has positive effect on investors' satisfaction*

*Government responsiveness:* This dimension refers to the ability of local government authority's response to investors' enquires. Because IZs are a government-designated area for the industrial production of products and services, public services provided by local government and supports from local government authorities to investors will influence the satisfaction of investors. Previous studies shown that investors are unhappy with the delay of administrative procedure (Piecyk, Mordue, & Yates, 2016). So, the responsiveness of local government is required to make the investors' satisfaction at IZs. The second hypothesis is:

*H2: Government responsiveness has positive effect on investors' satisfaction*

*Preferential policies:* The preferential policies such as tax exemptions or reductions of Value-Added Tax (VAT), reducing land lease rate and supporting labor training. The aim of applying these policies is to promote and attract more investors to establish their plants in IZs. There are more preferential policies, the investors will be more satisfied as it will reduce production cost. Several previous studies found that there is significant correlation between preferential policies and investors' satisfaction (Dorożyński, 2020; Dzung, Tuan, & Tinh, 2017; Ślusarczyk, 2018). Thus, the third hypothesis is:

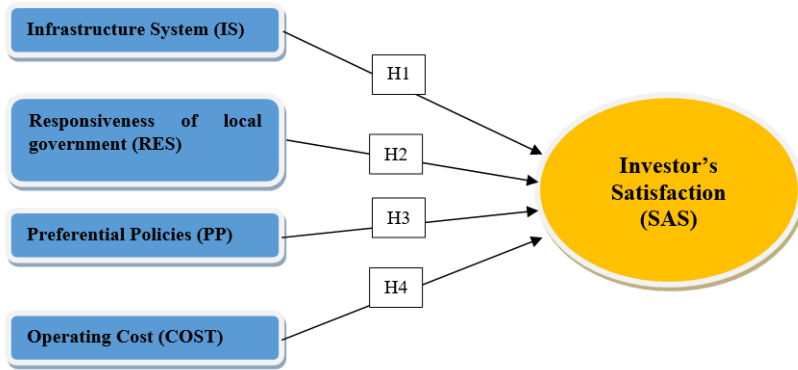
*H3: Preferential policies have positive effect on investors' satisfaction*

*Operating cost:* Operating cost in this context of this study relates to land cost, freight cost, labor cost and cost of waste disposal. Because these cost impacts on the long-term competitive advantages of the products, the investors will consider carefully when they decide to select IZs for their investment. The study carried out by Huong and Dung (2019) show that the cost of using infrastructure facilities such as electricity, water, waste disposal is critical factor influencing the satisfaction of investors. The fourth hypothesis is:

*H4: Operating cost has positive effect on investors' satisfaction*

Based on the reviewing of literature, the research conceptual model is shown in Figure 3.

**Figure 3:** Research conceptual model



### 3 Research methods

#### 3.1 Survey instrument

A survey instrument was adopted from reviewing of literature and the analysis of in-depth interviews with 10 investors who are doing business in the IZs at three selected provinces. The scale of investors' satisfaction at IZs is based on the research of Huong and Dung (2019). Table 1 described the details of items in this research:

**Table 1:** List of items

Code	Item	Sources
IS1	Transportation systems are convenient	N. M. Ha and Khuong (2015)
IS2	Land area meet investors' demand	In-depth interviews
IS3	Power and water supply are stable	N. T. T. Ha et al. (2016), (Huong & Dung (2019)
PP1	Land lease policy is reasonable	Dzung et al. (2017)
PP2	Tax policy is reasonable	Chinh and Tuan (2018), N. T. T. Ha et al. (2016)
PP3	Local governments strongly support labour training	Chinh and Tuan (2018)
PP4	Well waste treatment system	Dzung et al. (2017)
Res1	Local leaders are uasually willing to support investors	N. T. T. Ha et al. (2016);
Res2	Legal documents are be deployed quickly to investors	Huong and Dung (2019)
Res3	Local government reponse quickly to investor's enquires	Dzung et al. (2017)
Res4	Administrative procedures are fast and effective	Huong and Dung (2019), N. T. T. Ha et al. (2016)
Cost1	Labour cost is reasonable	Huong and Dung (2019)
Cost2	Land incentives	Dzung et al. (2017)
Cost3	Cost of freight are reasonable	In-depth interviews
Cost4	Cost of waste disposal is reasonable	N. T. T. Ha et al. (2016)
Sas1	The industrial zones meets investor's expectations	Huong and Dung (2019)
Sas2	Continuing to invest in the industrial zones	Huong and Dung (2019)
Sas3	Introducing these IZs to other investors	Huong and Dung (2019)

The quantitative research method was utilised for this study. The study population consists of CEO/directors who are owners or managers of companies operating in IZs in Quang Binh, Quang Tri and Thua Thien Hue. These people are targeted in the study

because they have experiences in doing business, so they have understandings of factors influencing the satisfaction of investors.

### **3.2 Data analysis**

In terms of data analysis, Partial Least Squares – Structural Equation Models (PLS-SEM) was employed to analysis data in this study. According to Hair, Risher, Sarstedt, and Ringle (2019), PLS-SEM approach is appropriate when the study aims to test a predictive relationship with small sample size. The aim of this research is to identify factors that influence investor satisfaction, thus, PLS-SEM is the best choice for data analysis. Regarding the sample size, this study applied the 10 times rule for determining minimum sample size because the study utilized PLS-SEM (Memon et al., 2020). According to this rule, the minimum sample for this study should be “10 times the largest number of structural paths directed at a particular construct in the structural model”. The structural model in this research (as shown in the Figure 3) involves four direct paths, thus the minimum required sample size is 40 respondents. In this study, the returned respondents are 343 and it meet the requirement.

## **4 Results**

### **4.1 Characteristics of Respondents**

Table 2 shown that the characteristics of survey respondents in this study have quite diverse. Most of respondents is male (79%). This proportion is similar to the proportion of total population because the number of male who hold high position in companies is usually higher than female in context of Vietnam. In terms of work experiences, majority of respondent has working experience from 5 to 15 year (nearly 69%).

**Table 2:** Characteristics of respondents

No	Indicator	Number of respondents	Percent (%)
Gender	Male	271	79.0
	Female	72	21.0
Position	Chairman of Management Board	78	22.7
	Director	97	28.3
	Vice director	86	25.1
	Head of department	65	19.0
	Others	17	5.0
	< 5 year	42	12.2
Work Experience	5 – <10 year	113	32.9
	10– < 15 year	124	36.2
	> 15 year	64	18.7
<b>Total</b>		<b>343</b>	<b>100</b>

## 4.2 Results

The SEM-PLS approach, recommended by Hair et al. (2019) was adopted for the data analysis in this research. There are two steps for data analysis. First step, the outer measurement model is examined throughout three criteria including the reliability of measurement items, convergent validity and discriminant validity. The second step will exam the relationships among the latent constructs by validating the structural model. The SmartPLS 3.0 software was utilised for analyzing data in this study.

### 4.2.1 Evaluation of measurement model

According to Hair (2019), the outer measurement model is examined throughout three criteria including the reliability of measurement items, convergent validity and discriminant validity (Hair et al., 2019).

First, the item reliability was examined by the indicator loadings (outer loadings in reflective measurement models). According to Zeng, Liu, Gong, Hertogh, and König (2021) the acceptable item reliability is 0.7. The results in Table 3 show that all outer

loadings values of observed variables are above 0.7, indicating that the construct explains more than 50% of the indicator's variance.

**Table 3:** Outer loadings

	IS	RES	PP	COST	SAS
IS1	0.856				
IS2	0.835				
IS3	0.844				
Res1		0.751			
Res2		0.800			
Res3		0.833			
Res4		0.800			
PP1			0.765		
PP2			0.845		
PP3			0.877		
PP4			0.844		
Cost1				0.773	
Cost2				0.814	
Cost3				0.783	
Cost4				0.803	
Sas1					0.863
Sas2					0.854
Sas3					0.832

Source: SmartPLS output.

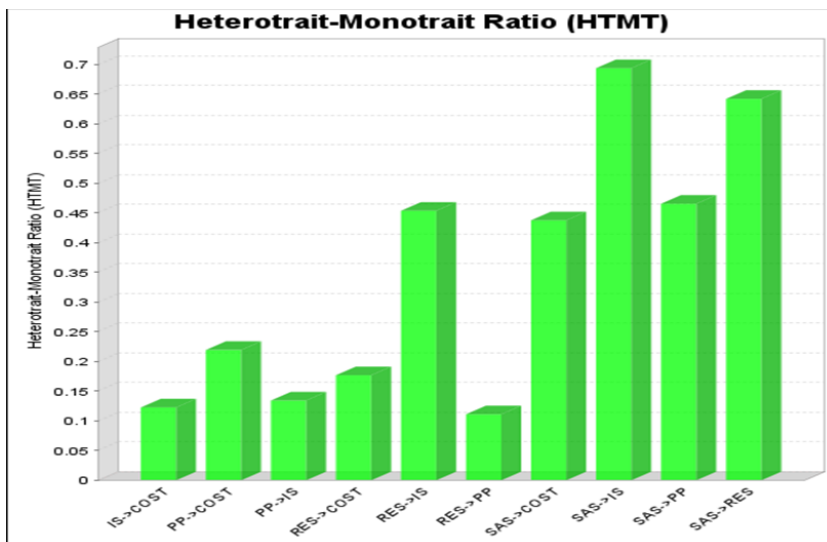
Composite reliability (CR) values are used to evaluate the reliability of the measurement items. According to Hair (2019), if CR values are above 0.70, the reliability of the measurement items will be confirmed. Table 5 indicates that all CR values of observed variables are higher than the 0.7 thresholds. Thus, the reliability of the measurement items is met. In terms of convergent validity, it is suggested that the AVE value of each construct should be above 0.5 (Hair et al., 2019). As shown in the Table 4, all the value of AVE is between 0.629 and 0.722, which indicates that the convergent validity is satisfied. Therefore, both the validity and reliability of the measurement model are confirmed.

**Table 4:** Results of Measurement Model

Factors	Cronbach's Alpha	CR	AVE
IS	0.800	0.882	0.714
RES	0.809	0.874	0.635
PP	0.823	0.884	0.659
COST	0.806	0.872	0.629
SAS	0.808	0.886	0.722

Source: SmartPLS output.

To exam the discriminant validity of measurement model, this study applies the heterotrait-monotrait ratio (HTMT) criterion. According to Zeng et al. (2021), the heterotrait-monotrait ratio (HTMT) criterion is applied to assess the discriminant validity of the reflective constructs as the Fornell-Larcker criterion and cross-loadings are not sufficiently sensitive to discover the discriminant validity problems of measurement model. As shown in Figure 4, all HTMT values are below the threshold of 0.90, which confirms that discriminant validity is established for the reflective constructs of this study.

**Figure 4:** The Heterotrait-monotrait ratio (HTMT)



### 4.2.2 Evaluation of structural model

The structural model is examined after the measurement model are confirmed. The  $R^2$  value measures the ability of the exogenous variables in explaining the endogenous variables in the structural model. Thus, it measures the predictive accuracy of the structural model. The result of bootstrap procedure shows that the  $R^2$  value in the structural model is 0.579. This indicates that all four factors in the proposed model (RES, IS, COST and PP) could explain 57.9 % of the variance of independent variable (SAS) (Hair et al., 2019).

**Figure 5:** The validated structural model

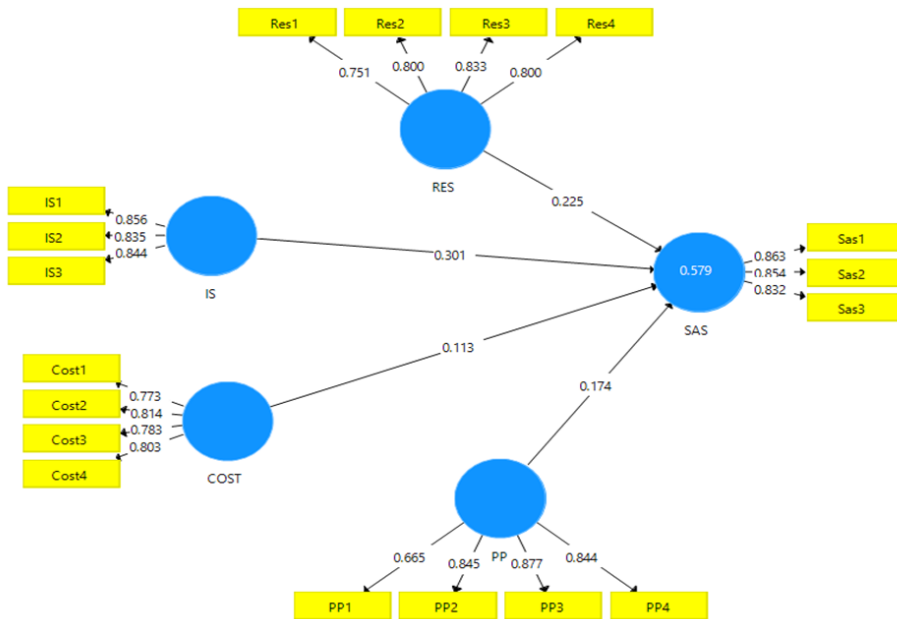


Table 5 illustrates the coefficient and the statistical significance of each path of the research proposed model. It can be seen that all four factors (IS, RES, PP and COST) have statistically significant and positive influence on investor satisfaction (SAS) at IZs in the central region of Vietnam. Of those factors, infrastructure system has strongest influence on investor satisfaction ( $\beta = 0.301$ ;  $t$ -value = 8.579), follow by the RES factor ( $\beta = 0.225$ ;  $t$ -value = 7.059). The impact of PP on investor satisfaction rank third ( $\beta = 0.174$ ;  $t$ -value = 7.466). The least influencing factor is COST ( $\beta = 0.113$ ;  $t$ -value = 6.657). Thus, hypothesis H1; H3; H4 and H4 are supported.

**Table 5:** Path coefficients and hypothesis testing

Hypothesis	Coefficient	Standard Deviation	T Statistics	Results
H1: IS -> SAS	0.301	0.045	8.579*	Support
H2: RES -> SAS	0.225	0.047	7.059*	Support
H3: PP -> SAS	0.174	0.037	7.466*	Support
H4: COST -> SAS	0.113	0.034	6.657*	Support

Source: SmartPLS output.

Predictive relevance ( $Q^2$ ) is used to evaluate the predictive accuracy. As a rule of thumb, if a  $Q^2$  value is larger than zero, the exogenous constructs have predictive relevance for latent endogenous constructs (Hair et al., 2019). The  $Q^2$  value of the proposed model is 0.391, which indicates that the endogenous construct (Investor Satisfaction) involved in this research have strong predictive relevance.

## 5 Discussion

The current study investigates the influence of four factors that are infrastructure system; government responsiveness; preferential policies and operating cost in relation to investor's satisfaction at IZs in the central region of Vietnam. The results show that the effect of the infrastructure system factor is more important than the other factors. This finding is in line with several past studies which showed that the physical system such as water system, electricity and other types of physical system may increase investors' satisfaction (Ho & Trung, 2011; Huong & Dung, 2019; Lan & Viet, 2018).

The responsiveness of local government is the second important factors influencing investors' satisfaction. This result of the study shows that the support from local government could increase the satisfaction of investors. The finding of this research is similar with the work of Huong and Dung (2019) where they found that the local government support played an important role in enhancing the satisfaction of investors at IZs. This finding suggests that, local authorities should set priority on improving the administrative procedures in order to increase the level of investor satisfaction at IZs.

Regarding preferential policies, during the last decade, the local governments in three selected provinces have proposed many preferential policies such as exemption the cooperate income tax for first five years and personal income tax payable will be reduced by 50%; reducing land lease rate and supporting labor training to enhance the ability to attract investment capital. The study illustrates that these policies have positive impacts

on the satisfaction of investors. This finding is consistent with the study carried out by Ślusarczyk (2018) in Poland and Huong and Dung (2019) in the Binh Dinh province.

## **6 Conclusion and policy recommendations**

The understanding of factors influencing investors' satisfaction in IZs is very crucial because if investor is satisfied with service quality and conditions offered by the local authorities or the management board of IZs, they feel more confident to invest at the IZs. This study indicates that all four proposed factors have positively influenced on the investors' satisfaction in the IZs in the central region of Vietnam. However, the level of importance is different among factors. Infrastructure system has strongest influences while operating cost factor has the least influence.

In order to enhance investor satisfaction and attract more investment in the future, it is important to create a favorable institution that ensures that investors develop production, the following recommendations should be implemented.

First, continuing to improve the infrastructure of industrial zones. Particular attention should be paid to the construction of waste water process, as it is the source of underwater pollution at IZs in the central region. Moreover, the transportation system between IZs and ports in Thua Thien Hue and Quang Binh need to be improved, thereby reducing the cost of production for businesses.

Secondly, implementing the "one-stop-shop" policy to avoid unnecessary procedures affecting the satisfaction of investors. The procedure to issue investment licensing for investors need to avoid errors and serious consequences. Therefore, it is recommended that these procedures should be implemented by Industrial Zone Management Board to create favorable conditions for investors.

Thirdly, the quality of social services need to be improved in order to enhance the quality of life for workers in the IZs. In addition, vocational training activities should be organized frequently to improve the quality of labor resources. This activity is very important as it will help investors recruiting high quality laborers into the production process.

Although the current study has identified critical factors that influence the satisfaction of investors, there are some limitations of this research that need to be point out. First, this study focus on the central region of Vietnam and it is limited to generalize the findings to other areas in the North and the South region as the different social economic conditions. Hence, future studies should be carried out at IZs in other regions to compare the influential factors on investor satisfaction. Second, the absence of qualitative research methods to explore deeply factors influencing the investors' satisfaction is another limitation of this study. Thus, future research should incorporate the qualitative methods

in research design. Lastly, it is suggested that future research need to be consider a longitudinal approach to identify whether investor the satisfaction of investor will impact on in the investors' decision.

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### References:

- Chinh, D. T. & Tuan, N. A. (2018) Factors Influencing Foreign Direct Investment Attraction in Hung Yen Industrial Zones, *Paper presented at the The 5th IBSM International Conference on Business, Management and Accounting* (Ha Noi).
- Cu, T. T., Hoang, T. H. H. & Le, T. Y. (2020) Impacts of Industrial Park Development on the Surroundings' Livelihood, *The Journal of Asian Finance, Economics, and Business*, 7(9), pp.737-746.
- Dorożyński, T. (2020) *Incentives to attract FDI: evidence from the Łódź province* (Łódź, Poland: Łódź University Press).
- Dzung, N. T., Tuan, N. A. & Tinh, D. P. T. (2017) The Role of Investment Attraction in Vietnamese Industrial Parks and Economic Zones in the Process of International Economic Integration, *The Journal of Asian Finance, Economics, and Business*, 4(3), pp. 27-34.
- General Statistics Office (2022) *The Statistical Yearbook* (Hanoi: Statistical Publishing House).
- Ha, N. M. & Khuong, N. D. (2015) Factors affecting investment of enterprises in industrial zones and industrial clusters in Tien Giang province, *Scientific Journal of Ho Chi Minh Open University*, 40(1), pp. 14-31.
- Ha, N. T. T., Ha, N. T., Duc, H. V. & Thang, H. V. (2016) Factors Affecting the Satisfaction of Investors In Industrial Zones of Thai Nguyen Province, *Business and Economics Journal*, 7(248), pp. 1-9.
- Hair, J. F., Risher, J. J., Sarstedt, M. & Ringle, C. M. (2019) When to use and how to report the results of PLS-SEM, *European Business Review*, 31(1), pp. 2-24.
- Ho, Đ. P. & Trung, H. M. (2011) Factors affecting foreign investor satisfaction with Vietnamese Industrial Parks: A Quantitative model and policy recommendations, *Journal of Economic Development*, (208), pp. 21-28.
- Huong, H. T. H. & Dung, N. T. T. (2019) Factors affecting investors' satisfaction in industrial zones and results in investment attraction in industrial Zones in Binh Dinh Province, Vietnam, *Economic Research*, 3(4), pp. 33-45.
- Khachoo, A. Q. & Khan, M. I. (2012) *Determinants of FDI inflows to developing countries: a panel data analysis*, available at: <https://mpira.ub.uni-muenchen.de/37278/1/> (May, 15, 2022).
- Kok, R. & Ersoy, B. A. (2009) Analyses of FDI determinants in developing countries, *International Journal of Social Economics*, 36(1/2), pp. 105-123.
- Lan, L. T. & Viet, N. D. (2018) Factors Affects Investment Decisions of Enterprises into Vietnam's Economic Zones, *Journal of Global Economics*, 6(280), pp. 1-6.

- Memon, M. A., Ting, H., Cheah, J. H., Thurasamy, R., Chuah, F. & Cham, T. H. (2020) Sample size for survey research: review and recommendations, *Journal of Applied Structural Equation Modeling*, 4(2), pp. 1-20.
- Ministry of Investment and Planning (2022) *Report on the development and establishment of industrial zone in Vietnam*, available at: <https://www.mpi.gov.vn/Pages/ktxh.aspx?idcm=207> (October 22, 2022).
- Nguyen, M. (2010) Factors affecting the attraction of foreign direct investment into a locality in Vietnam, *Journal of Science and Technology, University of Danang*, 40(5), pp. 270-277.
- Nguyen, T. D. (2009) Place development: attributes and business customer satisfaction in Tien Giang Province, Vietnam, *Journal of Macromarketing*, 29(4), pp. 384-391.
- Piecyk, A., Mordue, G. & Yates, C. (2016) *One-stop shopping for investment attraction: Does the ProMexico model work for Canada?* (Hamilton, Canada: Automotive Policy Research Centre).
- Ślusarczyk, B. (2018) Tax incentives as a main factor to attract foreign direct investments in Poland, *Administratie si Management Public*, (30), pp. 67-81.
- Tocar, S. (2018) Determinants of foreign direct investment: A review, *Review of Economic and Business Studies*, 11(1), pp.165-196.
- Zeng, N., Liu, Y., Gong, P., Hertogh, M. & König, M. (2021) Do right PLS and do PLS right: A critical review of the application of PLS-SEM in construction management research, *Frontiers of Engineering Management*, 8(3), pp.356-369.



## Behavioural Interventions in Tax and Fee Collection – Not Always a Success

MÁRIA MURRAY SVIDROŇOVÁ, KATARÍNA VITÁLIŠOVÁ, NIKOLETA JAKUŠ MUTHOVÁ  
& JURAJ NEMEC

**Abstract** Intergovernmental relations in terms of fiscal arrangements between the national and sub-national levels of government determine the way in which taxes are allocated and shared between the various levels of government. For local governments, local taxes and fees are the main source of revenue through which many public services are provided. Many local governments therefore seek to use various tools to increase the effectiveness and efficiency of tax and fee collection. Such tools include behavioural interventions to reduce the proportion of non-payers, i.e. taxpayers can be ‘nudged’ to pay their taxes on time and correctly. Many studies worldwide point to the successful use of nudges, but behavioural interventions can sometimes fail. Using the example of the Slovak city of Banská Bystrica, we show that the intervention did not produce the expected results and identify possible factors.

**Keywords:** • behavioural interventions • nudge • tax and fee Collection • Slovakia

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## 1 Introduction

Behavioural insights-based changes in public policies mainly use behavioural nudges and change the choice and setting of default options. The concept of nudges thus presents ways to ethically influence the behaviour of a target group of people in a desired direction. The role of nudges is to steer individuals towards a particular goal. Nudges come in different forms and shapes, depending mainly on the nature of a particular decision-making process and the deviations of rationality that arise in it. Even small and insignificant details can greatly influence people's behaviour and decision-making. People need to be nudged in situations where they do not know the right response. These are complex and infrequent decisions where they do not have clear and immediate feedback or have difficulty translating all aspects of a situation into language they understand (Thaler & Sunstein, 2008).

Changing people's behaviour (behavioural insights) is an important aim for policy-makers, municipalities, healthcare providers, educators, researchers etc. (Michie, Atkins, West, 2014b). It builds on lessons derived from behavioural and social science, including decision making, psychology, cognitive science, neuroscience, organizational and group behaviour (Hansen, 2018). Changing ingrained behaviour patterns can be challenging. Even when we know what we are trying to achieve, we may lack the time, the multidisciplinary team, access to those whose behaviour needs to change, an understanding of behaviour change theories or the knowledge and skills relevant to changing behaviour (Bernheim & Taubinsky, 2018; Michie, Atkins, West, 2014b). Behaviourally informed public policy is distinguished from traditional public policy making by (1) taking an inductive approach that is driven by experimentation and piloting, and (2) use of psychological theoretical underpinnings. Behavioural insights then challenge established assumptions of what is thought to be rational behaviour of citizens and businesses and use these findings to inform policies and regulation (Hansen, 2018).

The introduction of behavioural interventions in public policy making is also used in the area of tax and fee payment. In the collection of taxes and fees, there is often a problem of tax evasion. Although this is an illegal act, the solution to this problem is not simple (Allingham & Sandmo, 1972; Yitzhaki, 1974).

Some authors suggest tax audits are important in solving this issue (Hauptman et al. 2014). According to Allingham & Sandmo (1972) the tax declaration decision is a decision under uncertainty. The reason for this is that failure to report one's full income to the tax authorities does not automatically provoke a reaction in the form of a penalty. At the same time, less public revenue is collected at central or local level and fewer resources are available to provide public services. As Románova et al. (2019) pointed out in their research, the local government units do not have adequate powers to impose and collect local taxes.



There is also an ethical dimension to this problem where people who benefit from publicly provided services do not contribute to these services to the extent that they are legally obliged to do so. Addressing this problem is therefore important not only because non-payment of taxes results in revenue shortfalls in local government budgets but it also has an impact on the behaviour of taxpayers themselves. Taxpayers who pay their taxes and fees may feel that they bear the tax burden, while non-payers benefit from public services as much as those who fulfil their obligations. This may be perceived as unfair and may negatively affect their behaviour in terms of paying taxes and fees in the future. Non-payment of local taxes and fees is therefore not only a legal problem in terms of compliance with legislation, an economic problem in terms of obtaining adequate resources to ensure the financing of the needs of the municipality or city, but also an ethical and moral problem in relation to the residents of the municipality who pay local taxes and fees (Jakuš Muthová et al., 2022). According to Allingham & Sandmo (1972) the policy tools available to the government for the purpose of counteracting the tendency to evasion are the tax rates themselves, the penalty rates and the expenditure on investigation, which determines the probability of being detected.

Several studies (e.g. Hernandez et al., 2017; Hallsworth et al., 2017; Kettle et al., 2017; John & Blume, 2017; the Behavioural Insights Team, 2018) have confirmed that the use of a behavioural intervention can be a suitable tool to reduce the proportion of non-payers, i.e. taxpayers can be ‘nudged’ to pay taxes on time and correctly. The application of behavioural interventions to tackle problems with defaulters is usually done by sending out arrears notices that contain behavioural elements. Compared to standard reminders, the effectiveness of such reminders is generally higher.

In the conditions of the Slovak Republic, the use of behavioural economics is only in its beginnings, the first nudges took place in the city of Prievidza in 2018 (Sloboda et al., 2020) with a positive impact. Academia has thus started to work with local governments to implement further behavioural interventions in different areas to further explore the possibilities of applying this tool. The aim of this paper is to analyse an experiment implemented in the area of tax and fee collection in the city of Banská Bystrica, with the intention of highlighting the factors behind the fact that the interventions in this case did not turn out as expected. The main methods used are a behavioural experiment on a sample of 520 tax payers. The results in this particular city show that the intervention did not produce the expected results; we discuss other examples of Slovak local governments that show the positive effect of behavioural interventions in the area of tax and fee collection.

In the first part of the paper, we review behavioural interventions in tax and fee collection. We then present a selected local government focusing on its revenues from taxes and problems connected with tax and fee collection. We implemented the behavioural intervention in the form of a randomised controlled experiment, which is described in the

Research Concept section, including the statistical methods used to evaluate the experiment. The next section presents the results of the experiment and a discussion with the results of similar experiments in other Slovak municipalities. In the Conclusion we summarise the main points of the paper and point out the limits of our research.

## 2 Literature overview

A number of local governments around the world are currently implementing behavioural interventions. Many times, it is the most efficient and least costly way to nudge citizens to make the right decisions that will benefit the citizen, the local government and society as a whole.

When designing and implementing an experiment aimed at increasing tax and fee payment rates, one can take inspiration from the many studies that have emerged from successful previous experiments in this area. In this overview, we list a number of such experiments and studies.

Between 1995 and 1996, experiments aimed at increasing tax compliance were conducted in Minnesota, U.S.A. The intervention used a reformulation of reminders that appealed to taxpayers to pay their taxes and confronted taxpayers with perceived societal norms. Members of the intervention group received a tax payment reminder with a social norm message. The reminder focused on calling attention to social norms and stated that 93 percent of people pay taxes on time. The results of this intervention confirmed that tax collection was statistically higher for those subjects who received a reminder with a social norm reference compared to subjects in the control group (Coleman, 2007).

The British Behavioural Insights Team (BIT) tested how social norms can be used to motivate defaulters to pay their taxes (Halpern, 2015). Non-payers are sent reminders, which they supplement with text pointing to social norms. Some reminders emphasised that the vast majority of people in the recipient's immediate area paid the tax on time, but the geographic area was not precisely named. In an alternative formulation, the text of the reminder emphasised that most similar debtors had already paid the tax. Some defaulters received letters that combined both pieces of information. The results showed that the more specific the text of the reminder letter was, the more likely the defaulter was to pay the tax. If the text combined both emphasised information, the proportion of tax paid by defaulters increased by 5 per cent. Thus, in the 2012/13 financial year, in the UK, sending reminders highlighting social norms led to additional tax revenue of GBP 210 million. Another way to increase the effectiveness of communication with citizens that can be used in tax collection is through personalisation of messages. In an experiment targeting non-payers of road tax, the BIT found that sending reminders accompanied by a photograph of a vehicle for which road tax had not been paid increased tax collection by 9 per cent. This intervention was based on the assumption that if people receive a personalised letter from a public institution, it will reduce the costs and benefits associated

with the action to which the letter refers. For example, if an entity that has failed to pay its tax on time receives a personalized letter using moral norms describing the possible consequences of noncompliance, the recipient may feel that public institutions have accurate and detailed information about their actions and will consider the consequences described in the letter to be very real.

In Canada, an experiment was conducted among employers who had been late paying tax in previous years. Letters containing nudges provided information on where and when to file a tax return. This intervention resulted in a 4.2% increase in tax payments in the first year and a 6.1% increase in the second year compared to the control group (OECD 2017).

Moving from Anglo-Saxon environments to European contexts, experiments were conducted in Norway in 2012-2013 to increase the collection of foreign income taxes (Bott et al., 2017). Prior to the intervention, taxpayers reported the amount of foreign income without any prompting. In the intervention, taxpayers were divided into four groups, one control and three intervention groups. The control group did not receive any letter from the tax authority. Subjects in the intervention groups were sent a letter. All the letters that were sent had a positive effect on the amount of taxes collected compared to the control group. During the intervention, the Norwegian Tax Authority was able to increase the tax revenue by USD 25 million. The most important contributors to the increase in tax collection were the wording of the letters that referred to social norms and to the fact that the tax office had information on the individual's income from abroad.

In 2014-2015, an experiment was carried out in Ireland to show how the wording of reminder letters based on personalisation and simplification of the text would affect tax defaulters. The experiment focused on taxpayers who had not filed their tax returns on time and were in arrears with their corporation tax payments. A generically worded letter was sent to some companies. A reminder was sent to a second group of companies stating that, according to information from a third party, the company was still in business. Compared to the broadly worded text, this change in wording alone led to a 17 percent increase in delinquent tax filings. Another group of companies was sent a reminder with a simplified text that was shorter and contained only key information. Replacing complex legalese with clear and plain language led to a 3 per cent increase in the number of tax returns filed in Ireland in 2015 and resulted in around EUR 2.8 million in additional tax revenue. The results of this experiment also show that written communication between public institutions and citizens is more effective if it is written in plain language, clearly communicates the substance of the message right from the start, and is highly personalised (Service et al, 2017).

Hernandez et al., (2017) conducted a field experiment in Poland with the aim of increasing the share of personal income tax among those who did not pay their tax on time. The nationwide randomised evaluation included 149 952 taxpayers and examined how the wording of letters using nudges affects the payment rate, the amount of payment,

the unpaid tax liability, and what effect the method of letter delivery has (ordinary or registered). This research confirmed that changing the wording of the reminder letters led to a statistically significant increase in the proportion of those who paid the tax. Letters containing a nudge affected individuals' behaviour positively compared to a control letter; letters written in a coarse tone were more effective than letters with a soft tone, which were even less effective than standard letters, although effectiveness also depended on the characteristics of individual taxpayers. The method of letter delivery did not affect taxpayers' behaviour. The biggest positive effect was the so-called deterrent reminder, which led to an 8.4 % decrease in the proportion of non-payers. The smallest positive impact was caused by a reminder containing the information that non-payment of taxes negatively affects the financing of publicly provided goods or services such as schools, roads or defence and security. However, even sending this reminder increased the proportion of non-payers who paid the tax after the reminder (by 6.7% compared to the control group).

An experiment was conducted in Belgium which focused on income tax defaulters at the national level (Luts & Roy, 2019). They sent various reminder letters to taxpayers who had not paid their tax. They used 7 alternative letters (including a control group) in which they applied nudges of different nature. The first letter used social norms formulated in such a way that 95% of taxes in Belgium are paid on time. Another letter informed taxpayers about the areas that are financed thanks to taxes (education, health, etc.) and also a negative version of this letter. Other versions of the letters used, for example, heuristics, the status quo, loss aversion and informed about the fines for not paying taxes, or were a combination of several versions of the letters. The most effective version of the letter contained information about the fine. It resulted in a 20% increase in payments compared to the control group.

In the conditions of the Slovak Republic, where our experiment was carried out, interventions have also been implemented in this area. The Financial Administration of the Slovak Republic, in cooperation with the Institute of Financial Policy, the Value for Money Institute, the University of Economics in Prague and City University in London, launched an experiment aimed at making taxpayers aware of the obligation to pay income tax on the sale of real estate and thus increase the success rate of its collection. A taxpayer is legally obliged to file a tax return if they sell a property within 5 years of its acquisition or 5 years of its removal from business property. Between 2016 and 2019, there were over 15 thousand sales of real estate that could have been affected by this taxation, but only in one third of the cases was a tax return filed. These properties were identified based on changes in the real estate cadastre database, while most of the transfers, which are not subject to taxation according to the law, were excluded from the examined sample. The estimated annual loss in taxes and fees amounts to approximately EUR 22 million. The identified entities that may have incurred a tax liability were subsequently divided into two groups based on the time of the tax liability: potential debtors and potential taxpayers. The essence of the experiment was to find out which type of notice works best for

potential debtors and taxpayers. The identified subjects were therefore randomly divided into a control and test group before the letters were sent. Subjects in the control group did not receive any letter, while subjects in the test group were sent several forms of letters with different behavioural modifications (deterrent effect: threat of audit and threat of fines – letter contained also information on the probability of being audited and the penalty rate according to tax administration statistics or letter informed firms of the exact audit probability that was assigned to them, moral appeal saying– for example nine of ten people pay their tax on time, and implicit threat – there is no difference between omission and knowing non-payment of tax). The sending of the warnings generated an additional EUR 2.5 million for the state budget, of which approximately EUR 1.8 million were collected from potential debtors (ex-post) and approximately EUR 0.7 million were collected from potential taxpayers (ex-ante). This amount is already net of the control group, i.e. the amount of funds collected from entities to which no letter was sent. This confirmed that behavioural interventions are an effective method to reach tax debtors and to remind them to comply with their tax obligations at minimal cost to the public administration. This result suggests, among other things, that ignorance rather than a conscious effort by taxpayers to avoid paying taxes is behind non-compliance following the sale of a property. Based on the results of the experiment, the Tax Authority will send annual notices to taxpayers focusing on the obligation to declare the income from the sale of the property. Given the frequent failure to declare income from the sale of houses and flats, other types of real estate, such as land, will also be targeted in the near future (Rybošová et al., 2021).

At the local level, the introduction of the intervention was part of the Behavioural Policy for a Caring City project, which follows a global trend to use behavioural insights for the benefit of local residents. The Institute of Public Policy of the Faculty of Public Policy of the University of Economics in Bratislava and the Civita Center collaborated on the intervention. The intervention was implemented in May 2019, with the mapping of the city's agenda and the design of the intervention taking place between May 2018 and April 2019. The intervention not only tested the effectiveness of the municipal waste arrears reminder itself, but also tested the effectiveness of two types of framing - social norm and thank you. The intervention succeeded in collecting 7% of the total amount owed. The results of the regression analysis show that the most effective intervention is the reminder together with the social norm, which increased by 1.7 times the chance of paying at least part of the arrears. Further testing and replication of the research design is essential. However, initial testing suggests the potential of both the reminder tool and the framing of the challenge in the form of a social norm. It also shows that local governments should use reminders to reach out in particular to debtors who do not have a long history of non-payment (Civita Center, 2020).

Another proposed behavioural intervention aimed to increase the rate of payment of the municipal waste fee in Hlohovec. In the proposed experiment, leaflets were used, which were sent to individuals together with the municipal waste payment notice by regular

mail, i.e. the experiment did not include subjects who use an electronic form of communication with the city. Households were divided into three groups, with approximately 3 000 households in each group. Households in the control group did not receive any leaflet, they were only sent a standard fee schedule. Households in the first intervention group were sent a leaflet with the fee assessment aimed at deterring illegal behaviour, reminding them that if they did not pay the fee on time, distraint proceedings could follow. Households in the second intervention group received a leaflet with the fee assessment oriented towards a social norm, which took the form of information that the vast majority of households pay the fee. Consistent with previous research (e.g., Dell'Anno, 2009; Castro & Scartascini, 2015), the aim of the leaflet was to influence the perception of the rate of compliance with waste fee payment deadlines by other city residents. The results of the analysis showed that an intervention using a positive message (i.e. attaching a leaflet with a social norm) had a positive and statistically significant effect on the payment of the municipal waste fee in the post-intervention period. Subjects who received a notice to pay the municipal waste fee together with a leaflet from which they learned that the vast majority of citizens pay their municipal waste fees on time were also more likely to pay the fee on time than citizens in the control group who were only sent a payment notice (Čaplánová et al., forthcoming).

The above-mentioned studies use various models that decipher factors of human behaviour. An overview of the most commonly used models, which also underpin our proposed interventions, is provided in Table 1.

The COM-B (Capability, Opportunity, Motivation - Behaviour) model was developed by analysing existing models for behaviour change and designing behavioural interventions. Thus, it represents an integrative model that helps to determine what behavioural interventions are appropriate for a given type of problem. According to the COM-B model, behaviour is the result of a combination of physical and psychological fitness, physical and social opportunity, and last but not least, the reflexive and automatic motivation of its performers (Michie et al., 2011).

Dolan et al., (2012) defined the nine most significant factors influencing individuals' actions, referred to as the MINDSPACE concept. The premise is that individuals analyse information in the form of the myriad of cues available to them from politicians, the state, local governments and the market when making decisions, and the result is decisions that reflect, given these cues, their best interests.

In many experiments the behavioural approach is based on interventions that are called EAST: Easy, Attractive, Social and Timely. To make it easy the authors (Service et al., 2017) recommend harnessing the power of defaults, reduce the 'hassle factor' of taking up a service and simplify messages. Attractiveness is aimed at attracting attention and designing rewards and sanctions for maximum effect. Social in this concept means showing that most people perform the desired behaviour, using the power of networks and encourage people to make a commitment to others. To make the intervention timely

is to prompt people when they are likely to be most receptive, consider the immediate costs and benefits and help people plan their response to events.

Behavioural insights help explain not only why people fail to act, but what can be done to encourage people to take action. Created by the »Behavioural Interventions to Advance Self-Sufficiency« project team, the SIMPLER framework describes behavioural principles that were commonly applied across the project's interventions. The SIMPLER concept aims to increase and capture the attention of citizens and motivate them to become genuinely engaged in public policy problem solving (Anzelone et al., 2018).

**Table 1:** Models of factor influencing human behaviour

<i>Behavioural aspect according to the COM-B model</i>	<i>MINDSPACE concept</i>	<i>EAST concept</i>	<i>SIMPLER concept</i>
<i>Michie et al., 2011</i>	<i>Dolan et al., 2012</i>	<i>BIT, 2014</i>	<i>Anzelone et al., 2018</i>
PHYSICAL ABILITY - physical skill, strength or energy	Messenger - education, knowledge of the issue, appearance, gender, age, charisma of the leader, confidence	Easy	social influence
PSYCHOLOGICAL ABILITY - the knowledge or psychological skill, strength or energy to engage in the necessary mental processes	Incentives -incentives to perceive the situation - risk aversion, trust		implementation prompts
PHYSICAL OPPORTUNITY - an opportunity provided by the physical environment that includes time, resources, location, stimuli, and physical space	Norms - social (ethnicity, group size, group affiliation, different types of social groups), cultural, societal norms	Attractive	mandated deadlines
SOCIAL OPPORTUNITY - opportunity provided by interpersonal influences, social cues and cultural norms that affect the way we think about things, e.g. the words and concepts that make up our language	Defaults - repetition of a given situation, individual decision-making	Social	personalisation
	Salience - clarity of message		loss aversion
REFLECTIVE MOTIVATION - reflective processes involving planning: conscious intentions and reassessment, assumptions about what is good and bad	Priming - the way the message is disseminated (advertising), the environment in which the message is disseminated, the acceptance by the individual		
AUTOMATIC MOTIVATION - automatic processes involving emotional reactions, desires, wants and needs, impulses and obstacles, reflexes and other motives	Affect - emotional associations	Timely	ease
	Commitments - commitment, individual's promise		reminders
	Ego - success of the individual		

Source: Own based on authors.



### 3 Research

The aim of the paper is to analyse an experiment implemented in the area of tax and fee collection in the city of Banská Bystrica with the intention of pointing out the factors that were behind the fact that the interventions in this case did not turn out as expected.

The city of Banská Bystrica (BB) is both a district and regional seat of local government, with a population of 78 484 inhabitants it is the sixth largest town in Slovakia. Real estate taxes constitute a significant part of the city's income, almost one-fifth (Table 2).

**Table 2:** Percentage share of real estate tax on current tax revenues of the city of BB for the years 2015 – 2020

Year	% share of real estate tax in current tax revenue
2015	19.43
2016	18.00
2017	17.10
2018	16.10
2019	15.56
2020	19.52

Source: Own based on Banská Bystrica's budgets.

A list of defaulters is published by the city by 31 December each year on its website, namely those whose arrears exceed € 160 in the case of a natural person and € 1 600 in the case of a legal entity.

The city sends a reminder to tax defaulters - a notice to pay every 2 years. If the debtors fail to pay the arrears even after the expiry of the deadline for payment set in the notice sent, the recovery of the arrears in the tax distraintment procedure is assigned to an external bailiff.

In addition to the service of summonses and the referral of cases for distraintment, the names of debtors are published on an electronic notice board. The list of debtors is published in accordance with Article 52 of Act No 563/2009 Coll., the list of tax debtors as at 31 December of the previous year whose aggregate amount of tax arrears exceeded € 160 for a natural person and € 1 600 for a legal person.

The City of Banská Bystrica registers approximately 4 440 real estate tax defaulters as of 18 October 2021 (Banská Bystrica, 2021). The total debt of natural persons amounts to approximately € 516 000. Arrears for municipal waste for individuals amounted to approximately € 1.65 million. In this case, there are 10 455 defaulters.

Interviews with representatives of the City of Banská Bystrica revealed that defaulters are often from socially disadvantaged groups making the recovery of arrears particularly challenging. The administration associated with sending notices and distraintment proceedings is also time-consuming, so the city was interested in trying to use behavioural intervention to increase the efficiency of tax and fee collection and reduce the number of defaulters.

The main objective of the experiment was to actively contribute to solving the problem of non-payers of local taxes and the local municipal waste fee in the city of Banská Bystrica through the use of behavioural nudging, and thus to maximise the desired behaviour of debtors - to pay the arrears of their local tax or fee. There are several types of local taxes in Slovakia: real estate tax, dog tax, vending machine tax, accommodation tax, and one local fee for municipal waste. Using a behavioural intervention, we investigated how defaulters react to different forms of behavioural nudges embedded in a leaflet that was part of a reminder sent to the debtor.

The experiment was conducted during the months of October and November 2021, when tax administrators typically send reminders to debtors (tax assessments are sent in May), by sending leaflets containing a simple infographic reflecting a particular type of nudge to reinforce their effect. Leaflets were sent to defaulters assigned to each intervention group (Intervention Group 1 - Moral norm leaflet, Intervention Group 2 - Social norm leaflet, Intervention Group 3 - Fear of loss intervention leaflet), together with an invitation to pay the tax arrears.

The first leaflet using the moral norm emphasised the fact that if the defaulter paid the arrears, they would become part of the paying majority (first leaflet in Figure 1). In designing the leaflet and using this moral norm, we were inspired by successful experiments (e.g. Hallsworth et al., 2014; Popper, 2015; Hernandez et al., 2017, Kettle et al., 2016, Sičáková-Beblavá et al., 2019) where the effectiveness of such a nudge has been demonstrated. The effectiveness of moral norms is mainly ensured by social opinion, as they evaluate the behaviour of citizens. Moral norms include honesty, fairness, responsibility, etc.

The leaflet sent to the second group refers to social norms, and in particular to a person's belief that he or she should act in a certain way. When creating the leaflet, we focused on belonging to a group of people who share the same surname (leaflet 2 in Figure 1). A social norm, broadly defined, is any information about the standard of behaviour of other members of a particular social group (Cialdini et al., 1990). A social norm can take several forms. A descriptive norm describes how others in the group behave. An injunctive norm describes a popular assumption about what should be right and wrong behaviour in a group.

A leaflet created for the third group is intended to be intimidating. It encourages defaulters to pay the tax assessed to avoid distraintment proceedings. The leaflet works with the concept of loss aversion and informs the defaulters that "There is a high probability that if you are found to be irregular in paying your taxes, your case will be referred to distraintment proceedings and, among other things, your driving licence may be revoked, or the arrears withdrawn from your pension, salary or account" (Fig.1, leaflet 3). This information is intended to make the defaulter feel the importance of paying the tax and the possible consequences of not paying the tax. The defaulter should take action to avoid loss from non-compliance. Loss in this case may include the withdrawal of a driving licence, so the leaflet also features a graphic representation of a car to attract attention. Factors influencing people's decision on how to behave have been addressed in a number of studies. Deterrence by drawing attention to the risk and/or cost of detection provides people with a rational reason not to do such and such behaviour (Iyer et al., 2010). Fear of norm violation, nonconformity, and social pressure have been used effectively in public administration several times in the context of energy, waste management, and recycling, as well as elections (Allcott, 2011; Cialdini & Goldstein, 2004; Gerber & Rogers, 2009; Schultz, 1999).

All three intervention leaflets were created in the same style and the typical colours of the city, the red and white stripes, which can be found on the coat of arms and flag of Banská Bystrica, can also be seen. The leaflets were consulted with the city's economic department to provide correct and truthful information.

**Figure 1:** Leaflets used in the implementation of the experiment in Banská Bystrica

Source: Own.

\*Translation of the text on leaflets:

**Join the paying majority! -  
Moral norm letter**

Did you know that 9 out of 10 taxpayers in Banská Bystrica have already paid their local taxes and municipal waste fee?

**Join the paying majority! - Social norm letter**

Did you know that people with the same surname as you pay their local taxes and municipal waste fee on time?

**Pay up and avoid distraint proceedings! - Threatening letter**

There is a high likelihood that if you are found to be in arrears in paying your council tax and council tax, your case will be referred to distraint proceedings and, amongst other things, your driving licence may be revoked or the arrears taken from your pension, wages or account.

The experiment involved 520 tax subjects, 130 subjects in each intervention group and 130 subjects in the control group. The Economic Department randomly selected the tax subjects, i.e., the randomization was fully in their hands. The tax subjects were non-payers of real estate tax, dog tax and local municipal waste tax.

As part of the experiment, basic data on all 520 tax subjects were collected after the leaflets had been sent out. The type of tax for which the taxpayer is in arrears, the amount of the arrears (as well as the amount of the paid and unpaid part of the arrears) and whether or not the taxpayer accepted delivery of the leaflet sent by the municipality were recorded. Out of 520 tax subjects, 393 (75.58 %) accepted the notice to pay the tax arrears or the reminder. The remaining 127 tax subjects did not take delivery of the notice.

**Table 3:** Number of leaflets eventually reached the recipients

	Number of letters sent	% of tax subjects accepted the notice to pay	% of tax subjects did not take delivery of the notice
Control group	130	77%	23%
1. group (moral norm)	130	75%	25%
2. group (social norm)	130	75%	25%
3. group (fear of loss norm)	130	75%	25%
Total	520	393	127

Source: Own.

There was no significant difference in the number of notices taken up and not taken up (75.38 % i.e., 98 taken up in Groups 1 and 2; 74.61 % i.e., 97 taken up in Group 3 and 77 % i.e., 100 taken up in the control group).

We used descriptive statistics (e.g. the number of defaulters who paid the tax after the notice, the total value of summonses paid, etc.).

## 4 Discussion

In the table below, we report the arrears payment rate by each experimental group monitored.

**Table 4:** Baseline experimental results by group

Group	Amount in €	Amount in %	Number of appeals	Effectiveness - % of taxes/fees paid on the notice received
Control group				
Unpaid notices	€ 8 471.26	50.60%	75	75
Notices outstanding	€ 8 270.65	49.40%	55	
Total	€ 16 741.91	100%	130	
1. group (moral norm)				
Unpaid notices	€ 6 457.23	52.99%	66	67.35
Notices outstanding	€ 5 727.78	47.01%	64	
Total	€ 12 185.01	100%	130	
2. group (social norm)				
Unpaid notices	€ 4 487.28	43.76%	69	70.41
Notices outstanding	€ 5 767.88	56.24%	61	
Total	€ 10 255.16	100%	130	
3. group (fear of loss norm)				
Unpaid notices	€ 3 956.19	34.13%	53	54.64
Notices outstanding	€ 7 635.03	65.87%	77	
Total	€ 11 591.22	100%	130	

Source: Own.

The most successful group was the control group, in which 75 arrears totalling € 8 471.26 were paid and 30 arrears totalling € 8 270.65 remained unpaid. In terms of intervention groups, the second intervention – social norm group was the most successful. Our results are similar to Halpern (2015), Civita Center, 2020; Dell'Anno, 2009; Castro & Scartascini, 2015, where the results showed that the more specific the text of the reminder letter was, the more likely the defaulter was to pay the tax. In our case, the surname of the individual was decisive.

The intervention in this group appears to have been effective, although it is not possible to clearly identify the proportion of the impact of the intervention and other factors that may have influenced the decision of the defaulters. In terms of the number of notices

taken up, the first intervention group was third. There were 66 notices paid, representing 51 %. The total amount of arrears paid was € 6 457.23. Last in terms of both receipt of reminders and payment of arrears was surprisingly the fourth group with the notice for possible loss due to non-payment. It can be stated that a total of 188 out of 390, i.e. 48.20%, of the arrears were paid within the intervention groups. In the control group, which did not receive the reminder leaflet, 75 arrears out of 130, i.e. 57.69%, were paid. Based on the above results, the behavioural intervention appears to be unsuccessful. Contrary to our results Pomeranz and Vila-Belda (2019) claim that nudges implemented by tax authorities are more effective in shifting perceptions of audit probabilities than perceptions of social norms.

To further analyse the effectiveness of the intervention, we examined the impact of the interventions on the different tax and fee groups whose arrears were targeted by the experiment. Table 5 presents the results of the comparison.

**Table 5:** Evaluation of the experiment by type of tax and local fee

Type of tax/fee	Group	Number of notices	Number of notices received	% of notices received	Amount of arrears paid on receipt of the notice	Total amount of arrears paid	% effectiveness - amount of arrears upon acceptance/amount of arrears paid
Real estate tax	Control group	50	34	68.00%	1 728.3	1 833.3	94.27%
	1. group	50	38	76.00%	1 777.45	18 72.95	94.90%
	2. group	40	32	80.00%	<b>787.2</b>	<b>787.2</b>	<b>100.00%</b>
	3. group	50	38	76.00%	911.75	1 198.01	76.11%
Dog tax	Control group	19	17	89.47%	299	335	89.25%
	1. group	19	15	78.95%	<b>428</b>	<b>428</b>	<b>100.00%</b>
	2. group	20	15	75.00%	582	618	94.17%
	3. group	19	14	73.68%	432	540	80.00%
Municipal waste fee	Control group	61	49	80.33%	6 270.02	6 302.96	99.48%
	1. group	61	45	73.77%	<b>4 156.28</b>	<b>4 156.28</b>	<b>100.00%</b>
	2. group	70	51	72.86%	2 928.78	3 082.08	95.03%
	3. group	61	45	73.77%	2 202.08	2 218.18	99.27%

Source: Own.

In the table, we see that in terms of the effectiveness of each intervention in relation to the selected tax or fee, the intervention using the social norm in the case of property tax has been shown to be potentially effective. All those who received the notice and leaflet also paid the arrears. For the dog tax and, similarly, for the municipal waste fee, an

intervention based on a moral norm, pointing out that 9 out of 10 taxpayers had already paid the tax or charge, appeared to be the most effective intervention.

Although overall it appeared that the intervention was unsuccessful and did not meet our expectations, a deeper analysis of the results of the experiment points to the fact that individual types of interventions had a different effect on the behaviour of the residents and on inducing their activity. A number of factors may have influenced the results achieved by the experiment:

- **Communication with the city of Banská Bystrica** was promising at the beginning, with both the mayor and the deputy mayor pledging support for the experiment. However, when it came to the implementation of the experiment, officials from the Economic Department declared that they could not provide the necessary information and that participation in the experiment would be contrary to the legislation of the Slovak Republic. The research team had to argue that similar experiments had been conducted in the municipality of Prievidza and therefore there was nothing illegal. Still, the research team had to undergo a great number of meetings during a year and a half. Consequently, 10 months elapsed between the admission of the possibility to realise this intervention to its implementation, but this was also due to the fact that the intervention was applied to reminders. Civil servants, overburdened with their duties, were apparently reluctant to participate in the research because it meant additional tasks for them. We can observe here the so-called civil servant resistance (Hemmer, 2014; Shah, 2019). The civil servants eventually agreed to participate, but we also encountered resistance when evaluating the results, and the team had to repeatedly ask them to provide data in a format that could be further worked with. Despite the fact that the long communication with the employees did not influence the real implementation of intervention as such, we lost the opportunity to use intervention as a part of regular tax call. It could have offered an interesting comparison of experiment results among tax payers and tax non-payers.
- **The heterogeneity of the groups** was conditioned by the fact that the city of Banská Bystrica decided to combine three types of taxes and fees that were to be the subject of the experiment: real estate tax, dog tax and municipal waste fee. The city divided the research sample of 520 defaulters into 4 groups (1 control, 3 intervention) and although they tried to maintain an approximately equal share of defaulters of each tax and fee, this distribution was no longer even with respect to the amount owed. The types of arrears selected by the city for which it wanted to intervene are diametrically different in terms of the subject of taxation or fee, and the amount of the arrears is also significantly different. According to the data provided, the highest arrears were for the municipal waste tax and the lowest for the dog tax. This fact is supported by the results of the examination of the relationship between the payment of arrears in the second intervention group and the amount of arrears in the second intervention group, where a low to medium level of dependence was confirmed. These differences could then be reflected both in the number of reminders paid and



in the total amount owed, which skewed the results of the nudge. This also limited the experiment based conclusions.

- **Lack of information about the research sample** - in processing the results of the experiment, we encountered the additional limitation of lack of information about the research sample, such as gender, age, length of arrears, regularity of payment of fees, and whether they were in arrears in only one or more areas. If we had these data, it would be possible to better assess whether the individual is a 'habitual defaulter' on whom no intervention is likely to be effective, or just an 'occasional defaulter' who could be nudged to pay the arrears by an intervention. However, these data were not provided by the city, while in Prievidza they helped to reveal other contexts. According to the results of the experiment in Prievidza (Sloboda et al., 2022), the most effective type of reminder for municipal waste fee debtors was Intervention A, i.e. letter + social norm, and they also found that the intervention was more effective on men than on women, but this result is difficult to interpret as it may be related to income inequality or single-parent families with more difficult economic circumstances. The useful feature that should be also researched is the regularity in non-payment of taxes of each subject. On the other hand, the city of Banská Bystrica does not regularly collect such data; it works with different software than the city of Prievidza. Therefore, it would be very complicated and time-consuming for the Economic Department to provide us with additional data on the research sample. The lack of data about the research sample limited the possibilities of statistical evaluations, e.g. regression and correlation analysis.
- **Premature disclosure of information about the experiment** was made by the city. As local elections are approaching, the city leadership used the information about the experiment as an opportunity to promote itself as an innovative smart city that engages in projects and research and uses the latest findings of behavioural economics. By publishing the information before the leaflets were sent out, they were able to influence non-payers in a negative direction in the sense that people do not like to be 'manipulated' (Wilkinson, 2013), i.e. they chose to ignore the invitation with the leaflet and did not pay the tax/fee on purpose.
- **Social status of the tax payers** - single-parent families, households with one or more protected persons, etc.
- **The COVID-19 pandemic** persisting since March 2020 could have a negative impact on the ability of individuals to pay local taxes and fees, regardless of social status as outlined above.
- **Time factor** - the intervention took place in the months October - November 2021 but there are many non-payers who pay their obligations by the end of the year, always in December. This has also been confirmed by the city's Economic Department, which has this experience with chronic non-payers - despite a reminder (sent by the city every year as standard) to pay their taxes and fees by the deadline, they do so basically on 31 December every year.

As in the case of Banská Bystrica, other research points to the possible failure of tax and fee interventions. Research in 2017 showed that messages with social norms or other behavioural nudges work, but cannot be applied everywhere and in every circumstance (Hallsworth et al., 2017; Hernandez et al., 2019). In the case of the Guatemala intervention, there was no increase in tax payments (The Behavioural Insights Team, 2018). Similarly, in Nebraska, an informational nudge was unlikely to be sufficient to substantially change tax filing behaviour (Anderson, 2017). Findings from studies in the United Kingdom suggest that successful interventions at the national level may not necessarily be successful at the local level (Hallsworth et al., 2017; John & Blume, 2017). Therefore, when introducing behavioural interventions, it is essential to consider the particular characteristics of the area where the intervention will be implemented and to identify potential problems with the introduction of the intervention.

Although the experiment in Banská Bystrica did not produce the desired effect in the form of a higher number of paying tax subjects, we can mention other Slovak municipalities (Prievidza, Hlohovec), as well as other examples that we have presented in the theoretical section. among the successful cases that tried to improve tax collection from tax subjects and timely tax payment.

In the case of Banská Bystrica, it is also necessary to consider the possibility of using another form of behavioural intervention, e.g. changing the wording of the notice to the arrears management, simplifying the provision of data on the form of payment when paying via QR codes, send email, etc.

## 5 Conclusions

The aim of the paper was to analyse an experiment implemented in the area of tax and fee collection in the city of Banská Bystrica with the intention of pointing out the factors behind the fact that the intervention in this case did not turn out as expected. The intervention took the form of distributing variously worded leaflets to citizens assigned to the intervention groups. We expected that the proportion of tax defaulters would decrease as a result of this intervention. Based on the data obtained from the experiment, we found that 188 out of 390, i.e. 48.20%, to whom the intervention leaflet with reminder was sent, paid the arrears. In the control group that did not receive the reminder leaflet, 75 out of 130, i.e. 57.69%, of the arrears were paid. This expectation has not been met and we gave a number in the discussion of reasons why this might be the case. We consider the main reason to be the heterogeneity of the research sample. The fact that the sample included not only tax defaulters, but also defaulters of local dog tax and municipal waste fees, affected whether they paid or not (it makes a difference whether the taxpayer has to pay € 15 for the dog or € 150 for the waste). The most important factor is probably the composition of taxpayers in the intervention and control groups. The research team could not directly influence the composition of the sample, which also proved to be crucial in the evaluation of the implemented experiment. Although random sampling is

considered to be one of the most appropriate from a statistical perspective, its use produced very heterogeneous groups. A more appropriate composition of the groups would have been with debtors with equal proportional representation of each type of tax and fee. At the same time, other data on tax subjects and their behaviour (e.g. gender, age, length of the period for which the arrears are recorded) were absent, which would have made it possible to draw more valuable conclusions from the experiment carried out. On the other hand, it is possible to learn from the implementation of the above experiment and to be inspired when implementing other behavioural interventions, whether in other Slovak or foreign local governments.

In the implementation of experiments aimed at the use of nudges to reduce tax and fee arrears, given that this is a relatively sensitive topic, the willingness of public officials to cooperate and create adequate conditions for its implementation plays a crucial role.

An important factor is also a well-designed methodology for the experiment, which at the same time must always reflect the relevant legislative framework, the specificities of the different levels of government and their competences, and be respected by all the actors involved. The success of an experiment can be influenced by a large number of factors, not all of which can be anticipated in advance and reflected in the methodology of the experiment to be carried out.

Nevertheless, the experience of similar experiments available in the literature and, in part, the results obtained in our research suggest that behavioural interventions aimed at increasing the payment of taxes and fees should be considered as an effective and inexpensive way of reducing the share of non-payers of taxes and fees, not only at the local level but also at the central level.

The presented research has its limitations, in particular the focus of the analysis on only one municipality. The experiment was conducted on a relatively small research sample with considerable heterogeneity. Future research will focus on examining the composition of arrears types in different groups. Nevertheless, several aspects of why the behavioural intervention may fail have emerged, and this may be an issue for further research. Why and when do nudges fail to meet expected outcomes, and what can we learn from such failures?

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## References:

- ACT on tax administration (Tax Code) No. 563/2009*, (December 1, 2009), Slov-Lex, available at: <https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2009/563/> (September 12, 2022).
- Allcott, H. (2011). Social norms and energy conservation, *Journal of Public Economics*, 95(9–10), pp. 1082–1095, <https://doi.org/10.1016/j.jpubeco.2011.03.003>.
- Allingham, M. G. & Sandmo, A. (1972) Income tax evasion: a theoretical analysis, *Journal of Public Economics*, 1(3–4), pp. 323–338.
- Anderson, J. E. (2016) Paying the State Use Tax, *Public Finance Review*, 45(2), pp. 260–282, <https://doi.org/10.1177/1091142115614390>.
- Anzelone, C., Yu, J. & Subedi, P. (2018a) Using behavioral insights to increase participation in social services programs: A case study, *MRDC (OPRE Report 2018-73)*, available at: <https://www.mdrc.org/publication/using-behavioral-insights-increase-participation-social-services-programs> (September 2, 2022).
- Bernheim, B. D. & Taubinsky, D. (2018) Behavioral Public Economics, *NBER Working paper series*, available at: [https://www.nber.org/system/files/working\\_papers/w24828/w24828.pdf](https://www.nber.org/system/files/working_papers/w24828/w24828.pdf) (August 28, 2022).
- Bott, K. M., Cappelen, A. W., Sorensen, E. & Tungodden, B. (2017) You’ve got mail: A randomised field experiment on tax evasion, *SSRN Electronic Journal*, <https://doi.org/10.2139/ssrn.3033775>.
- Castro, L. & Scartascini, C. (2015) Tax compliance and enforcement in the pampas evidence from a field experiment, *Journal of Economic Behavior & Organization*, 116, pp. 65–82, <https://doi.org/10.1016/j.jebo.2015.04.002>.
- Cialdini, R. B. & Goldstein, N. J. (2004) Social influence: Compliance and conformity, *Annual Review of Psychology*, 55(1), pp. 591–621, <https://doi.org/10.1146/annurev.psych.55.090902.142015>.
- Cialdini, R. B., Reno, R. R. & Kallgren, C. A. (1990) A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places, *Journal of Personality and Social Psychology*, 58(6), pp. 1015–1026, <https://doi.org/10.1037/0022-3514.58.6.1015>.
- Civita Center (2020) *Pripomienky dlžníkom na poplatku za komunálny odpad*, available at: [https://www.civitacenter.sk/wp-content/uploads/2020/05/04\\_Ciastkovy\\_doc\\_Sprava\\_01Reminders\\_final.pdf](https://www.civitacenter.sk/wp-content/uploads/2020/05/04_Ciastkovy_doc_Sprava_01Reminders_final.pdf) (September 12, 2022).
- Coleman, S. (2017) The Minnesota income tax compliance experiment: Replication of the social norms experiment, *SSRN*, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1393292](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1393292) (March 16, 2022).
- Čaplánová, A., Siraková, E., Vitálišová, K. & Pavlovský, P. (2022) Behaviorálne intervencie zamerané na zvyšovanie výberu daní a poplatkov na centrálnej a miestnej úrovni, In: Sičáková Beblavá, E., Čaplánová, A. & Sloboda, M. (eds.) *Behaviorálna veda v službách verejnej správy: behaviorálne intervencie v praxi* (Bratislava: FSEV UK), pp. 81–118.
- Dell’Anno, R. (2009). Tax evasion, tax morale and policy maker’s effectiveness, *The Journal of Socio-Economics*, 38(6), pp. 988–997, <https://doi.org/10.1016/j.jsocec.2009.06.005>.
- Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R. & Vlaev, I. (2012) Influencing behaviour: The Mindspace way, *Journal of Economic Psychology*, 33(1), pp. 264–277, <https://doi.org/10.1016/j.joep.2011.10.009>.
- Gerber, A. & Rogers, T. (2009) Descriptive social norms and motivation to vote: Everybody’s voting and so should you, *The Journal of Politics*, 71(1), pp. 178–191.

- Hallsworth, M., List, J. A., Metcalfe, R. D. & Vlaev, I. (2017) The behavioralist as tax collector: Using natural field experiments to enhance tax compliance, *Journal of Public Economics*, 148, pp. 14–31.
- Halpern, D. (2015) *Inside the Nudge Unit: How small changes can make a big difference (Reprint)*, (London: Ebury Publishing).
- Hansen, P. G. (2018) Basic toolkit and ethical guidelines for policy makers – draft for consultation, *Paper presented at the Western Cape Government – OECD Behavioural insight conference*, September 27–28, in Cape Town, South Africa (Paris: OECD Publishing), available at: <http://www.oecd.org/gov/regulatory-policy/BASIC-Toolkit-Draft-for-Consultation.pdf> (September 12, 2022).
- Hauptman, L., Horvat, M. & Korez-Vide, R. (2014) Improving tax administration's services as a factor of tax compliance: The case of tax audit, *Lex Localis - Journal of local self-government*, 12(3), pp. 481–501.
- Hemmer, A. (2014) Civil servant suits, *The Yale Law Journal*, 124(3), pp. 758–803, available at: <https://www.yalelawjournal.org/note/civil-servant-suits> (September 20, 2022).
- Hernandez, M., Jamison, J., Korczyk, E., Mazar, N. & Sormani, R. (2017) Applying behavioral insights to improve tax collection, *Open Knowledge*, available at: <https://openknowledge.worldbank.org/handle/10986/27528> (March 16, 2022).
- Iyer, G. S., Reckers, P. M. J. & Sanders, D. L. (2010) Increasing tax compliance in Washington state: A field experiment, *National Tax Journal*, 63(1), pp. 7–32, <https://doi.org/10.17310/ntj.2010.1.01>.
- Jakuš Muthová, J., Murray Svidroňová, M. & Vitálišová, K. (2022) Smart Interventions for Smart Cities: Using Behavioral Economy in Increasing Revenue from Local Fees and Why It Might Sometimes Fail, *Computational Science and Its Applications – ICCSA 2022 Workshops*, pp. 141–156, [https://doi.org/10.1007/978-3-031-10592-0\\_12](https://doi.org/10.1007/978-3-031-10592-0_12).
- John, P. & Blume, T. (2017b) Nudges that promote channel shift: A randomized evaluation of messages to encourage citizens to renew benefits online, *Policy & Internet*, 9(2), pp. 168–183, <https://doi.org/10.1002/poi3.148>.
- Kettle, S., Hernandez, M., Ruda, S. & Sanders, M. (2016) Behavioral interventions in tax compliance, *Open Knowledge*, available at: <https://openknowledge.worldbank.org/handle/10986/24530> (March 13, 2022).
- Kettle, S., Hernandez, M., Sanders, M., Hauser, O. & Ruda, S. (2017) Failure to CAPTCHA Attention: Null Results from an Honesty Priming Experiment in Guatemala, *Behavioral Sciences*, 7(4), p. 28, <https://doi.org/10.3390/bs7020028>.
- Luts, M. & Roy, M. (2019) Nudging in the context of taxation, *IOTA*, available at: [https://www.iotatx.org/sites/default/files/documents/iota\\_paper\\_belgium\\_nudging\\_final.pdf](https://www.iotatx.org/sites/default/files/documents/iota_paper_belgium_nudging_final.pdf) (March 16, 2022).
- Michie, S., Atkins, L. & West, R. (2014b) *The behaviour change wheel: A guide to designing interventions* (Bream: Silverback Publishing).
- OECD (2017) *Behavioural insights and public policy: Lessons from around the world* (Paris: OECD Publishing), <https://doi.org/10.1787/9789264270480-en>.
- Pomeranz, D. & Vila-Belda, J. (2019) Taking State-Capacity Research to the Field: Insights from Collaborations with Tax Authorities, *Annual Review of Economics*, 11, pp. 755–781, <https://doi.org/10.1146/annurev-economics-080218-030312>.
- Popper, M. (2015b) Vymedzenie noriem, prvopočiatky morálky a vzájomná dôvera, *Filosofie Dnes*, 7(1), pp. 22–38, <https://doi.org/10.26806/fd.v7i1.187>.

- Románová, A., Radvan, M. & Schweigl, J. (2019) Constitutional Aspects of Local Taxes in the Slovak Republic and in the Czech Republic, *Lex Localis - Journal of local self-government*, 17(3), pp. 591-616.
- Rybošová, P., Gábik, R., Priesol, R. & Machlica, G. (2021) *Písať listy sa opláti: Ako zvýšiť daňové príjmy rýchlo a efektívne* (Ministerstvo financií Slovenskej republiky), available at: <https://www.mfsr.sk/files/archiv/49/Komentar.pdf> (August 30, 2022).
- Schultz, P. W. (1999) Changing behavior with normative feedback interventions: A field experiment on curbside recycling, *Basic and Applied Social Psychology*, 21(1), pp. 25–36.
- Service, O., Hallsworth, M., Halpern, D., Algate, F., Gallagher, R., Nguyen, S., Ruda, S., Sanders, M., Pelenur, M., Gyani, A., Harper, H., Reinhard, J. & Kirkman, E. (2017) EAST Four simple ways to apply behavioural insights, *Annual Review of Policy Design*, 5(1), pp. 1–53.
- Shah, B. (2019) Civil servant alarm, *Chicago-Kent Law Review*, 94(3), available at: <https://scholarship.kentlaw.iit.edu/cklawreview/vol94/iss3/8> (September 30, 2022).
- Sičáková-Beblavá, E., Sloboda, M. & Pavlovský, P. (2019) Záverečná správa z realizovanej behaviorálnej intervencie: Pripomienky dlžníkom na poplatku za komunálny odpad, *Behavioralna Verejna Politika*, available at: [https://www.behavioralnaverejnapolitika.sk/wp-content/uploads/2020/03/pripomienky\\_dlznikom\\_na\\_poplatku\\_za\\_komunalny\\_odpad.pdf](https://www.behavioralnaverejnapolitika.sk/wp-content/uploads/2020/03/pripomienky_dlznikom_na_poplatku_za_komunalny_odpad.pdf) (September 20, 2022).
- Sloboda, M., Pavlovský, P. & Sičáková-Beblavá, E. (2020) The effectiveness of behavioural interventions on increasing revenue from local fees, *Review of Behavioral Finance*, 14(1), pp. 1–15.
- Thaler, R. H. & Sunstein, C. R. (2008) *Nudge: improving decisions about health, wealth, and happiness (Illustrated ed.)* (New Haven: Yale University Press).
- The Behavioural Insights Team (2018) *Testing the optimal frequency of tax reminders in Guatemala. Bi Team*, available at: <https://www.bi.team/wp-content/uploads/2019/11/Guatemala-1-TR-Increase-declaration-during-a-tax-amnesty.pdf> (March 16, 2022).
- Wilkinson, T. M. (2012) Nudging and Manipulation, *Political Studies*, 61(2), pp. 341–355, <https://doi.org/10.1111/j.1467-9248.2012.00974.x>.
- Yitzhaki, S. (1974) A note on: Income tax evasion: a theoretical analysis, *Journal of Public Economics*, 3(2), pp. 201-202.

## Benchmarking the Efficiency of Montenegro's Local Self-governments

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**Abstract** We examine the technical efficiency of Montenegro's local self-governments and determine the effect of tourism activity on Montenegro's local self-government efficiency. Due to the relatively small number of local self-governments in Montenegro, to conduct our analysis we combined principal component analysis (PCA) and Data Envelopment Analysis (DEA). We estimated the average technical efficiency of Montenegro's local self-government in 2011 to be between 60.3% and 67.3%, depending on the model. Furthermore, we confirm D'Inverno, et al., (2017) findings about the inverse relationship between tourism activity and efficiency. We estimated that on average tourism activity reduced Montenegro's coastal LSG technical efficiency by 30.4%.

**Keywords:** • Montenegro • local governments • efficiency • PCA-DEA • financial management

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## 1 Introduction

The Local Self-Governments (LSG) efficiency in providing local public goods and services is often used as an argument for further decentralization or increased centralization. Insistence on decentralization by entrusting additional competencies to LSGs that fail to provide services efficiently would provide little gain (Geys & Moesen, 2009a). The motivation for more efficient provision of public goods and services does not come just from policy goals but from financial constraints. LSGs could address these financial constraints without political costs by improving operational efficiency. The alternative is the reduction of public expenditures or an increase in fiscal burden, which could produce high political costs.

Montenegro is relatively a young state, as it gained its independence from the State Union of Serbia and Montenegro in 2006. The public governance system and territorial organization of Montenegro were inherited from the former Yugoslavia and the State Union. Montenegro has several distinctive characteristics concerning the role and financing of the local self-government. First, Montenegro has a relatively simple structure with only one level of sub-sovereign government – municipalities. Montenegro is currently divided into 24 municipalities (including two city municipalities). Since 2011, the year that is due to data availability used as the setting of this study, an additional two LSG were formed municipalities. Second, Montenegro is a highly centralized country. In particular, the central government oversaw education, health care, and social security, which was not always the case in neighbouring countries. As a result, the extent of local self-government competencies in Montenegro was substantially narrower than in neighbouring countries (NALAS, 2012). Third, LSGs are funded through four different channels: own revenues (fiscal and otherwise), allocated taxes and fees, the Equalization Fund, and state budget grants. As a consequence of no social sector responsibilities, Montenegrin LGS have a very high share of own revenues in total revenues. Increased LSG financial independence was provided with legislative changes in 2011. The new revenue structure increased municipalities' direct share in income from concession fees (70% vs. 30% previously) and real estate transfer tax (80% compared to the previous 50%). In addition, the new income structure provided additional funds for the Equalization Fund, namely 100% of revenues from passenger car, vessel, and aircraft taxes and 40% of revenues from concessions on games of chance.

To the best of our knowledge, there are no studies examining efficiency of Montenegrin LSGs. Therefore, in this paper, we examine the technical efficiency of Montenegrin's LSGs using an integrated approach by combining principal component analysis (PCA) and data envelopment analysis (DEA). Furthermore, Montenegro, and especially several municipalities are heavily dependent on tourism, and paper also assesses the effects of tourism on the efficiency of the provision of local public goods and services.



To this end this paper aims to make three main contributions. To begin, we hope to fill a gap in the empirical literature concerning the efficiency of Montenegrin LSGs. Second, we intend to create performance benchmarks for the present LSG system in Montenegro. Montenegro has previously completed territorial reforms by creating two new LSGs in 2013 and 2014. Any additional reforms would require evidence-based policy decisions based on efficiency criteria. Third, because Montenegro is highly dependent on tourism, we wish to provide Montenegrin policymakers with new insights on the effects of tourism on the efficiency of local public goods and services provision. Finally, the upcoming census could be used to assess the extent of changes in efficiency of LSGs having this study as a benchmark.

The remainder of the paper is structured as follows: in the next section, we review literature. First, we outline the DEA and PCA approach that will be employed. Next, we describe the data and limitations. Section 4 describes the empirical strategy and examines the findings. The paper is summarized and concluded in Section 5.

## 2 Literature overview

In the last 30 years, numerous empirical studies have been conducted concentrating on various perspectives and contexts of the efficiency in LSG. According to De Borger & Kerstens (1996), empirical research concerning the efficiency of LSG is either focused on the evaluation of a particular local service or on the performances of LSGs in providing a broad range of public services. Individual public services that were usually the focus of empirical research were water services (Garcia-Sanchez, 2006a), waste management and street cleaning (Worthington & Dollery, 2000, 2001; Bosch, et al., 2000; Benito-Lopez, et al., 2011, 2015), street lighting (Lorenzo & Sanchez, 2007), road maintenance (Kalb, 2012), fire services (Garcia-Sanchez, 2006b), and library services (Stevens, 2005) and other.

A significant body of empirical research was devoted to estimating the efficiency of LSGs in providing a broad range of public services. The subject of these researches was the cost efficiency of LSGs in Belgium (De Borger & Kerstens, 1996; Geys & Moesen, 2009a; Geys & Moesen, 2009b), Germany (Kalb, et al., 2012; Geys, et al., 2013), Finland (Loikkanen & Susiluoto, 2005), Italy (Barone & Mocetti, 2011; Boetti, et al., 2012), Portugal (Alfonso & Fernandes, 2006, 2008; Da Cruz & Marques, 2014), Czech Republic (Šťastná & Gregor, 2011, 2015), Spain (Balaguer-Coll, et al., 2010a, 2010b; Benito-Lopez, et al., 2015) United States (O'Loughlin & Wilson, 2021), from other countries as well.

In addition to the cost-efficiency of a broad range of public services, authors tended to analyse relationships between LSG's cost efficiency and some important determinants of efficiency. These determinants of efficiency usually included fiscal decentralization, the influence of the spatial closeness between municipalities, effects of political competition

and other important factors (Narbón-Perpiñá & De Witte, 2018). In this context, the impact of tourism activity on the efficiency of LSGs was the subject of interest of several authors as well. Athanassopoulos & Triantis, (1998) stipulated that tourist activity in Greek 172 LSGs creates additional costs. Similarly, D'Inverno, et al., (2017) concluded in their research that Tuscan municipalities with a high level of tourism tend to be less efficient and that as the degree of tourism increases, the average level of efficiency declines. Furthermore, D'Inverno, et al., (2017) showed that LSGs with significant seasonality suffer greater costs than other LSGs.

The region of South-Eastern Europe was also represented in empirical publications concerning the efficiency of LSGs. Pevcin (2014, 2014b) estimated efficiency in 200 Slovenian LSGs in 2011 and concluded that their mean technical efficacy differs from 0.75 to 0.88. Slijepcevic, (2019) measured the efficiency of Croatian LSGs at the regional level and concluded that LSGs in the least efficient county could decrease their expenses on average by 55%. Soko & Zorič, (2018) found that the average municipal efficiency score of LSGs in Bosnia and Herzegovina is 0.71, while Lazović-Pita and Ščeta (2021) found that LSGs total expenditures can be reduced by 46.8%. Radulovic & Dragutinovic, (2015) estimated that 143 Serbian LSG in 2012 delivered public services at costs that are between 21% and 23% higher than the 'best practice' peers. Nikolov & Hrovatin, (2013) have shown that the average efficiency score of North Macedonian's 74 LSGs is at the level of 0.59. Similar results were obtained by Athanassopoulos & Triantis, (1998) while estimating the mean efficiency of 172 Greek LSGs, ranging from 0.50 to 0.85. Doumpos & Cohen, (2014) estimated the mean efficiency of 2,017 Greek LSGs in the period from 2002 to 2009 in a similar range of between 0.65 and 0.75.

The literature uses a variety of methodologies to assess the efficiency of LSGs. There are two fundamental types of efficiency, technical and allocative efficiency. Technical efficiency considers achieving maximum outputs with the least inputs, while allocative efficiency answers how different inputs are combined to produce a set of diverse outputs. An overall efficiency represents the joint effect of technical and allocative efficiency (Radulovic & Dragutinovic, 2015). The primary focus of this paper is on the input-oriented technical efficiency, or how inputs may be reduced while keeping output levels constant.

The nonparametric and parametric methods are the two primary branches of the best-practice frontiers approach in determining efficiency. The most often used nonparametric methods in determining the efficiency of LSGs are Data Envelopment Analysis (DEA) and its nonconvex counterpart Free Disposal Hull (FDH). Some researchers utilized a dynamic technique to demonstrate how LSGs' efficiency varies over time. The Malmquist Productivity Index is the most often used dynamic technique in the nonparametric domain. The Stochastic Frontier Approach (SFA), on the other hand, is the most widely utilized parametric technique in determining LSG's efficiency. Because of the various approaches used to determine local government efficiency, variable

selection, and sample sizes, the average LSG's efficiency scores varied significantly between the aforementioned studies, and even within studies covering the same country (Narbón-Perpiñá & De Witte, 2018).

### **3 Research**

#### **3.1 DEA Model**

The DEA is a linear programming nonparametric method that measures the technical efficiency of DMUs relative to a deterministic best practice frontier based on empirical observations of inputs and outputs (Pöldaru & Roots, 2014). The result of DEA is a relative efficiency score in the range between 0 and 1, where 1 refers to 100 per cent efficiency. The definition of DMU is generic and it could be used equally in the private and public sectors. In addition, standard DEA assumes the uniformity of all DMUs, or that all DMUs conduct the same activities with similar objectives, consumes similar inputs and produce similar outputs, and operate in similar operational environments (Syrjanen, 2004). In this paper, we observe Montenegrin's LSGs as DMUs in the process of determining their technical efficiency.

The Data envelopment analysis (DEA) is based on a convex production function frontier which derives its efficiency scores based on relative distances of inefficient observations from the best practice frontier (Afonso & Fernandes, 2006). The fact that the DEA measures DMUs' efficiency relative to the efficiency scores of the other DMUs in the sample (best practice frontier) means that the DEA calculates relative rather than absolute DMU's efficiency. This further implies that the real-life efficiency threshold could be higher compared to the efficiency threshold used in DEA to determine the most efficient DMU (Radulovic & Dragutinovic, 2015).

The DEA's non-parametric feature makes it the most suitable technique for measuring the efficiency of small samples of DMUs for which it would be a stretch to infer normal distribution according to the central limit theorem. Also, the combination of PCA and DEA is particularly useful when analysing small data sets (Adler & Yazhensky, 2010). This is the case of Montenegro that had in total of 21 LSGs in 2011, which effectively prevents the implementation of parametric methods in determining LSGs efficiency. Furthermore, we assume that the convexity assumption holds true, or that consumers would prefer to use all public services in similar quantities (average) rather than certain local public services more than others (extreme).

DEA also has some disadvantages, of which the key one relates to measurement errors. Because of DEA's deterministic nature, every divergence from the best practice frontier is seen as inefficiency. This further implies the assumption that data are free of measurement errors and other noises coming from the real-life data and thus attributes all deviations from the frontier to inefficiencies (Pöldaru & Roots, 2014). We employed

principal component analysis (PCA) to address the measurement error problem. In this paper, we focused our intention on the year 2011, as currently, the last fully available data for Montenegro's LSGs are from 2011.

DEA could be formulated with CCR or BCC specifications. *Charnes, et al., (1978)* proposed a CCR model that assumes a constant return to scale (CRS), or that any increase in input or output results in a proportional change in output or input respectively. Also, the CCR model assumes that there is no strong correlation between the scale of operation and efficiency, or it assumes that DMU is scale efficient. However, this assumption is only viable in instances where all DMUs are operating optimally. Otherwise, the technical efficiency measurements could be confounded by scale efficiencies (Coelli, et al., 2005). Therefore, when a CCR model is used, the resulting technical efficiency is a comprehensive technical efficiency that incorporates the scale efficiency component, rather than a pure technical efficiency (BRRC, 2009). *Banker, et al., (1984)* modified the CCR model by introducing variable return to scale (VRS) assumption instead, which relaxes the proportional change assumption of the CCR model. The BCC model permitted the measurement of pure technical efficiency (PTE) that is free of the scale efficiency effect (Young, 2014).

According to *Charnes, et al., (1978, p.430)*, efficiency is defined as “the maximum of a ratio of weighted outputs to weighted inputs subject that the similar ratios for every DMU be less or equal to unity”. Further, *Charnes, et al., (1978)* stipulates that the technical efficiency of DMU could be maximized under two constraints. First, the weights applied to DMU's outputs and inputs cannot generate an efficiency score greater than 1. Second, inputs and outputs weights are strictly positive and greater than zero. This represents a linear programming problem that must be solved for each DMU in the model. There are two different approaches for solving this problem, output or an input orientation of the model. The output-oriented efficiency holds input levels fixed and examines optimal output expansion, or the weighted sums of outputs are maximized holding inputs constant. On the other hand, the input-oriented efficiency estimates an optimal reduction of inputs without the change of outputs, or the weighted sums of inputs are minimized holding outputs constant (Huguenin, 2012). In other words, DEA estimates the extent to which output production could be increased without the addition of new inputs (Slijepcevic, 2019).

There is a significant consensus in the literature for utilizing input-oriented efficiency measures in policy settings. This is because policymakers are more likely to influence public expenditures (inputs) than the volume and quality of public goods and services (Radulovic & Dragutinovic, 2015). Thus, in this paper, we are focusing on CRS and VRS input-oriented models with slacks as the more appropriate orientation for determining the efficiency of the provision of local public goods and services.

The CRS input-oriented model can be expressed using the following linear programming envelopment form (Huguenin, 2012):

$$\text{Minimize } \theta_e - \varepsilon(\sum_{r=1}^s S_r + \sum_{i=1}^m S_i) \quad (1)$$

s. t.

$$Y_{re} - \sum_{j=1}^n \lambda_j Y_{rj} + S_r = 0, \quad r = 1, \dots, s \quad (2)$$

$$\theta_e X_{ie} - \sum_{j=1}^n \lambda_j X_{ij} - S_i = 0 \quad r = 1, \dots, m \quad (3)$$

$$\lambda_j, S_r, S_i \geq 0 \quad \forall j = 1, \dots, n; r = 1, \dots, s; i = 1, \dots, m \quad (4)$$

Where, we assume there are ( $n$ ) DMUs ( $DMU_j, j = 1, \dots, n$ ) that uses ( $m$ ) inputs ( $i = 1, \dots, m$ ) to produce ( $s$ ) outputs ( $r = 1, \dots, s$ );  $DMU_e$  represents DMU under evaluation ( $DMU_e, e = 1, \dots, n$ ); ( $Y_{re}$ ) is the quantity of output ( $r$ ) produced by DMU ( $e$ ); and; ( $X_{ie}$ ) is the quantity of input ( $i$ ) consumed by DMU ( $e$ ); ( $\theta_e$ ) represent the technical efficiency of  $DMU_e$ ; ( $\varepsilon$ ) represents the non-Archimedean value that is greater than zero and smaller than any positive real number; ( $S_r$ ) represents output slacks; ( $S_i$ ) represents input slacks; ( $\lambda_j$ ) represents the associated weighting of outputs and inputs of DMUs. In the VRS input-oriented model with slacks a measure of return to scale for DMUs is added to relax the CRS assumption:

$$\sum_{j=1}^n \lambda_j = 1 \quad (5)$$

The optimal solution to the abovementioned linear problem ( $\theta^*$ ) is known as the DMU's ratio (or radial) efficiency. The optimal solution, or technical efficiency of the DMU ( $\theta$ ), exposes the presence, if any, of excess inputs and shortfalls in outputs known as slacks. CCR-efficient DMUs have maximum ratio efficiency ( $\theta = 1$ ), and no slacks in any optimal solution. Otherwise, the DMU has a disadvantage in its reference-set when compared to other DMUs. By removing the surplus input and increasing the output production, a DMU may become more efficient (Tone, 2001). The CCR model is a radial DEA model, which implies that in the input-oriented case with multiple inputs, the CCR is mainly focused on proportional reduction of input resources. In other words, the CCR model seeks the maximum proportional rate of reduction of inputs, i.e., a radial contraction of multiple inputs used in the production of existing outputs (Avkiran, et al., 2008).

The main advantage of DEA lies in its nonparametric nature. This allows DEA to include multiple inputs and outputs without any other specifications but quantities. DEA also doesn't require any functional specification and it allows implementation of both CRS and VRS assumptions (Hossain, et al., 2012). However, DEA also has some limitations. DMUs, usually do not operate at the optimal level due to different business environments and other constraints that prevent an optimal operational level (Young, 2014). As a result, applying the CRS assumption using real-life observations could produce technical efficiency measurements confounded by the scale efficiency (Coelli, et al., 2005). Scale

efficiency could be defined as the amount by which production could be increased by moving to the most productive scale size. In other words, if a DMU is technically efficient but operates at a modest scale of operation, it is in the growing returns to scale section of the production frontier. This indicates that to reach the technically optimal productive scale, the DMU in question must expand its scale of operation. Otherwise, a DMU with decreasing returns must reduce its scale of operation to become more productive (Coelli, et al., 2005). In this paper, we will address this issue by isolating and quantifying scale inefficiency by implementing the BCC model with VRS assumption as well (Dyson, et al., 2001). The disparity in efficiency ratings between the CCR and BCC models in the radial model indicates that the DMU in question demonstrates scale inefficiency. The scale inefficiency could be derived by dividing CRS technical efficiency scores with the VRS technical efficiency scores (BRRC, 2009).

Though, the DEA's main limitations refer to its sensitivity to measurement errors and the total number of inputs and outputs used in the model. The sensitivity on measurement errors is pronounced due to the deterministic nature of DEA that assumes that all deviation from the best practice frontier could be attributed to inefficiency (Hossain, et al., 2012). Due to wrong model specification, the total number of DMUs located at the best practice frontier tend to increase with the higher number of input and output variables (Berg, 2010). This further implies that DEA in the presence of measurement errors and wrong model specifications produces biased estimates (Ruggiero J., 2007). This is also referred to as a discriminatory power problem or discrimination problem.

To overcome the measurement error problem, we reduced the dimensionality of the DEA model by implementing PCA analysis as suggested by *Pöldaru & Roots, (2014) and Adler & Golany, (2001, 2002)*. The PCA contributes to solving this problem by reducing the total number of variables (dimensionality) and PCA components are less influenced by measurement errors (Pöldaru & Roots, 2014). Further on we followed recommendations on the desired number of inputs and outputs in the model. *Golany & Roll, (1989)* stipulated that the total number of DMU should be at least twice the combined number of inputs and outputs. *Bowlin, (1998)* argued for the need that the total number of input and output variables should be less than one-third of the number of DMUs. *Dyson, et al., (2001)* suggested that the total number of DMUs should be at least equal to two times the product of the number of input and output variables. The total number of DMUs in our analysis satisfies all these recommendations.

Another DEA limitation is the inability to compute negative numbers and zeros. This DEA feature is sometimes referred to as a "positivity" requirement. One of the most common ways for dealing with non-positive values in DEA has been to add a suitably large positive constant to the non-positive input or output integer. This strategy would satisfy the "positivity" requirement, however, depending on the scale of altering constant value, it might impact the result of the analysis as well. This is one of the reasons why *Bowlin, (1998)* suggests converting negative or zero values into numbers with a smaller

magnitude than the other numbers in the data set. Following the recommendation of *Bowlin, (1998)* and *Zhu & Cook, (2007)*, *Huguenin, (2012)* proposed a method of dealing with the zero values for inputs and outputs in the dataset by substituting them with very low values such as 0.01.

### 3.2 PCA

The PCA decreases the total number of original variables used in the analysis by creating fewer principal components (PC) that represent linear combinations of the original variables. In this process, most of the variance of original data is attributed to the first few PC. These PC could be used instead of original input and output variables in the PCA-DEA model, with a minimal loss of information. The PCA complements the DEA analysis in two important ways. First, PC are modestly subject to the effects of measurement errors coming from the real-life data. Secondly, PC are reducing the dimensionality of the DEA model, by reducing the total number of variables in the model. In this paper, we implement PCA to combine multiple variables that represent outputs of Montenegrin's LSGs' provision of local public goods and services into PC used as output indicators in the PCA-DEA model. To secure a minimal loss of information, only a PC that can explain the most variance of the original data is used in a further input-oriented PCA-DEA model.

We standardized the data before performing the PCA by subtracting the column mean from the observations and then dividing the result by the column standard deviation. Data standardization was carried out for two reasons. First, hence the PCA tend to prefer variables with higher variance, the different variables measurement units tend to exaggerate this PCA feature and lead to biased PCA outputs (*Kriegsman, 2016*). By standardizing the data, we provided equal weight to all original variables that were included in the PCA. The second reason refers to the linearity assumption. This means that the original variables should have a Gaussian distribution, and if they don't, normalizing gets them closer to a normal or Gaussian distribution (*Prykhodko, 2016*).

The PCA scores for output variables are computed using the following formulas (*Pöldaru & Roots, 2014*):

$$PC_r = l_{1r} * Y_1 + l_{2r} * Y_2 + \dots, l_{sr} * Y_s \quad (6)$$

$$s. t. \quad Var(PC_r) = max, and \quad \sum_{j=1}^s l_{js}^2 = 1 \quad (7)$$

Where, ( $PC_r$ ) represents principal component of outputs ( $r = 1, \dots, s$ ); ( $l$ ) represents normalized eigenvectors ( $l_{1r}, l_{2r}, \dots, l_{sr}$ ); ( $Y$ ) is the quantity of output ( $r$ ) produced by DMU;

Commonly, PCA is used to aggregate original variable's groups with a common theme. The first several PC usually contains most of the variance of original values' sample data.

These PC are uncorrelated and ranked by their variances in descending order (Adler & Golany, 2001). Some of the original data's explanatory power is lost in the process of producing PC in favour of the discriminatory strength of the PCA-DEA model (Pöldaru & Roots, 2014). In the PCA-DEA model, the PC could be used as the substitute for inputs or outputs or simultaneously for both inputs and outputs. The properties of the DEA model are not affected using the PC. However, PC could contain negative values. Consequently, PC with negative signs must be transformed into PC with positive values. Pöldaru & Roots, (2014), Afonso & St. Aubyn, (2011) and Ismail, *et al.*, (2018) suggested a method for transformation of negative PC into the positive one by increasing PC values by the value of the most negative PC increased by the value of one:

$$Z_j = PC_j + Q \quad (8)$$

$$\text{where } Q = -\min\{PC_j\} + 1 \quad (9)$$

### 3.3 Inputs and Outputs

Narbón-Perpiñá & De Witte, (2018) have systematized commonly used variables as inputs and outputs in more than 80 empirical studies focusing on the efficiency of LSGs. They conclude that the selection of inputs and outputs could vary across countries due to the availability of data, specific accounting practices, different characteristics and jurisdictions of LSG and the research focus. Therefore, it is not feasible to establish uniform set variables across countries that could be used as a universal set of inputs and outputs. According to the same authors most research relied on input variables in cost terms because prices and physical units were not always easily available. They classified the inputs utilized in these studies into three categories: financial expenditures, financial resources, and non-financial inputs. Table 1 highlights the variables that are typically utilized as inputs.

**Table 1:** Input variables and description of input variables

Input variable	Output categories
- Total expenditures	- Total output indicator
- Other variants of total expenditures	- Population
- Current expenditures	- Area of municipality and built area
- Other variants of current expenditures	- Administrative services
- Personnel expenditures	- Infrastructures
- Capital and financial expenditures	- Communal services
- Other financial expenditures	- Parks, sports, culture, and recreational facilities
- Local revenues	- Health
- Current transfers	- Education
- Public health services	
- Area	

Source: Narbón-Perpiñá, I. & De Witte, K., 2018. Local governments' efficiency: a systematic literature review—part I. International transactions in operational research, Volume 25.

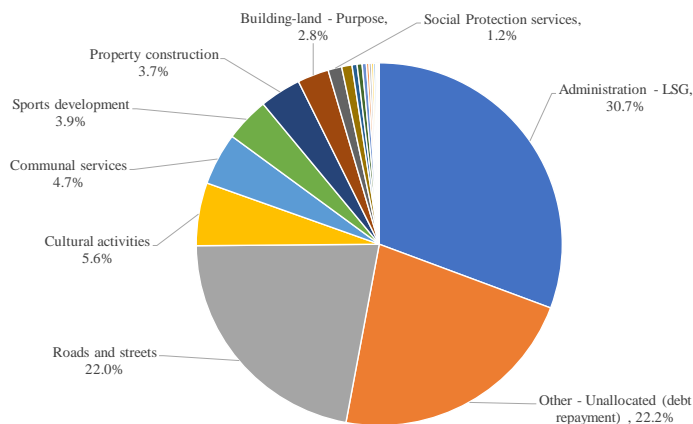


Different studies utilize different output metrics, even when analysing LSGs efficiency using the same country data. Furthermore, the number of output variables considered in the various research varies, since some studies aggregate diverse municipal services into a global index, whilst others analyse a collection of specialized local services. *Narbón-Perpiñá & De Witte, (2018)* identified 17 primary output categories used in empirical studies on LSGs' efficiency. Table 2 lists some of the most often utilized variables as outputs.

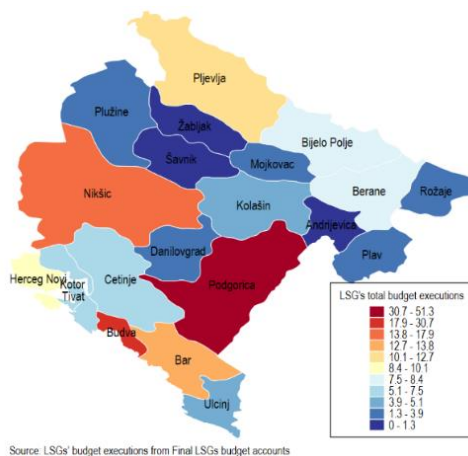
Other factors, in addition to the primary categories of output, were used to determine the efficiency of LSGs or some of their local public services as well. Tourism and tourism-related services variables were included in some of these studies as output variables as well. More precisely, researchers frequently utilized a share of non-residents, the number of tourists and overnights, the number of beds in tourism establishments as a proxy for services delivered to the non-resident population (*Narbón-Perpiñá & De Witte, 2018*). In their study, *D'Inverno, et al., (2017)* used the resident population increased by average annual tourist presence as a proxy for higher demand for local public services. They also used a ratio of average annual tourist presence and the total population as output indicators in their analysis. On the other hand, *Wang & Kim, (2021)* stipulate the usage of tourist arrivals, tourism revenue and the number of nights spent as output variables. *Pavković, et al., (2021)* and *Ilić & Petrevska, (2018)* used a similar selection of output variables in their research of tourism efficiency.

### 3.4 Data

The most significant public expenditures of 21 Montenegrin LSGs in 2011, according to the LSGs' budget executions from final LSGs budget accounts, were costs of LSGs' administration (30.7%), road infrastructure and maintenance costs (22.0%), property construction and building-land related costs (6.4%), cultural activities costs (5.6%) and communal services costs (4.7%). Because of the limitation of data availability due to specific accounting practices, Authors couldn't accurately allocate costs to their specific purposes coming from LSGs' bank loans (22.2%). Figure 1 represents the structure of cumulative public expenditures of 21 Montenegrin LSGs in 2011, while Figure 2 geographical representation of cumulative budget executions in 2011.

**Figure 1:** Montenegrin LSGs cumulative budget executions structure in 2011

Source: Authors' calculations based on the data on LSGs' budget executions from Final LSGs budget accounts.

**Figure 2:** Montenegrin LSGs cumulative budget executions in 2011

### 3.5 Selection of inputs and outputs

Primary sources for data regarding public expenditures were LSGs' budget executions from Final budget accounts from the year 2011 for each of 21 LSGs. Final budget accounts for Montenegrin LSGs are available on the Institute alternative website (Institut

Alternativa, 2021). Montenegro's population census from 2011 was used as a source for LSGs' population statistics (Monstat, 2021a), while Monstat's Statistical yearbooks for 2011 and 2012 (*Monstat, 2011; Monstat, 2012*) and Monstat's database (Monstat, 2021b) were used as sources for data on physical and other LSGs' characteristics (See Table 3).

From the economic standpoint land, labour and capital are seen as the basic factors of production, therefore the selection of input would belong to one of the basic factors of production. The choice of input and output variables is heavily influenced by Montenegro's Local Governance framework, LSGs' execution of public expenditures in 2011 and the focus of this research. In determining Montenegrin's LSG efficiency in providing a broad range of public services as input variable we selected:

- LSG' total expenditure executions

Hence, Montenegrin's LSG competencies were financed in a significant amount from borrowed funds, see Figure 1, we believe that the total expenditure as a proxy for the total cost of service provisions is the most appropriate choice for input in the PCA-DEA model.

**Table 3:** Summary statistics for input and output variables used in the PCA-DEA is presented

Variable	Obs	Mean	Std. Dev.	Min	Max
Total LSG's expend. executions	21	9496264.7	11840313	1041044.6	51222808
Population	21	29525.19	39652.66	2070	185937
Land area in km2	21	657.71	489.77	46	2065
<i>Number of Local communities</i>	21	17.52	11.43	6	57
Number of settlements	21	60.38	41.94	12	159
Local roads in km	21	217.72	178.09	26.5	828.5
Number of roads	21	41.52	44.39	5	221
Number of cars	21	9353.29	14513.18	349	68492
Water connections	21	9229.86	12615.45	380	58832
Heating connections	21	771.14	959.46	22	4207
Communal waste (t)	21	13287.65	14795.19	311.19	61537
Constructed areas (ha)	21	1548.76	1867.27	249	8677
Dwellings built	21	206.81	327.12	3	1489
Dwellings	21	14985.91	15917.90	2181	72688
Cultural institutions	21	10.86	15.97	1	71
Population 65+	21	3789.76	4358.66	411	19952
Children social beneficiaries	21	488.57	614.90	22	2363
<i>Social services beneficiaries;</i>	21	2465.10	4287.85	92.45	19145.73
Population + Tourist guests	21	94927.76	150571.69	2076	656796

Source: Authors' calculations.

In determining Montenegrin's LSG efficiency in providing a broad range of public services using the PCA-DEA model as output variables we selected *principal components (PC) that describes the following themes*: LSGs' administration, road infrastructure and

maintenance, construction activity, cultural activities, communal services, social services, and tourism activity. The above-mentioned themes were chosen based on the most significant categories of cumulative public expenditures executions of 21 Montenegrin LSGs in 2011. The only exception to this criterion is tourism activity, due to its overall relevance to Montenegro and their LSGs.

#### 4 Discussion

We began by running PCAs for the appropriate DEA-PCA models. We initially standardized the data to give the original variables equal priority due to the large disparities in original value magnitudes caused by different units of measurement. To assess the validity of the initial variables used to create PCs, we ran a set of diagnostic tests. The Bartlett test of sphericity rejected the null hypothesis that the original variables were not intercorrelated in each PCA at a significance level of less than 10% (See Table 5). The KMO test results in values ranging from 0.671 to 0.773, indicating adequate sampling adequacy of the initial variables used to create PCs (See Table 4). The eigenvalues of the first PCAs' components ranged between 2.6 and 3.1, significantly above Kaiser's rule that recommends using components with eigenvalues greater than 1 (See Table 5). Other components' Eigenvalues were less than 1 (See Tables 5-9).

**Table 4:** PCAs' diagnostic tests results

Tests	PCA Admin	PCA Roads	PCA Communal.	PCA Constr.	PCA Social
Bartlett test of sphericity	0.035	0.056	0.031	0.061	0.045
Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)	0.728	0.672	0.671	0.773	0.767
The first PC's Eigenvalue	3.117	2.652	2.735	2.698	2.737
The first PC's Proportion of explained variance	0.779	0.884	0.911	0.899	0.912

Source: Authors' calculations using STATA version 15.

Furthermore, we used Horn's and Ender's parallel analysis to establish the exact number of components to keep in the PCA. Both tests showed that we should only include the first component in every PCA model. Additionally, a proportion of explained variance threshold for components selection is often set at the level between 70% and 90% (*Jolliffe, 2011*). Proportion of the explained original variables variance of the first components in this paper ranged between 0.779 and 0.912 (See Table 4). Finally, we performed DEA analysis. Before doing the DEA analysis, we converted negative values in the data using the methods proposed by *Pöldaru & Roots, (2014)*, *Afonso & St. Aubyn, (2011)* and *Ismail, et al., (2018)*. Furthermore, we mean-normalized the input employed in the DEA models to provide more trustworthy DEA results. We did this because high magnitude variables tend to dominate DEA calculation (*Sueyoshi & Mika Goto, 2013; Zhu & Cook, 2007*).

#### 4.1 Principal Component Analysis (PCA)

We acquire the synthetic composite outputs after using PCA on the output variables. Tables 6-10 show the outcomes of five PCAs. The first column in Tables 6-10 displays the list of PCs for each PCA. The eigenvalues of the PCs are shown in the second column. The third column denotes the proportion of explained variation of the original variables regarding a single PC, and the fourth column denotes the cumulative explained variance of PCs. The coefficients of correlation between the PCs and the original output variables are shown in columns fifth to seventh (eight).

Table 5 shows the result of the PCA of variables use as proxy for LSGs' administration output. Output variables used in this PCA are population (Y1), land area in km2 (Y2), *number of local communities* (Y3) and *number of settlements* (Y4). Coefficients of correlations indicate that the first PC represents a measure of the size of each DMU in terms of population, land area and administrative organization. The first PC is characterized by a high correlation and its positive relationship with all original variables.

**Table 5:** PCA results of LSGs' administration output variables and coefficient of correlations.

Components	Eigen-analysis			Coefficient of correlations			
	Eigenvalue	Proportion	Cumulative	Y1	Y2	Y3	Y4
Comp 1	3.117	0.779	0.779	0.885	0.847	0.914	0.884
Comp 2	0.590	0.147	0.927	-0.413	0.445	-0.334	0.332
Comp 3	0.194	0.048	0.975	0.029	0.290	0.022	-0.323
Comp 4	0.098	0.025	1.000	0.212	0.013	-0.231	0.014

Source: Authors' calculations using STATA version 15.

Table 6 shows the result of the PCA of variables use as proxy for road infrastructure and maintenance output. Output variables used in this PCA are the length of local roads (Y1), number of roads (Y2) and number of cars (Y3). Correlation coefficients show that the first PC reflects a measure of size of road infrastructure and pool of vehicles. The first PC is distinguished by a high correlation between all original variables. Also, all the original variables are positively associated to PC1.

**Table 6:** PCA results of road infrastructure and maintenance output variables and coefficient of correlations.

Components	Eigen-analysis			Coefficient of correlations		
	Eigenvalue	Proportion	Cumulative	Y1	Y2	Y3
Comp 1	2.652	0.884	0.884	0.926	0.974	0.919
Comp 2	0.269	0.090	0.974	-0.354	-0.021	0.379
Comp 3	0.079	0.026	1.000	0.129	-0.224	0.108

Source: Authors' calculations using STATA version 15.

Table 7 shows the result of the PCA of variables use as proxy for communal services output. Output variables used in this PCA are the connections on the public water supply system (Y1), connections on the public heating system (Y2) and communal waste (Y3). According to the correlation coefficients, the first PC indicates a measure of size of public communal services systems. The first PC stands out due to a high correlation between all original variables and positively association with all original variables.

**Table 7:** PCA results of communal services output variables and coefficient of correlations

Components	Eigen-analysis			Coefficient of correlations		
	Eigenvalue	Proportion	Cumulative	Y1	Y2	Y3
Comp 1	2.735	0.911	0.911	0.982	0.945	0.936
Comp 2	0.212	0.070	0.982	-0.032	-0.306	0.343
Comp 3	0.053	0.017	1.000	-0.184	0.110	0.082

Source: Authors' calculations using STATA version 15.

Table 8 shows the result of the PCA of variables use as proxy for construction activity. Output variables used in this PCA are the constructed areas (Y1), number of dwellings built (Y2) and number of dwellings (Y3). Coefficients of correlations indicate that the first PC represents a measure of size of construction activity. The first PC stands out because of its high correlation with all original variables and its positive relationship with all original variables.

**Table 8:** PCA results of construction activity output variables and coefficient of correlations

Components	Eigen-analysis			Coefficient of correlations		
	Eigenvalue	Proportion	Cumulative	Y1	Y2	Y3
Comp 1	2.698	0.899	0.899	0.950	0.944	0.951
Comp 2	0.162	0.054	0.954	-0.166	0.330	-0.161
Comp 3	0.139	0.046	1.000	0.262	0.003	-0.265

Source: Authors' calculations using STATA version 15.

Table 9 shows the result of the PCA of variables use as proxy for social services activity. Output variables used in this PCA are population 65+ (Y1), number of children social beneficiaries (Y2) and number of social services beneficiaries (Y3). Correlation coefficients show that the first PC reflects a measure of size of social services activity. The first PC is distinguished by a high correlation between all original variables and positive relationship with all original variables.

**Table 9:** PCA results of social services output variables and coefficient of correlations

Components	Eigen-analysis			Coefficient of correlations		
	Eigenvalue	Proportion	Cumulative	Y1	Y2	Y3
Comp 1	2.737	0.912	0.912	0.953	0.947	0.965
Comp 2	0.160	0.053	0.966	-0.249	0.308	-0.057
Comp 3	0.103	0.034	1.000	0.170	0.090	-0.256

Source: Authors' calculations using STATA version 15.

## 4.2 Data Envelopment Analysis (PCA-DEA)

Table 10 shows the Pearson correlation coefficients between all the input and output variables. The results demonstrate a positive link between input and output variables, showing that they are isotonic and may be employed by the DEA model (Golany & Roll, 1989). The isotonic relationship indicates that if the input increases while all other factors remain constant, the output quantity cannot decrease under the same conditions. The Pearson correlation coefficients also show a strong correlation between input and output variables, showing that the selected variables are highly relevant. Highly correlated variables, in general, would not have a large impact on DEA output, because weights may easily be moved from one component to another without having a substantial impact on the efficiency score. The exclusion of a highly correlated variable, on the other hand, might result in considerable changes in the efficiency of DMUs (Dyson, et al., 2001).

**Table 10:** The Pearson correlation coefficients of input and outputs

Variables	X1	Y1	Y2	Y3	Y4	Y5	Y6	Y7
(X1) Total LSG's expenditure executions	1.000							
(Y1) PC Administration	0.744	1.000						
(Y2) PC Roads	0.818	0.837	1.000					
(Y3) PC Communal	0.911	0.878	0.902	1.000				
(Y4) PC Construction	0.868	0.852	0.925	0.969	1.000			
(Y5) Cultural institutions	0.827	0.744	0.846	0.859	0.850	1.000		
(Y6) Population + Tourist	0.660	0.101	0.180	0.382	0.289	0.367	1.000	
(Y7) PC Social Services	0.794	0.879	0.895	0.935	0.938	0.781	0.167	1.000

Source: Authors' calculations.

In the current study, we use three PCA-DEA models with different specifications. The first two models included one input and six outputs variables, but with different selection of outputs. The role of the third model with one input and five outputs is to test and to isolate the effects of tourism activity on the DMUs (Montenegro's LSGs) technical efficiency (see Table 11).

**Table 11:** The Pearson correlation coefficients of input and outputs

Models' characteristics	Model 1				Model 2				Model 3			
Number of input variables	1				1				1			
Number of output variables	6				6				5			
Input variables	X1				X1				X1			
Output variables	Y1	Y2	Y3	Y4	Y1	Y2	Y3	Y4	Y1	Y2	Y3	Y4
	Y5 Y6				Y5 Y7				Y5			

Table 12 summaries results of the PCA-DEA analysis with constant return to scale (CRS). Each column displays the PCA-DEA analysis findings for a separate specification, and each row corresponds to a summary statistics of a separate model specification.

**Table 12:** Summary characteristics of PCA-DEA results for different specifications

Models' characteristics	Model 1 - CCR	Model 2 - CCR	Model 3 - CCR
Number of inputs and outputs	7	7	6
Number of technically efficient DMUs	6	4	4
Proportion of DMUs deemed technical inefficient	0.714	0.810	0.810
Average technical efficiency score	0.673	0.603	0.578
Minimum technical efficiency score	0.259	0.126	0.126
Standard deviation	0.263	0.284	0.280

Source: Authors' calculations.



The number of relative technically efficient DMUs estimated using DEA is presented in the third row of Table 12. Model 2 with one input and six outputs produced the same number of relative technical efficient DMUs as model 3 with one input and five outputs. This indicates that the dimensionality of the models (number of inputs and outputs) doesn't have a significant impact on the technical efficiency measure.

Hence, the first model has produced a higher number of relative technically efficient DMUs than Model 2 with the same specification, it further stipulates that the selection of outputs have a significant impact on the performance measure. In this case, it would be the inclusion of a proxy for touristic activity in the PCA-DEA model.

The proportion of DMUs found inefficient using DEA is shown in the fourth row of Table 12, and it ranges between 71.4 % and 81.0 %. Thus, Model 2 and Model 3 have estimated the same portion of relative technically inefficient DMUs it further argues in favour that the selection of output variables produces a higher impact on the efficiency measure than the dimensionality of the models. However, the average technical efficiency scores, represented in the fifth row of Table 12, tend to increase with the increasing number of inputs and outputs. Though, the effect of the increasing number of inputs and outputs on the average technical efficiency scores of the PCA-DEA models is relatively small. All the above indicates that the discrimination problem within the observed PCA-DEA models is relatively small due to proper models' specifications. Consequently, there is no pronounced trade-off between complete PCA-DEA information and the need to reduce the overestimation bias.

Table 12 compares the rankings of the DMUs for separate PCA-DEA model specifications. The rankings are assessed using the Spearman measure of correlation. The ranking correlation coefficients further confirms the hypothesis that the selection outputs, in this case, the inclusion of proxy for tourism activity in Model 1, has a profound impact on DMUs' efficiency scores. Model 1 DMUs' rankings are moderately correlated with the other two models, while DMUs' rankings of Models 2 and 3 are strongly correlated.

**Table 13:** Spearman correlation coefficients between DMUs' rankings for different PCA - DEA model specifications.

PCA -DEA model specifications	Model 1	Model 2	Model 3
Model 1 (DMUs – ranking)	1.000		
Model 2 (DMUs – ranking)	0.545	1.000	
Model 3 (DMUs – ranking)	0.408	0.771	1.000

Additionally, we tested rankings of models 1 and 2 against the rankings of the corresponding DEA models with ordinary variables instead of principal components. As a control for Model 1, we selected a model with the same input and land area in km<sup>2</sup>,

local roads in km, connections on the public water supply system, number of dwellings built, population + tourist guests and number of cultural institutions as outputs. We found that the correlation of Model 1 DMU's ranking with the Control Model 1 DMU's ranking were somewhat lower ( $\rho = 0.442$ ), but still moderate. Similarly, we selected a control model for Model 2 with a similar specification as Control Model 1. The only differences are that we selected population instead of land area in km<sup>2</sup> and the number of *social services beneficiaries instead of* population + tourist guests. The correlation between Model 2 DMUs' rankings and the Control Model 2 DMU's ranking was weak ( $\rho = 0.319$ ).

Similarly, we compared the Spearman correlation coefficients of Models 1 and 2 technical efficiency scores. We found a strong correlation between the technical efficiency score of Models 1 and 2, and a very strong correlation between the technical efficiency score of Models 2 and 3 (See Table 14). We also compared correlation between the technical efficiency score Models 1 and 2 and corresponding Control Models and found a very a very strong correlation of  $\rho = 0.921$  and  $\rho = 0.935$  respectively.

**Table 14:** Spearman correlation coefficients between DMUs' efficiency scores for different PCA - DEA model specifications

PCA -DEA model specifications	Model 1	Model 2	Model 3
Model 1 (DMUs – efficiency score)	1.000		
Model 2 (DMUs – efficiency score)	0.695	1.000	
Model 3 (DMUs – efficiency score)	0.777	0.948	1.000

**Table 15:** The technical efficiency scores for 21 Montenegro's LSGs for 2011

Model 1 -CCR			Model 2 - CCR		Model 3 - CCR	
Rank	DMU	TE score	DMU	TE score	DMU	TE score
1	Andrijevisa	1.000	Andrijevisa	1.000	Andrijevisa	1.000
2	Cetinje	1.000	Cetinje	1.000	Cetinje	1.000
3	Herceg Novi	1.000	Savnik	1.000	Savnik	1.000
4	Savnik	1.000	Zabljak	1.000	Zabljak	1.000
5	Ulcinj	1.000	Plav	0.865	Plav	0.833
6	Zabljak	1.000	Rozaje	0.846	Kotor	0.819
7	Kotor	0.890	Kotor	0.819	Herceg Novi	0.789
8	Plav	0.833	Herceg Novi	0.789	Danilovgrad	0.758
9	Danilovgrad	0.805	Danilovgrad	0.758	Pluzine	0.623
10	Budva	0.762	Pluzine	0.623	Mojkovac	0.564
11	Pluzine	0.623	Mojkovac	0.611	Bijelo Polje	0.468
12	Mojkovac	0.564	Bijelo Polje	0.475	Rozaje	0.421
13	Bar	0.519	Podgorica	0.418	Podgorica	0.418
14	Bijelo Polje	0.505	Kolasin	0.418	Kolasin	0.418
15	Podgorica	0.446	Ulcinj	0.386	Ulcinj	0.386
16	Kolasin	0.430	Berane	0.373	Berane	0.373
17	Rozaje	0.421	Pljevlja	0.354	Pljevlja	0.354
18	Berane	0.373	Bar	0.334	Bar	0.334
19	Pljevlja	0.373	Niksic	0.240	Niksic	0.231
20	Tivat	0.330	Tivat	0.222	Tivat	0.222
21	Niksic	0.259	Budva	0.126	Budva	0.126

Source: Authors' calculations using MaxDEA version 8.

Table 15 summarizes the PCA-DEA models' technical efficiency scores with a constant return to scale (CRS). As a result of the DEA producing measures of relative technical efficiency, technical efficient DMUs (Montenegro's LSGs) are only efficient when compared to other DMUs in the model. DEA does not generate an absolute efficiency measure or a universal efficiency threshold against which DMU efficiency is measured. This further implies that a DMU that is deemed to be technically efficient does not always imply that their operational methods are the most efficient, but merely in comparison to the practices of other DMUs in the model.

Availability of the resources and pronounced differences in tourism activity among DMUs are the most important factors that shaped the DMUs' ranking and the technical efficiency scores presented in Table 16. We compared the Spearman correlation coefficients of DMUs ranking in the availability of the resources, in terms of LSG' total expenditure executions, and DMUs ranking in technical efficiency scores in Models 1 and 2. We found a negative correlation in both models that diverged in the intensity while being weak in Model 1 ( $\rho = -0.279$ ) and moderate in Model 2 ( $\rho = -0.544$ ). This implies that DMUs (Montenegro's LSGs) that had more inputs or budget funds on their disposal tended to be less technically efficient. In other words, "wealthier" LSGs were more prone to inefficient allocation (squandering) of their budgetary funds. While, on the other hand, "less wealthy" LSGs had to apply stringier spending practices to be able to provide the required local public services and goods. This further indicate that, even if "less wealthy"

LSGs are generally deemed to be more efficient than "wealthier" LSGs, this does not necessarily imply that the "less wealthy" LSGs' operating practices are efficient. These findings could be explained by the insufficiently developed financial management and overall operational management skills among Montenegro's LSGs.

The other important factor relates to the hypothesis that tourism activity puts additional costs on LSGs in providing their local public services. To test this hypothesis, we compared the efficiency scores of coastal LSGs in Model 1, with a proxy for higher demand for local public services due to tourism activity, and Model 3 that has the same specification as Model 1 but without the effects of tourism activity. The results of comparisons show that the technical efficiency scores of six coastal LSGs are affected by the tourism activity disproportionately more compared to non-coastal LSGs (see Table 16).

The fact that the technical efficiency scores of six coastal Montenegro's LSGs depend heavily on tourism is not unexpected having in mind the distribution of tourist arrival. However, the intensity of the tourism impact of the LSGs on the six coastal Montenegro's LSGs compared to the non-coastal LSGs is somewhat surprising. By comparing PCA-DEA results from Models 1 and 3, we estimated that tourism activity reduced technical efficiency scores of Montenegro's coastal and non-coastal LSGs on average by 0.304 and 0.011 index points respectively. This corresponds to the 30.4% lower technical efficiency of Montenegro's coastal LSGs and 1.1% of non-coastal LSGs in Model 3 compared to Model 1. This disparity in six coastal LSGs' technical efficiency scores has translated into lower average overall DMUs' technical efficiency in Model 3 by 9.5% compared to Model 1 (see Table 17). Our findings on the impact of tourism activity on Montenegro's LSGs efficiency corresponds to the conclusions made by *Athanassopoulos & Triantis, (1998)* and *D'Inverno, et al., (2017)* about the effect of tourist activity on Greek LSGs and Tuscan municipalities respectively. Both groups of authors argued that there is an inverse relationship between tourism and LSGs' efficiency. Also, *D'Inverno, et al., (2017)* by combining DEA and Tobit regression analysis found that Tuscan municipalities with high tourism activity were on average 31.8% less efficient in 2011.

**Table 16:** The technical efficiency scores for 6 Montenegro's coastal LSGs for 2011

Model 3 -Without Tourism effect		Model 1 – With Tourism effect		Difference (Model 3 - Model 1)	
DMU	TE score	DMU	TE score	DMU	TE score
Bar	0.334	Bar	0.519	Bar	-0.185
Budva	0.126	Budva	0.761	Budva	-0.636
Herceg Novi	0.789	Herceg Novi	1.000	Herceg Novi	-0.211
Kotor	0.819	Kotor	0.890	Kotor	-0.071
Tivat	0.222	Tivat	0.330	Tivat	-0.108
Ulcinj	0.386	Ulcinj	1.000	Ulcinj	-0.614
Other LSGs (Average)	0.631	Other LSGs (Average)	0.642	Other LSGs (Average)	-0.011
Other LSGs (SD)	0.277	Other LSGs (SD)	0.270	Other LSGs (SD)	0.016
Average TE	0.578	Average TE	0.673	Average TE	-0.095

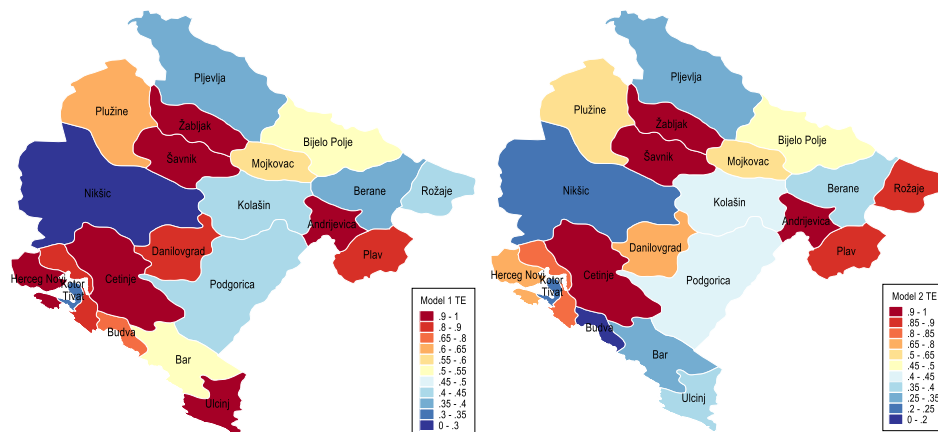
Source: Authors' calculations.

Having determined the impact of tourism on Montenegro's LSGs efficiency we believe that PCA-DEA Model 2 is biased against Montenegro's coastal LSGs. By not including the proxy for higher demand for local public services due to tourism activity Model 2 favours non-coastal LSGs in estimating technical efficiency. As a result of this and given the importance of tourism to Montenegro and its LSGs, we believe PCA-DEA model 1, which contains a proxy for tourist activity, to be more relevant in estimating Montenegro's LSGs efficiency.

**Figure 3:** Geographical distribution of Montenegrin LSGs technical efficiencies in 2011

A – Model 1 TE efficiency scores

B– Model 2 TE efficiency scores



Source: Authors' calculations using MaxDEA version 8.

Tables 17 summarise the scale efficiency of the PCA-DEA Model 1. The third column refers to the technical efficiency score computed using the CCR model based on the constant return to scale (CRS). Similarly, the fourth column represents the pure technical efficiency score (PTE) calculated using the BCC model based on the variable return to scale (VRS). The fifth column lists scale efficiency scores (SE) and the sixth column represents the regions of return to scale (RTS) under which DMU is operating.

**Table 17:** PCA-DEA Model 1 - The scale efficiency for 21 Montenegro's LSGs for 2011

		Model 1 -CCR	Model 1 - BCC	Scale efficiency (SE)	RTS
Rank	DMU	TE score	PTE score	SE score	
1	Andrijevisa	1.000	1	1	Constant
2	Cetinje	1.000	1	1	Constant
3	Herceg Novi	1.000	1	1	Constant
4	Savnik	1.000	1	1	Constant
5	Ulcinj	1.000	1	1	Constant
6	Zabljak	1.000	1	1	Constant
7	Kotor	0.890	1	0.890113	Decreasing
8	Plav	0.833	1	0.832679	Decreasing
9	Danilovgrad	0.805	1	0.805469	Decreasing
10	Budva	0.762	1	0.76198	Decreasing
11	Pluzine	0.623	0.964596	0.646221	Decreasing
12	Mojkovac	0.564	0.571692	0.98658	Increasing
13	Bar	0.519	1	0.519213	Decreasing
14	Bijelo Polje	0.505	1	0.50487	Decreasing
15	Podgorica	0.446	1	0.445746	Decreasing
16	Kolasin	0.430	1	0.430074	Decreasing
17	Rozaje	0.421	0.736541	0.571587	Decreasing
18	Berane	0.373	1	0.373012	Decreasing
19	Pljevlja	0.373	1	0.372839	Decreasing
20	Tivat	0.330	0.414933	0.795154	Decreasing
21	Niksic	0.259	1	0.258668	Decreasing

Source: Authors' calculations using MaxDEA version 8.

Under variable return to scale (VRS) assumption majority of Montenegro's LSG achieved pure technical efficiency (PTE) in both models (see Table 18). The differences between DMUs' TE and PTE estimation indicates the existence of scale inefficiency. For DMUs that scale efficiency score is below 1, it indicates that combination of their inputs and outputs is not scale-efficient. DMU is scale-inefficient when the size of its activities is suboptimal and modifications to its size are necessary to make DMU more efficient (Coelli, *et al.*, 2005). This further indicate that technical efficiency scores cannot distinguish the effects of increased productivity due to DMU's shifting to a more productive scale size from the effects of cost reduction.

All technical inefficient DMUs in Model 1 (71.4%), are scale inefficient as well (see Tables 18). Furthermore, apart from LSG "Mojkovac", all scale inefficient DMUs operate with decreasing returns to scale. In other words, 66.6% of Montenegro's LSGs are beyond their optimal scale and may improve their technical efficiency by reducing either their size or scope of their responsibilities (local public goods and services). This indicates that any proportional increase in these LSG's inputs would result in a less than proportionate increase in its outputs. In other words, any increase in outputs by 1% would result in an increase of inputs by more than 1%. On the other hand, LSG "Mojkovac" operated in the region with increasing returns to scale. This implies that LSG "Mojkovac" could increase

its technical efficiency by increasing the size or scope of its responsibilities. It further indicates that any increase in LSG "Mojkovac's" scale of operation would result in a greater than proportionate increase in its outputs.

Tables 18 depict input and output slacks of the PCA-DEA Model. The second column refers to the input slacks, while output slacks are represented from third to eight columns.

We chose slacks under the variable return to scale (VRS) assumption for PCA-DEA Model 1 as the more appropriate method for the computation of slacks. We believe the BCC model is far more relevant since the CCR model's technical efficiency is confounded by scale efficiencies. This has significant consequences for slacks calculation since DMUs' or LSGs' management do not have discretionary power to change the size of LSGs. As a result, in the case of LSG, calculating slacks (input excesses and output shortfalls) based on the pure technical efficiency free of the scale efficiency is more appropriate when analysing LSG's management performances.

**Table 18:** PCA-DEA Model 1 (BCC) – Slacks under variable return to scale (VRS) assumption

DMU	X1	Y1	Y2	Y3	Y4	Y5	Y6
Andrijevisa	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cetinje	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Herceg Novi	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Savnik	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ulcinj	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zabljak	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Kotor	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Plav	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Danilovgrad	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Budva	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Pluzine</b>	<b>-0.009</b>	0.000	0.000	<b>0.311</b>	<b>0.350</b>	<b>0.025</b>	<b>0.194</b>
<b>Mojkovac</b>	<b>-0.091</b>	<b>0.159</b>	<b>0.612</b>	<b>0.030</b>	0.000	<b>0.032</b>	<b>0.121</b>
Bar	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bijelo Polje	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Podgorica	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Kolasin	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Rozaje</b>	<b>-0.106</b>	<b>0.237</b>	0.000	0.000	0.000	0.000	<b>0.037</b>
Berane	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pljevlja	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>Tivat</b>	<b>-0.454</b>	<b>0.960</b>	0.000	0.000	<b>0.053</b>	0.000	0.000
Niksic	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors' calculations using MaxDEA version 8.

Input and output slacks are present in four DMUs in PCA-DEA Model 1. It stipulates that for these LSGs to be more efficient they need to reduce input and increase output production at the same time by making internal practices more efficient. After we transform DMUs' normalized input data into the original data and adjust it for input



excesses, PCA-DEA Model 1 suggests input reduction for “Mojkovac” (-42.7%), “Pluzine” (-3.6%), “Rozaje” (-26.3%) and “Tivat” (-58.5%). In other words, data in PCA-DEA Model 1 show that with the achieved level of outputs in 2011 these four LSG on average have inefficiently allocated budgetary funds in the amount that correspond to 32.8% of their total expenditure execution. The fundamental disadvantage of PCA is the difficulty in interpreting PCs, as their interpretation is not straightforward. As a result, we could only identify areas in which output should be increased either through the increased reach of local public services or the scale of offered public goods.

However, because relatively few DMUs have slack issues, the main finding of the slack analysis is that scale inefficiency is a greater source of LSGs inefficiencies than internal practices. This suggests that to improve Montenegro's LSGs efficiency, it is necessary to re-evaluate the territorial organization of local self-governments in Montenegro, as well as the scope of responsibilities allocated to Montenegro's LSG.

## 5 Conclusions

Montenegro could develop a decentralized governance system based on the needs of its citizens. To do so, any further extensive reforms would require an evidence-based policy decision that will be based on the performance benchmarks for the overall efficiency of their local governance system. According to our findings, the range of technical efficiency of Montenegro's local governance system in 2011 was between 60.3% and 67.3%, depending on the observed model. Furthermore, we found evidence of an inverse relationship between tourism activity and the efficiency of Montenegro's LSGs. We found that on average tourism activity reduces Montenegro's coastal LSG technical efficiency by 30.4%. Inefficient internal practices and scale inefficiency were identified as the primary sources of technical inefficiency.

We found evidence of the insufficiently developed LSG's financial management and operational management skills as the main cause of the inefficient internal practices. However, a much greater generator of inefficiencies comes from scale inefficiency due to the suboptimal size of Montenegro's LSGs and/or the scale of delegated responsibility in terms of providing public services and goods. Therefore, to make Montenegro's LSGs more efficient it is necessary to improve the financial management and operational management know-how of Montenegro LSGs' management personnel. Though, the biggest impact on the improvement of the overall efficiency of Montenegro's local governance system would be achieved by re-evaluating the territorial organization of local self-governments in Montenegro, as well as the scope of responsibilities allocated to Montenegro's LSG. Given the influence of tourism on efficiency, we propose that any future analysis of LSG efficiency in Montenegro and any other country with pronounced tourism activity include a proxy for tourism activity. Also, any future evidence-based policy decision would require an updated efficiency analysis of Montenegro LSGs based on the most recent data.

## References:

- Adler, N. & Golany, B. (2001) Evaluation of deregulated airline networks using data envelopment analysis combined with principal component analysis with an application to Western Europe, *European Journal of Operational Research*, 132(2), pp. 260-273.
- Adler, N. & Golany, B. (2002) Including principal component weights to improve discrimination in data envelopment analysis, *Journal of the Operational Research Society*, 53(9), pp. 985-991.
- Adler, N. & Yazhemsky, E. (2010) Improving discrimination in data envelopment analysis: PCA-DEA or variable reduction, *European Journal of Operational Research*, 202(1), pp. 273-284.
- Afonso, A. & St. Aubyn, M. (2011) Assessing health efficiency across countries with a two-step and bootstrap analysis, *Applied Economics Letters*, 18(15), pp. 1427-1430.
- Afonso, A. & Fernandes, S. (2006) Measuring Local Government Spending Efficiency: Evidence for the Lisbon Region, *Regional Studies*, 40(1), pp. 39-53.
- Afonso, A. & Fernandes, S. (2008) Assessing and Explaining the Relative Efficiency of Local Government, *Journal of Socio-Economics*, 37(5), pp. 1946-1979.
- Athanassopoulos, A. D. & Triantis, K. P. (1998) Assessing aggregate cost efficiency and the related policy implications for Greek local municipalities, *INFOR*, 36(3), pp. 66-83.
- Avkiran, K., Tone, K. & Tsutsui, M. (2008) Bridging radial and non-radial measures of efficiency in DEA, *Annals of Operations Research*, 164(1), pp. 127-138.
- Balaguer-Coll, M., Prior, D. & Tortosa-Ausina, E. (2010b) Devolution dynamics of Spanish local government, *Environment and Planning A*, 42(6), pp. 1476-1495.
- Balaguer-Coll, M., Prior, D. & Tortosa-Ausina, E. (2010a) Decentralization and efficiency of local government, *Annals of Regional Science*, 45(3), pp. 571-601.
- Banker, R. D., Charnes, A. & Cooper, W. W. (1984) Some models for estimating technical and scale inefficiencies in data envelopment analysis, *Management Science*, 30(9), pp. 1078-1092.
- Barone, G. & Mocetti, S. (2011) Tax morale and public spending inefficiency, *International Tax and Public Finance*, 18(6), pp. 724-749.
- Benito, B., Bastida, F. & Garcia, J. A. (2010) Explaining Differences in Efficiency: An Application to Spanish Municipalities, *Applied Economics*, 42(4), pp. 515-528.
- Benito-Lopez, B., Moreno-Enguix, M. R. & Solana-Ibanez, J. (2011) Determinants of efficiency in the provision of municipal street-cleaning and refuse collection services, *Waste Management*, 31(6), pp. 1099-1108.
- Benito-Lopez, B., Solana, J. & Moreno, M. R. (2015) Explaining efficiency in municipal services providers, *Journal of Productivity Analysis*, 42(3), pp. 225-239.
- Berg, S. (2010) *Water Utility Benchmarking: Measurement, Methodology, and Performance Incentives* (London: International Water Association).
- Boetti, L., Piacenza, M. & Turati, G. (2012) Decentralization and Local Governments' Performance: How Does Fiscal Autonomy Affect Spending Efficiency?, *Finanz Archiv / Public Finance Analysis*, 68(3), pp. 269-302.
- Bosch, N., Pedraja, F. & Suarez-Pandiello, J. (2000) Measuring the efficiency of Spanish municipal refuse collection services, *Local Government Studies*, 26(3), pp. 71-90.
- Bowlin, W. F. (1998) Measuring Performance: An Introduction to Data Envelopment Analysis (DEA), *Journal of Cost Analysis*, 7, p. 3-27.
- BRRC (2009) *MaxDEA Pro 6.3 Manual*, CHENG Gang, QIAN (Zhenhu: Beijing Realworld Research and Consultation Company Ltd.).

- Charnes, A., Cooper, W. W. & Rhodes, E. (1978) Measuring the efficiency of decision making units, *European Journal of Operational Research*, 2(6), pp. 429-444, [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8).
- Coelli, T. J., Dodla Sai, P. R., O'Donnell, C. J. & Battese, G. E. (2005) *An introduction to efficiency and productivity analysis*, 2nd ed. (New York, USA: Springer).
- D'Inverno, G., Carosi, L. & Ravagli, L. (2018) Global public spending efficiency in Tuscan municipalities, *Socio-Economic Planning Sciences*, 61, pp. 102-113.
- Da Cruz, N. & Marques, R. (2014) Revisiting the determinants of local government performance, *Omega*, 44(C), pp. 91– 103.
- De Borger, B. & Kerstens, K. (1996) Cost efficiency of Belgian local governments: a comparative analysis of FDH, DEA, and econometric approaches, *Regional Science and Urban Economics*, 26(2), pp. 145-170.
- Doumpos, M. & Cohen, S. (2014) Applying Data Envelopment Analysis on accounting data to assess and optimize the efficiency of Greek local governments, *Omega*, 46, pp. 74-85.
- Dyson, R. G., Allen, R. , Camanho, A. S., Podinovski, V. V., Sarrico, C. S. & Shale, E.A. (2001) Pitfalls and Protocols in DEA, *European Journal of Operational Research*, 132(2), pp. 245–259.
- Garcia-Sanchez, I. M. (2006a) Efficiency measurement in Spanish local government: the case of municipal water services, *Review of Policy Research*, 23(2), pp. 355-372.
- Garcia-Sanchez, I. M. (2006b) Estimation of the effect of environmental conditions on technical efficiency: the case of fire services, *Revue d'Economie Regionale & Urbaine*, 2006(4), pp. 597-614.
- Geys, B., Heinemann, F. & Kalb, A. (2013) Local government efficiency in German municipalities, *Raumforschung und Raumordnung*, 71(4), pp. 283-293.
- Geys, B. & Moesen, W. (2009a) Exploring Sources of Local Government Technical Inefficiency: Evidence from Flemish Municipalities, *Public Finance and management*, 9(1), pp. 1-29.
- Geys, B. & Moesen, W. (2009b) Measuring Local Government Technical (In)Efficiency: An Application and Comparison of FDH, DEA, and Econometric Approaches, *Public Performance & Management Review*, 32(4), pp. 499-513.
- Golany, B. & Roll, Y. (1989) An Application Procedure for DEA, *Omega*, 17(3), pp. 237–250.
- Hossain, K., Kamil, A. A., Baten, A. & Mustafa, A. (2012) Stochastic Frontier Approach and Data Envelopment Analysis to Total Factor Productivity and Efficiency Measurement of Bangladeshi Rice, *PLoS ONE*, 7(10), <https://doi.org/10.1371/journal.pone.0046081>.
- Huguenin, J. (2012) *Data Envelopment Analysis (DEA) - A pedagogical guide for decision makers in the public sector*, 276 ed. (Lausanne: IDHEAP).
- Institut Alternativa (2021) *mojgrad.me*, available at: <https://www.mojgrad.me/naslovna> (June 5, 2021).
- Ismail, A., Zahid, Z., Sheikh Hussin, S. & Khairi, M. (2018) Modelling the Efficiency of Paddy Production in Peninsular Malaysia Using Principal Component Analysis and Data Envelopment Analysis (PCA-DEA), *International Journal of Supply Chain Management*, 7(4), pp. 158-171.
- Jolliffe, I. (2011) Principal Component Analysis, In: Lovric, M. (ed.) *International Encyclopedia of Statistical Science* (Berlin, Heidelberg: Springer), p. 1095.
- Kalb, A. (2012) What determines local governments' cost-efficiency? The case of road maintenance, *Regional Studies*, 48(9), pp. 1-16.
- Kalb, A., Geys, B. & Heinemann, F. (2012) Value for money? German local government efficiency in a comparative perspective, *Applied Economics*, 44(2), pp. 201-218.
- Kriegsman, M. (2016) *In which case data need to be normalized before PCA, Cluster... analysis?*, available at:

- [https://www.researchgate.net/post/In\\_which\\_case\\_data\\_need\\_to\\_be\\_normalized\\_before\\_PCA\\_Cluster\\_analysis](https://www.researchgate.net/post/In_which_case_data_need_to_be_normalized_before_PCA_Cluster_analysis) (August 1, 2021).
- Lazović-Pita, L. & Šćeta, L. (2021) A Stochastic Frontier Approach to Measuring Inefficiency of Local Communities in Bosnia and Herzegovina, *South East European Journal of Economics & Business*, 16(1), pp.18-29.
- Loikkanen, H. & Susiluoto, I. (2005) Cost Efficiency of Finnish Municipalities in Basic Service Provision 1994–2002, *Urban Public Economics Review*, 4, pp. 39-63.
- Lorenzo, J. P. & Sanchez, I. G. (2007) Efficiency evaluation in municipal services: an application to the street lighting service in Spain, *Journal of Productivity Analysis*, 27(3), pp. 149-162.
- Monstat (2011) *Statistical yearbook* (Podgorica, Montenegro: Statistical Office of Montenegro – MONSTAT).
- Monstat (2012) *Statistical yearbook* (Podgorica, Montenegro: Statistical Office of Montenegro – MONSTAT).
- Monstat (2021a) *Census 2011 – Data*, available at: <https://www.monstat.org/eng/page.php?id=392&pageid=57> (June 5, 2021).
- Monstat (2021b) *Statistical office of Montenegro*, available at: <https://www.monstat.org/eng/index.php> (June 5, 2021).
- NALAS (2012) *Fiscal Decentralization Indicators for South-East Europe: 2006-2011* (Skopje: NALAS).
- Narbón-Perpiñá, I. & De Witte, K. (2018) Local governments' efficiency: a systematic literature review—part I, *International transactions in operational research*, 25(2), pp. 431-468.
- Nikolov, M. & Hrovatin, N. (2013) Cost efficiency of Macedonian municipalities in service delivery: does ethnic fragmentation matter?, *Lex Localis - Journal of local self-government*, 11(3), p. 743.
- O'Loughlin, C. T., & Wilson, P. W. (2021) Benchmarking the performance of US Municipalities, *Empirical economics*, 60(6), pp. 2665-2700.
- Pevcin, P. (2014a) Costs and efficiency of municipalities in Slovenia, *Lex Localis- Journal of local self-government*, 12(3), p. 417.
- Pevcin, P. (2014b) Efficiency levels of sub-national governments: a comparison of SFA and DEA estimations, *TQM Journal*, 26(3), pp. 275-283.
- Pöldaru, R. & Roots, J. (2014) A PCA-DEA approach to measure the quality of life in Estonian, *Socio-Economic Planning Sciences*, 48(1), pp. 65-73.
- Prud'homme, R. (1995) The Dangers of Decentralization, *World Bank Reserach Observer*, 10(2), pp. 201-220.
- Prykhodko, S. (2016) *In which case data need to be normalized before PCA, Cluster... analysis?*, available at: [https://www.researchgate.net/post/In\\_which\\_case\\_data\\_need\\_to\\_be\\_normalized\\_before\\_PCA\\_Cluster\\_analysis](https://www.researchgate.net/post/In_which_case_data_need_to_be_normalized_before_PCA_Cluster_analysis) (August 1, 2021).
- Radulovic, B. & Dragutinovic, S. (2015) Efficiency of local self-governments in Serbia: SFA estimations, *Industrija*, 43(3), pp. 123-142.
- Ruggiero, J. (2007) A comparison of DEA and the stochastic frontier model using panel data, *Intl. Trans. in Op. Res.*, 14, p. 259–266.
- Sljepcevic, S. (2019) Measuring Efficiency at the Regional Level: A Data Envelopment Analysis Approach, *Lex Localis - Journal of local self-government*, 17(3), pp. 679-696.
- Soko, A. & Zorič, J. (2018) Municipal Efficiency and Economies of Scale in Bosnia and Herzegovina, *Lex Localis - Journal of local self-government*, 16(4), pp. 715-734.
- Šťastná, L. & Gregor, M. (2011) Local government efficiency: evidence from the Czech municipalities, *Prague: Working Paper*, No. 14 (Institute of Economic Studies).

- Štátná, L. & Gregor, M. (2015) Public sector efficiency in transition and beyond: evidence from Czech local governments, *Applied Economics*, 47(7), pp. 680-699.
- Stevens, P. A. (2005) Assessing the performance of local government, *National Institute Economic Review*, 193(1), pp. 90-101.
- Sueyoshi, T. & Mika Goto, M. (2013) Pitfalls and Remedies in DEA Applications: How to Handle an Occurrence of Zero in Multipliers by Strong Complementary Slackness Conditions, *Engineering*, 5(5), pp. 29-34.
- Syrjanen, J. M. (2004) Non-discretionary and discretionary factors and scale in data envelopment analysis, *European Journal of Operational Research*, 158(1), pp. 20-33.
- Tone, K. (2001) A slack-based measure of efficiency in data envelopment analysis, *European Journal of Operational Research*, 130(3), pp. 498-509.
- Worthington, A. C. & Dollery, B. E. (2000) Measuring efficiency in local governments' planning and regulatory function, *Public Productivity & Management Review*, 29(2), pp. 469-485.
- Worthington, A. C. & Dollery, B. E. (2001) Measuring efficiency in local government: an analysis of New South Wales, *Policy Studies Journal*, 29(2), pp. 232-249.
- Young, T. (2014) *Performance, Risk and Competition in the Chinese Banking Industry*, 1st ed. (Oxford, United Kingdom: Chandos Publishing).
- Zhu, J. & Cook, D. (2007) *Modeling Data Irregularities and Structural Complexities in Data Envelopment Analysis* (New York, USA: Springer).



## Delimitation of Energy and Financial Regulation on the EU Wholesale Energy Market

STRAHINJA OBRENOVIĆ

**Abstract** Wholesale energy markets in the European Union (EU) are regulated both by financial and energy legal frameworks. The introduction of the energy regulatory framework supplemented the existing regulation for the financial markets in the EU. However, subsequent changes in the financial legal regime opened some questions regarding the interplay between financial and energy regulation in the EU wholesale energy markets. The aim of this paper is to explain the growing complexity of the existing regulatory framework on the wholesale energy market in the EU. This complexity is raising concerns about possible overlaps of different legal regimes and division of competence between financial and energy regulatory authorities both at the EU and Member States levels. Nevertheless, closer cooperation and information exchange between different regulators can reduce some uncertainties and make the market functioning even more effective.

**Keywords:** • energy market regulation • financial market regulation • EU wholesale energy markets • physical and financial contracts • regulatory authorities

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## 1 Introduction

Wholesale energy markets in the European Union (EU) are characterized by their growing complexity. Instead of relatively isolated national wholesale energy markets that were present in the Member States for decades, the process of liberalization of energy markets brought a radical shift toward the “Europeanization” of the energy sector. With these changes, markets are playing crucial roles across the Member States. The main idea behind the process of liberalization of the energy sector was integrating national energy markets into Single Energy Market (SEM). It was obvious that the focus of new energy regulations was on retail (downstream) and midstream markets, especially in the natural gas sector. However, gaining momentum in energy liberalization brought new dynamics to energy markets. While the energy industry was largely based on long-term contractual relationships between sellers and buyers, a new phenomenon was trading on spot markets and short-term trading. In parallel to commodity trading, market players have been involved in financial energy markets. The development of energy *acquis* in the European Union was focused on the liberalization of electricity and natural gas markets, thus reducing the role of states in the markets and adopting a *laissez-faire* approach to energy trading and accessing the markets. Financial trading in energy markets was partly covered by financial regulation, while over-the-counter (OTC) trading was excluded from its scope. It was only trading on regulated markets that were initially covered by financial regulation.

A significant change came with the introduction of a new energy regulation covering wholesale energy markets in the EU and aiming to prevent market abuse and insider trading. This helped to fill the regulatory gap that existed for years in liberalized markets in the European Union. In addition, a new financial framework was introduced by revision of existing legal acts and introducing new ones. While this legislative action helped to cover some practices that were previously excluded from the scope of directives and regulations, concerns were raised about the growing complexity and potential overlapping jurisdiction. This is also reflected in the existence of separate bodies in energy and financial markets in the EU.

Given the latest energy crisis and rising energy prices, it is of particular importance to analyze the existing framework governing the EU wholesale energy markets. The aim of the paper is to present both energy and financial regulation and their delimitation on the wholesale energy market in the European Union. This includes an analysis of EU bodies established under both financial and energy frameworks, namely the European Securities and Markets Authority (ESMA) and the Agency for the Cooperation of Energy Regulators (ACER). In the paper, we argue although the delimitation between energy and financial regulation is undeniable in the EU wholesale energy markets, cooperation between financial and energy regulators is of crucial importance to overcome the complexity and prevent market misconduct.



## 2 Literature overview

In the last three decades, most academic interests have been directed toward the liberalization process in European markets. This trend reflected legislative actions inside the European Union. The main concern in the 1990s was primarily removing the barriers between Member States and integrating national markets into Single Energy Market. It was only in the 2000s that grand monographs appeared following the adoption of the First Energy Package. But, directives contained in the First Energy Package did not regulate wholesale energy trading, nor did the subsequent so-called energy packages – Second and Third Energy Packages. As Cameron notes, while the Electricity Directive of 1996 covered the production of electricity, the same provisions were absent from Gas Directive in 1998 (Cameron, 2007: 180). This was a direct result of the adoption of the Hydrocarbons Licensing Directive in 1994, which brought under its scope natural gas production. While electricity generation is located to large extent in Europe, the production of natural gas in Europe is not enough to meet the internal demand so countries are oriented towards imports from external suppliers. The same pattern and aim are present in the Second and Third Energy Packages.

Important legislative action regarding the financial markets in the European Union was taken with the adoption of Directive 2003/6/EC on insider dealing and market manipulation in 2002 (in further text Market Abuse Directive or MAD). The change in the financial framework was followed up by academic writing on this topic (Ferrarini, 2004), although the relationship between new financial regulation and energy trading was not prominent in the papers and books. Two reasons could be mentioned for lacking the academic interest regarding the application of the Market Abuse Directive in energy markets– first, the rules under the MAD are applicable only to financial markets and thus not to the whole energy market, and second, in the time of the adoption of MAD energy markets were still undergoing restructuring process as a part of liberalization and integration efforts. The Market Abuse Directive replaced previous Council Directive 89/592/EEC on insider trading while adding new rules on market manipulation (Siems, 2008: 39). This finally established a broad framework for financial markets and included rules on market manipulation, insider trading prohibition and disclosure obligation – something that Hansen describes as a 'trinity of market regulation' (Hansen, 2003: 88). In his paper Lannoo emphasized the role of disclosure obligation and its importance as a 'core principle of securities markets regulation' (Lannoo, 2003: 349). Alongside MAD, Simonetti explores the Markets in Financial Instruments Directive (MiFID) adopted in 2004 and its relevance for the energy sector in the Netherlands (Simonetti, 2007).

Radical shift and proliferation of academic text on the regulation of wholesale energy markets in Europe followed up the introduction of the Regulation on Wholesale Market Integrity and Transparency (REMIT) in 2011. However, it is important to understand a wider context and enhanced regulation of the energy market in the EU. Before the adoption of REMIT, the single most important event in the energy sector in Europe was

the enactment of the Third Energy Package in 2009. Although this package contains far-reaching provisions regarding many aspects of the electricity and natural gas markets (Pepermans, 2019: 9), it does not deal in detail with the functioning of the wholesale energy market. Nevertheless, it incorporates some important provisions on transparency and data disclosure (Michetti, 2011: 3). One of the most successful results was the establishment of the Agency for the Cooperation of Energy Regulators (ACER) as a part of the Third Energy Package (Haverbeke, Naesens, Vandorpe, 2010; Maggetti, 2013: 501). Its status, legal positions, and mandate were governed by Regulation (EC) No 713/2009 until it was repealed by Regulation (EU) 2019/942 in 2019. The role of ACER is very important for the European electricity and natural gas markets, as it is one of the main bodies in a complex multi-governance energy structure together with other European institutions and national bodies (Maher, Stefan, 2019: 88). Some authors further examine the duties and tasks of ACER under the REMIT (Klopčič, Hojnik, Pustovrh, 2020: 95; Papageorgiou, 2015). One of the most comprehensive analyses of REMIT and the application of anti-manipulation law to wholesale energy markets in the European Union came from Cagri Corlu, who also considers the interplay between REMIT and competition law (Cagri Corlu, 2018).

A significant event in the financial markets was the establishment of the European Securities and Markets Authority (ESMA) in 2011 which replaced the Committee on European Securities Regulators (CESR). Special attention in some of the papers was devoted to financial risks coming from energy and environmental markets and the applicable financial framework to those markets (Diaz-Rainey, Siems, Ashton, 2011). Some research rightly points out the rising interdependency and connection between physical and financial markets, especially in the context of the wholesale energy market in the European Union (Nijman, 2012: 469). This bond between financial and energy markets became more evident with further changes in financial framework, with the replacement of MiFID in 2014 with MiFID II and Markets in Financial Instruments Regulation (MiFIR), but also the replacement of MAD in 2014 with MAD II and Market Abuse Regulation (MAR). While it brought significant changes to financial markets in the European Union, it also attracted attention from academia (Lannoo, 2017; Kalss et al., 2021).

The aim of this paper is to present the chronological evolution of the regulatory framework in the European Union in order to understand how the wholesale energy markets function today. Beginning with the existing literature, this research should bring some explanation regarding different legal regimes applicable to the wholesale energy markets, but also give some reflection on the position of different regulatory bodies at both national and European levels. This complexity is likely to remain given the specific nature of the energy markets, especially the electricity and natural gas markets. The process of the energy transition is undergoing and bringing some challenges, but also provides some opportunities for both financial and energy markets.

### 3 Research

For decades energy markets were national in scope, and Member States had a dominant role. This situation lasted until the 1980s, and somewhere even through the 1990s. The paradigm shift from a state-centric approach to a market-oriented position was evident across the globe. It was quite similar in the European Union, where a gradual approach was taken toward market liberalization and market integration. The main concern was how to ensure competition between market players and how to regulate network access, which would in turn bring more benefits to customers. In this initial phase, the question of wholesale energy markets was not of special concern. That was evident from the rules incorporated in the so-called energy packages. European legislator was preoccupied with the proposals on unbundling, third-party access, consumer rights, the introduction of national energy regulators in Member States, and fostering cooperation at the EU level (Johnston, Block, 2012: 25). Even the ambitious Third Energy Package, which brought detailed regulation to electricity and natural gas markets, is not preoccupied with the wholesale energy markets and potential market abuse behavior of participants at this level of the market. Nevertheless, one of the main features of the Third Energy Package was the Regulation that envisaged the establishment of the Agency for the cooperation of energy regulators (ACER). As we will see further in the text, this agency has a prominent role in the implementation of REMIT.

Paradoxically, although the energy packages didn't address specifically wholesale energy markets until the adoption of REMIT, they prepared the ground for its adoption. While energy markets became more liberalized and integrated, the need emerged to regulate wholesale energy markets at the EU level. Some experience was also gained implementing the financial regulation, which addressed the issue of market abuse behavior in the financial sector. Growing trade on spot markets in contrast to traditional long-term contracts brought new dynamics to the markets. In parallel, there was a fast development of trade in energy derivatives. Interestingly, Energy Sector Inquiry which was undertaken under the competition provisions identified problems in the wholesale electricity and gas markets (DG Competition, 2007: 7). The picture was not so optimistic with a conclusion that wholesale energy markets are highly concentrated and still largely national in scope, while wholesale gas trade is not that developed as trading in electricity. Consequently one of the proposals was to ensure 'a monitoring system for trading on wholesale markets', which should bring confidence to the market participants and address market manipulation (DG Competition, 2007: 17). Three years later European Commission published a working document with a proposal for the adoption of Regulation on Energy Market Integrity and Transparency (European Commission, 2010). In this document, it was detected that the rules contained in the Third Energy Package are insufficient to adequately regulate wholesale energy trading. Key stakeholders agreed that the new framework was necessary to improve transparency in the wholesale energy markets and to prevent market misconduct.

Even before the REMIT, some provisions were applicable to wholesale energy trading. For instance, the Market Abuse Directive 2003 (MAD) contained rules applicable to financial instruments, including energy derivatives. All financial instruments covered by MAD were defined in art. 3, including derivatives on commodities, but also any financial instrument traded on a regulated market. According to art. 9 of MAD 2003, it is applicable to 'any financial instrument admitted to trading on a regulated market in at least one Member State', obviously limiting the scope to trade in regulated markets. This left a large part of the wholesale energy market outside the scope of MAD, rising concern about different market abuse practices, i.e. market manipulation and insider trading. This was problematic given that 'abuses of financial markets are a major concern of financial regulation' (Diaz-Rainey, Siems, Ashton, 2011: 364). Also, over-the-counter trade which was the dominant type of trade in energy markets was not covered. Additionally, financial markets were covered by another instrument – Markets in Financial Investments Directive 2004 (MiFID). This Directive provided investor protection provisions, and once again its provisions were oriented toward financial instruments. Both MAD 2003 and MiFID 2004 covered energy derivatives traded on regulated markets or power exchanges (Michetti, 2011: 3).

Those shortcomings were addressed in various reports and publications, including some findings coming from the Committee of European Securities Regulators (CESR), which was later replaced with the European Markets and Securities Authority (ESMA), and European Regulators' Group for Electricity and Gas (ERGEG), which was replaced with the Agency for the Cooperation of Energy Regulators (ACER). One of the conclusions of these bodies, supported by the Union of the Electricity Industry (EURELECTRIC), was that 'it would be inappropriate to expand the scope of MAD to the physical markets' and that was caused by differences that exist between physical and financial markets (Eurelectric, 2008).

The ultimate result was the adoption of Regulation on Wholesale Market and Integrity in 2011, as a general framework or in Cagri Corlu's words 'tailor-made' framework for wholesale electricity and gas markets (Cagri Corlu, 2011). The structure and provisions of REMIT are comparable to those in MAD, and as Nijman correctly points out 'REMIT is largely analogous to MAD' (Nijman, 2012: 472). Obviously, integrity and transparency were problematic in wholesale energy markets and European institutions answered with a new regulatory instrument that would complement existing rules in financial markets. Three pillars of REMIT include prohibitions of market manipulation and insider trading, but also data disclosure obligations. This Regulation also defines what market manipulation and insider trading represent. It is interesting that under REMIT not only engagement in market manipulation is prohibited, but also any 'attempt to engage in' such behavior (art. 5 REMIT). Prohibition is also placed on any 'person who possesses inside information in relation to a wholesale energy product' (art. 3 REMIT). Extensive rules are envisaged for data disclosure, effective monitoring, and registration of market participants, but also cooperation at the national and EU level.

The question is how the REMIT operates together with financial regulation on the wholesale energy markets in the European Union. We already said that the financial framework is applicable to some extent to wholesale energy markets. The main task of the European Commission was to cover all transactions and trade in the wholesale energy markets (Michetti, 2011: 4). This failure was obvious in the electricity and natural gas markets. The trend in recent years was not only increasing trade in physical commodities, but also financial instruments and energy derivatives. While financial rules were helpful in the case of financial contracts, clear market abuse provisions were missing for physical contracts. Article 1 (2) of REMIT defined the scope of Regulation, and it 'applies to trading in wholesale energy products'. From the same paragraph, it is clear that the Regulation doesn't exclude the application of Directive 2003/6/EC (MAD) and Directive 2004/39/EC (MiFID), but also competition rules. What falls under wholesale energy products is defined in art. 2(4) and includes: contracts for energy (i.e. natural gas and electricity) supply where the delivery point is in the European Union; derivatives related to energy (i.e. natural gas and electricity) produces, traded, or delivered in the European Union; contracts that are connected to the transportation of energy (i.e. natural gas and electricity) in the European Union; derivatives relating to the transportation of both electricity and natural gas in the European Union. As the Regulation is explicit in the enumeration of these contracts, it also left out the scope of supply/distribution contracts of electricity and gas intended for the final consumers, but only under the certain consumption threshold set in the Regulation.

The Regulation is explicit that articles on the prohibition of insider trading and market manipulation are not applicable to 'wholesale energy products which are financial instruments' and instead the provisions of MAD are in place and regulating this situation. It is interesting to note that obligation to publish information (art. 4 REMIT) is not excluded from the scope as is the case with art. 3 and art. 5 of REMIT when provisions of MAD are applicable. However, trade in financial instruments (energy derivatives, options, swaps) falls under the scope of REMIT if that trade is happening outside the regulated markets or exchanges. As we already said, over-the-counter (OTC) trade was very common in the energy markets which is left outside regulated markets.

The world economic crisis in 2008 was a real test for financial markets. One of the consequences of this crisis was a move from over-the-counter trading toward regulated markets because the first one came under greater regulatory scrutiny (Nijman, 2012: 470). In the European Union stakeholders were debating on the necessity to change the existing financial framework and regulation, and soon came up with a proposal to update the legal framework (Kudrna, 2016: 259). This issue was also seriously taken at the G20 Summit in Pittsburgh in 2009, where the participants agreed to act and improve the situation in financial markets (Alexander, Maly, 2015: 243).

In the European Union, one of the first measures was the introduction of the Regulation on OTC derivatives, central counterparties, and trade repositories (European Market Infrastructure Regulation or EMIR) in 2012. This new legal act introduced a requirement for standardised derivative contracts to be traded on exchanges or at least on a transparent electronic platform (Alexander, Maly, 2015: 245). Also, one of the aims is to promote standardised OTC contracts, while imposing extensive reporting obligations (Francioni, Freis, Hachmeister, 2017: 267-277). Another important step was the decision that both MAD 2003 and MiFID 2004 need to be updated and revised. The ultimate result was the adoption of the Market Abuse Directive 2014 (MAD 2014), Market Abuse Regulation (MAR), Markets in Financial Instruments Directive II (MiFID II), and Markets in Financial Instruments Regulation (MiFIR) in 2014. These legal acts significantly change the regulatory framework in financial markets, intervening more in these markets and introducing far-reaching obligations.

As a result of MiFID II and MiFIR enactment in 2014, the application of rules is not limited to regulated markets, but also to financial instruments traded in organised platforms, such as MTFs (multilateral trading facilities) and OTFs (organised trading facilities). The real novelty was the introduction of organised trading facilities as a trading venue in the legislation (Busch, 2018: 127), while the main purpose of this wider scope was to bring OTC transactions under regulatory scrutiny and organised trading venues. In comparison to the previous regulatory framework, some of the aims of the new regulation focused on strengthening the provisions on transparency and investor protection. In line with MiFID II and MiFIR 2014, the Market Abuse Directive 2014 and Market Abuse Regulation brought significant changes to financial markets and market players. The first one was adopted in the form of a directive, leaving some discretion to the Member States in implementing it. Criminal sanctions are envisaged by MAD 2014 for all participants in the markets who violate the provision on insider trading and market manipulation prohibition, and it was a step to harmonize sanctions between Member States (Alexander, Maly, 2015: 245). In fact, the Market Abuse Regulation (MAR) replaced the previous Market Abuse Directive 2003. As a result of changes that were brought by MiFID II and MiFIR, the Market Abuse Regulation's provisions are applicable not only to trade in regulated markets but also to other trading venues like MTFs and OTFs. This effectively broadens the scope of application of this Regulation compared to MAD 2003. It is important to say that the widening scope of MAR had consequences for the REMIT application and scope, and certain financial energy products that fell under the REMIT provisions are now regulated under the financial framework.

#### **4 Discussion**

In the previous part of the paper we analyzed former and existing legal frameworks applicable to the EU wholesale energy markets. Although we primarily focused on energy and financial regulation, it would be wrong to perceive these frameworks isolated from the wider context and other relevant rules. The overall picture has a few more dimensions

– competition and sector-specific rules applicable to the energy markets. The adoption of REMIT came only after the adoption of three energy packages in the European Union. Liberalization and integration of national markets was an important task for the European Union and its Member States after decades of a state-centric approach to energy markets. This process was accompanied by rising complexity in regulation. The open question was not only the appropriate legislative framework for energy markets but also the appropriate enforcement of these rules through the establishment of competent authorities. The Member States are obliged to establish national regulatory authorities (NRAs) for the electricity and natural gas markets, and all of them have at least one NRA at the national level (Johnston, Block, 2012: 126). Similar provisions are contained under the financial framework in the European Union, where competent authorities play an important role in financial markets.

In parallel to national bodies in charge of financial and energy markets, separate bodies are created at the EU level. In the 1990s when the liberalization and integration process just started at the EU level in energy markets, important venues for Member States, regulatory authorities, market participants, and industry stakeholders were forums in Florence and Madrid. Those informal meetings although non-institutionalized were important for discussion, information exchanges, consensus building, and laying the ground for some important decisions in the future (Eberlein, 2008: 78). The continuation of meetings between Member States was further formalized through the establishment of the Council of European Energy Regulators (CEER) and three years later through the European Regulators' Group for Electricity and Gas (ERGEG). The latter was dissolved after the establishment of the Agency for the Cooperation of Energy Regulators (ACER) in 2011. Although the Agency for the Cooperation of Energy Regulators was a product of sector-specific rules contained in the Third Energy Package, it is also relevant to the wholesale energy markets. Its importance and relevance are explicitly stated under REMIT, recognizing ACER's expertise regarding the functioning of electricity and natural gas markets but also giving monitoring powers to ACER at the EU level. While ACER has powers at the EU level, national regulatory authorities retain monitoring powers at the national level. Monitoring at both EU and national levels is a *conditio sine qua non* for effective market functioning and ensuring its integrity and transparency. If effective monitoring is in place it helps to detect market abuse in the wholesale energy markets and also contributes to the prevention of such practices.

Similar to energy regulation, financial regulation largely relies on the activities of different authorities in national and EU markets. Already Market Abuse Directive 2003 and Markets in Financial Instruments Regulation 2004 envisaged important roles of competent authorities in the implementation of provisions. The growing importance of financial markets and financial instruments brought new challenges to the regulation. In 2011 the Committee of European Securities Regulators (CESR) was founded as a part of the so-called *Lamfalussy process*, together with the Committee of European Banking Supervisors (CEBS) and the Committee of European Insurance and Occupational

Pensions Supervisors (CEIOPS). During its existence, CESR contributed to an efficient implementation of financial market rules by fostering cooperation between securities regulators. The global financial and economic crisis raised some important questions regarding financial regulation and effective monitoring of financial markets. One of the first responses to the crisis was the establishment of the European Securities and Markets Authority (ESMA) as a part of the *European System of Financial Supervision* and which replaced CESR in 2011. The powers of ESMA are further strengthened to ensure investor protection, better cooperation, and coordination between competent authorities, with the ultimate aim to improve the situation in financial markets in the European Union (Schammo, 2011). This authority is also known informally as the ‘securities watchdog’ or ‘financial markets watchdog’ in the European Union, which tells a lot about its position and importance for financial and securities markets. Some of the powers granted to ESMA include imposing decisions on market actors but also issuing guidance, recommendations, and opinions (Moloney, 2011: 65).

We already analyzed financial and energy rules governing wholesale energy markets in the European Union. The complex nature of the applicable rules is evident from the existence of separate but interconnected financial and energy regulations. Some authors tend to argue that large and complex systems need some degree of centralization in terms of regulatory, technical and economic functions or ‘functional centralization’ (Vasconcelos, 2019: 3). Although the financial provisions were applicable to some types of energy markets and trade in regulated markets, it soon became evident that further rules are necessary to address market abuse practices in the wholesale energy markets. The EU answer was the adoption of REMIT with provisions on insider trading and market manipulation prohibition and disclosure obligation on the wholesale energy market. Filling the regulatory gap, this Regulation helped to improve the functioning of the wholesale energy market. Parallel and overlapping jurisdictions became more evident with the reform of financial regulation in the EU. While REMIT complemented the previous financial framework established under MAD 2003 and MiFID 2004, changes in financial regulation brought a more interventionist approach to wholesale markets and limited the scope of REMIT in practice. Now under the financial framework is not only trade in regulated markets and energy/power exchanges but also trade in other venues such as MTFs (multilateral trading facilities) and OTFs (organised trading facilities). This creates a risk of overlapping competencies and regulatory uncertainty for market players and other actors.

Coordination and cooperation between different regulatory authorities and agencies are thus crucial for the effective implementation of the existing energy and financial provisions. In a context of complex and multiple frameworks, this collaboration is even more important (Mathieu, Matthys, Verhoest, Rommel, 2020: 1). It is unlikely that wholesale energy trading would be covered by a single piece of regulation, which is also reflecting the different nature of contracts and products traded in wholesale energy markets. Close cooperation between ACER and ESMA is in that sense of paramount



importance, but also cooperation between national regulatory and financial authorities in the Member States. ACER's mandate is wide and is not limited only to wholesale energy markets, thus diverting some of the resources for other tasks. Some steps were taken quite early by ACER and ESMA signing a Memorandum of Understanding on the consultation and cooperation regarding their regulatory responsibilities in relation to EU wholesale energy markets (MoU, 2013). This non-binding document provided that wholesale energy markets are increasingly changing and cooperation between Agency and Authority is essential for creating functional markets. This cooperation is based on information exchange which could help in preventing market abuse practices in both commodity and derivative markets. Documents such as this MoU are helping to achieve coherent enforcement and application of energy and financial provisions. It is important to say that the relationship between ACER and ESMA is not limited by this MoU, so they are free to expand and deepen not only their mutual cooperation but also their cooperation with national (energy) regulatory authorities and financial authorities. This was expanded through the work in Energy Trading Enforcement Forum (ETEF), which is a format that gathers not only ACER and ESMA but also national energy and financial regulators, i.e. national regulatory authorities and national competent authorities.

The rising prices in energy markets that started in 2021 and continue in 2022 show how much commodity and derivative markets are interconnected. Once the prices for energy commodities are going upward it is immediately reflected in prices in derivative markets. Price volatility is nothing new in energy markets, but the current situation is challenging the existing regulatory framework and its effectiveness. In October 2022 ACER and ESMA decided to further develop their cooperation through a new joint Task Force with the aim to 'reinforce their cooperation and enhance coordination' (ACER, 2022). This is nothing unexpected given the current situation in the energy markets and growing concerns among Member States, market players, regulators, energy companies, and consumers. The current financial and energy frameworks are once again put to the test and effective implementation is needed in order to ensure the integrity of commodity and derivatives markets and prevent market abuse behaviors.

## 5 Conclusions

The wholesale energy market in the European Union is covered by both energy and financial regulation. That was the case for almost two decades with the adoption of a comprehensive financial framework under the Market Abuse Directive (MAD) and Markets in Financial Instruments Directive (MiFID). In parallel with financial regulation, there was vibrant legislative activity in the energy sector but not a single sector-specific rule addressed wholesale energy market integrity and transparency until the adoption of the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT). This was an evident 'regulatory gap' given that the financial framework only covered trading in regulated markets. Changes introduced with the REMIT fill this gap and cover trading not regulated by the financial framework, reducing uncertainty and effectively addressing

the issue of market manipulation, insider trading, and information disclosure obligation. Monitoring task at the EU level is given to the Agency for the Cooperation of Energy Regulators (ACER), a legal body established under the Third Energy Package. The global economic and financial crisis brought significant changes to the financial markets and the rules applicable to them. One of the results was the creation of a new 'EU's financial watchdog' under the name European Securities and Markets Authority (ESMA). With that reform, the complexity of wholesale energy regulation increased even more. The scope of application of financial rules increased which ultimately resulted in a reduced scope of application of REMIT. A dividing line between financial and energy regulation has become blurred, rising concerns about overlapping jurisdiction and legal uncertainty. In order to avoid this situation, it is important to ensure a coordinated approach at both EU and national levels. Coordination between energy and financial authorities started quite early and the Memorandum of Understanding on the consultation and cooperation regarding their regulatory responsibilities in relation to EU wholesale energy markets was signed between ACER and ESMA in 2013. Although not legally binding this document proved to be very useful in terms of cooperation and mutual assistance. Both financial and energy regulations have the goal to prohibit market manipulation and insider trading. Also, commodity and derivatives markets are becoming more connected and interdependent.

The recent rise in prices in energy markets is a significant challenge to the whole 'regulatory architecture' and trust in regulation. Although price volatility is nothing new to the energy market, each crisis opens a debate on the appropriateness and effectiveness of the regulatory framework. In that sense, cooperation between regulatory bodies at both EU and Member States levels seems crucial in maintaining the coherence of the existing framework.

## References:

- ACER (2022) *ACER and ESMA enhance cooperation to strengthen oversight of energy and energy derivative markets*, available at: <https://acer.europa.eu/events-and-engagement/news/acer-and-esma-enhance-cooperation-strengthen-oversight-energy-and-energy-derivative-markets> (November 10, 2022).
- Alexander, K. & Maly, V. (2015) The new EU market abuse regime and the derivatives markets, *Law and Financial Markets Review*, 9(4), pp. 243-250, <http://doi.org/10.1080/17521440.2015.1114246>.
- Busch, D. (2018) MiFID II and MiFIR: stricter rules for the EU financial markets, *Law and Financial Markets Review*, 11(2-3), pp. 126-142, <https://doi.org/10.1080/17521440.2017.1412060>.
- Cagri Corlu, H. (2018) *Application of Anti-manipulation Law to EU Wholesale Energy Markets and Its Interplay with EU Competition Law* (Alphen aan den Rijn: Wolter Kluwer).
- Cameron, P. D. (2007) *Competition in energy markets: Law and Regulation in the European Union*, 2nd edition (New York: Oxford University Press).
- DG Competition (2007) *Report on Energy Sector Inquiry, SEC(2006) 1724* (Brussels).

- Diaz-Rainey, I., Siems, M. & Ashton, J.K. (2011) The financial regulation of energy and environmental markets, *Journal of Financial Regulation and Compliance*, 19(4), pp. 355-369, <https://doi.org/10.1108/13581981111182956>.
- Directive 2003/6/EC of the European Parliament and of the Council of 28 January 2003 on insider dealing and market manipulation, *Official Journal of the European Union*, L 96, 12.4.2003, p. 16–25.
- Directive 2004/39/EC of the European Parliament and of the Council of 21 April 2004 on markets in financial instruments amending Council Directives 85/611/EEC and 93/6/EEC and Directive 2000/12/EC of the European Parliament and of the Council and repealing Council Directive 93/22/EEC, *Official Journal of the European Union*, L 145, 30.4.2004, p. 1–44.
- Directive 2014/57/EU of the European Parliament and of the Council of 16 April 2014 on criminal sanctions for market abuse, *Official Journal of the European Union*, L 173, 12.6.2014, p. 179–189.
- Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU, *Official Journal of the European Union*, L 173, 12.6.2014, p. 349–496.
- Eberlein, B. (2008) The Making of the European Energy Market: The Interplay of Governance and Government, *Journal of Public Policy*, 28(1), pp. 73-92, <https://doi.org/10.1017/S0143814X08000780>.
- Eurelectric (2008) *Consultation Paper on CESR and ERGEG advice to the European Commission in the context of the Third Energy Package –Response to Question F.20 – Market Abuse Annex to EURELECTRIC letter of 1 September 2008*, available at: <https://www.esma.europa.eu/file/7993/download?token=hNAsAMvt> (October 10, 2022).
- Ferrarini, G. (2004) The European Market Abuse Directive, *Common Market Law Review*, 41(3), pp. 711-741, <https://doi.org/10.54648/cola2004022>.
- Francioni, R., Freis, J. H. & Hachmeister, A. (2017) Financial Market Regulation, In: Francioni, R. & Schwartz, R. A. (eds.) *Equity Markets in Transition: The Value Chain, Price Discovery, Regulation, and Beyond* (Cham: Springer), pp. 239-286.
- European Commission (2010) *Commission staff working document Impact assessment – Accompanying document to the Proposal for a Regulation of the European Parliament and of the Council on energy market integrity and transparency, SEC(2010) 1510 final* (Brussels).
- Gómez, T. & Esobar, R. (2014) *Building a European energy market: legislation, implementation and challenges* (Madrid: Funcas).
- Hansen, J. L. (2003) The trinity of market regulation: Disclosure, insider trading and market manipulation, *International Journal of Disclosure and Governance*, 1(1), pp. 82-96, <https://doi.org/10.1057/palgrave.jdg.2040015>.
- Haverbeke, D., Naesens, B. & Vandorpe, W. (2010) European Energy Markets and the New Agency for Cooperation of Energy Regulators, *Journal of Energy & Natural Resources Law*, 28(3), pp. 403-429.
- Johnston, A. & Block, G. (2012) *EU Energy Law* (Oxford: Oxford University Press).
- Kalss, S., Oppitz, M., Torggler, U. & Winner, M. (eds.) (2021) *EU Market Abuse Regulation: A Commentary on Regulation (EU) No 596/2014* (Cheltenham: Edward Elgar).
- Klopčič, L., Hojnik, J. & Pustovrh, A. (2020) ACER's Success in Establishing and Ensuring the Functioning of the Internal Energy Market: Through the Eyes of NRAs and Traders, *Managing Global Transitions*, 18(2), pp. 91-110, <https://doi.org/10.26493/1854-6935.18.91-110>.
- Kudrna, Z. (2016) Financial market regulation: crisis-induced supranationalization, *Journal of European Integration*, 38(3), pp. 251-264, <http://doi.org/10.1080/07036337.2016.1140153>.

- Lannoo, K. (2003) The Emerging Framework for Disclosure in the EU, *Journal of Corporate Law Studies*, 3(2), pp. 329-358, <https://doi.org/10.1080/14735970.2003.11419906>.
- Lannoo, K. (2017) MiFID II and the new market conduct rules for financial intermediaries: Will complexity bring transparency?, *ECMI Policy Brief*, No. 24, available at: [https://www.ceps.eu/download/publication/?id=10025&pdf=ECMI%20PB%20No%2024%20KL\\_MarketConductRules.pdf](https://www.ceps.eu/download/publication/?id=10025&pdf=ECMI%20PB%20No%2024%20KL_MarketConductRules.pdf) (October 15, 2022).
- Maggetti, M. (2013) The Politics of Network Governance in Europe: The Case of Energy Regulation, *West European Politics*, 37(3), pp. 497-514, <http://doi.org/10.1080/01402382.2013.814966>.
- Maher, I. & Stefan, O. (2019) Delegation of powers and the rule of law: Energy justice in EU energy Regulation, *Energy Policy*, 128, pp. 84-93, <https://doi.org/10.1016/j.enpol.2018.12.046>.
- Mathieu, E., Matthys, J., Verhoest, K. & Rommel, J. (2020) Multilevel regulatory coordination: The interplay between European Union, federal and regional regulatory agencies, *Public Policy and Administration*, 36(3), Special Issue, pp. 1-18, <https://doi.org/10.1177/0952076719886736>.
- Michetti, E. (2011) *Transparency in the European Wholesale Energy Markets: Filling the Regulatory Gaps* (Florence: European University Institute), available at: <http://fsr.eui.eu> (October 10, 2022).
- Moloney, N. (2011) The European Securities and Markets Authority and Institutional Design for the EU Financial Market – A Tale of Two Competences: Part (1) Rule-Making, *European Business Organization Law Review*, 12, pp. 41-86, <https://doi.org/10.1017/S1566752911100026>.
- MoU (2013) *Memorandum of Understanding between ESMA and ACER concerning the consultation and cooperation regarding their regulatory responsibilities in relation to EU wholesale energy markets*, available at: <https://documents.acer.europa.eu/en/remit/Pages/MoUs.aspx> (October 10, 2022).
- Nijman, L. (2012) The impact of the new wave of financial regulation for European energy markets, *Energy policy*, 47, pp. 468-477, <http://doi.org/10.1016/j.enpol.2012.05.030>.
- Papageorgiou, S. (2015) Wholesale Energy Market Monitoring: ACER and the Technical Implementation of REMIT, *5<sup>th</sup> International Youth Conference on Energy (IYCE)*, pp. 1-4, <https://doi.org/10.1109/iyce.2015.7180802>.
- Pepermans, G. (2019) European energy market liberalization: experiences and challenges, *International Journal of Economic Policy Studies*, 13, pp. 3-26, <https://doi.org/10.1007/s42495-018-0009-0>.
- Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators, *Official Journal of the European Union*, L 211, 14.8.2009, p. 1-14.
- Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency, *Official Journal of the European Union*, L 326, 8.12.2011, p. 1-16.
- Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories, *Official Journal of the European Union*, L 201, 27.7.2012, p. 1-59.
- Regulation (EU) No 596/2014 of the European Parliament and of the Council of 16 April 2014 on market abuse (market abuse regulation) and repealing Directive 2003/6/EC of the European Parliament and of the Council and Commission Directives 2003/124/EC, 2003/125/EC and 2004/72/EC, *Official Journal of the European Union*, L 173, 12.6.2014, p. 1-61.
- Regulation (EU) No 600/2014 of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Regulation (EU) No 648/2012, *Official Journal of the European Union*, L 173, 12.6.2014, p. 84-148.

- Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators, *Official Journal of the European Union*, L 158, 14.6.2019, p. 22–53.
- Schammo, P. (2011) The European Securities and Markets Authority: Lifting the veil on the allocation of powers, *Common Market Law Review*, 48(6), pp. 1879-1913, <https://doi.org/10.54648/cola2011073>.
- Siems, M. M. (2008) The EU Market Abuse Directive: a case-based analysis, *Law and Financial Markets Review*, 2(1), pp. 39-49, <http://doi.org/10.1080/17521440.2008.11427939>.
- Simonetti, S. (2007) Financial markets regulation in the energy sector. A few financial aspects of energy transactions, *Nederlands Tijdschrift voor Energierecht*, 6(1), pp. 11-21.
- Vasconcelos, J. (2019) Energy regulation in Europe: The politics of regulation and regulatory policy revisited, *Competition and Regulation in Network Industries*, 20(3), pp. 1-10, <http://doi.org/10.1177/1783591719857664>.



# Impact of Behaviour Nudges on Tax Compliance: Age as a Factor in Municipalities in the Republic of North Macedonia

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**Abstract** We examine the effects of a tax behaviour nudging experiment on non-compliant property taxpayers in three Macedonian municipalities. The results indicate that on average the deterrence message was almost 6 percentage points more effective for non-compliant taxpayers when compared to the control group, while the social norm message and public good message were on average 4.4 and 3.2 percentage points more effective when compared with the control group, respectively. Furthermore, age as a variable is significant and negatively associated with tax compliance behaviour in one of the three municipalities. Finally, we recommend the experiment's approach to policymakers as effective, while being inexpensive and not requiring legislative changes.

**Keywords:** • North Macedonia • tax morale • tax behaviour • probit model

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## 1 Introduction

Tax non-compliance and tax evasion are universal problems, present both in developed and developing countries, but more pronounced in the latter. Tax evasion and non-compliance are primarily constrained by the threat of possible detection and punishment (explained in Allingham and Sandmo, 1972). While enforcement in many cases is empirically shown to lead to positive tax compliance (Birskyte, 2013), so are behavioural factors; these can thus be considered applicable in tax (non-)compliance research. The control of tax non-compliance affected by social and psychological factors has been explained by Andreoni, Erard, and Feinstein (1998). The psychological factors affecting compliance are said to stem from an individual's inner feeling of 'embarrassment' in their community (social norm), inner responsibility for not fulfilling their civic duty, or the possibility of sanctions (Luttmer and Singhal, 2014). In this context, individuals may have intrinsic motivations or norms to pay or not pay taxes (Dwenger et al., 2016). The existence of social and psychological factors is increasingly being recognized and studied. Empirical studies demonstrate the effects and importance of tax authority efforts (including of governments on either level) in modifying taxpayer behaviour and enhancing public resource mobilization.

Tax non-compliance (to tax legislation) results in losses in public revenues. It can be estimated that there is a roughly one hundred million EUR annual loss of public revenues in the Republic of North Macedonia due to non-compliance as a result of low tax morale (Smilevski et al., 2020). The Treasury within the Ministry of Finance and the Public Revenues Office of North Macedonia have not calculated this loss (public revenue forgone), thus the estimate is based on the assumptions valid for other European Union countries. The taxation capacity of the authorities in developing countries is more limited, and tax evasion is more present. Therefore, it is more likely that both group/community and individual attitudes concerning tax non-compliance would differ compared to those in developed countries. Hence, considering the lower degree of tax morale in the Republic of North Macedonia, i.e., lower than the average European Union levels, these losses are likely to be even higher. Furthermore, local tax losses, especially property tax losses, can be even higher due to shortcomings in the overall process of local property tax management (Garvanlieva et al., 2020).

Behavioural interventions in tax compliance attract attention because of the expected positive impact on the behaviour of taxpayers, as well as increased cash inflows for resource mobilization. The effectiveness of these behavioural interventions has been tested in many countries: USA (e.g., Coleman, 2007, Iyer et al., 2010, Meiselman, 2018, Chirico et al., 2019), UK (e.g., Hallsworth, 2014, John & Blume, 2018, Larkin et al., 2019), South and Central America (e.g., Castro & Scartascini, 2015, Bergolo et al., 2017, Brockmeyer et al., 2019), and different European countries (e.g., Hernandez et al., 2017, Doerrenberg & Schmitz, 2017, De Neve et al., 2019, Sloboda et al., 2022, Muthova et al., 2022, Dwengler et al., 2016). Different interventions have examined the effectiveness of



different intrinsic and extrinsic motivators such as social norms, deterrence, simplification, reminders, etc. Findings from various experiments provide inconclusive and complex conclusions on what works best and what does not.

The goal of this article is to test the effectiveness of behavioural interventions with different tax nudging messages on tax compliance and property tax revenue mobilization among non-compliant taxpayers. Furthermore, we test the significance of age and gender as variables in tax compliance to detect local variations. Therefore, the research questions covered herein are: Did the different nudge messages help to change the behaviour of non-compliant taxpayers of the local property tax? Which of the three messages had the most positive behavioural change? Are age and gender predictors of tax compliance behaviour?

In this paper, we present the results of a random control trial (quasi-experiment) for determining the effect of different behavioural messages, intended to nudge non-compliant taxpayers to pay their overdue property tax liabilities. The messages were sent via letters through the postal service, addressed from the municipalities to the non-compliant taxpayers. We present the impact of these different messages on the behaviour of non-compliant taxpayers, while focusing on the significance of age as a variable. The experiment was conducted in three municipalities (local self-government units - LSGUs) in the Republic of North Macedonia in 2020.

Our results from the experiment have noteworthy policy implications since they demonstrate the effects of a behaviour-nudging approach to local resource mobilization and tax compliance. The benefits of this approach are several, as this practice does not entail legislative changes or tax rate increases, while offering a relatively inexpensive method for local revenue mobilization. Thus, the approach results in a cost-effective complement to the standard measures governments and/or tax authorities undertake to discourage tax evasion. Furthermore, the approach does not affect possible privacy issues as constructed. Possible future experiments concerning public disclosure of non-compliant taxpayers entail other privacy issues (as shown in Lenter, Slemrod, and Shackelford, 2003; Blank, 2014). Our paper contributes to the increasing empirical literature in assessing the influence of factors on tax compliance in North Macedonia as a unique approach at a local government level.

The first part of this article introduces the theoretical basis of behavioural approaches to tax payment, with an overview of empirical research in the field. The second part presents the methodology and data used, followed by the experiment results. We implemented behavioural intervention in the form of a randomized controlled trial, presented in the section on the results of the experiment and models. The last two parts provide a discussion of the results from similar experiments in other countries and, in the end, we summarize the main points and provide conclusions.

## 2 Literature overview

There is a plethora of public finance literature in emerging and developed countries on the subject of non-compliance and tax morale, with consideration of various underlying socio-demographic characteristics (as shown by, for example, Scholz and Pinney, 1995; Luttmer and Singhal, 2014; Pomeranz, 2015; Stainmo, 2018). The motivation to avoid tax compliance has been researched across different scientific disciplines, and the models that predict the behaviour can be categorized either as rational economic or behavioural economic models (Hashimzade et al., 2012; Weber et al., 2014).

The initial tax compliance models (as explored, for example, by Becker, 1968; Allingham & Sandmo, 1972; Yitzhaki, 1974) are predominantly rooted in the economic theory of expected utility. Generally, economists have modelled tax evasion behaviour as a decision made under uncertainty (Allingham and Sandmo, 1972), meaning that the evasion (the evaded tax amount) will enable additional disposable income to the tax evader (non-compliant taxpayer). However, at the same time, the evader takes the risk that if detected, the evaded tax amount will be recovered in addition to a fine. Nevertheless, the model developed by Allingham and Sandmo (1972) is based on deterrence and does not offer an explanation of all tax evasion aspects, i.e., it does not take into account social, psychological-behavioural factors such as the feeling of guilt, embarrassment, intrinsic values, and attitudes or social and demographic characteristics of the taxpayer. In these early models, taxpayers are portrayed as rational and expected to maximize utility by measuring the monetary benefits of 'dishonest' behaviour, while assuming that the decision-making is influenced by the risk of being exposed and penalized. Thus, policy responses to such assumptions have been focused on increased frequency and coverage of financial controls and stricter penalties to deter non-compliance.

Later on, authors such as Walsh (2012), Alm and Torgler (2006), and others debate the above models as quite simplistic and neglectful of other aspects of tax compliance. Batrancea et al. (2012) in their review present models of tax compliance with an emphasis on economic and behavioural perspectives beyond the early models. These models argue that tax compliance is influenced by other factors as well, such as a sense of fairness (in Castro & Scartascini, 2015; Alm et al., 1995), trust in the tax system (positively influencing voluntary compliance), power of tax authorities (through enforced tax compliance) (as presented by Kirchler et al., 2008), the 'slippery slope' framework, the complexity of the tax system, etc. (by Dwenger et al., 2016). These authors suggest that the effectiveness of different tax compliance interventions in strengthening taxpayers' compliance predominantly depends on the intrinsic motivators of the taxpayer, such as moral values, as well as external motivators, such as deterrence/rewards systems.

Empirical studies published on socio-demographic effects on the level of tax compliance or evasion globally are inconclusive. Some studies suggest that tax compliance varies across socio-demographic categories (for example, Ahmed and Braithwaite, 2004; Bobek, Roberts, and Sweeney, 2007; Kastlunger et al., 2010). These studies note significant differences among different professional categories (jobs) and their opportunities to evade taxes, while research on the relationship between tax compliance and age, gender or education, disposable income, etc. does not offer clear and uniform results across countries.

On one hand, some studies (Ahmed and Braithwaite, 2004; Bobek, Roberts, and Sweeney, 2007; Kastlunger et al., 2010) show a significant link between these variables and tax compliance, while other authors (such as Grasmick and Bursik, 1990; Ashby, Webley, and Haslam, 2009; Muehlbacher and Kirchler, 2009; Muehlbacher, Kirchler, and Schwarzenberger, 2011) show no significant effect. Still, these factors could be confounders or variables that interact with primary variables. Empirical studies on this subject have been predominantly focused on the developed and Western world and much less on emerging markets.

Antinyan and Asatryan (2020) in their meta-data analysis provide an extensive, global overview of recent studies based on forty-five randomized controlled trials with behavioural tax nudges and compare the results. They conclude that interventions concerning individual tax morale are on average ineffective in combating tax evasion and inducing better tax compliance compared to the positive effect of deterrence nudges. Overall, the effects of deterrence nudges show a modest increase in the probability of compliance of 1.5 to 2.5 percentage points compared to non-deterrence nudges. Furthermore, they suggest that nudges are more effective for late payers and when delivered in-person, while they are less effective for long-term behaviour change and among lower income countries. Some randomized controlled trial results in other countries, such as in Guatemala, indicate that deterrence messages are most effective, as are social norm messages having a lesser, but still significant impact (Kettle et al., 2016). Study results in a municipality in Argentina (Castro and Scartascini, 2015) find deterrence letters to be most effective, while messages of reciprocity and peer-effect were found to be insignificant. In Slovenia, compliance of small businesses was positively affected through personal communication rather than letters (Doerrenberg and Schmitz, 2017). In London and the surrounding areas, social norm messages have not only been unsuccessful, but have had an adverse effect (as explained by John & Blume, 2018).

In a separate study, Torgler and Schaltegger (2005) provide empirical evidence that age (as one of the factors of tax behaviour) is an important and significant determinant for tax morale and tax behaviour. They demonstrate that age is statistically significant in determining tax behaviour for all age groups and positively correlated with tax compliance in Europe overall (in 1989/90). Specifically, the authors demonstrate a positive and significant relationship between age and tax morale in Switzerland (in 1989,

but not significant in 1999), Germany (in the same period), Spain (in 1990, but not in 1995), Belgium, and Great Britain. In the same paper, they also find positive results on the American continent, as well as in transitional European countries (in the 1990s), such as Russia, Estonia, Poland, Bulgaria, and Slovenia.

Hofmann, Voracek, and Kirchler (2017) find that the correlation between age and tax compliance varies depending on the (global) geographical region, i.e., the region where the data were collected. Their research reveals a stronger positive relationship in Eastern Europe, Central Asia, and North America, then a less significant positive link in East Asia and Pacific Sub-Saharan Africa, Latin America, and the Caribbean, and no relation between age and tax compliance in South Asia. Their results support the hypothesis that older taxpayers are more compliant than younger ones.

The justification behind the age-tax compliance link comes through socialization aspects. Social values and attitudes of younger people differ from those of older people; however, the authors explain that these values and attitudes are transformative with age and can move in either direction (becoming more or less compliant). As an individual ages, the need for public services/public goods increases, and so does the need for social security benefits and health care. Consequently, the appreciation for and value of the benefits of the paid taxes increase as well. Additionally, older generations might be financially better off (Kirchler, 2007). In this same vein, tax knowledge increases with age (Eriksen and Fallan, 1996), and risk aversion intensifies. On the other hand, older age could be linked to reduced tax compliance as well, as in Warneryd and Walerud (1982) and Wahlund (1992) who find a negative connection, where older taxpayers are less compliant compared to younger generations of taxpayers.

In our case study, we present the impact of various nudging messages on tax compliance, as well as demonstrate the significance of age and gender as socio-demographic characteristics in achieving compliance. We present experimental results taking into consideration the relationship between local property tax compliance and the age and gender of the non-compliant taxpayer in three municipalities in North Macedonia.

### 3 Research

The three LSGUs covered in the experiment are heterogeneous in size and area, geographical position, and share of the property tax in local revenues, which makes them representative of the heterogeneity of Macedonian LSGUs. In terms of population size, there is one LSGU in each of the following categories: large, medium, and small (the average population of municipalities in North Macedonia is 23,000). All municipalities have a seat in urban centres. The selection and inclusion of the three LSGUs in the research are based on their interest to implement the tax behaviour intervention experiment, conducted from July to September 2020.

Property tax collected from natural persons is a significant portion of the municipal own source revenues. For the LSGUs covered in this experiment, the property tax collected from natural persons represents 7%, 12%, and 20% of their own source tax revenues, respectively. The cumulative overdue liabilities of the taxpayers over the past several years present a significant amount for all LSGUs and often surpass the property tax revenues collected annually (Table 1).

**Table 1:** Selected data from the sample LSGUs

		LSGU1	LSGU2	LSGU3
Population	(in '000)	81.0	5.5	17.5
Avg. annual revenue from PT	(in mill MKD)	12.1	0.9	6.3
Avg. annual OSR from Taxes	(in mill MKD)	175.7	7.6	31.5
Share of PT in OSR from Taxes	(in %)	7%	12%	20%
5 year cumulative PT liabilities	(in mill MKD)	42.93	1.41	5.97
Sample size	#	1,021	451	607
Treatment response rate	(in %)	8%	23%	21%
Sample Cumulative PT: Prior treatment	(in mill MKD)	15.60	1.12	5.24
Sample Cumulative PT: After treatment	(in mill MKD)	15.13	1.01	4.49
Change (pre/post)	(in %)	-3%	-9%	-14%

Note: PT – property tax revenues, natural persons only

OSR – Own Source Revenues

1 EUR = 61.69 MKD

### 3.1 Data and Methodology

To raise local property tax compliance and the mobilization of revenues, we evaluate the effectiveness of behavioural nudges through random controlled trials in three municipalities in the Republic of North Macedonia. The nudges were sent through printed letter messages to non-compliant taxpayers. The three municipalities (authorities) agreed to alter their conventional communication for the collection of the property tax and to include different letters when mailing annual property tax bills. Thus, they agreed to participate in a randomized experimental setting. This study used quantitative methodology to determine the effects of different nudging messages addressed solely to non-compliant taxpayers, and the goal of the messages was to prompt non-compliant taxpayers to pay their overdue liabilities for the local property tax. The research was conducted in three municipalities in North Macedonia (overall sample size  $n=2,079$ ).

The overdue taxpayer liability for the property tax was recorded before treatment, and the effects were measured after treatment. The data are based on the financial records of the municipalities, which cover the personal property outstanding balance of taxpayers who are owners of real estate and who are registered as property taxpayers. The difference between the outstanding balance prior to the treatment and after the treatment is the

indicator of whether the taxpayer fully or partially paid the outstanding debt for the property tax. The sample was stratified by age groups and by gender, based on the distribution of these categories in the overall population of non-compliant taxpayers.

The treatment was conducted through three different messages in specially designed letters, printed and marked with the municipal official letterhead alongside the 'new' annual property tax bills. The messages were delivered by postal service to the residency of the taxpayer. The content of the messages was intended to nudge the non-payers' behaviour by invoking their inner values and attitudes toward social norms, public good, and deterrence. The sample excluded taxpayers who had a mailing address outside the municipality. In the course of the selection, an average of around 5 per cent of taxpayers could not be matched across both the register of taxpayers and the list of taxpayers' property tax bills; these individuals were also excluded from the sample. One of the municipalities was smaller in terms of the total number of taxpayers and, thus, non-compliant taxpayers and the sample included all identified, non-compliant taxpayers. Each non-compliant taxpayer was then randomly assigned to a treatment group and to a control group. Overall, 75 per cent of the sample was assigned to one of the three treatment groups, and 25 per cent was randomly assigned to the control group. The treatment groups included letters with messages as shown in Table 2.

**Table 2:** Treatment messages

Type of message sent within a letter attached to the tax property annual bill	Excerpt of the letter with the message to be conveyed
The Social Norm Letter/Message	<i>...According to our records, most of the citizens in the municipality have paid their property tax. You are part of the minority that has not yet fulfilled that duty...</i>
The Public Good Letter/Message	<i>...Do you know that 100% of the property tax revenues collected are spent for your needs and the needs of our citizens? With these revenues the municipality finances preschool and primary education, building local infrastructure and social programs. Do not be an irresponsible citizen and pay your tax...</i>
The Deterrence Letter/Message	<i>...Not paying taxes places an unfair burden on all the taxpayers who are honestly fulfilling their obligations. The municipality can undertake execution procedures, thus exposing you to additional costs...</i>

### 3.2 Experiment and model results

The overall results achieved through the randomized controlled trial in the three municipalities in North Macedonia can be summarized as follows: on average 10 per cent of the treated non-compliant taxpayers with overdue liability for the property tax reacted positively by paying their full liability. An additional 6 per cent partially paid their

overdue liabilities. Taxpayers within the treatment groups of the experiment reduced their overdue liabilities for the property tax by 6 per cent.

Overall, the most effective result was achieved by the deterrence letter, followed by the social norm message and the public good message. There are geographical differences per the municipality as well, and in the sub-samples, the social norm took precedence. Furthermore, females reacted better to the social norm message, unlike males who reacted better to the deterrence message. The average overdue liability owed by a single citizen before treatment in the treated sample was reduced by 6 per cent on average. The results indicate the following impact on tax payments (of the overdue property tax):

- (1) **Deterrence message:** The impact on tax payments for those who received the deterrence message was on average almost 6 percentage points higher than for the control group (taxpayers who did not receive any message).
- (2) **Social norm message:** The impact on tax payments for those who received the social norm message was on average 4.4 percentage points higher than for the control group.
- (3) **Public good message:** The impact on tax payments for those who received the public good message was on average 3.2 percentage points higher than for the control group.

On a single municipal level, in two of the three municipalities, the social norm letter influenced property taxpayers' beliefs significantly, while in the third, the deterrence letter influenced their beliefs significantly.

To estimate the causal effects of the treatment messages on tax compliance, we employed a probit model. Based on the nature of the dependent variable (payment of overdue liability), which is captured using a dummy 1 and 0, the specified model is analysed using binary regression techniques, as classical regression techniques will not be suited for dichotomous dependent variables. We assume that the cumulative distribution follows a standard normal distribution, thus the use of the probit form of the binary regression technique. We employ the probit technique as adequate as it was also used by other authors of comparable research (Doerenberg & Peichl, 2018; Castro & Scartascini, 2015; Anderson, 2015; Trogler et al., 2008, etc.). We employ baseline summary statistics with an OLS regression of the pre-treatment variable in question on treatment dummies and a constant term. We then employ the probit model to estimate the causal effects of the treatment messages on tax compliance.

The observations are unstructured and present the number of taxpayers per municipality with overdue liability. In the OLS regression, the dependent variable is a binary (1=paid; 0=not paid) and takes the value of 1 if the taxpayer paid an amount of the total tax liabilities during the observed period of the experiment. The constant captures the value for the control group (no message). The social norm, public good, and deterrence

variables show the difference in Macedonian denars (MKD) between the treatment groups and the control group. The results of the OLS regression are presented in Table 3.

**Table 3:** Baseline summary statistics from the OLS regression

Municipality Dependent Variable	Constant (1)	Social norm (2)	Public good (3)	Deterrence (4)
LSGU <sub>1</sub> paid	0.0658*** (0.018)	0.0125 (0.024)	-0.001 (0.024)	0.051** (0.025)
LSGU <sub>2</sub> paid	0.164*** (0.035)	0.124** (0.054)	0.067 (0.056)	0.086 (0.053)
LSGU <sub>3</sub> paid	0.174*** (0.032)	0.078* (0.047)	0.026 (0.046)	0.064 (0.046)

Note: The constant captures the value for the control group (no message). Columns (2)-(4) show the difference between the treatment groups and the control group. Monetary amounts are in Macedonian denars (MKD). Standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . LSGU – local self-government unit, municipality

The results from Table 3 illustrate that:

- For LSGU1: The deterrence letter influences the property tax taxpayers' beliefs significantly; almost 7 per cent paid as a control group
- For LSGU2: The social norm letter influences the property tax taxpayers' beliefs significantly; some 16 per cent paid as a control group
- For LSGU3: The social norm letter influences the property tax taxpayers' beliefs significantly; some 17 per cent paid as a control group

We employ the probit model to estimate the causal effects of the treatment messages on tax compliance. The model takes the following algebraic form of equation (1):

$$Pr(Y_i = 1|X) = \Phi(\alpha + \beta_1 T1i + \beta_2 T2i + \beta_3 T3i + \gamma Zi + \delta is) \quad (1)$$

where Y is the binary outcome variable equal to one if the individual taxpayer-i meets their tax obligations in the period; T-are binary variables representing the three treatment messages (T1=Social norm; T2=Public good; and T3=Deterrence), Z-is a vector of control variables comprising taxpayers' observable characteristics (age and gender), and  $\delta$ -is a set of strata fixed effects.

In the following Table 4, we present the average treatment effects of the probit estimation described in the above equation (1). The dependent variable is a binary variable (1=paid; 0=not paid), and it takes the value of 1 if the taxpayer paid some amount of the total tax liability overdue. The three municipalities' estimations include three treatment messages (social norm, public good, and deterrence) and the fixed effects. The control variables are age and gender.



The probit model estimate explains the payment of the overdue property tax liability to the taxpayer receiving a specific letter message, conditional to the age and gender of the taxpayer. A positive coefficient means that an increase in the predictor leads to an increase in the predicted probability, while a negative coefficient means that an increase in the predictor leads to a decrease in the predicted probability. Thus, we are testing the null hypothesis that the payment reaction of the taxpayer is unrelated to the gender/age of the taxpayer. The testing with a statistically significant and positive coefficient estimate is indicating that we would reject the null hypothesis and conclude that the regression coefficient has been found to be statistically different from zero given the other variables in the model.

**Table 4:** Probit regression statistics

	LSGU <sub>1</sub>	LSGU <sub>2</sub>	LSGU <sub>3</sub>
Constant	-1.528*** (0.316)	0.199 (0.353)	-1.363*** (0.337)
Social norm	0.093 (0.169)	0.366** (0.186)	0.265* (0.161)
Public good	-0.011 (0.174)	0.233 (0.195)	0.100 (0.164)
Deterrence	0.313* (0.167)	0.238 (0.186)	0.233 (0.161)
Age	-0.001 (0.004)	-0.018*** (0.004)	0.003 (0.004)
Gender	0.103 (0.189)	0.071 (0.192)	0.291* (0.160)

Note: The dependent variable used in each regression is identified in the header. The set of regressions includes the three treatment messages, control variables, and block-level fixed effects. Note that the interpretation of the coefficient values is complicated by the fact that estimated coefficients from a binary model cannot be interpreted as the marginal effect on the dependent variable. (See more: [http://www.eviews.com/help/helpintro.html#page/content%2Fflimdep-Binary\\_Dependent\\_Variable\\_Models.html%23ww37432](http://www.eviews.com/help/helpintro.html#page/content%2Fflimdep-Binary_Dependent_Variable_Models.html%23ww37432)).

Robust standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

LSGU – local self-government unit, municipality

The results from Table 4 illustrate that:

- For LSGU1: The deterrence letter influences the property tax taxpayers' beliefs significantly. Age and gender are not statistically significant. The H-L and the Andrews test statistic show mixed results in testing the goodness of fit of the probit regression, suggesting that caution should be used in the interpretation of the results of the model estimation.
- For LSGU2: The social norm letter influences the property tax taxpayers' beliefs significantly. Age is statistically significant. We would reject the null hypothesis

and conclude that the regression coefficient for age has been found to be statistically different from zero. The older the taxpayer, the less tax compliance in LSGU2, i.e. the older the taxpayer there is less probability for payment of the overdue tax liability. The H-L and the Andrews test statistic show satisfying goodness of fit of the probit regression, suggesting that the model shows a good reliance that can be placed on the results.

- For LSGU3: The social norm letter influences the property tax taxpayers' beliefs significantly. Gender is statistically significant for tax compliance in LSGU3. We would reject the null hypothesis and conclude that the regression coefficient for gender has been found to be statistically different from zero. Males have higher tax compliance behaviour than females in LSGU3. The H-L and the Andrews test statistic show mixed results in testing the goodness of fit of the probit regression, suggesting that caution should be used in the interpretation of the results of the model estimation.

#### 4 Discussion

We conducted a randomized field controlled trial to test whether including messages in the property tax bill about the social norm, public good, or enforcement of the tax would modify taxpayers' behaviour and cause them to pay their overdue liabilities. Through the experiment, we made efforts to provide evidence of the significance of the approach as a complementary policy instrument of the classical enforcement instruments in North Macedonia. With the findings, we test the hypotheses of which message is more effective and whether age is a significant variable in the direction of tax compliance. Using a local property tax on a municipal level allows for more localized information on the impact, providing data on possible local differences.

When put into perspective, extending the use of the nudging behaviour messages to the overall population of non-compliant taxpayers on a national level throughout the municipalities in North Macedonia may result in a substantial increase in compliance and local revenue mobilization. We further investigated age as a variable for improved tax compliance, and the results indicated that age is negatively associated with tax compliance; however, age was significant for only one of the three municipalities in our study. This result indicates that in one of the municipalities, the older the taxpayers are, the more likely the non-compliance with property tax obligations. This may stem from different underlying reasons that could be explored further. These results are in line with the findings of Warneryd and Walerud (1982) and Wahlund (1992), but differ from the findings of Kirchler (2007) and Eriksen and Fallan (1996).

The results indicate that the effect on tax payments (for the overdue property tax) for the group of taxpayers who received the deterrence message was on average almost 6 percentage points higher when compared to the control group (taxpayers who did not receive any message). The impact on tax payments for those who received the social norm

message was on average 4.4 percentage points higher than for the control group, while the impact on tax payments for those who received the public good message was on average 3.2 percentage points higher than for the control group.

On a municipal level, in two of the three municipalities, the social norm letter significantly influenced the property taxpayers' beliefs, while in the third municipality, the deterrence letter significantly influenced their beliefs. Our findings are partially in line with the findings of other authors. Our findings for two municipalities coincide with the findings of Muthova et al. (2022) on the positive effects of social norm messages in one municipality in Slovakia. Unlike Torgler et al. (2008), who conclude that females are more tax compliant, we did not find significance between tax compliance and gender except in one of the municipalities, where we found a weak correlation, but among male taxpayers. The findings are in line with the extensive meta-analysis of Antioyan and Asatryan (2020), as well as with the findings of Hernandez et al. (2017) and others, that the approach can be an effective policy instrument, complementing enforcement, and that behaviour nudges are more effective among non-payers, with deterrence messages having the overall strongest effect.

The most important result of our study is that deterrence has a positive nudging effect on non-compliant taxpayers, as does social information on individual tax compliance. Individuals are inclined to change their tax-compliance behaviour when exposed to the possibility of being penalized, as well as exposed to information on the 'good' behaviour of others in the community.

While our results provide novel empirical evidence for North Macedonia about whether influencing taxpayers' behaviour affects tax compliance, more in-depth research is needed to further understand the causal channels, and it may be useful to replicate the experiments on a larger scale covering more municipalities that are more regionally dispersed, as well as covering other taxes.

## **5 Conclusions**

The approach of nudging behaviour towards enhanced tax compliance is an innovative, alternative, inexpensive, and effective method. This tax compliance enhancement tool can be used as a complement to other tax compliance methods. The models confirm that different messages can have various effects on the taxpayers' behaviour, depending on one's beliefs and values that vary locally as well. Furthermore, characteristics such as gender or age may be statistically significant in individuals being more or less tax compliant depending on the specific location. Our paper explores empirically whether providing different information/messages to taxpayers influences the individual taxpayer's compliance decision, as well as the significance of age.

While our results provide innovative empirical evidence for North Macedonia about whether influencing taxpayers' behaviour affects tax compliance, more in-depth research is needed to understand the causal channels further, and it may be useful to replicate the experiments on a larger scale covering more municipalities that are more regionally dispersed, as well as covering other taxes.

Furthermore, this paper presents evidence on the importance of policymakers managing and making use of opportunities to influence citizens' beliefs with policies of behavioural nudges, customized to the taxpayers' profile. Our work also demonstrates how this alternative/complement could yield benefits. The effectiveness of this approach and the fact that it can be used complementary to traditional approaches should serve as valid motivation for local governments to introduce it when dealing with non-compliant taxpayers. The benefits of the approach are that it is inexpensive and does not encompass legislative changes. It is also significant and valid for North Macedonia as a method to contribute to the shift in attitudes and norms toward better tax compliance.

One should be careful with the possible extrapolation of the findings to the overall population of taxpayers and other municipalities, as we have explored a limited range of parameters. It is nevertheless observable that both deterrence and social norm messages have a stronger impact on individuals. Our findings highlight the importance of acknowledging peer effects and deterrence when studying tax compliance behaviour. Therefore, this study provides information and guidance for local policies designed to deter local tax evasion. In particular, the results imply that providing information on the extent to which one's close community complies with local tax may encourage higher compliance.

Finally, there are limitations in this study as it was conducted on a limited number of municipalities and provides localized results. Therefore, additional testing and replication of the experiment design are important. This study has limitations caused by local data availability connected with the profile of the taxpayers. It may be possible to analyse extended longer-term effects and to consider other variables besides age and gender, such as marital status, household size, employment status, education level, etc. Furthermore, due to the usage of postal services for the delivery of the messages, the effects may have been underestimated as we are assuming that all the letters reached all targeted taxpayers.

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## References:

- Ahmed, E. & Braithwaite, V. (2004) When tax collectors become collectors for child support and student loans: Jeopardizing the revenue base?, *Kyklos*, 57(3), pp. 303–326.
- Allingham, Michael G. & Sandmo, A. (1972) Income Tax Evasion: A Theoretical Analysis, *Journal of Public Economics*, 1(3-4), pp. 323–338.
- Alm, J. & Torgler, B. (2006) Culture differences and tax morale in the United States and in Europe, *Journal of Economic Psychology*, 27, pp. 224–246.
- Alm, J., Sanchez, I. & DE Juan, A. (1995) Economic and Noneconomic Factors in Tax Compliance, *Kyklos*, 48(1), pp. 1–18, <https://doi.org/10.1111/j.1467-6435.1995.tb02312.x>.
- Anderson, J. E. (2016) Paying the State Use Tax, *Public Finance Review*, 45(2), pp. 260–282.
- Andreoni, J., Erard, B. & Feinstein, J. (1998) Tax Compliance, *Journal of Economic Literature*, 36(2), pp. 818–860.
- Antinyan, A. & Asatryan, Z. (2020) Nudging for Tax Compliance: A Meta-Analysis. *CESifo Working Paper*, No. 8500, available at: [https://www.econstor.eu/bitstream/10419/223572/1/cesifo1\\_wp8500.pdf](https://www.econstor.eu/bitstream/10419/223572/1/cesifo1_wp8500.pdf) (September 20, 2021).
- Ashby, J. S., Webley, P. & Haslam, A. S. (2009) The role of occupational taxpaying cultures in taxpaying behaviour and attitudes, *Journal of Economic Psychology*, 30(2), pp. 216–227.
- Batrancea, L. Nichita R. & Moldovan, B. (2012) Tax Compliance Models: From Economic to Behavioral Approaches, *Transylvanian Review of Administrative Sciences*, 8, pp. 13–26.
- Becker, G. S. (1968) Crime and Punishment: An Economic Approach, *Journal of Political Economy*, 76(2), pp. 169–217.
- Bergolo, M. L., R. Ceni, G. Cruces, M. Giacobasso & Perez-Truglia R. (2017) Tax audits as scarecrows: Evidence from a large-scale field experiment, *Working Paper Series*, 23631 (National Bureau of Economic Research), available at: [https://www.nber.org/system/files/working\\_papers/w23631/w23631.pdf](https://www.nber.org/system/files/working_papers/w23631/w23631.pdf) (June 10, 2022).
- Birskyte, L. (2013) Effects of Tax Auditing: Does the Deterrent Deter?, *Research Journal of Economics, Business and ICT*, 8(2), available at: <https://ojs.journals.cz/index.php/RJEBI/article/view/393> (May 20, 2022).
- Blank, J. D. (2014) Reconsidering Corporate Tax Privacy, *New York University, Journal of Law & Business*, 11(1), pp. 31–122, available at: [https://www.nyuylb.org/\\_files/ugd/716e9c\\_f560a5519f174f8197db92cb0cc38c4e.pdf](https://www.nyuylb.org/_files/ugd/716e9c_f560a5519f174f8197db92cb0cc38c4e.pdf) (June 1, 2022).
- Bobek, D. D., Roberts, R. W. & Sweeney, J. T. (2007) The social norms of tax compliance: Evidence from Australia Singapore, and the United States, *Journal of Business Ethics*, 74, pp. 49–64.
- Brockmeyer, A., Smith, S., Hernandez, M. & Kettle, S. (2019) Casting a Wider Tax Net: Experimental Evidence from Costa Rica, *American Economic Journal: Economic Policy*, 11(3), pp. 55–87, <https://doi.org/10.1257/pol.20160589>.
- Castro, L. & Scartascini, C. (2015) Tax compliance and enforcement in the pampas evidence from a field experiment, *Journal of Economic Behavior & Organization*, 116, pp. 65 – 82.
- Chirico, M., Inman, R., Loeffler, C., MacDonald, J. & Sieg, H. (2019) Detering property tax delinquency in Philadelphia: An experimental evaluation of nudge strategies, *National Tax Journal*, 72(3), pp. 479–506.
- Coleman, S. (2007) The Minnesota Income Tax Compliance Experiment: Replication of the Social Norms Experiment, *SSRN Scholarly Paper*, ID 1393292 (Social Science Research Network), <https://doi.org/10.2139/ssrn.1393292>.

- De Neve, J. E., Imbert, C., Luts, M., Spinnewijn, J. & Tsankova, T. (2019) How to improve tax compliance? evidence from population-wide experiments in Belgium, *Technical report, CEPR Discussion Paper*, 13733, available at: <https://cep.lse.ac.uk/pubs/download/dp1621.pdf> (January 31, 2022).
- Doerrenberg, P. & Peichl, A. (2018) Tax Morale and the Role of Social Norms and Reciprocity. Evidence from a Randomized Survey Experiment, *CESifo Working Paper Series*, No. 7149, available at: [https://www.cesifo.org/DocDL/cesifo1\\_wp7149.pdf](https://www.cesifo.org/DocDL/cesifo1_wp7149.pdf) (June 1, 2022).
- Doerrenberg, P. & Schmitz, J., (2017) Tax compliance and information provision. A field experiment with small firms, *Journal of Behavioral Economics for Policy*, 1(1), pp. 47-54.
- Dwenger, N., Kleven, H., Rasul, I. & Rincke, J. (2016) Extrinsic and Intrinsic Motivations for Tax Compliance: Evidence from a Field Experiment in Germany, *American Economic Journal: Economic Policy*, 8(3), pp. 203–232.
- Eriksen, K. & Fallan, L. (1996) Tax knowledge and attitudes towards taxation: A report on a quasi-experiment, *Journal of Economic Psychology*, 17(3), pp. 387–402.
- Garvanlieva Andonova, V., Nikolov, M., Dimovska, G. & Petrovska, A. (2020) *Challenges in the Local Tax System in the Municipalities of North Macedonia: Focus on Property Tax* (Center for Economic Analyses), available at: <https://cea.org.mk/wp-content/uploads/2020/09/0.-Predizvitsi-lokalni-danotsi-za-imot-natsrt-01092020.pdf> (May 30, 2022).
- Grasmick, H. G. & Bursik, R. J. (1990) Conscience, significant others, and rational choice: Extending the deterrence model, *Law & Society Review*, 24(3), pp. 837–861.
- Hallsworth, M. (2014) The use of field experiments to increase tax compliance, *Oxford Review of Economic Policy*, 30(4), pp. 658–679, <https://doi.org/10.1093/oxrep/gru034>.
- Hashimzade, N., Myles, G.D. & Tran-Nam, B. (2012) Applications of behavioural economics to tax evasion, *Journal of Economic Surveys*, 27(5), pp. 1-37.
- Hernandez, M., Jamison, J., Korczyk, E., Mazar, N. & Sormani, R. (2017) *Applying Behavioral Insights to Improve Tax Collection: Experimental Evidence from Poland* [Working Paper] (World Bank), <https://doi.org/10.1596/27528>.
- Hofmann, E., Voracek, M., Boch, C. & Kirchler, E. (2017) Tax compliance across sociodemographic categories: Meta-analyses of survey studies in 111 countries, *Journal of Economic Psychology*, 62(C), pp. 63-71.
- Iyer, G. S., Reckers, P. M. & Sanders, D. L. (2010) Increasing tax compliance in Washington state: A field experiment, *National Tax Journal*, 63(1), p. 7.
- John, P. & Blume, T. (2018) How best to nudge taxpayers? The impact of message simplification and descriptive social norms on payment rates in a central London local authority, *Journal of Behavioral Public Administration*, 1(1), <https://doi.org/10.30636/jbpa.11.10>.
- Kastlunger, B., Dressler, S. G., Kirchler, E., Mittone, L. & Voracek, M. (2010) Sex differences in tax compliance: Differentiating between demographic sex, gender-role orientation, and prenatal masculinization, *Journal of Economic Psychology*, 31(4), pp. 542–552.
- Kettle, S., Hernandez, M., Ruda, S. & Sanders, M. (2016) Behavioral Interventions in Tax Compliance: Evidence from Guatemala, *World Bank Policy Research Working Paper*, No. 7690, available at: <https://ssrn.com/abstract=2811337> (January 30, 2021).
- Kirchler, E. (2007) *The economic psychology of tax behaviour* (Cambridge: Cambridge University Press).
- Kirchler, E., Hoelzl, E. & Wahl, I. (2008) Enforced versus voluntary tax compliance: The “slippery slope” framework, *Journal of Economic Psychology*, 29(2), pp. 210–225, <https://doi.org/10.1016/j.joep.2007.05.004>.

- Larkin, C., Sanders, M., Andresen, I. & Algate, F. (2019) Testing local descriptive norms and salience of enforcement action: A field experiment to increase tax collection, *Journal of Behavioral Public Administration*, 2(1), <https://doi.org/10.30636/jbpa.21.54>.
- Lenter, D., Slemrod, J. & Shackelford, D. (2003) Public Disclosure of Corporate Tax Return Information: Accounting, Economics, and Legal Perspectives, *National Tax Journal*, 56(4), pp. 803–830.
- Luttmer, E. F. P. & Singhal, M. (2014) Tax Morale, *Journal of Economic Perspectives*, 28(4), pp. 149–168.
- Meiselman, B. S. (2018) Ghostbusting in Detroit: Evidence on nonfilers from a controlled field experiment, *Journal of Public Economics*, 158, pp. 180 – 193.
- Muehlbacher, S. & Kirchler, E. (2009) Origin of endowments in public good games: The impact of effort on contributions, *Journal of Neuroscience, Psychology, & Economics*, 2(1), pp. 59–67.
- Muehlbacher, S., Kirchler, E. & Schwarzenberger, H. (2011) Voluntary versus enforced tax compliance: Empirical evidence for the “slippery slope” framework, *European Journal of Law and Economics*, 32(1), pp. 89–97.
- Muthová, N.J., Svidroňová, M.M. & Vitálišová, K. (2022) Smart Interventions for Smart Cities: Using Behavioral Economy in Increasing Revenue from Local Fees and Why It Might Sometimes Fail, In: Gervasi, O., Murgante, B., Misra, S., Rocha, A.M.A.C. & Garau, C. (eds.) *Computational Science and Its Applications – ICCSA 2022 Workshops. ICCSA 2022. Lecture Notes in Computer Science*, vol 13382 (Cham: Springer), pp. 141-156.
- Pomeranz, D. (2015) No Taxation without Information: Deterrence and Self Enforcement in the Value Added Tax, *American Economic Review*, 105(8), pp. 2539– 2569.
- Scholz, J. T. & Pinney, N. (1995) Duty, Fear, and Tax Compliance: The Heuristic Basis of Citizenship Behavior, *American Journal of Political Science*, 39(2), pp. 490-512.
- Serim, N. & ve Yağanoğlu, N. Y. (2017) Good Governance and Tax Compliance: An Ordered Probit Application in Çanakkale, *Girişimcilik ve Kalkınma Dergisi*, 12, pp. 51-64.
- Sloboda, M. , Pavlovský, P. & Sičáková-Beblová, E. (2022) The effectiveness of behavioural interventions on increasing revenue from local fee, *Review of Behavioral Finance*, 14(1), pp. 1-15, <https://doi.org/10.1108/RBF-06-2020-0126>.
- Smilevski, B., Dimovska, G., Nikolov, M., Garvanlieva Andonova, V. & Petrovska, A. (2020) *Tax morale in the Republic of Northern Macedonia: Analysis of the factors* (Center for Economic Analyses), available at: <https://cea.org.mk/wp-content/uploads/2020/06/0.-Analiza-na-danocen-moral-DETERMINANTI-CEA-28052020-so-CIP-2.pdf> (June 10, 2021).
- Steinmo, S. (ed.) (2018) *The Leap of Faith: The Fiscal Foundations of Successful Government in Europe and America* (Oxford: Oxford University Press).
- Torgler, B. & Schaltegger, C. A. (2005) Tax Morale and Fiscal Policy, *CREMA Working Paper Series*, 2005-30 (Center for Research in Economics, Management and the Arts (CREMA)), available at: <https://www.files.ethz.ch/isn/28858/2006-02.pdf> (May 30, 2022).
- Torgler, B., Demir, I. C., Macintyre, A. & Schaffner, M. (2008) Causes and Consequences of Tax Morale: An Empirical Investigation, *Economic Analysis and Policy*, 38(2), pp. 313–339.
- Walsh, K. (2012) Understanding Taxpayer Behaviour—New Opportunities for Tax Administration, *Economic and Social Review*, 43(3), pp. 451–475.
- Warneryd, K. & Walerud, B. (1982) Taxes and Economic Behavior: Some Interview Data on Tax Evasion in Sweden, *Journal of Economic Psychology*, 2(3), pp. 187-211.
- Weber, T.O., Fookien, J. & Herrmann, B. (2014) Behavioural economics and taxation, *European Union Working paper*, No. 14, available at: [https://taxation-customs.ec.europa.eu/system/files/2016-09/taxation\\_paper\\_41.pdf](https://taxation-customs.ec.europa.eu/system/files/2016-09/taxation_paper_41.pdf) (March 27, 2022).

V. Garvanlieva Andonova & M. Nikolov: Impact of Behaviour Nudges on Tax Compliance: Age as a Factor in Municipalities in the Republic of North Macedonia

Yitzhaki, S. (1974) Income tax evasion: A theoretical analysis, *Journal of Public Economics*, 3(2), pp. 201–202, [https://doi.org/10.1016/0047-2727\(74\)90037-1](https://doi.org/10.1016/0047-2727(74)90037-1).



# Is There a Relationship Among Investor Sentiment Industries? Evidence from the Vietnamese Stock Market

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& THANH TRUNG LE

**Abstract** Investor sentiment and its influence on the stock market dynamics has become a growing concern in recent years especially among emerging economies. While the literature has focused on the sentiment of national stock market, the sentiment related to stock sectors has been largely ignored. Thus motivated, this research aims to examine the dynamic spillover among sentiment of different stock sectors in Vietnam during 2013-2022. To this aim, we use a financial network consisting of the sentiment variable in the TVP-VAR-based spillover framework. Our results show strong independence among sentiment indices in our network, especially from 2015 onwards. Overall, we find that industries heavily affected by government regulation, including Utilities, Finance, Banking, Oil Industry and Consumer Services, are net transmitters of shocks. The other industries, including Technology, Industrials, Consumer Discretionary, Health Care and Basic Materials, are net recipients.

**Keywords:** • investor sentiment • stock market • TVP-VAR • industries • Vietnam

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## 1 Introduction

Many researchers have reported the importance of measuring and assessing investor sentiment in stock markets in developed countries (see, among others, Antoniou et al., 2016; Baker et al., 2012; Baker & Wurgler, 2006; Chung et al., 2012; Huang et al., 2015; Smales, 2017; Xu et al., 2022) and emerging and frontier stock markets (Pandey & Sehgal, 2019; Phan et al., 2021 and Xiong et al., 2019). However, most studies in this field have only focused on developed markets. According to Ángeles López-Cabarcos et al. (2019), research on behavioral finance with keywords “emerging markets”, “asset pricing”, “stock market”, and “sentiment” have only appeared from 2014 onwards. The keyword “frontier markets” does not appear as a notable linking phrase. Therefore, investor sentiment in emerging and frontier markets is still a topic that needs further research to add to the behavioral finance knowledge system.

The objective of this study is to explore the dynamic spillovers of investor sentiment among industries in frontier markets with evidence from the Vietnamese stock market during the period 2012-2022. This is an exciting research topic due to two reasons. First, to measure and assess investor sentiment, many previous studies on investor sentiment have recently constructed a sentiment index at country-level (see, for example, Antoniou et al., 2016; Baker et al., 2012; Baker & Wurgler, 2006; Chung et al., 2012; Huang et al., 2015; Smales, 2017; Xu et al., 2022). However, to our knowledge, few authors have drawn on any systematic research into industry-level sentiment index. Indeed, few studies have constructed sentiment indices for one or two specific industries (Peng et al., 2022; G. Wang et al., 2021). This study therefore adds significantly to the existing literature as sentiment indices for 10 industries in the stock market will be established. Second, while many studies have been carried out on investor sentiment, the relationship between industry sentiment indices has been under-studied. This study thus provides an exciting opportunity to advance our knowledge of investor sentiment and behavioural finance.

This paper combines and is related to two strands of literature. First, our topic draws from research investigating the measures of investor sentiment on stock markets. Previous studies have provided three main approaches to construct a sentiment index: market-based, survey-based and text- or media-based (Zhou, 2018). Second, we gain further insight from the literature on the relationship between investor sentiment industries (Kaplanski & Levy, 2010; Tiwari et al., 2022). All these strands of literature have increasingly advocated a time-varying association between investor sentiment industries. In order to allow for such dynamism, we utilize a time-varying parameter vector autoregressive model (TVP-VAR) developed by Antonakakis et al. (2020).

Our study reveals some critical findings using data collected on the Vietnamese stock market. First, we document a strong independence among sentiment indices in our network, especially from 2015 onwards. Second, we find that industries heavily affected

by government regulation, including Utilities, Finance, Banking, Oil Industry and Consumer Services, are net transmitters of shocks. The other sectors, including Technology, Industrials, Consumer Discretionary, Health Care and Basic Materials, are net recipients.

The rest of this paper has been divided into four parts. Section 2 begins by laying out the theoretical dimensions of the research and looks at how to measure investor sentiment. Section 3 introduces the methodology used in this study. Section 4 presents the findings of the research. Section 5 gives a brief summary and critique of the findings.

## 2 Literature overview

There are two stands of literature relating to this topic.

The first stand is measures of investor sentiment. According to Zhou (2018), investor sentiment indicators are classified into 3 categories, based on the data used to measure them, including (1) survey-based sentiment index, (2) text-based index và media-based index, (3) market-based sentiment index. *First*, the survey-based sentiment index is constructed by data from surveys. Some popular surveys worldwide are the American Association of Individual Investors survey, ING Investor Dashboard Sentiment Index, and Investors Intelligence survey. The weaknesses of the survey-based sentiment index include limited scope, limited research time, and that the answer depends a lot on how the questionnaire is designed (Zhou, 2018). Nevertheless, it is an important indicator, especially in the robustness test for sentiment indices constructed by other methods (Shen et al., 2017; Smales, 2017). In Vietnam, there has currently been no organization to survey with a large enough scale and long enough time to build a survey-based sentiment index. *Second*, the text-based index và media-based index is constructed by textual data mining tools. With the development of machine learning, many studies have used text-based and media-based indexes to measure sentiment (Da et al., 2015; García, 2013; Jiang et al., 2019). The strength of this approach is that big data can provide plenty of information, and data can be collected in minutes (Zhou, 2018). *Third*, the market-based sentiment index is constructed by proxy variables related to investor sentiment (secondary data). Several proxies used to construct sentiment indices are closed-end fund discount (Lee et al., 2002; Zweig, 1973), volatility index, put call ratio, option premiums, buy-sell imbalance, and open interest (Bathia & Bredin, 2013; Hachicha & Bouri, 2008; Muhammad, 2022; Pan & Poteshman, 2006; Reis & Pinho, 2020; Yang & Zhou, 2015). The most popular market-based sentiment index is the index proposed by Baker and Wurgler (2006) (Zhou, 2018). This index is constructed from six proxies: closed-end fund discount, market turnover, the number of IPOs, the first-day return of IPOs, the share of equity issues, and dividend premium. Sentiment measurements based on a multifactor approach are better at explaining volatility in stock returns than using each factor alone (Baker & Wurgler, 2006; Huang et al., 2015; Zhou, 2018). In addition, Pandey & Sehgal (2019) mentioned a mixed sentiment index, which is constructed from primary (survey) and secondary (market or text data) data.

The second stand is the relationship of sentiment in different industries. The existing literature on the relationship between sentiment and industry is sparse (Chen et al., 2013). Kaplanski & Levy (2010) found that market sentiment has a more significant effect on less stable industries, such as the Hi-TEC industry, during aviation disasters, whereas utilities are the most negligible influence. Tiwari et al. (2022) also consider indices of Australia's aggregate Consumer Sentiments index and components of the aggregate index, including CSI Rural Australia, CSI-Aged 18–24; CSI – Aged 25 to 44, and CSI–Aged 45 and above for different industries in Australia. The authors report asymmetric and unidirectional causality-in-returns from consumer sentiments to industry stock returns. Gong et al. (2022) said that the relationship between high-frequency stock price volatility and investor sentiment is time-varying. Especially, they found that the connectedness in risk spillover networks between stock volatility and investor sentiment in the long term is considerably lower than that in the short term. However, the above studies only focus on the effect of sentiment on stock returns in various industries. Wang et al. (2022) construct dynamic networks of the investor sentiment of 10 sectors in the Chinese stock market. They figured out that the spillover effect or connectedness on the investor sentiment layer is less than that of stock return, but the connectedness of the investor sentiment increased more rapidly compared to stock returns. The fact that few studies investigate the spillovers among investor sentiment of industries leaves a research gap for this paper.

### 3 Research methodology

#### 3.1 Principle Analysis Component

This study uses the Principal Component Analysis (PCA) to construct a sentiment index for the Vietnamese stock market. PCA is a method of reducing the dimensionality of the data space. Many variables are correlated while ensuring the maximum possible variance of the data (Jolliffe, 2002). The sentiment index is constructed as follows:

$$SENT = a \times NIPO + b \times RIPO + c \times TURN + d \times S + e \times P^{D-ND} + f \times MFI + g \times INV \quad (1)$$

where: *SENT* is the investor sentiment, *NIPO* is the number of IPOs, *RIPO* is the average first-day return, *TURN* is the market turnover, *S* is equity share in new issues,  $P^{D-ND}$  is value-weighted dividend premium, *MFI* is money flow index, and *INV* is the number of new investors.

### 3.2 The TVP-VAR-based dynamic connectedness approach

In order to explore the dynamic connectedness in a time-varying manner, we employ the TVP-VAR approach introduced by Antonakakis et al. (2018). The TVP-VAR methodology combines the connectedness approach of Diebold & Yilmaz (2009, 2012, 2014) and Koop & Korobilis (2014). This framework allows the variances to vary over time via a Kalman Filter estimation with forgetting factors. The TVP-VAR(p) model can be expressed as:

$$y_t = \beta_t z_{t-1} + \epsilon_t \quad \epsilon_t | F_{t-1} \sim N(0, S_t) \quad (2)$$

$$vec(\beta_t) = vec(\beta_{t-1}) + v_t \quad v_t | F_{t-1} \sim N(0, R_t) \quad (3)$$

where  $y_t$  and  $z_{t-1} = [y_{t-1}, \dots, y_{t-p}]'$  respectively represent  $N \times 1$  and  $Np \times 1$  dimensional vectors.  $\beta_t$  is an  $N \times Np$  dimensional time-varying coefficient matrix and  $\epsilon_t$  is an  $N \times 1$  dimensional vector of error disturbance with an  $N \times N$  time-varying variance-covariance matrix,  $S_t$ .  $vec(\beta_t)$ ,  $vec(\beta_{t-1})$  and  $v_t$  are  $N^2p \times 1$  dimensional vectors and  $R_t$  is an  $N^2p \times N^2p$  dimensional matrix.

To calculate the generalised impulse response functions (GIRF) and generalised error variance decomposition (GFEVD) (Koop et al., 1996; Pesaran & Shin, 1998), we need to transform the TVP-VAR to a TVP-VMA using the Wold representation theorem:

$$y_t = \sum_{j=0}^{\infty} L' W_t^j L \epsilon_{t-j} \quad (4)$$

$$y_t = \sum_{j=0}^{\infty} A_{it} \epsilon_{t-j} \quad (5)$$

where  $L = [I_N, \dots, 0_p]'$  is an  $Np \times N$  dimensional matrix,  $W = [\beta_t; I_{N(p-1)}, 0_{N(p-1) \times N}]$  is an  $Np \times Np$  dimensional matrix. The GIRFs represent the responses of all variables following a shock in variable  $i$ . We compute the differences between a  $J$ -step-ahead forecast where once variable  $i$  is shocked and once where variable  $i$  is not shocked. The difference can be accounted to the shock in variable  $i$ , which is given by:

$$GIRF_t(J, \delta_{j,t}, F_{t-1}) = E(Y_{t+J} | \epsilon_{j,t} = \delta_{j,t}, F_{t-1}) - E(Y_{t+J} | F_{t-1}) \quad (6)$$

$$\varphi_{j,t}^g(J) = \frac{A_{j,t} S_t \epsilon_{j,t}}{\sqrt{S_{ij,t}}} \frac{\delta_{j,t}}{\sqrt{S_{ij,t}}} \quad , \quad \delta_{j,t} = \sqrt{S_{ij,t}} \quad (7)$$

$$\varphi_{j,t}^g(J) = S_{jj,t}^{-1/2} A_{j,t} S_t \epsilon_{j,t} \quad (8)$$

where  $\varphi_{j,t}^g(J)$  is the GIRFs of variable  $j$ ,  $J$  represents the forecast horizon,  $\delta_{j,t}$  is the selection vector with value of one on the  $j$ -th position and zero otherwise, and  $F_{t-1}$  is the information set until  $t - 1$ . Then, we compute the GFEVD that can be interpreted as the variance share one variable has on others. The calculation is as follows:

$$\tilde{\phi}_{ij,t}^g(J) = \frac{\sum_{t=1}^{J-1} \phi_{ij,t}^{2,g}}{\sum_{j=1}^N \sum_{t=1}^{J-1} \phi_{ij,t}^{2,g}} \quad (9)$$

with  $\sum_{j=1}^N \tilde{\phi}_{ij,t}^g(J) = 1$  and  $\sum_{i,j=1}^N \tilde{\phi}_{ij,t}^g(J) = N$ . Based on the GFEVD, we can build the total connectedness index (TCI) as follows:

$$C_t^g(J) = \frac{\sum_{i,j=1, i \neq j}^N \tilde{\phi}_{ij,t}^g(J)}{\sum_{i,j=1}^N \tilde{\phi}_{ij,t}^g(J)} \times 100 = \frac{\sum_{i,j=1, i \neq j}^N \tilde{\phi}_{ij,t}^g(J)}{N} \times 100 \quad (10)$$

The connected approach allows to examine how a shock in one variable spills over to other variables. First, the shock transmitted from variable  $i$  to all other variables  $j$ , i.e. the *total directional connectedness TO others* can be defined as:

$$C_{i \rightarrow j,t}^g(J) = \frac{\sum_{i,j=1, i \neq j}^N \tilde{\phi}_{ij,t}^g(J)}{\sum_{j=1}^N \tilde{\phi}_{ij,t}^g(J)} \times 100 \quad (11)$$

Second, the shock that variable  $i$  receives from all other variables  $j$ , i.e. the *total directional connectedness FROM others* can be defined as:

$$C_{i \leftarrow j,t}^g(J) = \frac{\sum_{i,j=1, i \neq j}^N \tilde{\phi}_{ij,t}^g(J)}{\sum_{j=1}^N \tilde{\phi}_{ij,t}^g(J)} \times 100 \quad (12)$$

Finally, the *net total directional connectedness* can be given by subtracting the total directional connectedness TO others from the total directional connectedness FROM others:

$$C_{i,t}^g = C_{i \rightarrow j,t}^g(J) - C_{i \leftarrow j,t}^g(J) \quad (13)$$

This net total directional connectedness can be interpreted as the influence of variable  $i$  on the analyzed network. If the net total directional connectedness of variable  $i$  is positive, variable  $i$  influences the network more than being influenced by it. This also means that variable  $i$  is a shock transmitter. On the other hand, if the net total directional connectedness is negative, variable  $i$  is driven by the network, meaning that it is a shock receiver.

As the net total directional connectedness is an aggregated measure and sometimes masks important underlying dynamics, we want to calculate the net pairwise directional connectedness (NPDC), which informs about the bilateral transmission process between variables  $i$  and  $j$ :

$$NPDC_{ij}(J) = \tilde{\phi}_{ji,t}(J) - \tilde{\phi}_{ij,t}(J) \quad (14)$$

A positive (negative) value of  $NPDC_{ij}(J)$  indicates that variable  $i$  is driving (driven by) variable  $j$ .

### 3.3 Data

We selected Vietnam to collect data because Vietnam is a frontier market (FTSE Russell, 2022), with more than 95 per cent of investors being domestic individual investors (HOSE, 2022). This group is vulnerable because they are strongly influenced by sentiment rather than fundamental factors (Ackert & Deaves, 2010). Therefore, the Vietnamese stock market can be significantly affected by sentiment. We employ monthly data collected from the FiinPro platform, a financial database in Vietnam, from 2012 to 2022. The choice of these time windows is restricted to the availability of investor sentiment data. We compute investor sentiment indices for industries following the method of Baker and Wurgler (2006). The investor sentiment series for Vietnam is constructed from seven proxies: market turnover, number of IPOs, average first-day return on IPOs, equity share of new issuances, the log difference in book-to-market ratios between dividend payers and dividend non-payers, money flow index and the number of new investors. After using PCA, the sentiment indicators are then transformed into stationary series by taking the growth rate.

Vietnam has two stock exchanges, including Ho Chi Minh City Stock Exchange, which was established in 2005 and Hanoi Stock Exchange, which was established in 2007. Adopting the ICB standard, companies listed on two Vietnamese stock exchanges are classified into 11 industries. Table 1 describes the number of firms in each industry. As the Telecommunications industry has only one company, we need more data to construct a sentiment index for the telecommunications industry. Therefore, we only construct sentiment indices for ten industries except for Telecommunications. As can be seen from Table 1, the selected sample covers all companies listed on the Vietnamese stock market.

**Table 1:** Number of companies listed in the stock market sectors on the Vietnam stock market

Industry	Number of companies		
	Ho Chi Minh City Stock Exchange	Hanoi Stock Exchange	Total
Basic Materials	60	43	103
Consumer Discretionary	65	35	100
Industrials	106	159	265
Services	26	34	60
Banking	17	2	19
Finance	94	38	132
Health Care	14	10	24
Utilities	31	18	49
Technology	8	11	19
Oil	2	3	5
Telecommunications	0	1	1
<b>Total</b>	<b>423</b>	<b>354</b>	<b>777</b>

Source: Data collected from FiinPro (2022).

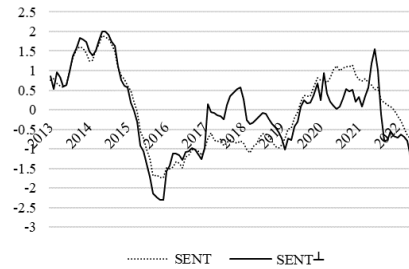
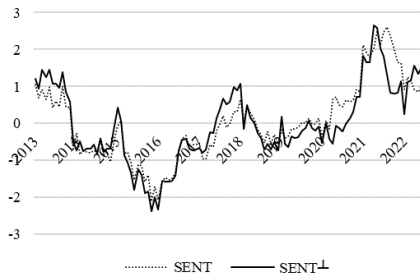
## 4 Results and Discussion

### 4.1 Descriptive statistics

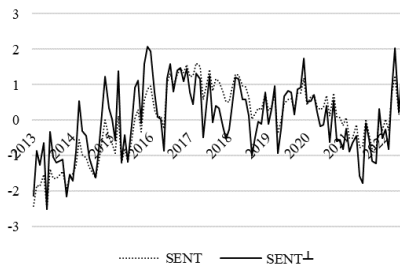
Using the principal component analysis (PCA), this study measures sentiment for ten industries on the Vietnamese stock market (Figure 1). Following Baker & Wurgler (2006), we label SENT ( $SENT^\perp$ ) as the sentiment index constructed from the six raw (orthogonalized) measures.



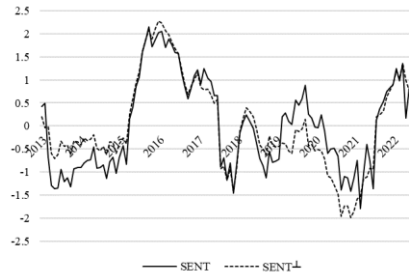
**Figure 1:** Sentiment indices for 10 industries on the Vietnamese stock market



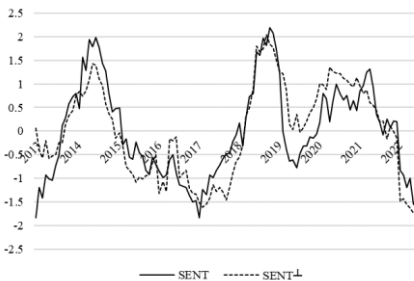
### Technology



### Industrials



### Oil

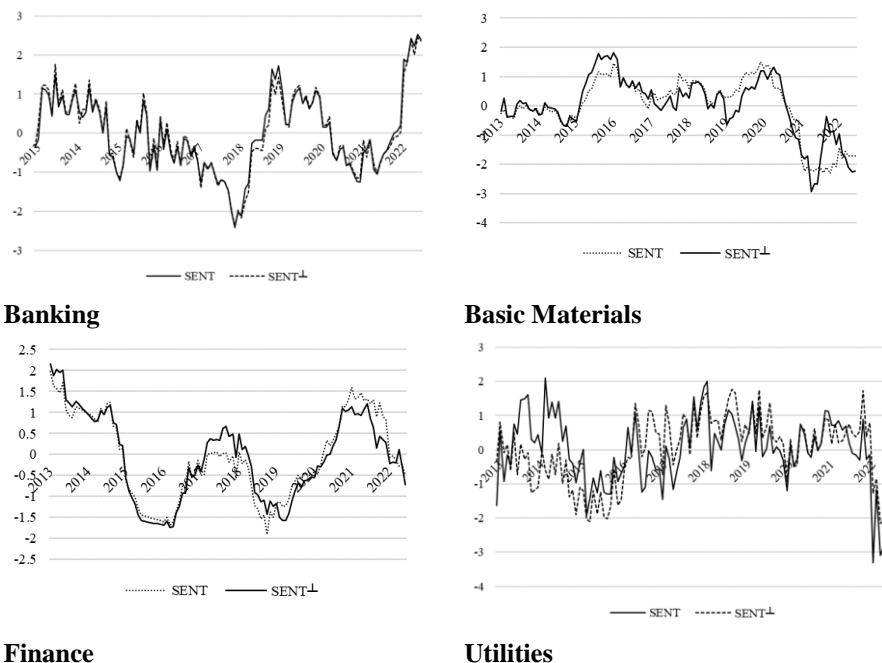


### Services



### Health Care

### Consumer Discretionary



Notes: We regress each measure on the growth in industrial production, employment growth, consumption growth and the dummy variable for the business cycle. The dashed (solid) line is the first principal component index of the six raw (orthogonalized) measures, labelled as SENT (SENT $\perp$ ). Both are standardized to have zero mean and unit variance.

Figure 1 shows market sentiment changes among industries on the stock market. Several features are noticed in Figure 1.

First, in general, the SENT and SENT $\perp$  of ten industries are closely related, and all sentiment indices are influenced by economic and political events. For example, although each sentiment index of each industry changes differently, most of the sentiment indices declined in 2014, 2016, 2018 and 2020. These are the times when several important political and economic events occurred, such as the dispute between Vietnam and China in the East Sea in 2014, the trading interruption of the Chinese stock market in 2016, the US-China trade war in 2018 and the COVID-19 epidemic in early 2020. Second, although most sentiment indices are influenced by economic and political events, sentiment indices vary across industries. While market sentiment in the Oil, Banking, and Utility industries tends to fluctuate continuously, sentiment in the rest tends to fluctuate less continuously. In addition, in some periods, an industry's sentiment index differs from the other industries. For example, the year 2020 saw sentiment for stocks in most industries

increase due to the impact of market expectations during the COVID-19 period. However, the sentiment of the Basic Materials and Services industry is still decreasing at a low level. This might be because of the strong damaging impacts from the epidemic.

As another example, Figure 1 shows that sentiment for the Oil industry increased at the beginning of 2022, while sentiment in other sectors did not grow after 2021. This can be explained by the fact that these industries' sentiment depends mainly on each industry's specific characteristics. The sentiment index of Oil stocks is highly dependent on changes in oil prices and government policies (Kassouri et al., 2021; Si et al., 2021). For example, the 2022 Russian invasion of Ukraine led to a sharp increase in oil prices (OECD, 2022), leaving the market to maintain a reasonably positive expectation of the performance of companies in this industry. In addition, government policies affect the Oil, Banking and Utility industries more often than other industries (Si et al., 2021). This is also why the sentiment of these industries fluctuates strongly and does not change cyclically.

After using PCA, the sentiment indicators are then transformed into stationary series by taking the growth rate. Table 2 and Table 3 indicate the summary statistics of the growth rate of investor sentiment industries on the Vietnamese stock market. The variance of sentiment indices indicate that sentiments of Banking and Utilities are the most volatile, while sentiments of Consumer Discretionary and Finance are the least volatile. Next, skewness and kurtosis measures indicate that all series are leptokurtic and significantly left skewed. All variables except for sentiment indicators are not normally distributed. Moreover, all variable are stationary at 5% significance level. Finally, we find evidence suggesting that series are autocorrelated and exhibit ARCH errors, making it legitimate for the choice of a TVP-VAR model with time-varying covariances.

**Table 2:** Summary statistics

	Mean	Variance	Skewness	Kurtosis	JB	ERS	Q(20)	Q2(20)
Technology	0.517	48.245***	8.655***	86.783***	34766.022***	- 4.597***	1.326	1.162
Industrials	0.331*	3.894***	7.265***	66.385***	20087.085***	- 2.843***	1.242	0.243
Oil	-1.014**	18.087***	-3.685***	20.045***	1637.946***	- 3.976***	18.276**	22.372***
Services	0.182	3.846***	4.097***	38.556***	6323.916***	- 5.188***	20.305**	5.418
Health care	0.079	5.394***	6.998***	67.988***	20991.494***	- 4.362***	5.685	0.238
Consumer Discretionary	0.001	1.478***	3.036***	28.158***	3181.489***	- 3.599***	8.427	1.339
Banking	9.003	7164.231***	10.362***	109.482***	55897.583***	- 4.618***	0.080	0.063
Basic Materials	-0.682	41.858***	-7.069***	68.729***	21470.790***	- 4.313***	6.877	0.665
Finance	-0.025	1.279***	0.474***	15.877***	791.940***	- 4.998***	8.438	10.650
Utilities	-17.224	11346.190***	-6.341***	42.569***	8201.338***	- 4.761***	2.553	1.217

Notes: \*\*\*, \*\*, and \* denote significance at 1%, 5% and 10% significance levels respectively; Skewness: D'Agostino (1970) test; Kurtosis: Anscombe and Glynn (1983) test; JB: Jarque and Bera (1980) normality test; ERS: Stock *et al.* (1996) unit root test; Q(10) and Q<sup>2</sup>(10): Fisher and Gallagher (2012) weighted portmanteau test.

**Table 3:** Pairwise correlation matrix.

	Technology	Industrials	Oil	Services	Health care	Consumer Discretionary	Banking	Basic Materials	Finance	Utilities
Technology	1									
Industrials	0.029	1								
Oil	0.0208	-0.0103	1							
Services	0.0299	0.0179	-0.0462	1						
Health care	0.0359	0.0575	0.0659	-0.0246	1					
Consumer Discretionary	0.0106	0.0008	-0.0422	-0.0796	-0.0053	1				
Banking	-0.0886	-0.0297	-0.017	-0.005	0.0701	0.0436	1			
Basic Materials	0.0105	-0.0478	0.0048	0.0149	0.0162	-0.0006	0.0166	1		
Finance	0.1249	-0.0393	0.0251	0.1045	0.008	-0.0807	-0.0593	0.004	1	
Utilities	0.0035	0.0587	0.2314	-0.2173	-0.0041	0.038	0.0168	-0.0119	-0.199	1

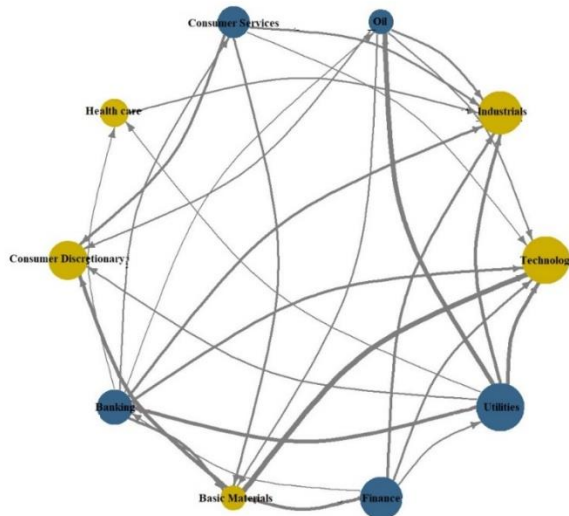
#### 4.2 The dynamic spillovers among investor sentiment industries on the Vietnamese stock market

Table 4 reports the results of the average dynamic connectedness analysis. Each row of Table 4 corresponds to the individual contribution of each variable to the forecast error variance of all other variables of our network. In contrast, each column shows the forecast error variance that other variables have contributed to each variable separately. Elements on the main diagonal represent own-variable effects, while the off-diagonal elements show the effect from/to others.

**Table 4:** Averaged dynamic connectedness table

	Technology	Industrials	Oil	Services	Health care	Consumer Discretionary	Banking	Basic Materials	Finance	Utilities	Contribution FROM others
Technology	16.17	6.14	7.28	7.74	10.95	3.39	9.04	16	11.8	11.49	83.83
Industrials	4.88	15.81	8.42	14.28	8.29	8.66	10.92	6.45	11.17	11.11	84.19
Oil	3.44	3.69	22.19	7.51	6.72	4.81	16.44	3.28	9.41	22.54	77.81
Services	4.77	9.85	7.68	20.84	9.58	9.5	9.82	6.39	13.68	7.88	79.16
Health care	9.84	5.13	6.05	10.51	18.83	7.83	8.98	11.52	13.2	8.11	81.17
Consumer Discretionary	3.12	9.06	7.86	14.74	6.88	17.36	7.62	14.3	11.02	8.05	82.64
Banking	3.86	5.05	13.49	6.84	6.05	5.62	19.97	2.46	13.67	23	80.03
Basic Materials	6.13	5.65	6.34	11.04	9.59	6.71	8.25	25.55	12.61	8.13	74.45
Finance	7.54	5.36	8.35	12.74	11.28	9.36	10.9	6.1	21.49	6.81	78.51
Utilities	3.64	4.43	13.45	5.94	5.21	4.99	15.22	6.25	10.77	30.09	69.91
Contribution TO others	47.22	54.35	78.93	91.33	74.55	60.87	97.19	72.75	107.33	107.16	791.69
Inc. Own	63.4	70.17	101.12	112.17	93.37	78.23	117.16	98.3	128.82	137.26	TCI
NET directional connectedness	-36.6	-29.83	1.12	12.17	-6.63	-21.77	17.16	-1.7	28.82	37.26	87.97/ 79.17
NPDC transmitter	0.00	2.00	5.00	5.00	3.00	2.00	7.00	4.00	9.00	8.00	

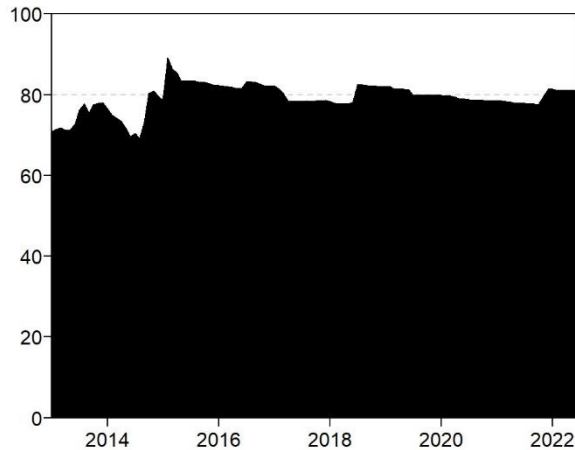
Notes: Values reported are variance decompositions for estimated TVP-VAR(2) model. A lag length of order 2 was selected by the Bayesian information criterion. Variance decompositions are based on 10-step-ahead forecast.

**Figure 2:** Averaged dynamic connectedness of investor sentiment industries

Notes: Blue dots represent net transmitters. Yellow dots represent net recipients. The size of a dot represents the level of effect on investor sentiment of each industry.

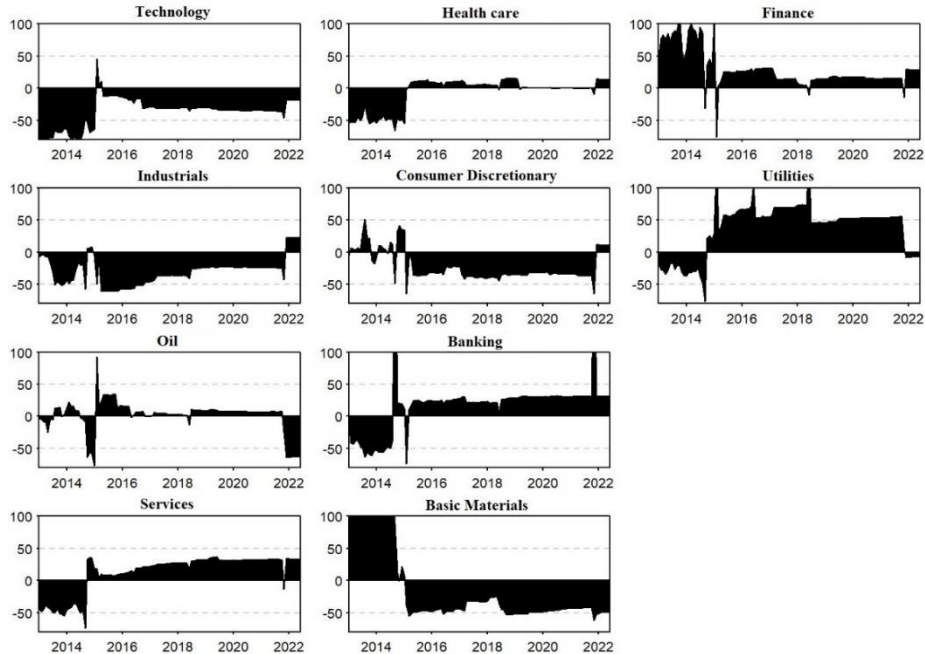
As can be seen from Table 4, the total connectedness is 79.17%, suggesting a strong interdependence among the variables in our network. These results indicate that over 20% of the forecast error variance can be attributed to own-variable innovations. On average, we observe from Table 4 and Figure 2 that Oil, Services, Banking, Finance and Utilities are net transmitters of shocks. These industries are heavily affected by government regulation (FTSE Russell, 2022), and as a result, this might be the reason for their impacts on other industries in the network. These findings further support the idea of Hua et al. (2020), who suggest that investor sentiment in the stock market is significantly affected by industry policies promulgated by the government. On the other hand, Technology, Industrials, Health care, Consumer Discretionary, and Basic Materials are net recipients.

Although Table 4 reveals some interesting observations on the interdependence between investor sentiment industries, these results correspond to aggregate measures considering the sample period. Using average figures can mask several economic and geopolitical events during the sample period and may lead to considerable deviations from the average TCI values reported in Table 4. Thus, we will proceed with the dynamic approach. The aim is to identify specific episodes that influenced connectedness across our variables over time.

**Figure 3:** Dynamic total connectedness

The time-varying connectedness measures are shown in Figure 3. It is clear that the total connectedness measure changes considerably over time and behaves heterogeneously across industries. The range for the total connectedness spans from 64% to 84%. Thus, the interrelationship between investor sentiment industries is indeed time-dependent. A closer look at Figure 4 reveals that the connectedness is less pronounced during periods of economic turbulence or bear periods. These episodes include, for example, rumours of prosecuting Mr Tran Bac Ha, Chairman of the Board of Directors of the Bank for Investment and Development of Vietnam and the adoption of policies closer to international standards in calculating non-performing loans (2013), the event that China placed an oil rig in the East Sea (which is called as South China Sea by China) (May 2014), the global oil price plummet (December 2014), US-China trade tensions in 2018 and the onset of the COVID-19 pandemic (March 2020). Thus, it is evident that time-specific developments and events entirely drive the relationship among variables in our networks. However, the fact that the connectedness index fluctuates around 80% shows that the magnitude of the spillover effects has remained strong over the studying time.

Next, we compute the time-varying net directional connectedness to disentangle the linkage between investor sentiment industries further. By concentrating on net directional connectedness, we can deduce whether one of the variables is either a net transmitter or a net receiver of shocks within a particular country. Initially, we concentrate on the nature (net transmitter or net recipient of shocks) of each one of the variables of interest in contrast with all other variables. The variable of interest is considered a net transmitter of shocks when the line lies within the positive upper part of each panel. Results are plotted in Figure 4.

**Figure 4:** Net directional connectedness

Most variables are persistent about the role they assume throughout the sample period. Regarding transmitters, for example, the oil industry appears to be a persistent transmitter of shocks except for the second half of 2014 with the event that China placed an oil rig in the East Sea and the year 2022 with the Russia–Ukraine war, though the magnitude is relatively small. These results match those observed in earlier studies about the oil industry's importance. Le & Luong (2022) demonstrate the influence of oil prices on the sentiment index and stock return on the Vietnamese market from 2010 to 2020. In which, oil price plays the role of a transmitter of shock and has greatly influenced the other two variables in the oil price crisis period from 2014 to 2018 and the COVID-19 period from 2019 to 2020. We also can observe that the Banking, Utilities and Services industries were always net receivers of shock prior to 2014; yet, their role has been switching between net transmitters for the rest of the remaining time. Regarding the Finance industry, its sentiment was a significant net transmitter of shocks in most of the study period. This finding corroborates with Swamy & Dharani (2019), who conclude the critical role of finance in the economy and its effects on other industries.

Turning to net recipients, Technology and Industrials were persistent receivers of shocks for most of the examination period. Basic materials and Consumer Discretionary were



net transmitters of shock in the early period of our study, especially from 2012 to 2015, with the net directional connectedness measure of Basic materials peaking up at over 100%. The fear of the flash crash is hence clearly felt. Since 2015, the sentiment of Basic materials and Consumer Discretionary has switched its role and turned into a net receiver of shocks.

## 5 Conclusions

This paper aims to examine the dynamic spillovers between investor sentiment of Vietnam's industries during 2012-2022. In doing so, we consider a financial network consisting of 10 sentiment indices in a time-varying parameter vector autoregression (TVP-VAR)-based spillover framework. Following Baker and Wurgler (2006) method, we construct a sentiment indicator from seven proxies by PCA. These proxies include market turnover, number of IPOs, average first-day return on IPOs, equity share of new issuances, the log difference in book-to-market ratios between dividend payers and dividend non-payers, money flow index and the number of new investors.

Our results show a strong interdependence among the variables in our networks. Further, the relationship among investor sentiment industries is driven by time-specific developments and events. Overall, we find that industries heavily affected by government regulation, including Utilities, Finance, Banking, Oil Industry and Consumer Services, are net transmitters of shocks. The other industries, including Technology, Industrials, Consumer Discretionary, Health Care and Basic Materials, are net recipients.

These findings have important policy implications. Firstly, this study has confirmed that government regulations are one of the decisive factors in the performance of financial markets in Vietnam. The sentiment of industries heavily affected by government regulations will influence the sentiment of other industries. Secondly, because the relationship between sentiment indices of industries is time-varying and entirely driven by time-specific developments and events, policymakers should have a monitoring system in all the above areas to react promptly. Our results suggest that a change in Utilities, Finance, Banking, Oil Industry and Consumer Services likely impacts the others, thus posing spillover risks to the financial system.

Our study, however, is not without limitations. Due to the different characteristics of mature and emerging countries (Chang et al., 2000; Corredor et al., 2013), it is possible to lead to different results as developed markets are examined. Future studies should shed further light on this by considering sentiment of industries in developed countries.

## References:

- Ackert, L. F. & Deaves, R. (2010) *Behavioral finance : psychology, decision-making, and markets* (Ohio, the United States: South-Western Cengage Learning).
- Ángeles López-Cabarcos, M., Pérez-Pico, A. M., Vázquez-Rodríguez, P. & Luisa López-Pérez, M. (2019) Investor sentiment in the theoretical field of behavioural finance, *Economic Research-Ekonomska Istraživanja*, 33(1), pp. 2101–2119, <https://doi.org/10.1080/1331677X.2018.1559748>.
- Antonakakis, N., Chatziantoniou, I. & Gabauer, D. (2020) Refined Measures of Dynamic Connectedness based on Time-Varying Parameter Vector Autoregressions, *Journal of Risk and Financial Management*, 13(4), p. 84, <https://doi.org/10.3390/JRFM13040084>.
- Antonakakis, N., Gabauer, D., Gupta, R. & Plakandaras, V. (2018) Dynamic connectedness of uncertainty across developed economies: A time-varying approach, *Economics Letters*, 166, pp. 63–75, <https://doi.org/10.1016/J.ECONLET.2018.02.011>.
- Antoniou, C., Doukas, J. A. & Subrahmanyam, A. (2016) Investor sentiment, beta, and the cost of equity capital, *Management Science*, 62(2), pp. 347–367, <https://doi.org/10.1287/mnsc.2014.2101>.
- Baker, M. & Wurgler, J. (2006) Investor sentiment and the cross-section of stock returns, *Journal of Finance*, 61(4), pp. 1645–1680, <https://doi.org/10.1111/j.1540-6261.2006.00885.x>.
- Baker, M., Wurgler, J. & Yuan, Y. (2012) Global, local, and contagious investor sentiment, *Journal of Financial Economics*, 104(2), pp. 272–287, <https://doi.org/10.1016/j.jfineco.2011.11.002>.
- Bathia, D. & Bredin, D. (2013) An examination of investor sentiment effect on G7 stock market returns, *European Journal of Finance*, 19(9), pp. 909–937, <https://doi.org/10.1080/1351847X.2011.636834>.
- Chang, E. C., Cheng, J. W. & Khorana, A. (2000) An examination of herd behavior in equity markets: An international perspective, *Journal of Banking and Finance*, 24(10), pp. 1651–1679, [https://doi.org/10.1016/S0378-4266\(99\)00096-5](https://doi.org/10.1016/S0378-4266(99)00096-5).
- Chen, M. P., Chen, P. F. & Lee, C. C. (2013) Asymmetric effects of investor sentiment on industry stock returns: Panel data evidence, *Emerging Markets Review*, 14(1), pp. 35–54, <https://doi.org/10.1016/J.EMEMAR.2012.11.001>.
- Chung, S. L., Hung, C. H. & Yeh, C. Y. (2012) When does investor sentiment predict stock returns?, *Journal of Empirical Finance*, 19(2), pp. 217–240, <https://doi.org/10.1016/J.JEMPFIN.2012.01.002>.
- Corredor, P., Ferrer, E. & Santamaria, R. (2013) Investor sentiment effect in stock markets: Stock characteristics or country-specific factors?, *International Review of Economics and Finance*, 27, pp. 572–591, <https://doi.org/10.1016/j.iref.2013.02.001>.
- Da, Z., Engelberg, J. & Gao, P. (2015) The sum of all FEARS investor sentiment and asset prices, *Review of Financial Studies*, 28(1), pp. 1–32, <https://doi.org/10.1093/rfs/hhu072>.
- Diebold, F. X. & Yilmaz, K. (2009) Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets\*, *The Economic Journal*, 119(534), pp. 158–171, <https://doi.org/10.1111/J.1468-0297.2008.02208.X>.
- Diebold, F. X. & Yilmaz, K. (2012) Better to give than to receive: Predictive directional measurement of volatility spillovers, *International Journal of Forecasting*, 28(1), pp. 57–66, <https://doi.org/10.1016/J.IJFORECAST.2011.02.006>.
- Diebold, F. X. & Yilmaz, K. (2014) On the network topology of variance decompositions: Measuring the connectedness of financial firms, *Journal of Econometrics*, 182(1), pp. 119–134, <https://doi.org/10.1016/J.JECONOM.2014.04.012>.

- FTSE Russell (2022) *FTSE Equity Country Classification September 2022 Annual Announcement*, available at: [https://research.ftserussell.com/products/downloads/FTSE-Country-Classification-Update\\_latest.pdf](https://research.ftserussell.com/products/downloads/FTSE-Country-Classification-Update_latest.pdf) (September 5, 2022).
- García, D. (2013) Sentiment during Recessions, *Journal of Finance*, 68(3), pp. 1267–1300, available at: <https://www.jstor.org/stable/42002620> (September 5, 2022).
- Gong, X. L., Liu, J. M., Xiong, X. & Zhang, W. (2022) Research on stock volatility risk and investor sentiment contagion from the perspective of multi-layer dynamic network, *International Review of Financial Analysis*, 84, <https://doi.org/10.1016/J.IRFA.2022.102359>.
- Hachicha, N. & Bouri, A. (2008) Behavioral Beta and Asset Valuation Models, *International Research The Journal of Finance and Economics*, 16, pp. 175–192.
- HOSE (2022) *Quy mô niêm yết*, available at: <https://www.hsx.vn/Modules/Listed/Web/ListingSummary/153?fid=8761a1187cea4f33839ffa5a936e62c1> (September 5, 2022).
- Hua, G., Zhou, S., Zhang, S. & Wang, J. (2020) Industry policy, investor sentiment, and cross-industry capital flow: Evidence from Chinese listed companies' cross-industry M&As, *Research in International Business and Finance*, 53, <https://doi.org/10.1016/J.RIBAF.2020.101221>.
- Huang, D., Jiang, F., Tu, J. & Zhou, G. (2015) Investor sentiment aligned: A powerful predictor of stock returns, *Review of Financial Studies*, 28(3), pp. 791–837, <https://doi.org/10.1093/rfs/hhu080>.
- Jiang, F., Lee, J., Martin, X. & Zhou, G. (2019) Manager sentiment and stock returns, *Journal of Financial Economics*, 132(1), pp. 126–149, <https://doi.org/10.1016/J.JFINECO.2018.10.001>.
- Jolliffe, I. T. (2002) *Principal Component Analysis* (New York, the United States: Springer-Verlag), <https://doi.org/10.1007/B98835>.
- Kaplanski, G. & Levy, H. (2010) Sentiment and stock prices: The case of aviation disasters, *Journal of Financial Economics*, 95(2), pp. 174–201, <https://doi.org/10.1016/J.JFINECO.2009.10.002>.
- Kassouri, Y., Kacou, K. Y. T. & Alola, A. A. (2021) Are oil-clean energy and high technology stock prices in the same straits? Bubbles speculation and time-varying perspectives, *Energy*, 232, <https://doi.org/10.1016/J.ENERGY.2021.121021>.
- Koop, G. & Korobilis, D. (2014) A new index of financial conditions, *European Economic Review*, 71, pp. 101–116, <https://doi.org/10.1016/J.EUROECOREV.2014.07.002>.
- Koop, G., Pesaran, M. H. & Potter, S. M. (1996) Impulse response analysis in nonlinear multivariate models, *Journal of Econometrics*, 74(1), pp. 119–147, [https://doi.org/10.1016/0304-4076\(95\)01753-4](https://doi.org/10.1016/0304-4076(95)01753-4).
- Le, T. H. & Luong, A. T. (2022) Dynamic spillovers between oil price, stock market, and investor sentiment: Evidence from the United States and Vietnam, *Resources Policy*, 78, <https://doi.org/10.1016/J.RESOURPOL.2022.102931>.
- Lee, W. Y., Jiang, C. X. & Indro, D. C. (2002) Stock market volatility, excess returns, and the role of investor sentiment, *Journal of Banking & Finance*, 26(12), pp. 2277–2299, [https://doi.org/10.1016/S0378-4266\(01\)00202-3](https://doi.org/10.1016/S0378-4266(01)00202-3).
- Muhammad, A. ur R. (2022). The impact of investor sentiment on returns, cash flows, discount rates, and performance, *Borsa Istanbul Review*, 22(2), pp. 352–362, <https://doi.org/10.1016/J.BIR.2021.06.005>.
- OECD (2022) *Economic and Social Impacts and Policy Implications of the War in Ukraine* (Paris, France: OECD Economic Outlook), <https://doi.org/10.1787/4181D61B-EN>.
- Pan, J. & Potesman, A. M. (2006) The information in option volume for future stock prices, *Review of Financial Studies*, 19(3), pp. 871–908, <https://doi.org/10.1093/rfs/hhj024>.

- Pandey, P. & Sehgal, S. (2019) Investor sentiment and its role in asset pricing: An empirical study for India, *IIMB Management Review*, 31(2), pp. 127–144, <https://doi.org/10.1016/J.IIMB.2019.03.009>.
- Peng, K. L., Wu, C. H., Lin, P. M. C. & Kou, I. T. E. (2022) Investor sentiment in the tourism stock market, *Journal of Behavioral and Experimental Finance*, 37, <https://doi.org/10.1016/J.JBEF.2022.100732>.
- Pesaran, H. H. & Shin, Y. (1998) Generalized impulse response analysis in linear multivariate models, *Economics Letters*, 58(1), pp. 17–29, [https://doi.org/10.1016/S0165-1765\(97\)00214-0](https://doi.org/10.1016/S0165-1765(97)00214-0).
- Phan, T. N. T., Bertrand, P., Phan, H. H. & Vo, X. V. (2021) The role of investor behavior in emerging stock markets: Evidence from Vietnam, *Quarterly Review of Economics and Finance*, <https://doi.org/10.1016/j.qref.2021.07.001>.
- Reis, P. M. N. & Pinho, C. (2020) A new European investor sentiment index (EURsent) and its return and volatility predictability, *Journal of Behavioral and Experimental Finance*, 27, <https://doi.org/10.1016/j.jbef.2020.100373>.
- Shen, J., Yu, J. & Zhao, S. (2017) Investor sentiment and economic forces, *Journal of Monetary Economics*, 86, pp. 1–21, <https://doi.org/10.1016/j.jmoneco.2017.01.001>.
- Si, D. K., Zhao, B., Li, X. L. & Ding, H. (2021) Policy uncertainty and sectoral stock market volatility in China, *Economic Analysis and Policy*, 69, pp. 557–573, <https://doi.org/10.1016/J.EAP.2021.01.006>.
- Smales, L. A. (2017) The importance of fear: investor sentiment and stock market returns, *Applied Economics*, 49(34), pp. 3395–3421, <https://doi.org/10.1080/00036846.2016.1259754>.
- Swamy, V. & Dharani, M. (2019) The dynamics of finance-growth nexus in advanced economies, *International Review of Economics & Finance*, 64, pp. 122–146, <https://doi.org/10.1016/J.IREF.2019.06.001>.
- Tiwari, A. K., Abakah, E. J. A., Bonsu, C. O., Karikari, N. K. & Hammoudeh, S. (2022) The effects of public sentiments and feelings on stock market behavior: Evidence from Australia, *Journal of Economic Behavior & Organization*, 193, pp. 443–472, <https://doi.org/10.1016/J.JEBO.2021.11.026>.
- Wang, G. J., Xiong, L., Zhu, Y., Xie, C. & Foglia, M. (2022) Multilayer network analysis of investor sentiment and stock returns, *Research in International Business and Finance*, 62, <https://doi.org/10.1016/J.RIBAF.2022.101707>.
- Wang, G., Yu, G. & Shen, X. (2021) The effect of online environmental news on green industry stocks: The mediating role of investor sentiment, *Physica A: Statistical Mechanics and Its Applications*, 573, <https://doi.org/10.1016/J.PHYSA.2021.125979>.
- Xiong, X., Han, J., Feng, X. & An, Y. (2019) Sentiment Dispersion and Asset Pricing Error: Evidence from the Chinese Stock Market, *Emerging Markets Finance and Trade*, 56(4), pp. 820–839, <https://doi.org/10.1080/1540496X.2019.1570128>.
- Xu, Y., Liang, C., Li, Y. & Huynh, T. L. D. (2022) News sentiment and stock return: Evidence from managers' news coverages, *Finance Research Letters*, 48, <https://doi.org/10.1016/J.FRL.2022.102959>.
- Yang, C. & Zhou, L. (2015) Investor trading behavior, investor sentiment and asset prices, *The North American Journal of Economics and Finance*, 34, pp. 42–62, <https://doi.org/10.1016/J.NAJEF.2015.08.003>.
- Zhou, G. (2018) Measuring Investor Sentiment, *Annual Review of Financial Economics*, 10, pp. 239–259, <https://doi.org/10.1146/annurev-financial-110217-022725>.
- Zweig, M. E. (1973) An Investor Expectations Stock Price Predictive Model Using Closed-End Fund Premiums, *The Journal of Finance*, 28(1), pp. 67–78, <https://doi.org/10.2307/2978169>.

## Promises and Perils of E-taxation in Serbia

SERGEJ POPOVIĆ, MILOŠ MILOSAVLJEVIĆ & NEMANJA MILANOVIĆ

**Abstract** The paradigm of collection and administration of tax revenues has been shifted in the last few decades as affected by the development of novel information and communication technologies. Governments around the world have adopted different models of e-taxation. A Serbian government has fully implemented “e-Fiscalization” as a class of e-taxation services in 2021. The aim of this paper is to examine the user satisfaction with e-Fiscalization. Based on a primary data collected from N=173 entrepreneurs, we examine the satisfaction with e-taxation ecosystem in Serbia. The results indicate that the promises made by governmental authorities have not been properly accepted by taxpayers. The study concludes that these perils might be viewed as temporary if the issues of full deployment of e-taxation were addressed adequately.

**Keywords:** • e-taxation • taxpayer expectation • digitalization • Serbia

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## 1 Introduction

Tax administration around the globe has been rapidly digitalizing in the last few decades. A myriad of different sophisticated e-services has been used to enhance the taxpayer experience (Bassey, Mulligan & Ojo, 2022). Almost all authorities (local, national, and international) are advocating for the improvements in the ICT infrastructure of tax administration in order to fully change the tax collection paradigm. However, the straightforward influence of the digitalization of tax administrations on tax revenue mobilization and revenue collection efficiency is far from being empirically proven (Mallick, 2021). Some studies even find adversarial effects and lower tax reporting after the implementation of the digital solution in taxation (Mascagni, Mengistu & Woldeyes, 2021).

As for the case of Serbia, the tax administration has made the first steps toward the full digitalization of taxation and majority of efforts have been invested into developing the infrastructure for such a process. Nonetheless, all the effort aside, public revenue collection system in Serbia is still at the very beginning of the transformation process (Pitić et al., 2019). As stated by the tax administration officials, the new model of fiscalization will result in the decrease in taxpayers' operating costs (data transfer, cash register control tape, archiving costs, maintenance, and defiscalization), improve administration and create better business environment, which will utterly lead to the decrease of shadow economy (Serbian Tax Administration, 2022). Other benefits might also appear during the process of implementation. For instance, Naritomi (2016) implies that the digitization of fiscalization process allows consumers to act as tax auditors. Then, employees might contribute to the overall benefits of the eFiscalization as potential whistleblowers, as suggested by Kleven, Kreiner and Saez (2016).

The promises of the benefits of e-Fiscalization made by the Tax Administration have never been empirically confirmed. Given that Serbian administration in general lacks proper mechanism to control for potential failure in innovations (Milanović, Milosavljević & Milošević, 2019), and that most of the innovations are simple replications of other EU experiences (Milosavljević et al., 2021), there is a large potential research gap for examining the attitudes of taxpayers toward the e-Fiscalization.

The aim of this paper is to fill the lacuna in the present body of knowledge. In specific, we aim to explore how the main stakeholders (Ministry of Finance - Tax Administration, owners of SMEs in Serbia and suppliers of e-cash registers) affect the quality of deployment of novel technology for e-Taxation. To address this aim, we first provide a theoretical supposition for the technology acceptance of public sector innovations. Then, drawing on the operationalization given in Cicvaric Kostic et al. (2013), we examine the attitudes of entrepreneurs towards this digital transformation.

To the best of our knowledge, a study that examines a taxpayers' satisfaction with e-taxation in Serbia has never been conducted before. Satisfaction of taxpayers in general has been a vastly explored topic (Holbrook & Heideman, 2022). However, globally, there has been only a handful of studies examining taxpayer satisfaction with e-taxation. For instance, Haruna et al. (2021) develop a conceptual model of e-taxation satisfaction without any empirical confirmation for the model. Some studies examine the satisfaction with the platform for e-taxation or other technical features related to public revenue collection (Maharjan, Chang & Shrestha, 2020) or the effects of e-taxation on revenue collection (Nnubia et al., 2020).

The remainder of this paper is organized in the following order. Section 2 reviews the literature and explains the background of the research. Section 3 delineates the methodology of the paper – the research instrument, variables and measures, sampling procedure, data collection and data processing. Section 4 explains the findings of this study. Section 5 contextualizes the findings of this study, explains the main contributions, and policy implications. Section 6 is reserved for conclusions, limitations, and further recommendations.

## **2 Background**

Users' attitudes towards digitalization and acceptance of newly implemented technologies have been examined extensively within many disciplines, with public administration being no exception. Governments are moving from digitizing single administrative unit or service towards full-scale digital transformation of processes and operations (Janowski, 2015).

Recent studies revealed that tax administrations across the globe are investing significant resources in digital solutions, striving to ease the administrative burden, expand their service portfolio with completely digital services, improve tax compliance and tax collection efficiency (Nazarov, Mikhalaeva & Chernousova, 2019). To achieve expected benefits of digital transformation, this shift should focus on "simplifying procedures and permanently bringing taxpayers into the e-filing, e-payment, and e-document ecosystem" (Estevão, 2021).

According to the latest report of OECD (2022), over 90% of business taxpayers in 58 OECD countries filed their tax return electronically in 2021. The same report revealed that the "COVID-19 crisis accelerated the shift to digital services with a 30% increase in digital contacts in 2020" (OECD, 2022).

However, intensity, scope and performance of these initiatives differs drastically among public administrations. Recent literature stresses that the rationale lies in a lack of digital strategy on a national level, misguided public administration reforms, funding constraints and dissonance of the efforts across different levels of government (Scupola & Mergel,

2022). In addition, many scholars are advocating for the lack of users' technology acceptance as one of the essential causes of failing in unlocking full potential of digital transformation (Di Vaio et al., 2021).

The importance of taxpayers' acceptance of new technologies in tax administration has been growing in both industry and academia. The success of implementing any public service digital transformation initiative is contingent upon users' willingness to accept proposed innovations (Carter & Bélanger, 2005).

The existing body of knowledge abounds with empirically tested theoretical models for investigating drivers that substantially affect users' decisiveness to use novel technologies in various environments (Williams et al., 2015; Milanović et al., 2020). Nevertheless, most of these studies imply that users can individually decide whether to use new technology or not on a strictly voluntary basis. This opened a vivid discussion among scholars about pertinence of their results and conclusions for understanding technology acceptance in a mandatory environment.

Digital transformation of tax administration and related services mostly relies on technology innovations which, once they are fully integrated, become inevitable and mandatory for all stakeholders, including taxpayers and tax authorities. In such an environment, where most of novel technology usage is mandatory, it is challenging to identify if such use genuinely reflects users' (taxpayers) both positive and negative attitudes towards innovations (Hwang, Al-Arabi & Shin, 2016).

Understanding why taxpayers accept or refuse certain technology in tax administration domain remains to be a challenging issue even for countries with highest e-government rankings. For example, Fu, Farn and Chao (2006) conducted large-scale nationwide research to investigate Taiwanese taxpayers' behavioral intentions to use electronic tax-filing services. The study discovered that taxpayers are pragmatic and concentrated on the usefulness of digital tax-filing service, but despite well-perceived benefits of e-tax services, over 60% of all taxpayers were unwilling to leave the old, paper-based system. Such findings in one of the world's leaders in e-governance (Biberman, 2021) may affect less developed countries' (un)realistic expectations from their own e-taxation initiatives. Another study conducted in Indonesia finds that trust, effort expectancy, and performance expectancy positively affect taxpayers' intention to use e-taxation services (Hermanto, Windasari & Purwanegara, 2022). These study, nonetheless, observe digitization as an option, rather than as a mandatory requirement.

Nevertheless, the proponents of digitalizing tax administration unequivocally emphasize that tax administrations should continue to accelerate their digital transformation and to introduce digital innovations. In addition to importance of taxpayers' technology acceptance, Martínez, Arzoz and Arregui (2022) suggest that tax administrations should take significant efforts and measures to assist taxpayers in adopting and utilizing these



technological advancements, having in mind that governments are still facing severe problem of under-utilization (Diller, Asen & Spät, 2020).

Given that user's technology acceptance and their satisfaction significantly affect the success of technological innovations, this study scrutinizes the taxpayers' satisfaction with e-taxation ecosystem in Serbia using the example of e-Fiscalization model. From a strictly technological point of view, the model implies the integration of new electronic registers and abandoning conventional fiscal cash registers with control paper tapes. The new fiscalization model has been promoted through a comprehensive campaign named "Be eFiscalized". The Government announced to subsidize the purchase of each fiscal device with 100 EUR and additional 100 EUR per retail facility. Below is a shortlist of the key milestones of e-Fiscalization process:

- December 29, 2020: the New Law of Fiscalization came into the force (Official Gazette No. 153/2020)
- September 20, 2021: Decree for granting e-Fiscalization subsidies
- October 1, 2021: registration of retail facilities and fiscal devices on "ePorezi" portal
- October 15, 2021: opening of applications for subsidizing transition to the new fiscalization system
- November 1, 2021: the beginning of transition period of six months
- January 1, 2022: implementation of the Law
- April 30, 2022: the deadline for reporting entities to complete transition to the new fiscalization system.

After the abovementioned deadline, self-employment and corporate income taxpayers are obliged to record any transactions through newly installed electronic registers. Here the existence of the Decree on determining the activities in which there is no obligation to record retail trade through an electronic fiscal device must be noted, which thoroughly regulates the exceptions to the abovementioned rules.

### **3 Materials and methods**

In this section, we thoroughly delineate the methodology of this study. For the purpose of this study, we collected primary data using a questionnaire as a research instrument. Accordingly, we first explain the structure of the questionnaire, variables, and operationalized measures. Then, we explain the sampling procedure, data collection process and data processing.

#### **3.1 Research instrument, variables, and measures**

For the purposes of this study, a specific questionnaire was constructed. The questionnaire was divided in four parts presented in detail below.

The first part of the questionnaire was aimed at collecting the demographic data on respondents. Specific questions were related to age, gender, professional experience, and industry in which the company (SME) operates.

The second part of the questionnaire was focused on collecting the evidence on the success of the Tax Administration of the Republic of Serbia in deploying the process of eFiscalization. The construct was multi-itemed and consisted of five inquiries presented in Table 1.

**Table 1:** Multi-itemed construct for the role of Tax Administration in deploying eFiscalization

<i>Code</i>	<i>Inquiry</i>	<i>Reference</i>
TAdm_1	Sufficient time for the implementation	Inspired by: Oats & Tuck, 2019; Savic et al., 2015
TAdm_2	Information security system is simple and efficient	
TAdm_3	Transparency of the process	
TAdm_4	Sufficient effort by the tax administration	
TAdm_5	Support (servers, sites, communication) of the tax administration was efficient	

The third part of the questionnaire was aimed at collecting evidence on the capabilities of entrepreneurs in implementing the process of eFiscalization. This variable was also complex and consisted of 11 individual items presented in Table 2.

**Table 2:** Multi-itemed construct for the capability of entrepreneurs in deploying eFiscalization

<i>Code</i>	<i>Inquiry</i> <i>[I find the eFiscalization to be...]</i>	<i>Reference</i>
Entr_1	Incentivizing for startup	Developed following the conclusions of Radosavljević, Babin & Erić, (2023) and Savic et al., 2015
Entr_2	Cost-saving solution	
Entr_3	Supporting efficiency of the business	
Entr_4	Simplified solution	
Entr_5	Environmental friendly	
Entr_6	Tech-savy	
Entr_7	Transparent	
Entr_8	Tax-easy	
Entr_9	Minimazing gray economy	
Entr_10	Positive macroeconomic effects	
Entr_11	Untressful transition	

The final part of this questionnaire was aimed at collecting evidence in the quality of suppliers of ICT solutions (both hardware and software) for the eFiscalization. This variable is multi/itemed and consists of six different questions. These items are displayed in Table 3.

**Table 3:** Multi-itemed construct for the efficiency of suppliers in deploying eFiscalization

<i>Code</i>	<i>Inquiry</i>	<i>Reference</i>
Suppl_1	Software is simple and intuitive	Self-developed
Suppl_2	On-time delivery	
Suppl_3	No hidden costs	
Suppl_4	Customer support quality	
Suppl_5	Lag-free device	
Suppl_6	Monthly subscription is fair	

All the items from questionnaire parts 2-4 were measured on a Likert-type scale ranging from 1 (I completely disagree) to 5 (I absolutely agree).

### **3.2 Sampling procedure, data collection and data processing**

Sampling procedure was based on a snowball sampling procedure. This procedure is based on the creation of referral chains (Damnjanovic, Proud & Milosavljevic, 2020). The initial list of participants was created from the official list of SMEs in Serbia retrieved from the Agency of Business Registers. As this sampling procedure might be fragile due to the potential invasive sub-clustering, the referral chain was actively controlled. All the questionnaires were coded, following the principles given in Radonic, Vukmirovic and Milosavljevic (2021).

The approach used to collect data was CAWI (computer aided web interviewing). The main rationale behind the selection of this approach was the cost effectiveness (see Benkovic et al., 2022). Data was collected in the period August-September 2022. Data was collected directly by one of the authors of the study. After the data was collected, it was entered into the Statistics Kingdom (online calculator). Pre-analysis was conducted in MS Excel.

Demographic data were analyzed with statistics: percentages, means and standard deviation. For multiple comparisons the study used analysis of variance and standard deviation. Interdependence of determinants and customer satisfaction was determined by correlation (Pearson moments two tailed correlation coefficient analysis) and multiple regression.

## **4 Results**

In this section we dissected the results of the empirical survey. First, we explored the sample features. Then, we conducted pre-analysis, including the descriptive statistics, internal reliability testing for composite constructs, and correlation matrix. Finally, we conducted the regression analysis.

### **4.1 Sample features**

We first analyzed the main characteristics of the sample. In total, we collected 173 valid responses. As for the gender split, the sample was highly unbalanced. More than two third of the sample were female respondents (68.21%). When it comes to the function they act in the company – majority of the sample consisted of owners (76.30%), whereas the remainder were managers (see Table 4).

**Table 4:** Sample features – gender and position in the SME

<i>Gender</i>	<i>Total</i>	<i>%</i>	<i>Role</i>	<i>Total</i>	<i>%</i>
Female	118	68.21%	Owner	132	76.30%
Male	55	31.79%	Manager	41	23.70%
Other	0	0.00%	Other	0	0.00%
Total	173	100.00%	Total	173	100.00%

As for the experience (both life and professional), the sample was balanced. The youngest respondent was only 19 years old, and the eldest one was of the age of 70. Mean and median were around 40 years. As for the professional experience, in average respondents were engaged in the company they represent (either as owners or as managers) for approximately 12 years (Mean=11.95, STD=9.276). Interestingly, the most experiences entrepreneur was the owner of a company for 50 years (see Table 5).

**Table 5:** Sample features – the age of respondents and the experience in the SME

<i>Age</i>		<i>Experience</i>	
Mean	39.90	Mean	11.95
STD	9.736	STD	9.276
Median	40	Median	10
Min	19	Min	1
Max	70	Max	50

As for the predominant industry of the SME represented by the respondents, this was an open-ended question. Majority of respondents operated in the field of commerce – retail or wholesale (33%), followed by bookkeeping or consulting services (16%), and beauty salons (9%). The other industries were represented with less than 5% in the sample. In general, we found that the sample was adequately structured, particularly when compared to the demographics of the Republic of Serbia.

## 4.2 Pre-analysis

Next, we pre-analyzed the results. For this purpose, descriptive statistics (means and standard deviations) were analyzed for both individual items and multi-itemed constructs. This is displayed in Table 6.

**Table 6:** Descriptive statistics for the individual items and composite variables

	<i>Mean</i>	<i>STD</i>		<i>Mean</i>	<i>STD</i>
TAdm_1	3.202	1.524	Entr_1	1.855	1.079
TAdm_2	3.734	1.281	Entr_2	1.861	1.189
TAdm_3	3.006	1.292	Entr_3	2.110	1.251
TAdm_4	2.260	1.284	Entr_4	2.173	1.288
TAdm_5	2.329	1.286	Entr_5	2.659	1.488
<b>TAdm_Avg</b>	<b>2.906</b>	<b>1.012</b>	Entr_6	2.948	1.378
Suppl_1	2.965	1.334	Entr_7	3.272	1.352
Suppl_2	3.162	1.561	Entr_8	3.006	1.375
Suppl_3	3.497	1.500	Entr_9	2.555	1.537
Suppl_4	2.988	1.478	Entr_10	2.191	1.246
Suppl_5	3.000	1.462	Entr_11	1.671	1.060
Suppl_6	2.590	1.334	<b>Entr_Avg</b>	<b>2.391</b>	<b>0.942</b>
<b>Suppl_Avg</b>	<b>3.034</b>	<b>1.106</b>			

As displayed in Table 6, the effectiveness of the tax administration in deploying eFiscalization solution has been graded as 'moderate' (Mean=2.906, STD=1.102). Information security and safety has been marked as the best in this category (Mean=3.734, STD=1.281), whilst customer (taxpayer) support received the lowest score (Mean=2.329, STD=1.286).

The results presented in Table 6 also show that readiness of entrepreneurs for the digitalization and potential benefits of the system received the lowest total score (Mean=2.392, STD=0.942). Among the items of this construct, the lowest score was attributed to the level of stress associated with the process of eFiscalization – Entr\_11 (Mean=1.671, STD=1.060) This was followed by remarks that the process is not incentivizing for the startup phase – Entr\_1 (Mean=1.855, STD=1.079), and that it requires additional financial resources and raises total costs – Entr\_2 (Mean=1.861, STD=1.189).

Finally, when it comes to the suppliers of cash registers and equipment, they received the best relative score (Mean=3.034, STD=1.106). Respondents claimed there no hidden costs were recorded (Mean=3.497, STD=1.500). Not surprising, however, respondents claimed that monthly fee is unfair (Mean=2.590, STD=1.334).

Afterwards, we examined the internal reliability. The aim of this step is to assess whether singular items can be measured as complex, multi-itemed phenomena. The Cronbach

Alpha (CA) test was used for this purpose (see Table 7). For all the observed variables, CA was above the traditional threshold of  $CA > 0.700$  ( $CA_1 = 0.799$ ;  $CA_2 = 0.901$ ;  $CA_3 = 0.854$  respectively).

**Table 7:** Descriptive statistics, internal reliability, and correlation matrix for the observed variables

	<i>Mean</i>	<i>STD</i>	<i>CA</i>	<i>1</i>	<i>2</i>	<i>3</i>
<b>TAdm_Avg</b>	2.906	1.012	0.799	1		
<b>Entr_Avg</b>	2.391	0.942	0.901	0.501**	1	
<b>Suppl_Avg</b>	3.034	1.106	0.854	0.533**	0.372**	1

Note: \*\*  $p < 0.01$

### 4.3 Main analysis

After conducting pre-analysis, we moved forward to the regression analysis. Linear regression is based on a normality of residual errors. In our analysis, Shapiro Wilk p-value is equal to  $2.22e-16$  which indicates that our data did not show normal distribution.

As displayed in Table 8, p value is below the threshold  $p < 0.01$ . The White test p-value equals 0 ( $F = 131.716321$ ). It is assumed that the variance is not homogeneous. The coefficients' estimators are unbiased but inefficient estimators with large inaccurate standard errors, hence the statistical tests over the model and the coefficients are not accurate. in the discussion section of this paper, we will thusly inform the readers on potential limitations of the model.

**Table 8:** ANOVA

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Regression (between $\hat{y}_i$ and $\bar{y}$ )	2	10883063.85	5441531.926	100.47996	0.000
Residual (between $y_i$ and $\hat{y}_i$ )	343	18,575,300.58	54,155.395		
Total (between $y_i$ and $\bar{y}$ )	345	29,458,364.43	85,386.563		

Results of the multiple linear regression indicated that there was a strong collective significant effect between the  $X_1$ ,  $X_2$ , and  $Y$ , ( $F(2, 343) = 100.48$ ,  $p < .001$ ,  $R^2 = 0.37$ ,  $R^2_{adj} = 0.37$ ). The individual predictors were examined further and indicated that  $X_1$  ( $t = 6.741$ ,  $p < .001$ ) and  $X_2$  ( $t = 7.618$ ,  $p < .001$ ) were significant predictors in the model.  $R^2$  was 0.369. Accordingly, the predictors of our study ( $X_i$ ) explained approximately 37% of the variance of the dependent variable. Adj.  $R^2$  was 0.366. Accordingly, we can assume that the predictive power of our independent variables models is high (see Table 9).

**Table 9:** Coefficient Table (adjusted R-squared = 0.366)

	<b>Coeff</b>	<b>SE</b>	<b>t-stat</b>	<b>Stand Coeff</b>	<b>p-value</b>	<b>VIF</b>
b	62.604	16.440	3.808	0	0.000	
X1	0.325	0.048	6.741	0.331	0.000	1.310
X2	0.355	0.0466	7.618	0.374	0.000	1.310

As for the goodness of fit, the data for the overall regression are as follows: right-tailed,  $F(2,343) = 100.47996$ ,  $p\text{-value} = 0$ . Since  $p\text{-value} < \alpha (0.05)$ , we reject the  $H_0$ . The linear regression model,  $Y = b_0 + b_1X_1 + \dots + b_pX_p + \varepsilon$ , provides a better fit than the model without the independent variables resulting in,  $Y = b_0 + \varepsilon$ . All the independent variables ( $X_i$ ) are significant. The Y-intercept (b): two-tailed,  $T = 3.808012$ ,  $p\text{-value} = 0.000165934$ . Hence b is significantly different from zero.

The final model is presented below:

$$\hat{Y} = 62.604035 + 0.325411 \text{ TAdm\_Avg} + 0.355187 \text{ Suppl\_Avg}$$

## 5 Discussion

In this section we first put an emphasis on the main findings of this study. Afterwards, we contextualize our findings with the extant research and explain the contributions and policy implications of our study. Finally, we draw attention to the limitations of this study as well as some agenda for future research.

### 5.1 Key findings

In this paper, we examined the taxpayer attitudes towards the e-Fiscalization process in Serbia. We examined how three important stakeholders (tax authority, entrepreneurs, and suppliers of ICT infrastructure) affect the deployment of novel technologies in taxation. To address this purpose, primary data was collected from  $N=173$  entrepreneurs.

From the grand scheme of things, the respondents marked e-Fiscalization as poorly prepared and deployed process. Contrary to our belief, the respondents mostly stigmatized themselves in this process with the lowest grade. Nonetheless, the other two actors have not been marked as the 'role models' as well. Having in mind the existence of statistically significant correlation between the observed variables, the whole process of the digitalization of taxation could potentially be explained with other exogenous variables. Although it might be speculative, one of the reasons for a number of perils brought about with e-Fiscalization could be low transparency and responsiveness of the Serbian public authorities (Milosavljevic, Milanovic & Benkovic, 2017).



This study confirms that in practice, the whole model does not work as intended, that is, it seems that the idea was good until the system itself works in the best way. According to the opinions of entrepreneurs, e-Fiscalization did not contribute to the reduction of business costs, efficiency, or the reduction of the shadow economy, which through the lens of were listed as key advantages by the competent authorities. Of course, as seen the interviewed entrepreneurs, there are also good sides of e-Fiscalization. The entire business operations will be more transparent and the tax calculation will be automated, which is simpler compared to the previous tax model.

## 5.2 Contributions and policy implications

An important part of the tax administration reform in Serbia is the implementation of the e-Fiscalization model. The transition period of this reform es demanding and will certainly produce a number of challenges. the main promises behind such a reform are economic efficiency safety and environmental protection. Thanks to the new fiscalization model, the Tax Administration now has real-time data on turnover generated by the economy, and these data are comparable both by territory and by activity, as well as by the time of issue. It is possible to easily compare the recorded turnover with the cash receipts issued by the taxpayer. The flow of data from fiscal cash registers ensures better risk analysis and easier detection of irregularities in the business of our taxpayers, but also creates new ways of controlling the issuance of fiscal invoices because the validity of these invoices can be checked by simply scanning the QR code on them.

This study adds to the concurrent knowledge on e-Fiscalization with particular emphasis on issues in the early adoption and deployment of a such technology. A current body of knowledge mostly advocates e-Fiscalization as a preferable solution for the digitalization of taxation and improved transparency (Cobović, Katolik & Novak, 2013) This transparency will supposedly improve tax collection and decrease shadow economy, although the measurement of such impact is questionable (Zidková & Tepperová, 2017).

This study provides a number of policy implications for e-Fiscalization. We will concentrate only on the most important implications:

- Our study shows that technical requirements for the implementation of e-Fiscalization have not been fully met in the Republic of Serbia. With e-Fiscalization, there are several technical problems (lack of guidelines in Serbian language, lack of trainings, system testing and preparation were needed before the start of implementation). At the same time, however, the impression has been created that the primary effect (suppressing the shadow economy) will not be achieved, because "who until now he didn't work according to the regulations, he won't do it now either".
- From the ICT infrastructural point of view, in some parts of Serbia (primarily the east and southwest, there is a problem of internet connection and data flow, which significantly complicates business and compliance with new regulations.

- The results of this study show that the time required for the preparation of e-Fiscalization was insufficient. When it comes to the implementation of legal acts that affect SMEs, policymakers should consider delayed implementation of tax-related measures for the SME sector. Unlike their large counterparts, SMEs are highly vulnerable to external dynamics and require active governmental policies. Thus, the regulation would be first introduced to the financial sector and large companies, and only after that (when ‘child diseases’ pass by) the regulation should cover SMEs.
- Constant changes of regulation increase the risk for the SME sector. Whenever a policy measure is implemented, it should be preceded by the education of affected business. Any transition to new rules, systems and novel technologies related to taxation are seldom too complicated for small business.

### 5.3 Limitations and further recommendations

This paper has number of limitations that might potentially jeopardize the generalizability of the findings. First, the study is geographically constrained since it only examined the experience of e-Fiscalization in Serbia. Having in mind the cultural and historical background, the study findings might be indicative for the countries of the West Balkan region, particularly the ones lagging behind Serbia in the process of e-Fiscalization, such as Albania (van Brunschot et al., 2021), Bosnia and Herzegovina, Montenegro or North Macedonia). Accordingly, a new stream of research might be focused on cross-country analyses of e-Fiscalization adoption.

Second, this study examines the attitudes of entrepreneurs on a process that has only recently been adopted. When a technology is adopted on a voluntary basis – trailblazers react differently than late adopters (Milosavljevic, Joksimovic & Milanovic, 2019). From a limitation of the sampling procedure described previously, we can never tell how many ‘trailblazers’ or ‘late adopters’ were captured in this study. Nonetheless, we can only speculate that technology acceptance in Serbia is generally moderate (Milanović et al., 2020). Additionally, capturing a single moment in the deployment of any technology is questionable. An avenue for further research is the analysis of intertemporal changes in attitudes of entrepreneurs towards e-Fiscalization and e-Governance in general.

Third, this study is quantitative. As such, it only outlines the most important factors and stakeholders affecting the adoption of e-Fiscalization. Some technical limitation related to the statistical processing of the data have already been mentioned in the results section of this paper. Follow-up studies and projects should encompass a qualitative side of this phenomenon and extend the current body of knowledge with case studies and real-life examples of benefits and downsides of e-Fiscalization adoption.

## 6 Conclusions, limitations and further recommendations

This paper describes the fiscalization process as an integrated process in the development of the digital infrastructure of the Tax Administration of the Republic of Serbia. The implementation of the fiscalization process had the task of increasing transparency, minimizing business costs and creating a basis for the sustainable development of the tax system.

The Republic of Serbia is still at the beginning of the digitization and reform of the tax system. However, from the existing process of fiscalization, it is necessary to increase the level of its realization. It is concluded that digitization could help the tax system of the Republic of Serbia, which should close the gap and quickly approach the highest standards of the European Union.

Some interrogatives of the e-Fiscalization process remain unanswered. The power of digitization is high, and it is hard to believe that the speed of digitization is going to slow down in the near future. Nonetheless, there are always going to be some groups of entrepreneurs and SME owners that may never use modern technology. To name a few - the elderly, people living in remote rural areas with limited access to the Internet, SMEs in those industries that operate in labor-intensive rather than tech-intensive manner, old craftsman and late adopters of technologies in general. The tax administration must find a way to solve the problems of this group of taxpayers.

How digitization will affect the "morale" of taxpayers might also be further discussed. It rises the question whether transparent, secure and responsive e-taxation system affects taxpayers' intentions to evade taxes? It became with e-Fiscalization that the tax authorities decided to combat against the grey economy.

The closing issue, but not the least, is related to security. It is far genuine that technology innovations can boom performance and transparency, but what happens if majority of taxpayers are not ready and prepared to exchange information of the extent of paid taxes? Likewise, having all the facts on-line makes agencies greater uncovered to feasible fraud. Current examples have shown more records disclosures than ever before. The question is whether digitization and novel technology additionally convey a new stage of protection or not? The answer to that query continues to be not clear.

This paper has a number of flaws which might jeopardize the generalizability of its main findings. First, the study only examined a couple of factors with the most obvious and direct effect on taxpayer attitudes toward the eFiscalization. Other studies should incorporate other factors, particularly those behavioral by nature. Second, the study is based on a relatively small sample. Other studies should be nation-wide and include a number of different demographics. Finally, this is a cross-sectional rather than time-series analysis. Perceived perils of the implementation of any technology are seldom just a

mirage rather than a solid and real downside of technology. Accordingly, a similar study should be re-run in a near future to capture on a time-related differences.

## References:

- Bassey, E., Mulligan, E. & Ojo, A. (2022) A conceptual framework for digital tax administration - A systematic review, *Government Information Quarterly*, 39(4), <https://doi.org/10.1016/j.giq.2022.101754>.
- Benkovic, S., Milosavljević, M., Spasenik, Z. & Jovanovic, A. (2022) Antecedents of University Entrepreneurship: Empirical Evidence from Serbian Public Universities, *Croatian Journal of Education: Hrvatski časopis za odgoj i obrazovanje*, 24(2), pp. 397-427, <https://doi.org/10.15516/cje.v24i2.4324>.
- Biberman, J. (2021) E-Governance and Civic Technology: Lessons from Taiwan, *ICT India Working Paper*, No. 48, available at: <http://hdl.handle.net/10419/249837> (October 2, 2022).
- Cicvarić Kostić, S. C., Okanović, M., Milosavljević, M. & Vukmirović, J. (2013) Antecedents of citizens' satisfaction with local administration in Serbia, *Transylvanian Review of Administrative Sciences*, 9(40), pp. 22-34.
- Cobović, M., Katolik, A. & Novak, N. (2013) Control Of Cash Payment System Based On The Software As A Service, In: Bacher, U., Barković, D. & Runzheimer, B. (eds.) *Interdisciplinary Management Research*, 9 (Croatia: Josip Juraj Strossmayer University of Osijek, Faculty of Economics), pp. 127-137.
- Damnjanovic, V., Proud, W. & Milosavljevic, M. (2020) Mentoring development at student international business case competitions, *EuroMed Journal of Business*, (ahead-of-print), 16(2), <https://doi.org/10.1108/EMJB-12-2018-0092>.
- Di Vaio, A., Palladino, R., Pezzi, A. & Kalisz, D. E. (2021) The role of digital innovation in knowledge management systems: A systematic literature review, *Journal of business research*, 123, pp. 220-231.
- Diller, M., Asen, M. & Späth, T. (2020) The effects of personality traits on digital transformation: Evidence from German tax consulting, *International Journal of Accounting Information Systems*, 37(3).
- Fu, J.-R., Farn, C.-K. & Chao, W.-P. (2006) Acceptance of electronic tax filing: A study of taxpayer intentions, *Information & Management*, 43(1), pp. 109-126, <https://doi.org/10.1016/j.im.2005.04.001>.
- Haruna, I. U., Nadzir, M. M., Awang, H. & Mohamed, L. (2021) A Conceptual model of E-Taxation satisfaction: How can taxpayers be tickled pink with the smart Web-Based taxation application?, *Journal of Physics: Conference Series*, 1997(1), <https://doi.org/10.1088/1742-6596/1997/1/012041>.
- Hermanto, A. H., Windasari, N. A. & Purwanegara, M. S. (2022) Taxpayers' adoption of online tax return reporting: extended meta-UTAUT model perspective, *Cogent Business & Management*, 9(1), <https://doi.org/10.1080/23311975.2022.2110724>.
- Holbrook, T. M. & Heideman, A. J. (2021) Straight to the (Revenue) Source: Contextual and Individual-Level Determinants of Attitudes Toward Local Taxes, *American Politics Research*, 50(2), pp. 157-172, <https://doi.org/10.1177/1532673x211063212>.
- Hwang, Y., Al-Arabiati, M. & Shin, D.-H. (2016) Understanding technology acceptance in a mandatory environment: A literature review, *Information Development*, 32(4), pp. 1266-1283, <https://doi.org/10.1177/0266666915593621>.

- Janowski, T. (2015) Digital government evolution: From transformation to contextualization, *Government information quarterly*, 32(3), pp. 221-236.
- Kleven, H. J., Kreiner, C. T. & Saez, E. (2016) Why Can Modern Governments Tax So Much? An Agency Model of Firms as Fiscal Intermediaries, *Economica*, 83(330), pp. 219-246, <https://doi.org/10.1111/ecca.12182>.
- Maharjan, S., Chang, P. D. & Shrestha, D. (2020) Analysis of Design quality and user requirements of online taxation portal of Nepal, In: Raj, S. (ed.) *International Conference on Mobile Computing and Sustainable Informatics: ICMCSI 2020, EAI/Springer Innovations in Communication and Computing* (Cham: Springer), pp. 1-15, [https://doi.org/10.1007/978-3-030-49795-8\\_1](https://doi.org/10.1007/978-3-030-49795-8_1).
- Mallick, H. (2020) Do governance quality and ICT infrastructure influence the tax revenue mobilisation? An empirical analysis for India, *Economic Change and Restructuring*, 54(2), pp. 371-415, <https://doi.org/10.1007/s10644-020-09282-9>.
- Martínez, Y. U., Arzo, P. P. & Arregui, I. Z. (2022) Tax collection efficiency in OECD countries improves via decentralization, simplification, digitalization and education, *Journal of Policy Modeling*, 44(2), pp. 298-318, <https://doi.org/10.1016/j.jpolmod.2022.03.003>.
- Mascagni, G., Mengistu, A. T. & Woldeyes, F. B. (2021) Can ICTs increase tax compliance? Evidence on taxpayer responses to technological innovation in Ethiopia, *Journal of Economic Behavior & Organization*, 189, pp. 172-193, <https://doi.org/10.1016/j.jebo.2021.06.007>.
- Milanović, N., Milosavljević, M. & Milošević, N. (2019) Failure Management Approaches and Public Service Quality: Empirical Evidence from Serbia, *Lex Localis - Journal of Local Self-Government*, 17(3), pp. 417-434, [https://doi.org/10.4335/17.3.417-433\(2019\)](https://doi.org/10.4335/17.3.417-433(2019)).
- Milanović, N., Milosavljević, M., Benković, S., Starčević, D. & Spasenić, Ž. (2020) An acceptance approach for novel technologies in car insurance, *Sustainability*, 12(24), <https://doi.org/10.3390/su122410331>.
- Milosavljevic, M., Joksimovic, N. Z. & Milanovic, N. (2019) Blockchain accounting: Trailblazers' response to a changing paradigm, In: Drezgić, S., Živković, S. & Tomljanović, M. (eds.) *Economics of Digital Transformation* (Rijeka: University of Rijeka, Faculty of Economics and Business), pp. 425-439.
- Milosavljevic, M., Milanovic, N. & Benkovic, S. (2017) Waiting for Godot: Testing Transparency, Responsiveness and Interactivity of Serbian Local Governments, *Lex Localis - Journal of Local Self-Government*, 15(3), pp. 513-528, [https://doi.org/10.4335/15.3.513-528\(2017\)](https://doi.org/10.4335/15.3.513-528(2017)).
- Milosavljević, M., Spasenić, Ž., Benković, S. & Dmitrović, V. (2020) Participatory Budgeting in Serbia: Lessons Learnt from Pilot Projects, *Lex Localis - Journal of Local Self-Government*, 18(4), pp. 999-1021, [https://doi.org/10.4335/18.3.999-1021\(2020\)](https://doi.org/10.4335/18.3.999-1021(2020)).
- Naritomi, J. (2019) Consumers as Tax Auditors, *American Economic Review*, 109(9), pp. 3031-3072, <https://doi.org/10.1257/aer.20160658>.
- Nazarov, M. A., Mikhaleva, O. L. & Chernousova, K. S. (2019) Digital transformation of tax administration, In: Ashmarina, S., Vochozka, M. & Mantulenko, V. (eds.) *International Scientific Conference "Digital Transformation of the Economy: Challenges, Trends, New Opportunities"* (Cham: Springer), pp. 144-149.
- Nnubia, I. C., Okafor, G. O., Chukwunwike, O. D., Asogwa, O. S. & Ogan, R. J. (2020) Effect of e-taxation on revenue generation in Nigeria a pre-post analysis, *Academy of Entrepreneurship Journal*, 26(3), pp. 1-19.
- Oats, L. & Tuck, P. (2019) Corporate tax avoidance: is tax transparency the solution?, *Accounting and Business Research*, 49(5), pp. 565-583.
- OECD (2022) *Tax Administration 2022: Comparative Information on OECD and other Advanced and Emerging Economies* (Paris: OECD Publishing), <https://doi.org/10.1787/1e797131-en>.

- Pitić, G., Radosavljević, G., Babin, M. & Erić, M. (2019) Digitalization of the tax administration in Serbia, *Ekonomika Preduzeca*, 67(1–2), pp. 131–145, <https://doi.org/10.5937/ekopre1808131p>.
- Radonić, M., Vukmirović, V. & Milosavljević, M. (2021) The Impact of Hybrid Workplace Models on Intangible Assets: The Case of an Emerging Country, *Amfiteatru Economic*, 23(58), pp. 770–786, <https://doi.org/10.24818/EA/2021/58/770>.
- Radosavljević, G., Babin, M. & Erić, M. (2023) The Pathway for the Effective Digital Transformation of the Tax Administration in Serbia, In: Mihić, M., Jednak, S. & Savić, G. (eds.) *Sustainable Business Management and Digital Transformation: Challenges and Opportunities in the Post-COVID Era, Lecture Notes in Networks and Systems*, 562, (Cham: Springer), pp. 228–238, [https://doi.org/10.1007/978-3-031-18645-5\\_14](https://doi.org/10.1007/978-3-031-18645-5_14).
- Savić, G., Dragojlović, A., Vujošević, M., Arsić, M. & Martić, M. (2015) Impact of the efficiency of the tax administration on tax evasion, *Economic research-Ekonomska istraživanja*, 28(1), pp. 1138–1148.
- Scupola, A. & Mergel, I. (2022) Co-production in digital transformation of public administration and public value creation: The case of Denmark, *Government Information Quarterly*, 39(1), <https://doi.org/10.1016/j.giq.2021.101650>.
- Serbian Tax Administration (2022) *eFiscalization*, available at: [https://www.purs.gov.rs/eFiskalizacija/odgovori\\_najcesca\\_pitanja.html](https://www.purs.gov.rs/eFiskalizacija/odgovori_najcesca_pitanja.html) (October 10, 2022).
- van Brunshot, F., Vesperman, S., Jensen, A., O'Grady, M. & Dempsey, P. (2021) *Enhancing Tax Administration Capacity During Challenging Times*, available at: <file:///C:/Users/Milos/Downloads/AlbaniaCDreport.pdf> (October 10, 2022).
- Williams, M. D., Rana, N. P. & Dwivedi, Y. K. (2015) The unified theory of acceptance and use of technology (UTAUT): a literature review, *Journal of Enterprise Information Management*, 28(3), pp. 443–488, <https://doi.org/10.1108/jeim-09-2014-0088>.
- Zídková, H. & Tepperová, J. (2017) Registration of Sales. How to Measure Its Impact on Tax Revenues?, *Proceedings of the 21st International Conference Current Trends in Public Sector Research*, p. 231.

## Portfolio Selection: Micro and Macro Analysis of the Philippine Stock Market Using AHP and FTS-MC

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**Abstract** We have seen rapid development in financial stocks over the past decades, but variabilities in share price behavior remain due to micro and macroeconomic variables. This study examined the Philippine stock market from micro and macro perspectives in performing the following tasks: (1) Identify the top-performing industry and consider its top companies as an investment pool using AHP – analytic hierarchy processes; (2) Forecast future stock prices based on historical behavior utilizing FTS–MC – Fuzzy Time Series Markov Chain Model; (3) Present a portfolio selection framework considering an EWP – equally weighted portfolio strategy. These resulted in the following: (1) Property identified as the best industry; (2) Stock prices being accurately predicted; and (3) EWP portfolio that outperforms the benchmark (Philippine Stock Exchange). Hence, applying AHP in investment pool screening, FTS-MC in forecasting price movement, and EWP portfolio strategy can be a worthy investment framework.

**Keywords:** • stock market • AHP • markov analysis • FTS–MC • portfolio selection

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## 1 Introduction

The last few decades have witnessed rapid development in business and finance. The increased openness among nations resulted in a closer interconnection between economies, giving rise to financial integration (Dias et al., 2020; Raddant & Kenett, 2021). The established link between neighboring countries led to the advancement of financial markets. Generally, it is an excellent economic and investment platform. Among the assets that different entities could exchange in the financial market include the portions of a given company, commonly known as stocks. Purchasing a specific number of stocks grants holders an equivalent percentage of business ownership; they would become eligible for voting rights and part of the enterprise's profit (Bhandarkar et al., 2019). These gains benefit the venturers as they can have a large sum of money within a limited period.

On the other hand, the stock investment could also be advantageous based on the company's perspective. Firms that offer their shares to the public let them generate funds and raise capital; this situation could pave the way for expansion (Gautami & Kalyan, 2018). Most importantly, the advantages of stocks mentioned above are of a wide range because these are visible in many areas (Shah et al., 2019). While several studies have proven the benefits of stock investment to shareholders and enterprises, these advantages may still correspond to certain risks and uncertainties. Although this venture is profitable, it is hard to forecast and anticipate share price behavior (Badri et al., 2022). In turn, the instability in stocks could affect investor confidence and risk-taking tendencies (Kuhnen & Knutson, 2011). In addition, not all investors exhibit rational behavior (Chang et al., 2018). These attitudes attest that many investors lack proper knowledge of the stock market behavior, affecting their logical decision-making.

The stock market has been observed globally in response to this financial attitude. Researchers studied the financial market and monitored its uncertain behavior to support investment decisions. Theoretically, microeconomic and macroeconomic variables influence the variability in share prices (Rjoub et al., 2017). From a micro viewpoint, stock price uncertainties are influenced by the firm's profitability, efficiency, and ability to meet obligations (Prazak & Stavarek, 2017). With this, stock market studies often examine the firms' economic situation and use financial ratios to represent characteristics associated with price behavior (Jermisittiparsert et al., 2019; Musallam, 2018; Roodposhti et al., 2018). Furthermore, stock selection strategies have been prevalent in evaluating performance metrics by applying a multi-criteria decision approach, wherein standard methods included Analytic Hierarchy Processes (AHP) (Guo & Zhang, 2010).

Apart from microeconomic factors, the stock market behavior is influenced by various macroeconomic variables (Adesokan, 2018; Khan & Yousuf, 2013; Kavitha et al., 2013; Osamwonyi & Evbayiro-Osagie, 2012). Unfortunately, these outcomes are also evident



in developing countries like the Philippines, where the stock market is still emerging. The effects of macroeconomic variables on stocks are uncontrollable since the said factors govern the domestic economy (Lakmali & Madhusanka, 2015). Given this, individual firms might be unable to manage them easily (Sutrisno, 2017). Because of the stock's unforeseeable instability, the venture's success depends solely on investors' decisions and knowledge of share price movement. Thus, extensive stock selection and multi-criteria decision analysis might not be efficient; sophisticated optimization techniques must be simultaneously implemented. Since the stock price movement is stochastic, its behavior exhibits Markovian properties (Sultan et al., 2019). Therefore, studies have applied Markov chain theory to analyze such situations for studying stochastic processes; researchers also considered it a modern optimization and forecasting tool (Jannah & Fatekurohman, 2022). In terms of stock market research, the said tool provides more accurate results than other traditional forecasting techniques as it accounts for daily stock fluctuations (Vasanthi et al., 2011). In the Philippine setting, the Philippine Stock Exchange (PSE) classifies its firms into six sectors: Financials, Industrials, Holding Firms, Property, Services, and Mining and Oil. The country's stock market has continuously emerged as a field. While it has expanded domestically and internationally, its stock behavior remained sensitive to political and economic conditions (Bautista, 2003).

Previous studies have incorporated microeconomic or macroeconomic analysis in stocks. However, these papers have only used such tools to describe and evaluate the stock market. There remained a paucity of literature proving the efficiency of using techniques such as AHP and Markov Analysis simultaneously to generate a good investment pool and support investment decisions. Most significantly, stochastic studies have not been widely applied in the Philippines; these few papers have not even focused on evaluating a specific PSE industry as they were centered only on the stock market index in general. To cite examples, Cantuba et al. (2016) used the tool to forecast the Philippine Stock Exchange (PSE) prices and concluded an excellent forecasting performance for the Markov model. Identically, Almonares (2019) applied a two-state Markov switching analysis to observe the PSE monthly returns.

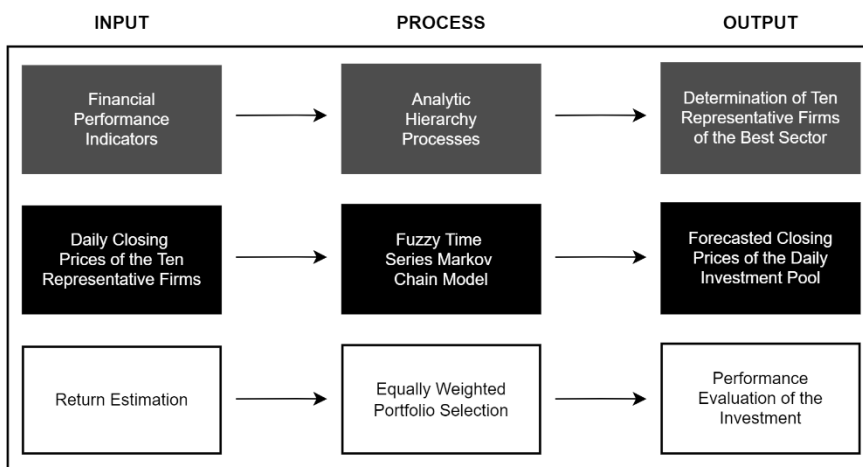
The present research addressed this gap by studying the Philippine stock market from micro and macroeconomic perspectives. From a microeconomic scope, the researcher chose a pool of representative companies from a particular industry based on the top-ranking sector by performance. From a macroeconomic viewpoint, this study forecasted future stock price movements based on their historical behavior. Finally, this research presented a portfolio selection model of the generated investment pool. The study is significant in various aspects as its findings benefit the enterprises, investors, and the academe.

## 2 Methodology

### 2.1 Conceptual Framework

The study applied a quantitative research approach and adopted a descriptive research design. This research was guided through the conceptual framework in Figure 1, showing the microeconomic and macroeconomic scope of the research analysis. Specifically, AHP was utilized to determine the best sector and choose representative firms under the top industry. Meanwhile, the study used Fuzzy Time Series Markov Chain Model (FTS-MC) to forecast closing prices and select the daily pool. Lastly, the researchers employed an equally weighted portfolio selection strategy to evaluate the performance of the generated investment pool with respect to the market.

**Figure 1:** Conceptual Framework



### 2.2 Data Collection

Three primary data were gathered in line with the study's objectives. The AHP multi-criteria decision tool required the criteria's importance weights and financial performance indicators for the microeconomic analysis. The pairwise importance ratings among the requirements were collected from survey responses distributed to 207 existing and potential investors. In addition, thirteen (13) accounting titles under 251 PSE company's financial reports, dated 31st December 2021, were gathered to serve as the performance indicators. These data included current assets, current liabilities, total assets, total equity, book value per share, current and previous sales, current and last net income, current and prior earnings per share, and share price. Meanwhile, the macroeconomic analysis

focused on the stock market's historical data. Thus, the daily closing prices of ten selected firms under the chosen industry were collected from 4th January 2016 to 29th December 2021.

## **2.3 Data Analysis**

### **2.3.1 Financial Ratios as Performance Indicators**

The present study conducted a preliminary analysis among the PSE sectors, including Financials, Industrials, Holding Firms, Property, Services, and Mining & Oil. For this objective, selected financial ratios were used to evaluate the performance and characteristics of the publicly listed companies. The study collected each firm's latest available data, wherein these accounting titles were utilized in calculating the different financial ratios shown in Table 1.

**Table 1:** Financial Ratios Formulas

Ratio	Meaning	Formula	Reference
<b>Liquidity Ratios</b>			
Current Ratio	Ability to pay short-term obligations	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$	Gitman et al. (2015);
Quick Ratio	Ability to pay short-term obligations with the most liquid asset	$\frac{* \text{Cash} + * \text{Receivables} + * \text{Short-term Investments} + * \text{Marketable Securities}}{\text{Current Liabilities}}$	Jermisittiparsert et al. (2019); Prazak & Stavarek (2017)
<b>Growth Ratios</b>			
Sales Growth	The growth of sales over one year	$\frac{ \text{Sales}_{\text{current}} - \text{Sales}_{\text{previous}} }{\text{Sales}_{\text{previous}}}$	Roodposhti et al. (2018)
Net Income Growth	The growth of net income over one year	$\frac{ \text{Net Income}_{\text{current}} - \text{Net Income}_{\text{pre}} }{\text{Net Income}_{\text{previous}}}$	
EPS Growth	The growth of EPS over one year	$\frac{ \text{EPS}_{\text{current}} - \text{EPS}_{\text{previous}} }{\text{EPS}_{\text{previous}}}$	
<b>Profitability Ratios</b>			
Net Income Margin	Remaining sales after paying for interest, taxes, and preferred dividends	$\frac{\text{Net Income}}{\text{Sales}}$	Gitman et al. (2015);
Earnings Per Share	Amount earned per share of common stock	$\frac{\text{Total Earnings}}{\text{Outstanding Shares}}$	Jermisittiparsert et al. (2019);
Return on Assets	Management’s effectiveness in generating income with assets	$\frac{\text{Net Income}}{\text{Total Assets}}$	Musallam (2018); Prazak & Stavarek (2017);
Return on Equity	The return earned on the shared investment of stockholders	$\frac{\text{Net Income}}{\text{Total Equity}}$	Roodposhti et al. (2018)
<b>Market Ratios</b>			
Price to Earnings Ratio	Amount investors are willing to pay for each dollar of a company’s earnings	$\frac{\text{Stock Price}}{\text{Earnings Per Share}}$	Gitman et al. (2015);
Market to Book Value Ratio	Assesses the firm’s performance from the investor’s perspective	$\frac{\text{Stock Price}}{\text{Book Value Per Share}}$	Jermisittiparsert et al. (2019); Musallam (2018)

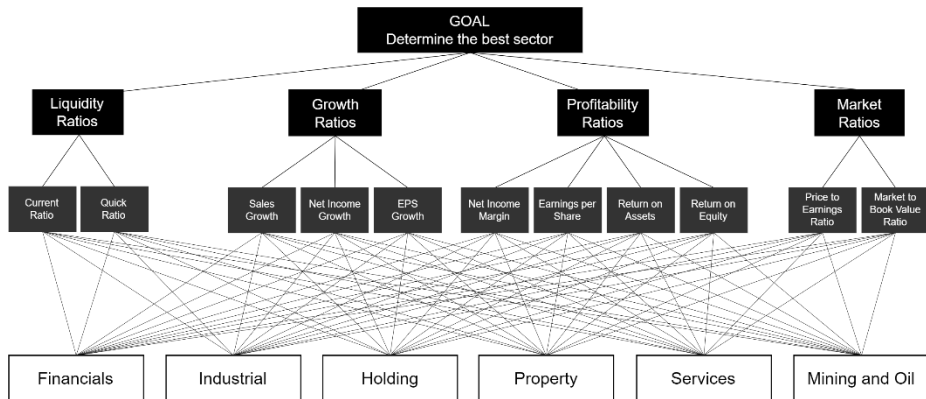
Data Source: PSE Edge, \*Wall Street Journal Markets.

After the computations, the PSE-registered firms were grouped based on their corresponding sectors, and the average values of the financial ratios were summarized per given industry. The liquidity, growth, profitability, and market ratios served as the performance indicators for evaluating the sectors.

### 2.3.2 Analytic Hierarchy Processes (AHP)

AHP is a multi-criteria decision tool incorporating hierarchical and pairwise comparisons (Munier, 2018). Saaty (1977) introduced it as a decision-making tool. This approach begins with establishing a hierarchy with the goal at the highest level and the criteria at the following ones, while the pairwise comparisons between the factors come afterward (Roodposhti et al., 2018). The results rank the options by yielding values representing the relative dominance of one choice over another. The current study utilized the AHP method to get the weights of different financial performance criteria and rank the six industries based on their sectoral performance. The procedure started with the hierarchical structure shown in Figure 2.

**Figure 2:** Analytic Hierarchy Processes Framework



Based on the diagram, the PSE sectors were treated as alternatives, while the liquidity, growth, profitability, and market ratios served as criteria for evaluation. Each criterion included selected ratios as sub-criteria. In performing the pairwise comparisons, Expert Choice software was utilized. The weights of each criterion and sub-criterion were established through the respondents' pairwise comparisons. Once the relative importance of these performance indicators was derived, each industry alternative was compared based on the geometric mean of the financial criteria and ratios' ratings. The consistency ratios among the pairwise comparisons were maintained to be 10% or less. In line with the study of Lirn et al. (2015), having a consistency ratio of less than or equal to 10% indicates informed judgments. Finally, the synthesized results yielded two findings: the importance weights of the financial performance indicators and the determination of the best-performing sector and firms based on the highest weighted scores.

### 2.3.3 Fuzzy Time Series Markov Chain Model

The study attempted to forecast future share prices through FTS–MC as it determines the predicted share price in a more specific numerical value instead of simply selecting the extent of stock movement. FTS–MC’s algorithm used historical data to construct TPMs to determine future closing prices. Unlike any other forecasting method, it extensively utilizes matrix and probability concepts; it puts a given closing price under a fuzzy state, and the forecasted stock price would be computed based on the probabilities of its occurrence during the past years (Kafi et al., 2019). The method integrates Fuzzy Time Series and Markov Chain concepts (Hui & Yusoff, 2021). Using the data from 29th December 2015 to 29th December 2020, FTS–MC was performed to forecast the 2021 closing prices of the selected companies. The current study followed the steps demonstrated by Kafi et al. (2019). First, the universal discourse  $U$  was determined based on the historical data’s minimum ( $D_{min}$ ) and maximum ( $D_{max}$ ) time series.  $U$  is defined in Equation 1.

$$U = [D_{min} - D_1, D_{max} + D_2] \quad (1)$$

The  $U$  was divided into several  $n$ -equal intervals. Equation 2 shows the formula, wherein  $N$  denotes the number of historical data’s time series.

$$n = 1 + 3.33 \log N \quad (2)$$

Afterward, the fuzzy set  $A_i$  was established using Equation 3, wherein  $\mu_{ij}$  is defined further in Equation 4.

$$A_i = \frac{\mu_{ij}}{u_j} \quad (3)$$

$$\mu_{ij} = \begin{cases} 1 & i = j \\ 0.5 & j = i - 1 \text{ or } i = j + 1 \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

The historical data was fuzzified based on the defined fuzzy set  $A_i$ , and a fuzzy logical relationship group was created. From here, the forecasted values for a given time  $t$  were calculated based on the rules defined in Equation 5. The variable  $m$  represents an interval’s mean of the maximum and minimum values.

$$\mu_{ij} = \begin{cases} m_i & \text{if } A_i \rightarrow \emptyset \\ m_k p_{ik} & \text{if } A_i \rightarrow a_k, p_{ij} = 0 \text{ and } p_{ik} = 1 \text{ with } j \neq k \\ m_1 p_{j1} + \dots + Y(t-1)p_j + \dots + m_n p_{jn} & \text{otherwise} \end{cases} \quad (5)$$

Consequently, the initial forecasted values are added with the adjustment values of  $D_{t1}$  and  $D_{t2}$ . These are calculated based on Equations 6 and 7. The adjusted forecast value is calculated through Equation 8.

$$D_{t1} = \begin{cases} -\frac{1}{2} & \text{if } A_i \leftrightarrow A_i, A_i \leftrightarrow A_j, i < j \\ -\frac{1}{2} & \text{if } A_i \leftrightarrow A_i, A_i \leftrightarrow A_j, i > j \end{cases} \quad (6)$$

$$D_{t2} = \begin{cases} -\frac{1}{2}s & \text{if } A_i \leftrightarrow A_{i+s}, i \leq s \leq n-i \\ -\frac{1}{2}v & \text{if } A_i \leftrightarrow A_{i-v}, i \leq v \leq i \end{cases} \quad (7)$$

The adjusted forecast value is calculated through Equation 8.

$$F'(t) = F(t) \pm D_{t1} \pm D_{t2} \quad (8)$$

The forecasting accuracy of FTS-MC was based on the Mean Absolute Percentage Error (MAPE) concerning the predicted and actual closing prices of ten selected Property firms. The MAPE was computed using Equation 9.

$$\text{MAPE} = \frac{1}{n} \sum_{t=1}^n \left| \frac{Y(t) - Y'(t)}{Y(t)} \right| \times 100\% \quad (9)$$

The present study summarized the predicted and actual share prices for 2021. Ramadani and Devianto (2020) state that a MAPE of less than 10% denotes perfect forecasting accuracy. If the data's MAPE falls into the acceptable criteria, FTS-MC is perceived to be an accurate forecasting tool for studying the stock market behavior in the Philippines.

### 2.3.4 Portfolio Selection

A portfolio selection was performed to fulfill the final aim. Primarily, the investment pool was generated using the micro and macroeconomic analyses of the study. First, the industry of focus was determined using AHP; similarly, the top ten firms under the selected sector were chosen using the said multi-criteria decision analysis tool. These were considered in the investment pool as they were perceived to give excellent performance in terms of liquidity, growth, profitability, and marketability. Second, the FTS-MC's forecast selected the daily pool so that the portfolio included only the companies predicted to increase in share price on a given day. Moreover, the study utilized 2021 closing price data, and the selection was based on daily returns calculated using Equation 10.

$$Returns = \frac{Closing\ Price_{Current}}{Closing\ Price_{Previous}} - 1 \quad (10)$$

The strategy employed in the model formulation was assumed to be equally likely. The probability assignment and selection model had equal weights of  $1/n$ , where  $n$  denoted the number of companies with an anticipated price increase. Afterward, the generated portfolios were compared with the Philippine Stock Exchange data. The bases for comparison were the mean returns, standard deviation, number of positive and negative returns, cumulative returns, and the results of the Paired T-Test. The portfolio selection results served as the investment pool's performance evaluation.

## 3 Results

The present study investigated Philippine stock behavior using multi-criteria decision-making and Markov chain models. For the microeconomic analysis, the researchers determined the comparative importance of performance indicators based on respondents' pairwise comparisons. The raw data were then converted into values appropriate for AHP, where all ratings favoring a reference attribute were assigned a corresponding integer value from 1 to 9, and ratings selecting the opposite comparison attribute were assigned reciprocal importance values from  $1/2$  to  $1/9$ . Afterward, the geometric means of these ratings were obtained and inputted in Expert Choice to determine a criterion's relative importance over another. The resulting weights, which depict the relative importance of the main criteria and their corresponding sub-criteria, are summarized in Table 2.



**Table 2:** AHP Importance Weights for Performance Indicators

Criteria	Weight	Sub-Criteria	Weight	Final Weight
Liquidity Ratios	0.230	Current Ratio	0.667	0.153
		Quick Ratio	0.333	0.077
Growth Ratios	0.340	Sales Growth	0.297	0.101
		Net Income Growth	0.540	0.184
		EPS Growth	0.163	0.055
Profitability Ratios	0.309	Net Income Margin	0.340	0.105
		Earnings per Share	0.287	0.089
		Return on Assets	0.237	0.073
		Return on Equity	0.136	0.042
Market Ratios	0.121	Price to Earnings Ratio	0.667	0.081
		Market to Book Value	0.333	0.040

After establishing the performance indicator's weights, the study chose an industry to be studied based on the top sector by performance. Upon gathering the raw financial reports of each firm and computing their ratios individually, the mean values of their performance indicators were summarized per sector. Outliers in the data were removed using Grubbs' Test. Given the weights and average financial performance, AHP was applied in the industry selection. Table 3 shows the AHP industry ranking and the ratings per sector.

**Table 3:** AHP Industry Ranking

Financial Ratios	Sector					
	Property	Financials	Holding	Mining	Industrials	Services
Current Ratio	0.247	0.116	0.266	0.124	0.124	0.124
Quick Ratio	0.183	0.119	0.273	0.142	0.142	0.142
Sales Growth	0.097	0.095	0.097	0.519	0.095	0.097
Net Income Growth	0.294	0.212	0.175	0.076	0.067	0.175
EPS Growth	0.245	0.123	0.107	0.406	0.056	0.062
Net Income Margin	0.341	0.167	0.167	0.141	0.100	0.084
Earnings Per Share	0.112	0.403	0.122	0.116	0.122	0.116
Return on Assets	0.243	0.080	0.127	0.236	0.277	0.038
Return on Equity	0.157	0.157	0.087	0.294	0.275	0.030
Price to Earnings	0.090	0.553	0.090	0.088	0.090	0.090
Market to Book Value	0.103	0.056	0.056	0.103	0.275	0.407
<b>Overall Rating</b>	0.224	0.180	0.172	0.171	0.130	0.123
<b>Rank</b>	1*	2	3	4	5	6

\*Selected as the top industry by performance.

With Property topping the selection, the firms proceeding to the macroeconomic analysis came from this sector. In choosing the representative companies, the initial list of all

Property firms was initially filtered to retain those listed before 2000 and those with above Php 45 billion in total assets. A similar multi-criteria analysis method was applied to the list. Given identical criteria weights from the sector selection, the study compared the remaining firms based on their relative performance differences. Table 4 shows the AHP firm ranking, wherein only the top 10 Property companies were selected as part of the investment pool.

**Table 4:** AHP Firm Ranking

Company	Code	Overall Rating	Rank
Ayala Land, Inc.	ALI	0.227	1
Empire East Land Holdings, Inc.	ELI	0.100	2
Filinvest Land, Inc.	FLI	0.082	3
Global-Estate Resorts, Inc.	GERI	0.077	4
Philippine Infradev Holdings, Inc.	IRC	0.076	5
Megaworld Corporation	MEG	0.073	6
Robinsons Land Corporation	RLC	0.073	7
Sta. Lucia Land, Inc.	SLI	0.068	8
SM Prime Holdings, Inc.	SMPH	0.065	9
Vistamalls, Inc.	STR	0.059	10
Shang Properties, Inc.	SHNG	0.053	11
Century Properties Group, Inc.	CPG	0.049	12

After determining the top companies through microeconomic analysis, the study also investigated these firms' behavior in response to the external financial environment. Thus, the macroeconomic analysis performed FTS–MC to analyze the companies' stock movement and forecast future share prices based on their historical behavior. The researchers gathered the firms' daily closing prices from 29th December 2015 to 29th December 2020, excluding holidays. Based on the Markov model constructed using these data, the study predicted the daily closing prices from 4th January to 31st December 2021.

The initial procedure was to determine the universal discourses  $U$  of the Property companies based on their maximum and minimum spanned time series data. The  $U$  for the selected firms were as follows:

$$U_{ALI} = [22.9, 53.50]$$

$$U_{ELI} = [0.20, 0.90]$$

$$U_{FLI} = [0.70, 2.20]$$

$$U_{GERI} = [0.60, 1.90]$$

$$U_{IRC} = [0.50, 2.90]$$

$$U_{MEG} = [1.80, 6.50]$$

$$U_{RLC} = [11.70, 32.10]$$

$$U_{SLI} = [0.70, 2.80]$$

$$U_{SMPH} = [18.80, 42.80]$$

$$U_{STR} = [3.10, 25.90]$$

Next, as calculated using Equation 2, the universal discourses for all firms must be partitioned into 12 equal intervals. Consequently, each company's historical daily closing prices were fuzzified based on their corresponding intervals and fuzzy sets  $A_i$  showed in Equation 10. Each fuzzy state's frequencies and logical relationships were utilized to construct the fuzzy transition probability matrix essential in forecasting.

$$A_1 = \left\{ \frac{l}{u_1} + \frac{0.5}{u_2} \right\}, A_2 = \left\{ \frac{0.5}{u_1} + \frac{l}{u_2} + \frac{0.5}{u_3} \right\}, \dots, A_{11} = \left\{ \frac{0.5}{u_{10}} + \frac{l}{u_{11}} + \frac{0.5}{u_{12}} \right\}, A_{12} = \left\{ \frac{0.5}{u_{11}} + \frac{l}{u_{12}} \right\} \quad (10)$$

Afterward, the 2021 closing prices for all companies were forecasted in Tables 42 to 51. Theoretically, if the current closing price falls under a specific fuzzy state, FTS-MC looks into its Markovian probabilities and applies rules using the conditions in Equation 5. Moreover, applicable adjustments based on Equations 6 and 7 were added. Tables 5 to 14 illustrate the forecasting.

**Table 5:** Illustrative Forecasted and Actual Closing Prices for ALI

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	41.1124	42.00
01/05/21	41.9664	41.00
⋮	⋮	⋮
12/31/21	35.9382	36.70

**Table 6:** Illustrative Forecasted and Actual Closing Prices for ELI

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	0.3107	0.32
01/05/21	0.3107	0.31
⋮	⋮	⋮
12/31/21	0.2617	0.26

**Table 7:** Illustrative Forecasted and Actual Closing Prices for FLI

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	1.1106	1.11
01/05/21	1.1031	1.10
⋮	⋮	⋮
12/31/21	1.0956	1.10

**Table 8:** Illustrative Forecasted and Actual Closing Prices for GERI

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	0.9268	0.93
01/05/21	0.9357	0.92
⋮	⋮	⋮
12/31/21	1.0121	1.01

**Table 9:** Illustrative Forecasted and Actual Closing Prices for IRC

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	1.3978	1.38
01/05/21	1.3716	1.38
⋮	⋮	⋮
12/31/21	1.0990	1.12

**Table 10:** Illustrative Forecasted and Actual Closing Prices for MEG

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	4.2361	4.18
01/05/21	4.0192	4.07
⋮	⋮	⋮
12/31/21	3.3003	3.15

**Table 11:** Illustrative Forecasted and Actual Closing Prices for RLC

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	21.0042	21.25
01/05/21	21.0465	21.20
⋮	⋮	⋮
12/31/21	19.4088	19.20

**Table 12:** Illustrative Forecasted and Actual Closing Prices for SLI

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	1.9668	2.00
01/05/21	1.9830	1.98
⋮	⋮	⋮
12/31/21	2.8319	2.88

**Table 13:** Illustrative Forecasted and Actual Closing Prices for SMPH

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	39.2631	39.25
01/05/21	39.0839	39.50
⋮	⋮	⋮
12/31/21	34.6765	33.90

**Table 14:** Illustrative Forecasted and Actual Closing Prices for STR

Day	Forecasted Closing Price	Actual Closing Price
01/04/21	4.2760	4.16
01/05/21	4.1977	4.06
⋮	⋮	⋮
12/31/21	3.7768	3.72

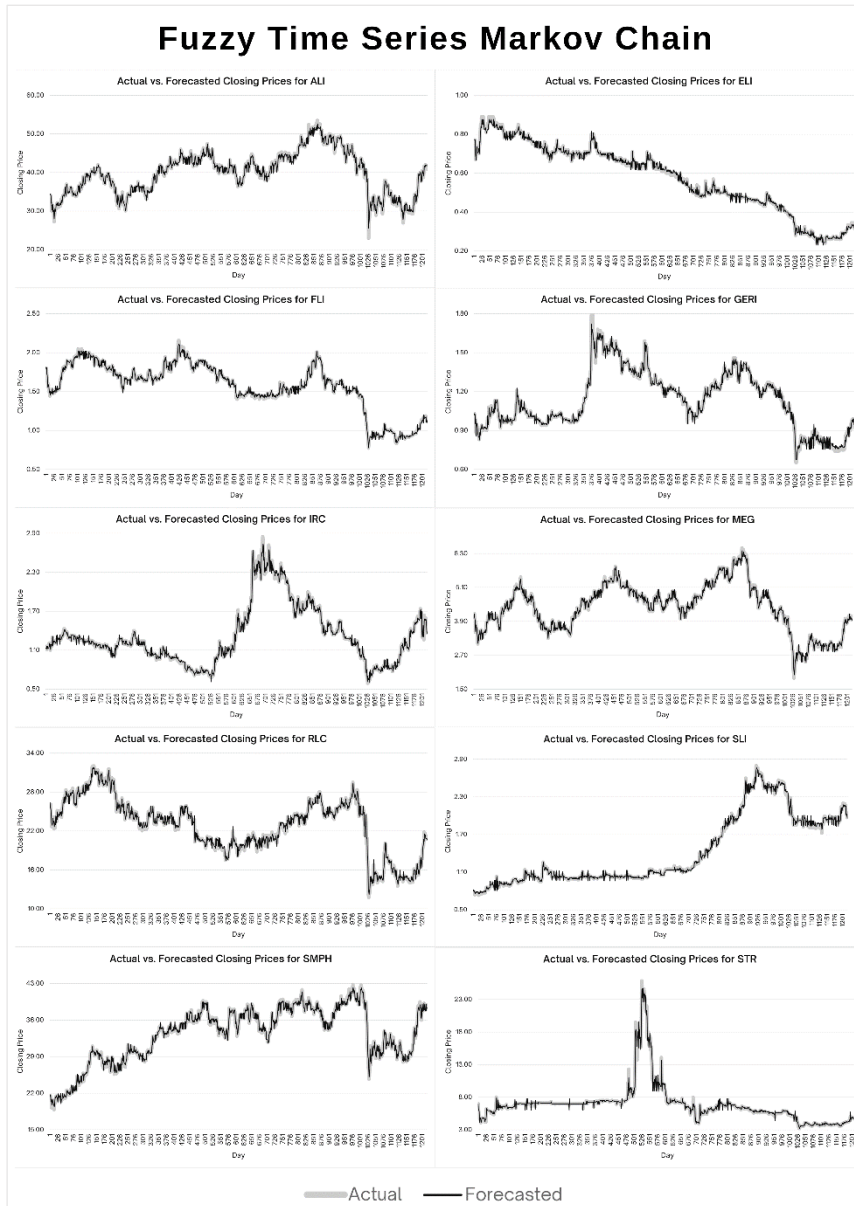
It was evident in the illustrative forecasts from the previous tables that the price prediction for all companies was perceived to be close to the actual stock prices spanning the same period. Although the values were near each other, the mean absolute percentage errors for all forecasts were calculated to verify the prediction accuracy further. The results of the computations are summarized in Table 15.

**Table 15:** MAPE of Forecasting among Property Firms

Company	MAPE	Remarks
ALI	1.2334%	perfect forecast
ELI	1.7062%	
FLI	1.0963%	
GERI	1.7999%	
IRC	1.6294%	
MEG	1.5313%	
RLC	1.4157%	
SLI	2.1539%	
SMPH	1.1414%	
STR	1.7030%	

As evident in Table 15, the MAPE results' highest error was observed in SLI, while the lowest was in FLI. Regardless of these numbers, all companies' forecasts are considered perfect because all MAPE values were less than 10% (Ramadani & Devianto, 2020). Also, based on Figure 3, the forecasted and actual prices in 2021 were close and nearly followed a similar trend. These results verified that FTS-MC is a reliable forecasting tool, and this technique could be accurately applied, especially in studying stock prices.

**Figure 3:** Fuzzy Time Series Markov Chain



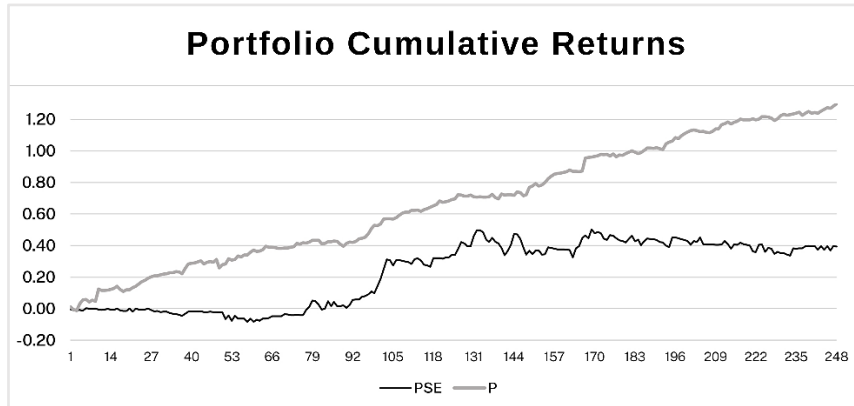
Finally, this study presented a portfolio selection model featuring the study's generated investment pool. In line with the microeconomic analysis, the pool considered in this research consisted of the ten selected firms from the best-performing sector—Property. Foremost, based on the AHP multi-criteria decision methodology, the chosen companies were perceived to have competent financial performance in terms of liquidity, growth, profitability, and market criteria. Another significant factor was that these companies have been operating for over 20 years, passing the history criterion. Concerning size, the selected firms also have total assets greater than Php 45 billion, making them ideal representative Property firms. Once the pool was established, the purpose of the macroeconomic analysis was to forecast the stock prices' anticipated movement. Thus, the study would include only those companies with a predicted price increase on a given day. Afterward, the study compared the generated portfolios with the PSE market

Table 16 compares the study's portfolio (P) to the market (PSE). Primarily, the results of the descriptive statistics entail that P yielded a higher mean price return of 0.0052. It also had a lower standard deviation of 0.0136 than the market, imposing that PSE has more risk in investment. Concerning the return count, P had higher positive and lesser negative returns. In addition, Figure 4 compares the cumulative returns of the portfolios. Consistent with the descriptive statistics, P also had higher ending cumulative returns, highest positive, and lowest negative cumulative returns, making it a favorable portfolio. Upon comparing the dataset using a more intensive Paired T-Test analysis, there was a significant difference between P2 and PSE, having a P-Value of 0.008. These results imply that investing in P would yield significantly higher returns than the market index.

**Table 16:** Portfolio Selection between P1 and PSE

	PSE	P
Count	248	248
Mean Returns	0.0016	0.0052
Standard Deviation	0.0218	0.0136
# of positive returns	93	161
# of zero returns	129	84
# of negative returns	26	3
Cumulative Returns	0.3926	1.2982
# of positive cumulative returns	177	246
# of negative cumulative returns	71	2
Paired T-Test T-Value		2.44
Paired T-Test P-Value		0.008*

\*Significant at 0.05 significance level.

**Figure 4:** Portfolio Cumulative Returns

#### 4 Discussion

The microeconomic analysis of the study evaluated the economic situation of each sector under the Philippine Stock Exchange. Mainly, from a micro perspective, stock prices are perceived to be influenced by internal company performance (Prazak & Stavarek, 2017). The present research has focused on the most outstanding financial performance sector, providing better opportunities to make stock investments worthwhile. In proceeding to the analysis, the industry selection through multi-criteria decision analysis ranked Property as the top sector, followed by Financials, Holding Firms, Mining and Oil, Services, and Industrials. This order was based on the most recent sectoral performance. Hence, present financial market conditions could elaborate on the ranking. Firstly, although Industrials and Services were generally known as profitable and efficient industries, the pandemic affected these sectors. Prawoto et al. (2020) emphasized that the industrial sector was impacted by the novel coronavirus when several manufacturing facilities were shut down across the globe. Khan et al. (2020) also stated that the SARS outbreak affected the stock returns of the Philippine service industry. Surprisingly, the Property sector topped the industry selection. Consistent with the study by Antenoracruz et al. (2020), Property has been the most efficient industry in recent years. Also, the real estate sector had relatively stable sales during the lockdown because people were restricted inside their homes, forcing them to secure their housing and property lease contracts (Shinozaki & Rao, 2021). In the long run, these increased revenues in the sector.

Because Property is perceived to have the best performance, the company selection would dwell under the said sector. The researcher implemented an identical multi-criteria decision analysis in the firm selection to determine the best representative firms. Furthermore, the study filtered the list of all Property companies in terms of history and



size. This process ensured that the pool of firms was top and preferable and had enough stock price data. Based on the selection, the ten representative companies were ALI, ELI, FLI, GERI, IRC, MEG, RLC, SLI, SMPH, and STR. As these Property firms were discerned to have an ideal economic situation, they proceeded to the macroeconomic analysis.

The microeconomic analysis determined the companies with outstanding performance. However, because the stock market behavior is also influenced by various macroeconomic variables (Adesokan, 2018), studies must simultaneously implement sophisticated optimization techniques to see how these firms react to the macroeconomic conditions of the financial market. In response to this need, the present study FTS–MC assesses stock behavior and forecasts future share prices. This method lets analysts know the predicted share price in a more specific numerical value instead of simply determining the extent of daily stock movement. FTS–MC’s algorithm used historical data to construct TPMs to determine future closing prices. Unlike any other forecasting method, it extensively utilizes matrix and probability concepts; it puts a given closing price under a fuzzy state, and the forecasted stock price would be computed based on the probabilities of its occurrence during the past years (Kafi et al., 2019). In using this method, the current study discovered that FTS–MC is an accurate forecasting method for stock prices since all companies’ mean absolute percentage errors denoted perfect forecasting. Thus, if investors utilized this tool in predicting stock movement, it would likely help them anticipate potential price increases based solely on how these shares behaved historically. By knowing a stock’s forecasted behavior, venturers would logically create good investment decisions.

Lastly, this study conducted a portfolio selection as the final objective. Portfolio P considered the micro and macroeconomic analysis results; the investment pool comprised the ten selected firms based on AHP. It also used FTS–MC to determine those companies with an expected price increase on a given day; thus, these firms would only be the ones included in the daily investment pool. The researchers employed an equally likely selection strategy. Afterward, the researcher compared the generated portfolio with the Philippine Stock Exchange data. The difference between P and the PSE market index was significant, proving that investing in P would yield significantly higher returns. As evident in the study, applying sophisticated optimization techniques like Markov analysis simultaneously with multi-criteria decision analysis could generate a good investment pool instead of solely using microeconomic analysis. Thus, in addition to studying the company’s internal situation, it is also crucial to consider external factors. Indeed, this research had successfully modeled a portfolio from a combination of middle and lower-tier firms that could become at par with the market consisting of blue-chip companies. Especially since buying blue-chip stocks is more expensive (Lubis, 2021), the study’s findings provided potential investors with economical options. For those who wish to invest in companies with lower stock prices, the study proved that they could still possibly

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acquire safe and reliable price returns as the PSE index through utilizing microeconomic and macroeconomic analysis of stock price behavior. Overall, the study's investment pool provided investors a profitable, sure, and worthy alternative option.

## 5 Conclusions

Several microeconomic and macroeconomic variables cause stochasticity in share price movement. Thus, simultaneously implementing multi-criteria decision analysis and Markov chain models could be advantageous for studying stock behavior. Using AHP, the microeconomic analysis of this study yielded Property as the top industry. Thus, ten representative Property firms proceeded to the macroeconomic analysis. The succeeding price forecasting using FTS-MC denoted a perfect forecast accuracy, aiding the researchers in predicting daily share price increases. Finally, the portfolio selection found that the study's generated portfolio significantly provided higher returns than the PSE market. In essence, the findings of this study are beneficial for both investors and enterprises.

Certain recommendations are still proposed for future studies. It is suggested that future studies compare two or more sectors in terms of performance and behavior. Also, potential researchers in this discipline could use other forecasting methods and compare these techniques. Lastly, an in-depth portfolio selection could be conducted by future researchers since this study used an equally weighted portfolio to the market performance.

## References:

- Adesokan, I. (2018) *Markov chain asset pricing model for an emerging market* [Doctoral dissertation] (Kenya: JKUAT).
- Almonares, R. A. L. (2019) Markov switching model of Philippine stock market volatility, *DLSU Business & Economics Review*, 29(1), pp. 24-30.
- Antenoracruz, J. M. V., Manzano, M. C. F. & Batac, R. C. (2020) Ranking the market efficiency of the Philippine stock exchange industry sectors using the multifractal detrended fluctuation analysis, *Journal of Physics: Conference Series*, 1593(1).
- Badri, A. K., Heikal, J., Terah, Y. A. & Nurjaman, D. R. (2022) Decision-making techniques using LSTM on Antam mining shares before and during the COVID-19 pandemic in Indonesia, *APTISI Transactions on Management (ATM)*, 6(2), pp. 167-180.
- Bautista, C. C. (2003) Stock market volatility in the Philippines, *Applied Economics Letters*, 10(5), pp. 315-318.
- Bhandarkar, V. V., Bhandarkar, A. A. & Shiva, A. (2019) Digital stocks using blockchain technology the possible future of stocks, *International Journal of Management (IJM)*, 10(3), pp. 44-49.
- Cantuba, J. R., Nicolas, P. E. & Co, F. (2016) Forecasting stock prices using hidden Markov models and support vector regression with firefly algorithm, *Population*, 25, p. 40.

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- Chang, K. H., Young, M. N. & Diaz, J. F. T. (2018) Portfolio optimization utilizing the framework of behavioral portfolio theory, *International Journal of Operations Research*, 15(1), pp. 1-13.
- Dias, R., Pardal, P., Teixeira, N. & Machová, V. (2020) Financial market integration of ASEAN-5 with China, *Littera Scripta*, 13(1), pp. 46-63.
- Gautami, S. & Kalyan, N. B. (2018) A comparative study on risk & return analysis of selected stocks in India, *International Journal of Management and Economics Invention*, 4(5), pp. 1730-1736.
- Gitman, L. J., Juchau, R. & Flanagan, J. (2015) *Principles of managerial finance* (Australia: Pearson Higher Education AU).
- Guo, M. & Zhang, Y. B. (2010) Notice of Retraction: A stock selection model based on analytic hierarchy process, factor analysis and TOPSIS, *2010 International Conference on Computer and Communication Technologies in Agriculture Engineering*, 2 (IEEE), pp. 466-469.
- Hui, L. X. & Yusoff, B. (2021) Exchange Rate Forecasting using Fuzzy Time Series-Markov Chain, *Universiti Malaysia Terengganu Journal of Undergraduate Research*, 3(3), pp. 183-194.
- Jannah, U. M. & Fatekurohman, M. (2022) Weather forecasting at BMKG Office Lumajang city using Markov chain method, *International Conference on Mathematics, Geometry, Statistics, and Computation* (Atlantis Press), pp. 211-214.
- Jermisittiparsert, K., Ambarita, D. E., Mihadjo, L. W. & Ghani, E. K. (2019) Risk-return through financial ratios as determinants of stock price: a study from asean region, *Journal of Security & Sustainability Issues*, 9(1), pp. 199-210.
- Kafi, R. A., Safitri, Y. R., Widyaningsih, Y. & Handari, B. D. (2019) Comparison of weighted Markov chain and fuzzy time series Markov chain in forecasting stock closing price of company X, *AIP Conference Proceedings*, 2168(1), (AIP Publishing LLC).
- Kavitha, G., Udhayakumar, A. & Nagarajan, D. (2013) Stock market trend analysis using hidden Markov models, *arXiv preprint arXiv*, 1311.4771.
- Khan, K., Zhao, H., Zhang, H., Yang, H., Shah, M. H. & Jahanger, A. (2020) The impact of COVID-19 pandemic on stock markets: An empirical analysis of world major stock indices, *The Journal of Asian Finance, Economics and Business*, 7(7), pp. 463-474.
- Khan, M. M., & Yousuf, A. S. (2013). Macroeconomic forces and stock prices: evidence from the Bangladesh stock market.
- Kuhnen, C. M. & Knutson, B. (2011) The influence of affect on beliefs, preferences, and financial decisions, *Journal of Financial and Quantitative Analysis*, 46(3), pp. 605-626.
- Lakmali, A. & Madhusanka, K. J. S. (2015) *The effect of macro-economic variables on stock prices in Sri Lankan stock market* (Sri Lanka: International Research Symposium of Rajarata University).
- Lirn, T. C., Thanopoulou, H. A., Beynon, M. J. & Beresford, A. K. (2015) An application of AHP on transshipment port selection: a global perspective, *Port Management* (London: Palgrave Macmillan), pp. 314-338.
- Lubis, P. R. (2021) The Effect of Fundamental Factor Analysis on Blue Chips Stock Returns on the Indonesia Stock Exchange, *Journal of Management Science*, 4(2), pp. 43-52.
- Munier, N. (2018) *What are the basic and technical difference between AHP and TOPSIS?*, available at: [https://www.researchgate.net/post/What\\_are\\_the\\_basic\\_and\\_technical\\_difference\\_between\\_AHP\\_and\\_TOPSIS](https://www.researchgate.net/post/What_are_the_basic_and_technical_difference_between_AHP_and_TOPSIS) (October, 2022).
- Musallam, S. R. (2018) Exploring the relationship between financial ratios and market stock returns, *Eurasian Journal of Business and Economics*, 11(21), pp. 101-116.

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- Osamwonyi, I. O. & Evbayiro-Osagie, E. I. (2012) The relationship between macroeconomic variables and stock market index in Nigeria, *Journal of Economics*, 3(1), pp. 55-63.
- Prawoto, N., Priyo Purnomo, E. & Az Zahra, A. (2020) *The impacts of Covid-19 pandemic on socio-economic mobility in Indonesia* (Indonesia: International Journal of Economics and Business Administration).
- Pražák, T. & Stavárek, D. (2017) The effect of financial ratios on the stock price development, *Interdiscip. Econ. Bus. Res*, 43, p. 3.
- Raddant, M. & Kenett, D. Y. (2021) Interconnectedness in the global financial market, *Journal of International Money and Finance*, 110.
- Ramadani, K., & Devianto, D. (2020) The forecasting model of Bitcoin price with fuzzy time series Markov chain and chen logical method, *AIP Conference Proceedings*, 2296(1), (AIP Publishing LLC).
- Rjoub, H., Civr, I. & Resatoglu, N. G. (2017) Micro and macroeconomic determinants of stock prices: The case of Turkish banking sector, *Romanian Journal of Economic Forecasting*, 20(1), pp. 150-166.
- Roodposhti, F. R., Jahromi, M. B. & Kamalzadeh, S. (2018) Portfolio selection using analytic hierarchy process and numerical taxonomy analysis: case study of Iran, *American Journal of Finance and Accounting*, 5(4), pp. 394-414.
- Saaty, T.L. (1977) *The Analytic Hierarchy Process* (New York: McGraw-Hill).
- Shah, D., Isah, H. & Zulkernine, F. (2019) Stock market analysis: A review and taxonomy of prediction techniques, *International Journal of Financial Studies*, 7(2), p. 26.
- Shinozaki, S. & Rao, L. N. (2021) *COVID-19 impact on micro, small, and medium-sized enterprises under the lockdown: evidence from a rapid survey in the Philippines* (Japan: Asian Development Bank Institute).
- Sultan Q., Fatima, K. & Ahmed, J. (2019) *Application of Markov Chain to Model and Predict Share Price Movements: A Study of HBL Share Price Movements in Pakistan's Stock Market* (Pakistan: Bi-Annual Research Journal).
- Sutrisno, B. (2017) Macroeconomic variables and sectoral indices: Case in the Indonesian stock exchange, *Etikonomi*, 16(1), pp. 71-80.
- Vasanthi, S., Subha, M. V. & Nambi, S. T. (2011) An empirical study on stock index trend prediction using markov chain analysis, *Journal of Banking Financial Services and Insurance Research*, 1(1), pp. 72-91.

# Cryptocurrency Portfolio Selection Using Technical Analysis Indicators

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**Abstract** The study designed and recommended a portfolio selection framework that can outperform traditional investment benchmarks in the cryptocurrency market. The study utilized technical analysis indicators to choose the investment pool. The study considered the top 169 cryptocurrencies in Yahoo Finance with a market cap of at least \$100M. The technical analysis indicators used were Simple Moving Average (SMA), Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), and On-Balance-Volume (OBV). The resulting safety-first and mean-variance portfolio outperformed the benchmark (S&P500 market index) in terms of descriptive statistics and pair-return difference T-test. Therefore, the portfolios generated could be viable investment alternatives for investors looking to build a portfolio in cryptocurrency markets.

**Keywords:** • simple moving average (SMA) • moving average convergence divergence (MACD) • relative strength index (RSI) • on-balance volume (OBV) • SP/A theory • cryptocurrency

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## 1 Introduction

For most investors, traditional stocks are the preferred option to build a portfolio. However, a new market utilizing digital currency recently emerged. The latest market is called cryptocurrency. Cryptocurrency is an emerging digital market with a virtual coinage system that functions much like a standard currency, enabling users to provide virtual payment for goods and services free from a central trusted authority (Farell, 2015). Cryptocurrency uses a decentralized ledger called a blockchain to record transactions and protect the information about transactions and exchanges made on the market (Chuen et al., 2017; Milutinović, 2018). Blockchain technology could act as a digital receipt that cannot be falsified. Cryptocurrencies and the blockchain were developed by a pseudonymous person named Satoshi Nakamoto in 2008 when Satoshi posted a paper to a cryptography forum entitled Bitcoin: A Peer-to-Peer Electronic Cash System (Arias-Oliva et al., 2019). The study recognizes that there are numerous risks involved in investing in cryptocurrencies. While cryptocurrencies are viable for an investment portfolio because of long-term profits, it is crucial to consider that the market is positively correlated. A portfolio's purpose is to limit market correlation, but most cryptocurrencies have a significant correlation. Hilmola (2021) discovered that nearly all privacy coins in Hilmola's study followed Bitcoin's price development. Thus, if Bitcoin, the mother coin of cryptocurrency, crashes, most cryptocurrencies are likely to follow. It is vital to have a long-term mindset when creating a portfolio in the cryptocurrency market as an investor.

The study's objectives are to (1) design and recommend a portfolio selection framework for the cryptocurrency market using technical analysis indicators and (2) determine whether the generated portfolio selection framework can outperform traditional investment benchmarks. The study's findings benefit investors who are not knowledgeable in creating a diversified portfolio or are exploring their portfolio selection techniques. Investors can utilize the portfolio framework design to maximize their gains more than traditional methods. Investors who believe in the effectiveness of technical analysis indicators in the cryptocurrency market can use the study to create their portfolio because the suggested portfolio selection techniques in choosing the investment pool may outperform traditional benchmarks. The methods can also be used or modified by beginner and advanced traders in the traditional or cryptocurrency markets. The technique and strategies can also be utilized by future researchers as reference data in the further development of the research topic.

## 2 Literature overview

Technical analysis indicators were used as a filter in the portfolio selection. Technical analysis is performed by using historical patterns of transaction data to assist traders in assessing and projecting possible market conditions. Technical analysis usually involves an examination of price and volume charts. The reason is that price and volume charts summarize all trading activity made by market participants, and these charts affect their

decisions (Fang et al., 2020). According to Abboud (2017), technical analysis attempts to evaluate a financial instrument by primarily focusing on market price movement. Price and volume could reveal current and possible future market conditions. While Kamrat et al. (2018) believe that technical analysis aims to profit from trading stocks at the right time rather than from long-term saving, the study aims to use technical analysis to create long-term profits in investors' portfolios.

There are some researchers, such as Puzyrev (2019) and Siswanto et al. (2020), who believe that technical analysis cannot be applied to cryptocurrency trading because of the market's price volatility and the existence of "market whales." Hudson & Urquhart (2019) add that technical analysis provides evidence against one of the most respected theories in finance, the efficient market hypothesis. Market efficiency states that all available information must be reflected in security prices, so technical analysis is thought to be unsuccessful.

However, many researchers still believe that technical analysis is practical and can be heavily applied to cryptocurrency trading. Fang et al. (2020) claim that many researchers have focused on technical indicators analysis for trading on cryptocurrency markets, while Phillips & Gorse (2018) argue that it is common for intraday traders to follow technical analysis pattern-based trading strategies. The reason for this could be that despite cryptocurrency volatility, the market still has graphs on its past market activity where the movement of the price can be exploited (Van der Avoird, 2020). Traders can receive more insight into the possible direction of prices in the future because of past data. Furthermore, a study by Huang et al. (2019) provided evidence that technical analysis strategies have strong predictive power and thus can be helpful in cryptocurrency markets like Bitcoin.

Related studies proved that technical analysis of cryptocurrency markets yielded significant profits. Corbet et al. (2019) stated that technical trading could generate 100 to 10,000 times of returns obtained from the buy-and-hold strategy in the cryptocurrency markets. Furthermore, Anghel (2021) concluded that economically significant profits seemed attainable by trading using prediction models inspired by Technical Analysis. Another study by Fousekis & Tzaferi (2021) stated that technical analysis utilizing information on past volume may attain abnormal profits and that past returns may be employed to forecast trading activity and liquidity in cryptocurrency markets.

Numerous researchers have applied technical analysis to the cryptocurrency market. Vo et al. (2019) applied traditional technical analysis to foresee what other investors are thinking based on the price and volume of the cryptocurrency. Shukla & Gupta (2019) have applied the principles of technical analysis to look for Bitcoin (BTC) and Ethereum (ETH) patterns and signals to conciliate the portfolio choice based on the Markowitz model with market strategies. Technical analysis of ETH and BTC let them identify the signals to set up long and short strategies. Danylchuk et al. (2020) and Anghel (2021)

combined technical analysis with other complex techniques for their studies. Alonso-Monsalve et al. (2020), Kristjanpoller & Minutolo (2018), and Shukla, S & Gupta, K (2019) also used technical analysis along with other techniques in the cryptocurrency market.

### 3 Research Methodology

**Figure 1:** Conceptual Framework of the Study

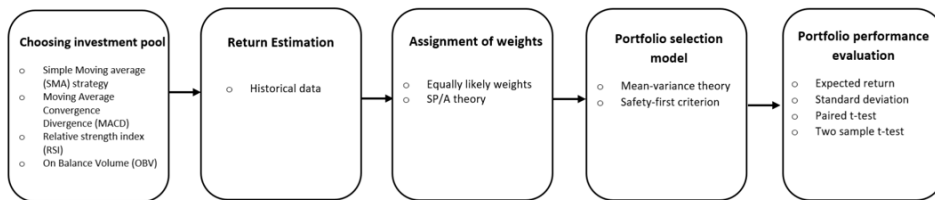


Figure 1 shows the conceptual framework of the study. The framework starts with choosing and screening an investment pool, determining the return estimation, and assigning weights. The subsequent procedures would be selecting models and evaluating the performance of the generated portfolio. Choosing investment pool determined the investment pool that will be used for the study. Return estimation determined the estimated returns when the investment pool is applied. The assignment of weights portion was used to determine the weights assigned to the probability of outcomes of the scenarios. The portfolio selection portion assigned portfolio weights of each asset considered, and the portfolio performance evaluation portion evaluated the performance of each portfolio generated.

The conceptual framework follows a standard portfolio performance evaluation procedure used by Chang et al. (2015) and Young (2020) in multiple studies. Additionally, the study adds another section from the initial framework entitled “choosing investment pool.” This section proposes criteria for choosing the investment pool using the technical analysis indicators mentioned. The study aims to fill a research gap in the “choosing investment pool” portion of the portfolio selection model.

#### 3.1 Choosing Investment Pool

In choosing the initial investment pool, the cryptocurrencies were screened through different criteria using technical analysis indicators to trim down the portfolio size and theoretically assign the cryptocurrencies with the highest likelihood of profitability and portfolio stability. Technical analysis was performed on the cryptocurrencies to determine the trend of the currency using technical indicators. The study utilized different technical analysis indicators in building the portfolio. The technical analysis indicators that were



used were: Moving Average (MA), Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI), and On Balance Volume indicator (OBV). The researchers believe that these technical indicators are the most appropriate for the study, considering the time frame of the research and the available historical data on price and volume. Other well-known technical analysis indicators usually require more than just price and volume. The cryptocurrencies were filtered out through various conditions of technical indicators. Once the cryptocurrencies are screened out, and an optimal number of investment pools is not achieved (e.g.,  $n > 5$  or  $n < 50$ ), the condition rate will be adjusted accordingly. The proposed technical analysis indicators were used to determine favorable entry and exit points in the cryptocurrency market and, if applicable, determine the stability of the selected market for portfolios. The open-high-low-close (OHLC) and volume data for the cryptocurrencies were taken from Yahoo Finance. The study utilized Microsoft Excel to apply the technical indicators to the OHLC and volume data with an evaluation period of 2020 to 2021. The study considered the top 169 cryptocurrencies in Yahoo Finance with a market cap of at least \$100M. Yahoo Finance is a website with free accessible stock quotes, portfolio management resources, and international market data. In Yahoo Finance, the top cryptocurrencies can be sorted, and the OHLC of cryptocurrencies and other stock markets can be downloaded into comma-separated values (CSV) files. Previous researchers have used Yahoo Finance to extract cryptocurrency data in their respective studies (Bashkeeva, 2021; Caferri, 2020; Chatterjee et al., 2020; Ferdiansyah et al., 2019; Mazanec, 2021; Pineault, 2022; Uras & Ortu, 2021).

### 3.1.1 Simple Moving Average (SMA) strategy

According to Wei et al. (2014) & Corbet et al. (2019), buy signals are generated when the short-period MA rises above the long period ( $S > L$ ), while sell signals are generated when short-period MA falls below the long-period ( $S < L$ ). A Simple Moving Average is calculated by adding the security prices for the most recent  $n$  periods and dividing by  $n$ . Rozario et al. (2020) defines the formula for *SMA* as:

$$SMA_n = \frac{1}{N} \sum_{i=n-N+1}^n x_i \quad (1)$$

Where  $N$  is a fixed window size of data points ( $x_1, x_2 \dots$ ) where  $n \geq N$ . The study utilized two values for the Simple Moving Average. The study used a period of 10 days and 20 days. Brock et al. (1992), Han et al. (2013), and Chen et al. (2016) adopted 10 days *SMA* for their research which yielded significant gains that surpassed traditional benchmarks, while Grobys et al. (2020) gained significant gains using 20 days *SMA*. Ahmed et al. (2020) generated a return of 8.76% per annum (p.a.) over the average market return using a simple 20 days moving average trading, while Papailias & Thomakos (2015) generated a gain of 1000% using a modified 20-day weighted moving average. Costanza (2018) interpreted the values of *SMA* by determining that there is an entry signal for when the

stock price crosses above the 20-day *SMA* while an exit signal if the price went below the 20-day *SMA*.

### 3.1.2 MACD

The technical indicator MACD is given by:

$$MACD = EMA_a(P) - EMA_b(P) \quad (2)$$

Where  $EMA_a$  and  $EMA_b$  are the exponential moving averages (EMA) over two periods where  $a < b$ .  $P$  is the current price at time  $T$ . Previous literature (Tajiri & Kumano, 2012; Awheda & Schwartz, 2013; Hansun, 2013; Grebenkov & Serror, 2014; Huang & Zhou, 2019; Vergura, 2020; Cai et al., 2021) define  $EMA$  as:

$$S_t = S_{t-1} + \alpha(P_t - S_{t-1}) \quad (3)$$

Where:

$S_t$  = Exponential moving average at time  $t$

$P_t$  = instantaneous value at time  $t$

$\alpha$  = degree of weighing decrease or smoothing constant

Smoothing constant  $\alpha$  implies the degree of weighting factor reduction.  $\alpha$  is set between 0 and 1. It is advised to buy when  $MACD > 0$  and sell when  $MACD < 0$  (Gerritsen, 2020; Schatzmann, 2020). Baisa et al. (2020) indicated a bullish signal when  $MACD > signal\ line$  while a bearish signal when  $MACD < signal\ line$ . The study used the standard periods in  $MACD$ , which are 12, 26, and 9 (Baisa et al., 2020).

### 3.1.3 Relative Strength Index

The technical indicator Relative Strength Index utilizes average gains and average losses. The formula is given by:

$$RSI = 100 - \left[ \frac{100}{1 + \frac{Average\ gain}{Average\ loss}} \right] \quad (4)$$

The *RSI* can be interpreted using failure swings. Failure swings occur when the *RSI* goes below 30 or above 70 (Baisa et al., 2020). Alexandros (2021) explains that when the  $RSI > 70$ , an asset is labeled as overbought or overvalued. If *RSI* crosses back below 70, it indicates an exit signal. When the  $RSI < 30$ , an asset is marked oversold or undervalued. If *RSI* crosses back above 30, it suggests an entry signal. The study used the standard period for *RSI*, which is 14 periods.

### 3.1.4 On-Balance Volume Indicator

The On Balance Volume equation is given by:

$$OBV_t = OBV_{t-1} + \begin{cases} volume_t & \text{if } close > close_{prev} \\ 0 & \text{if } close = close_{prev} \\ -volume_t & \text{if } close < close_{prev} \end{cases} \quad (5)$$

Interpreting the use of *OBV*, the study assumed that a rise in *OBV* indicates an increase in price while a drop in *OBV* suggests otherwise, as illustrated in equation 9 (Vo et al., 2020, Singpurwala 2021).

$$\begin{aligned} OBV \uparrow, price \uparrow \\ OBV \downarrow, price \downarrow \end{aligned} \quad (6)$$

### 3.1.5 Condition and Decision of Technical Analysis Indicators

**Table 1:** Condition and Decision of Technical Analysis Indicators

Decision	Condition
<i>SMA</i>	
Accept coin	$SMA_{10} > SMA_{20}$
Reject coin	$SMA_{10} < SMA_{20}$
<i>MACD</i>	
Accept coin	$MACD > 0$
Reject coin	$MACD < 0$
<i>RSI</i>	
Accept coin	$0 < RSI < 30$
Reject coin	$30 \geq RSI \geq 100$
<i>OBV</i>	
Accept coin	$OBV_t > OBV_{t-1}$
Reject coin	$OBV_t \leq OBV_{t-1}$

Once the values of *SMA*, *MACD*, *RSI*, and *OBV* were obtained, they were filtered out. Table 1 shows the conditions and decisions of technical analysis indicators in choosing the investment pool. According to Wei et al. (2014) & Corbet et al. (2019), buy signals are generated when the short-period moving average rises above the long period ( $S > L$ ) and vice versa. The idea behind the *SMA* criteria is when the moving average during a short period rises above a long period, a price breakout will occur because there is a rising trend in the short period. Baisa et al. (2020), Gerritsen (2020), and Schatzmann (2020) advise to buy when  $MACD > 0$  and sell when  $MACD < 0$ . The idea behind the *MACD*

criteria is when the  $MACD > 0$ ,  $EMA_a(P) > EMA_b(P)$ , the short-term EMA is greater than long-term EMA and a price breakout is expected to occur because there is a rising trend in the short period EMA. Alexandros (2021) suggests buying when  $RSI < 30$  and the market is oversold while selling when  $RSI > 70$  and the market is overbought. When the market is oversold, it indicates a bearish momentum where it is ideal to enter the market because the price is assumed to go up and vice versa. Vo et al. (2020) and Singpurwala (2021) discovered that a rise in  $OBV$  indicates an increase in price, while a drop in  $OBV$  suggests otherwise. The idea behind the  $OBV$  criteria demonstrates that if the majority of the current  $OBV$  is greater than yesterday's  $OBV$ , it would indicate that there are greater uprends than downtrends during the historical data considered. The  $OBV$  precedes price. Thus, the condition justifies the overall health of the coin. Ideally, the coins pass or satisfy 3 out of 4 technical indicators to be chosen as part of the investment pool.

### 3.2 Return Estimation

After determining the investment pool using the technical analysis indicators, the study determined and estimated the performance of the assets in the pool. The study then utilized historical data. The study used the OHLC and volume data of the top 169 cryptocurrencies in Yahoo Finance with a market cap of at least \$100M.

### 3.3 Assignment of Weights

The assignment of weights portion was used to determine the weights assigned to the probability of outcomes of the scenarios. The study used equally likely weights and SP/A theory to assign weights in identifying the optimal portfolio.

#### 3.3.1 Equally Likely scenarios and SP/A Theory

The study used historical data to forecast the outcomes of the scenarios. Each day in the back-test period was assigned equal probabilities where the probability ( $P_j$ ) of each scenario is equal to  $1/n$ , where  $\sum_i^n = 1, i = \{1, 2, 3 \dots, n\}$ . The SP/A theory provided probability weights based on fear and hope levels. SP/A theory was used in the assignment of weights of portfolios. SP/A theory is a dual criterion model that integrates two logically and psychologically separate criteria (Lopes & Oden, 1999). The criteria assume that investors base their decisions on fear and hope. Chang et al. (2018) observed that investors would likely put more weight on the worst outcomes when fearful while putting weight on the best outcomes when hopeful. The S in SP/A theory stands for security, the P stands for potential, and the A stands for aspiration (Shefrin & Statman, 2000). Investors would likely put more weight on the worst outcomes when they are fearful while putting weight on the best outcomes when hopeful (Chang et al., 2018). The study utilized  $q_s = 3$  and  $q_p = 1$ . Chang et al. (2018, 2019) define SP/A theory as:

$$H_s(D) = D^{1+q_s} \quad (7)$$

$$H_p(D) = 1 - (1 - D)^{1+q_p} \quad (8)$$

$$H(D) = (1 - \theta)H_s(D) + \theta H_p(D) \quad (9)$$

$$P_j = H(D_{j-1}) - H(D_j) \quad (10)$$

where:

$H_s(D)$  = decumulative weights for fear

$H_p(D)$  = decumulative weights for hope

$q_s$  = fear level of investor

$q_p$  = hope level of investor

$H(D)$  = combined decumulative weight

$P_j$  = probability of  $j^{th}$  scenarios

### 3.4 Portfolio selection model

The study used the mean-variance and safety-first models to assign the portfolio weights of each asset considered. The study used Python programming to identify the mean-variance and safety-first model optimal portfolios.

#### 3.4.1 Mean-Variance Model

In the mean-variance model, the investor would base their decision on where to invest using the returns and risk of the portfolio. The model will determine the optimal portfolio with a beneficial trade-off of return and risk. Young et al. (2019, 2020) define the generic model of mean-variance as:

$$Max \lambda \bar{R}_x - (1 - \lambda) \sigma_{x^2} \quad (11)$$

$$\sigma_{x^2} = w^2 \sigma_i^2 + \sum_i \sum_j w_i w_j \sigma_i \sigma_j \rho_{ij} \quad (12)$$

Additionally, Hanink (1985), Kroll et al. (1988) and Young et al. (2019, 2020) define the mean return  $\bar{R}_x$  as:

$$\bar{R}_x = \sum_{i=1}^n w_i E_i \quad (13)$$

Where:

$\bar{R}_x$  = expected mean return on portfolio  $X$

$\sigma_{x^2}$  = variance of portfolio  $X$

$w_i$  = weight on asset  $i$

$E_i$  = expected return on the asset  $i$

$\lambda$  = modulator between the portfolio's return and the portfolio's variance

$\sigma_i$  = standard deviation of asset  $i$

$\rho_{ij}$  = correlation between asset  $i$  and  $j$

### 3.4.2 Safety-first Model

In the safety-first model, an investor minimizes the probability of a portfolio return falling below a certain threshold. Rachev (2001), Ding & Liu (2011), Chang & Young (2018, 2019a, 2019b), and Young et al. (2019, 2020) define the generic model of safety-first as:

$$\text{Max } \bar{R}_x \quad (14)$$

$$\text{s. t. } P(R_x \leq R_L) < \alpha \quad (15)$$

$$R_x = \sum_{i=1}^n w_i E_{ij} \quad (16)$$

$$\bar{R}_x = \sum_{i=1}^n w_i E_i \quad (17)$$

Where:

$R_x$  = return of the portfolio

$\bar{R}_x$  = expected mean return on portfolio  $X$

$R_L$  = loss tolerance

$w_i$  = weight on asset  $i$

$E_{ij}$  = return on the asset  $i$

$E_i$  = expected return on the asset  $i$

$\alpha$  = acceptable probability of reaching the loss tolerance

## 3.5 Portfolio Performance Evaluation

Once return estimation, assignment probability weights, and portfolio selection models were completed, the performance of each portfolio was evaluated. The study utilized expected return, standard deviation, Paired t-test, and two-sample t-test for portfolio performance evaluation. The study applied these techniques to the actual market performance through a benchmark and the generated portfolios.

### 3.5.1 Expected return

The study used the Microsoft Excel application to obtain the expected mean return of the portfolios. The expected mean return is given by:

$$\bar{R}_x = \frac{R_{x1} + R_{x2} + R_{x3} + \dots + R_{xt}}{t} \quad (18)$$

Where:

$\bar{R}_x$  = mean return of portfolio  $X$  during the back-test period

$R_{xt}$  = return of portfolio  $X$  during test day  $t$ .

$t = \{1, 2 \dots n\}$

### 3.5.2 Standard Deviation

The study used the Microsoft Excel application to obtain the standard deviation of the portfolios. The standard of deviation is formulated as:

$$\sigma = \sqrt{\frac{\sum_{t=1}^n (R_{xt} - \bar{R}_x)^2}{n-1}} \quad (19)$$

Where:

$\sigma$  = standard deviation of the portfolio

$R_{xt}$  = return of portfolio  $x$  on test day  $t$

$\bar{R}_x$  = mean return of portfolio  $x$  during the back-test period

$n$  = number of data points

### 3.5.3 Paired t-tests

Due to the inadequate data that descriptive statistics show, paired t-tests and two sample t-tests were utilized. The generated portfolios and corresponding returns were compared using t-tests. The study used the Microsoft Excel application to obtain the paired t-test.

The null and alternative hypothesis is given by:

$H_0$ : The return difference is less than or equal to 0.

$H_a$ : The return difference is greater than 0.

## 4 Discussion

### 4.1 Portfolio Details

The proposed investment pool was back-tested against benchmarks and other portfolios using the Python programming language. The Python code utilized the OS module, xlr library, and the gurobipy or the Gurobi Python Application Programming Interface (API). The OS module was used for interacting with the operating system. In contrast, the xlr library was used to read and format information from Excel files, and the Gurobi API was used to perform mathematical optimization modeling.

The study utilized the top 169 cryptocurrencies according to Market Capitalization. The historical data used were two years, from January 2018 to December 2020. The S&P 500 index was chosen as the benchmark as previous researchers observed a connection between the S&P 500 index and cryptocurrencies. Corbet et al. (2018) discovered volatility spillovers from the S&P 500 to cryptocurrencies, while Liu and Serletis (2019) found that the returns of the S&P 500 positively influence cryptocurrency market returns. Zeng et al. (2020) also showed that Bitcoin is the net recipient of spillover from the S&P 500. Related literature suggests that the price of Bitcoin is heavily affected by the S&P500

index (Conrad et al., 2018; Fang et al., 2020; Kim et al., 2020; Yousaf & Ali, 2021; Hung, 2022).

**Table 2:** Pricing for cryptocurrency trades in Coinbase

Pricing Tier	Transaction Fee
\$10,000 – \$50,000	0.35%
\$50,000 – \$100,000	0.15%
\$100,000 - \$1 Million	0.10%

Table 2 shows the transaction fees applied in the portfolios. The costs used in the portfolios are based on Coinbase’s pricing tiers (Reiff, 2022). The fees are dependent on a budget of the model.

**Table 3:** Portfolio Details

Portfolio code	RL/RRF	Budget	Transaction fee	Equally likely or SP/A
<i>SF</i>	0.03	10,000	0.35%	Equally Likely
<i>MV</i>	0.5	100,000	0.10%	SP/A Theory

The evaluation compares eleven cryptocurrency portfolios, as shown in Table 3. The parameters examined were Loss Tolerance ( $R_L$ ), Return and Risk Factor modulator ( $RRF$ ), Budget, Transaction Fees, and Equally Likely scenarios or SP/A Theory. While multiple portfolios were tested, only the best *SF* and *MV* portfolios were presented in the study.

There were instances where the optimal solutions for some problems had an iteration time of more than 2 hours. The solution was to set a time limit as a stopping criterion. Puschner & Koza (1989) used loops that are bounded by a time limit to make the computation of the maximum execution time possible. Lin (2007) identified that some iterations have an infinite or close to an infinite loop, which must be interrupted by users using a time or iteration limit. Jones et al. (1993) also used an iteration limit in their optimization model. The study utilizes the 1000 seconds time limit constraint of Lin (2007) to make the solutions for all optimization problems calculable.



## 4.2 Portfolio Performance

**Table 4:** Descriptive Statistics of *SF*, *MV*, and Benchmark for the test period 2020 to 2021

	<b>Bench</b>	<b><i>SF</i></b>	<b><i>MV</i></b>	<b>Superior</b>
Mean Return	0.0009	0.0051	0.0066	<b><i>MV</i></b>
St. Dev	0.0165	0.1085	0.0825	<b>Bench</b>
Max Return	0.0938	2.0161	0.6952	<b><i>SF</i></b>
Min Return	-0.1198	-0.3053	-0.374	<b>Bench</b>
% with Positive return	0.5706	0.4575	0.4881	<b>Bench</b>
% with Negative return	0.4294	0.5425	0.5119	<b>Bench</b>
Cumulative return	0.4302	1.1808	10.2373	<b><i>MV</i></b>
Max Cumulative return	0.4585	13.7945	29.266	<b><i>MV</i></b>
Min Cumulative return	-0.3075	-0.7436	-0.2697	<b><i>MV</i></b>
% with Positive cumulative return	0.7866	0.8647	0.9596	<b><i>MV</i></b>
% with Negative cumulative return	0.2134	0.1353	0.0404	<b><i>MV</i></b>
Total				<b><i>MV</i>: 6/11</b>

Table 4 shows the descriptive statistics of the dominant portfolios for the years 2020 and 2021. If the values of mean return, max return, min return, % with positive return, cumulative return, max cumulative return, min cumulative return, and % with positive cumulative return have a higher value, it is chosen as the superior portfolio. In contrast, if standard deviation, % with a negative return, and % with negative cumulative return have lower value, it is chosen as the superior portfolio. *MV* outperformed the portfolios in 6 out of 11 criteria. *SF* had a cumulative return of 118.08%, and *MV* had a cumulative return of 1024.73%, while the benchmark only had a cumulative return of 43.02%.

Table 5 shows the T-test results of the portfolios for the test period form 2020 to 2021. *SF* and *MV* were compared using paired T-test while comparison with benchmark utilized 2 sample t-test. From the P-values, the average return of *MV* is greater than the average return of *SF*, while the average return of *MV* is greater than the average return of the benchmark.

**Table 5:** T-test results of *SF*, *MV*, and benchmark for the test period 2020 to 2021

	<i>SF</i>	<i>MV</i>	Bench
<i>SF</i>	-	0.999	0.149
<i>MV</i>	0.001	-	0.035
Bench	0.851	0.965	-

The results suggest that *SF* with a cumulative return of 118% under Equally Likely weights,  $R_L = 0.03$  and budget = 10,000 was profitable along with *MV* with a cumulative return of 1023% under SP/A theory,  $RRF = 0.5$ , budget = 100, 000. *SF* and *MV* outperformed the Benchmark S&P500 market index in terms of descriptive statistics. The paired t-test and 2-sample t-test of the p-value against the benchmark was also significant. The results support the superiority of the chosen portfolios. Therefore, the portfolios generated could be viable investment alternatives for investors looking to build a portfolio in cryptocurrency markets.

## 5 Conclusions

The study designed and recommended a portfolio selection framework that can outperform traditional investment benchmarks in the cryptocurrency market by utilizing technical analysis indicators to choose the investment pool. The study considered the top 169 cryptocurrencies in Yahoo Finance with a market cap of at least \$100M. The technical analysis indicators used are Simple Moving Average (*SMA*), Moving Average Convergence Divergence (*MACD*), Relative Strength Index (*RSI*), and On-Balance-Volume (*OBV*). Historical returns were used for return estimation. Equally likely weights and SP/A theory were used for the assignment of weights. The Mean-variance and Safety-First models were used for the portfolio selection. Lastly, expected return, standard deviation, paired t-test, and 2-sample t-test were utilized for portfolio performance evaluation.

The results suggest that *SF* with a cumulative return of 118% under Equally Likely weights,  $R_L = 0.03$  and budget = 10,000 was profitable along with *MV* with a cumulative return of 1023% under SP/A theory,  $RRF = 0.5$ , budget = 100, 000. While Chang et al. (2015) and Erfe et al. (2021) used a loss tolerance ( $R_L$ ) of  $-5\%$ , the study saw effectiveness in a  $R_L$  of  $-3\%$ . *SF* and *MV* outperformed the Benchmark S&P500 market index in terms of descriptive statistics. The paired t-test and 2-sample t-test of the p-value against the benchmark was also significant. Therefore, the portfolios generated could be viable investment alternatives for investors looking to build a portfolio in cryptocurrency markets.

Investors who believe in the effectiveness of technical analysis indicators in the cryptocurrency market can use the study to create their portfolio because the suggested portfolio selection techniques in choosing the investment pool outperformed traditional benchmarks. The study may contribute to future research on cryptocurrency portfolio selection by using technical analysis indicators in selecting an investment pool. As of 2022, more than 19,000 cryptocurrencies exist (Kharpal, 2022). Only 169 cryptocurrencies were considered in the study. Future research could consider more cryptocurrencies, especially undervalued currencies. Future research could also utilize more technical analysis indicators besides those used in the study. Determining how to quantify a technical analysis indicator into creating criteria is one of the challenges faced in the study.

### References:

- Abboud, H. (2017) Blockframe Charting-For Crypto Technical Analysis, *SSRN papers*, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3064115](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3064115) (December, 2022).
- Alexandros, N. (2021) Cryptocurrency analysis: Benefits, dangers and price prediction using neural networks, *Romanian Journal of Economics*, 52(1 (61)), pp. 5-17.
- Alonso-Monsalve, S., Suárez-Cetrulo, A. L., Cervantes, A. & Quintana, D. (2020) Convolution on neural networks for high-frequency trend prediction of cryptocurrency exchange rates using technical indicators, *Expert Systems with Applications*, 149, <https://doi.org/10.1016/j.eswa.2020.113250>.
- Anghel, D. G. (2021) A reality check on trading rule performance in the cryptocurrency market: Machine learning vs. technical analysis, *Finance Research Letters*, 39(C).
- Arias-Oliva, M., Pelegrín-Borondo, J. & Matías-Clavero, G. (2019) Variables influencing cryptocurrency use: a technology acceptance model in Spain, *Frontiers in Psychology*, 10, p. 475, <https://doi.org/10.3389/fpsyg.2019.00475>.
- Awheda, M. D. & Schwartz, H. M. (2013) Exponential moving average Q-learning algorithm, *2013 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning (ADPRL)*, (IEEE), pp. 31-38.
- Baisa, B., Buljat, B., Babić, A., Čapko, Z., Gaspari, F., Hruza, F., Volčik, S., Jaňurová, M., Chaloupková, M., Kaščelan, L., Filipović, A.L., Burić, M.N., Kaščelan, V., Makýšová, L., Maravić, D., Pezo, H., Samaržija, L., Pivar, J., Rikalović, G., Josipović, S., Molnar, D., Rossa, S., Rozmarinová, J., Stojanović, D., Simeunović, B., Tomašević, I., Jovanović, I., Šlogar, H., Bezić, H., Azoia, A.D., Bação, P., Duarte, A.P., Hodžić, S., Alibegović, D.J., Bečić, E., Buterin, D., Janković, S., Klaus, S., Vašiček, D., Juričić, D., Marenjak, S. & Marciniak, R. (2020) *Smart governments, regions and cities* (Rijeka, Croatia: University of Rijeka, Faculty of Economics and Business).
- Bashkeeva, M. (2021) *Crypto portfolio versus FAANG investment portfolio* (Jyväskylä, Finland: JAMK University of Applied Sciences).
- Brock, W., Lakonishok, J. & LeBaron, B. (1992) Simple technical trading rules and the stochastic properties of stock returns, *The Journal of Finance*, 47(5), pp. 1731–1764.
- C. Erfe, J. J., H. Magsombol, J. F. & Nayat Young, M. (2021) Portfolio Selection of Semiconductor companies in the NASDAQ Market during COVID19 PANDEMIC, *2021 The 2nd International Conference on Industrial Engineering and Industrial Management*, pp. 1-7.

- Caferra, R. (2020) Good vibes only: The crypto-optimistic behavior, *Journal of Behavioral and Experimental Finance*, 28(C).
- Cai, Z., Ravichandran, A., Maji, S., Fowlkes, C., Tu, Z. & Soatto, S. (2021) Exponential Moving Average Normalization for Self-supervised and Semi-supervised Learning, *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 194-203.
- Chang, K. H., Young, M. N., Hildawa, M. I., Santos, I. J. R. & Pan, C. H. (2015) Portfolio selection problem considering behavioral stocks, *Proceedings of the World Congress on Engineering*, 2, pp. 1-3.
- Chang, K. H. & Young, M. N. (2019) Behavioral stock portfolio optimization considering holding periods of B-stocks with short-selling, *Computers & Operations Research*, 112(C), <https://doi.org/10.1016/j.cor.2019.104773>.
- Chang, K. H. & Young, M. N. (2019) Portfolios Optimizations of Behavioral Stocks with Perception Probability Weightings, *Annals of Economics & Finance*, 20(2), pp. 817-845.
- Chang, K. H., Young, M. N. & Diaz, J. F. T. (2018) Portfolio Optimization Utilizing the Framework of Behavioral Portfolio Theory, *International Journal of Operations Research*, 15(1), pp. 1-13.
- Chatterjee, G., Edla, D. R. & Kuppili, V. (2020) Cryptocurrency: a comprehensive analysis, In: Zhang, Y., Mandal, J.K., So-In, C. & Thakur, N. (eds.) *Smart Trends in Computing and Communications* (Singapore: Springer), pp. 365-374.
- Chen, C. H., Su, X. Q. & Lin, J. B. (2016) The role of information uncertainty in movingaverage technical analysis: A study of individual stock-option issuance in Taiwan, *Finance Research Letters*, 18(C), pp. 263-272.
- Chuen, D. L. K., Guo, L. & Wang, Y. (2017) Cryptocurrency: A new investment opportunity?, *The Journal of Alternative Investments*, 20(3), pp. 16-40.
- Corbet, S., Eraslan, V., Lucey, B. & Sensoy, A. (2019) The effectiveness of technical trading rules in cryptocurrency markets, *Finance Research Letters*, 31, pp. 32-37.
- Costanza, N. (2018) *Cryptocurrency: The Argument for its Allocation Within the Traditional Investor's Portfolio* (Fayetteville, Arkansas: University of Arkansas, Fayetteville).
- Ding, Y. & Liu, H. (2011) Optimal portfolio of liability and risky assets under safety-first rule, *2011 Fourth International Conference on Business Intelligence and Financial Engineering*, (IEEE), pp. 328-332.
- Fang, F., Ventre, C., Basios, M., Kanthan, L., Martinez-Rego, D., Wu, F. & Li, L. (2020) Cryptocurrency trading: a comprehensive survey, *arXiv preprint arXiv*, 2003.11352.
- Fang, T., Su, Z. & Yin, L. (2020) Economic fundamentals or investor perceptions? The role of uncertainty in predicting long-term cryptocurrency volatility, *International Review of Financial Analysis*, 71(C).
- Fang, F., Ventre, C., Basios, M., Kanthan, L., Martinez-Rego, D., Wu, F. & Li, L. (2022) Cryptocurrency trading: a comprehensive survey, *Financial Innovation*, 8(1), pp. 1-59.
- Farell, R. (2015) *An analysis of the cryptocurrency industry* (Philadelphia, United States: University of Pennsylvania).
- Ferdiansyah, F., Othman, S. H., Radzi, R. Z. R. M., Stiawan, D., Sazaki, Y. & Ependi, U. (2019) A lstm-method for bitcoin price prediction: A case study yahoo finance stock market, *2019 International Conference on Electrical Engineering and Computer Science (ICECOS)*, (IEEE), pp. 206-210.
- Fousekis, P. & Tzaferi, D. (2021) Returns and volume: Frequency connectedness in cryptocurrency markets, *Economic Modelling*, 95(C), pp. 13-20.
- Gerritsen, D. F., Bouri, E., Ramezanifar, E. & Roubaud, D. (2020) The profitability of technical trading rules in the Bitcoin market, *Finance Research Letters*, 34(C).

- Grebenkov, D. S. & Serror, J. (2014) Following a trend with an exponential moving average: Analytical results for a Gaussian model, *Physica A: Statistical Mechanics and its Applications*, 394, pp. 288-303.
- Grobys, K., Ahmed, S. & Sapkota, N. (2020) Technical trading rules in the cryptocurrency market, *Finance Research Letters*, 32, <https://doi.org/10.1016/j.frl.2019.101396>.
- Han, Y., Yang, K. & Zhou, G. (2013) A new anomaly: The cross-sectional profitability of technical analysis, *Journal of Financial and Quantitative Analysis*, 48(5), pp. 1433-1461.
- Hanink, D. M. (1985) A mean-variance model of MNF location strategy, *Journal of International Business Studies*, 16(1), pp. 165-17.
- Hansun, S. (2013) A new approach of moving average method in time series analysis, *2013 conference on new media studies (CoNMedia)*, (IEEE), pp. 1-4.
- Hilmola, O. P. (2021) On prices of privacy coins and Bitcoin, *Journal of Risk and Financial Management*, 14(8), p. 361.
- Huang, J. Z., Huang, W. & Ni, J. (2019) Predicting Bitcoin returns using high-dimensional technical indicators, *The Journal of Finance and Data Science*, 5(3), pp. 140-155.
- Huang, J. & Zhou, W. (2019) Re 2 ema: regularized and reinitialized exponential moving average for target model update in object tracking, *Proceedings of the AAAI Conference on Artificial Intelligence*, 33(1), pp. 8457-8464.
- Hudson, R. & Urquhart, A. (2021) Technical trading and cryptocurrencies, *Annals of Operations Research*, 297(1), pp. 191-220.
- Hung, N. T. (2022) Asymmetric connectedness among S&P 500, crude oil, gold and Bitcoin, *Managerial Finance*, <https://doi.org/10.1108/MF-08-2021-0355>.
- Jones, D. R., Perttunen, C. D. & Stuckman, B. E. (1993) Lipschitzian optimization without the Lipschitz constant, *Journal of optimization Theory and Applications*, 79(1), pp. 157-181.
- Kamrat, S., Suesangiamsakul, N. & Marukatat, R. (2018) Technical analysis for cryptocurrency trading on mobile phones, *2018 3rd Technology Innovation Management and Engineering Science International Conference (TIMES-iCON)*, (IEEE), pp. 1-4.
- Kharpal, A. (2022) *Crypto firms say thousands of digital currencies will collapse, compare market to early dotcom days* (CNBC), available at: <https://www.cnbc.com/2022/06/03/crypto-firms-say-thousands-of-digital-currencies-will-collapse.htm> (July 19, 2022).
- Kim, J. M., Kim, S. T. & Kim, S. (2020) On the relationship of cryptocurrency price with us stock and gold price using copula models, *Mathematics*, 8(11), <https://doi.org/10.3390/math8111859>.
- Kristjanpoller, W. & Minutolo, M. C. (2018) A hybrid volatility forecasting framework integrating GARCH, artificial neural network, technical analysis, and principal components analysis, *Expert Systems with Applications*, 109(C), pp. 1-11.
- Kroll, Y., Levy, H. & Rapoport, A. (1988) Experimental tests of the mean-variance model for portfolio selection, *Organizational Behavior and Human Decision Processes*, 42(3), pp. 388-410.
- Lin, C. J. (2007) Projected gradient methods for nonnegative matrix factorization, *Neural computation*, 19(10), pp. 2756-2779.
- Liu, J. & Serletis, A. (2019) Volatility in the cryptocurrency market, *Open Economies Review*, 30(4), pp. 779-811.
- Lopes, L. L. & Oden, G. C. (1999) The role of aspiration level in risky choice: A comparison of cumulative prospect theory and SP/A theory, *Journal of mathematical psychology*, 43(2), pp. 286-313.
- Mazanec, J. (2021) Portfolio optimalization on digital currency market, *Journal of Risk and Financial Management*, 14(4), p. 160.
- Milutinović, M. (2018) Cryptocurrency, *Ekonomika, Journal for Economic Theory and Practice and Social Issues*, 64(1), pp. 105-122.

- Papailias, F. & Thomakos, D. D. (2015) An improved moving average technical trading rule, *Physica A: Statistical Mechanics and its Applications*, 428(C), 458-469.
- Phillips, R. C. & Gorse, D. (2018) Cryptocurrency price drivers: Wavelet coherence analysis revisited, *PloS one*, 13(4), <https://doi.org/10.1371/journal.pone.0195200>.
- Pineault, A. (2022) *Modeling the Impact of Adding Cryptocurrency in a Portfolio* (Durham, United States: University of New Hampshire).
- Puschner, P. & Koza, C. (1989) Calculating the maximum execution time of real-time programs, *Real-time systems*, 1(2), pp. 159-176.
- Puzryev, V. (2019) Deep convolutional autoencoder for cryptocurrency market analysis, *arXiv preprint arXiv*, 1910.12281.
- Rachev, S. T. (2001) Safety-first analysis and stable paretian approach to portfolio choice theory, *Mathematical and Computer Modelling*, 34(9-11), pp. 1037-1072.
- Reiff, N. (2022) How much are cryptocurrency exchange fees?, *Investopedia*, available at: <https://www.investopedia.com/tech/how-much-does-it-cost-buycryptocurrency-exchanges/> (May 3, 2022).
- Schatzmann, J. E. & Haslhofer, B. (2020) Bitcoin Trading is Irrational! An Analysis of the Disposition Effect in Bitcoin, *arXiv preprint arXiv*, 2010.12415.
- Shefrin, H. & Statman, M. (2000) Behavioral portfolio theory, *Journal of financial and quantitative analysis*, 35(2), pp. 127-151.
- Shukla, S. & Gupta, K. (2019) *Future of FinTech: Innovative Business Model for Financial Inclusion* (India: Book Bazooka Publication).
- Danylchuk, H., Kovtun, O., Kibalnyk, L. & Sysoiev, O. (2020) Monitoring and modelling of cryptocurrency trend resistance by recurrent and R/S-analysis, *E3S Web of Conferences*, 166, <https://doi.org/10.1051/e3sconf/202016613030>.
- Singpurwala, K. (2021) *Sentiment analysis trading indicators* [Bachelor's thesis] (University of Twente).
- Siswantoro, D., Handika, R. & Mita, A. F. (2020) The requirements of cryptocurrency for money, an Islamic view, *Heliyon*, 6(1), <https://doi.org/10.1016/j.heliyon.2020.e03235>.
- Tajiri, H. & Kumano, T. (2012) Input filtering of MPPT control by exponential moving average in photovoltaic system, *2012 IEEE International Conference on Power and Energy (PECon)*, (IEEE), pp. 372-377.
- Uras, N. & Ortu, M. (2021) Investigation of Blockchain Cryptocurrencies' Price Movements Through Deep Learning: A Comparative Analysis, *2021 IEEE International Conference on Software Analysis, Evolution and Reengineering (SANER)*, (IEEE), pp. 715-722.
- Van der Avoird, S. (2020) *Prediction and technical analysis of the Bitcoin crypto currency using machine learning* (Leiden, Netherlands: Leiden Institute of Advanced Computer Science (LIACS)).
- Vergura, S. (2020) Bollinger Bands Based on Exponential Moving Average for Statistical Monitoring of Multi-Array Photovoltaic Systems, *Energies*, 13(15), <https://doi.org/10.3390/en13153992>.
- Vo, A. D., Nguyen, Q. P. & Ock, C. Y. (2019) Sentiment Analysis of News for Effective Cryptocurrency Price Prediction, *International Journal of Knowledge Engineering*, 5(2), pp. 47-52.
- Wei, L. Y., Cheng, C. H. & Wu, H. H. (2014) A hybrid ANFIS based on n-period moving average model to forecast TAIEX stock, *Applied Soft Computing*, 19, pp. 86-92.
- Young, M. N. (2021) A safety-first portfolio selection framework: Estimating returns of exchange traded funds through regression analysis, *IOP Conference Series: Materials Science and Engineering*, 1072(1), (IOP Publishing).

- Young, M. N. & Chuahay, T. T. N. (2019) Mean-Variance Portfolio Selection Utilizing Exchange Traded Funds in Asia, *2019 IEEE 6th International Conference on Engineering Technologies and Applied Sciences (ICETAS)*, (IEEE), pp. 1-5.
- Young, M. N. Chuahay, T. T., & Diaz, J. F. (2019) *Portfolio Selection Utilizing Safety-First Optimization Model on Exchange Traded Funds in Asia* (Dubai, UAE: IEOM Society International).
- Young, M. N., Chuahay, T. T. N. & Diaz, J. F. T. (2020) Comparative Analysis of Mean-Variance and Safety-First Portfolio Utilizing Exchange Traded Funds in Asia, *2020 IEEE 7th International Conference on Industrial Engineering and Applications (ICIEA)*, (IEEE), pp. 1019-1024.
- Yousaf, I. & Ali, S. (2021) Linkages between stock and cryptocurrency markets during the COVID-19 outbreak: An intraday analysis, *The Singapore Economic Review*, pp. 1-20, <https://doi.org/10.1142/S0217590821470019>.
- Zeng, H. & Ahmed, A. D. (2022) Market integration and volatility spillover across major East Asian stock and Bitcoin markets: an empirical assessment, *International Journal of Managerial Finance*, (ahead-of-print).





## Writing Misdemeanor and Criminal Charges in Audit: Evidence from Serbia

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**Abstract** State Audit Institution of Serbia is obliged to submit a request for initiation of misdemeanor proceedings, and submit a criminal complaint to the competent authority, if during the audit process it discovers materially significant actions that indicate the existence of elements of a misdemeanor or a criminal act. Relying on that, the subject of the paper is to analyze the views of Serbian accountant and auditors about writing misdemeanor and criminal charges in public sector audits. An analysis of the results was carried out using the SPSS 28 software package. Descriptive statistics have been used in order to analyze the characteristics of the sample. The Mann-Whitney U test was conducted in order to compare two independent groups in regards to an observed scale variable. The p value is used to indicate if the differences between two particular A groups that were in this research are statistically significant (where  $p < 0.05$  is considered statistically significant at the 95% confidence level).

**Keywords:** • audit • auditors • charges • court • irregularity

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## 1 Introduction

In Article 41 of the Law on the State Audit Institution of Serbia, it is defined that the Institution is obliged to submit without delay a request for initiation of misdemeanor proceedings, and submit a criminal complaint to the competent authority, if during the audit process it discovers materially significant actions that indicate the existence of elements of a misdemeanor or a criminal act. This suggests that the employees of the State Audit Institution have an obligation to collect documentation and write reports for irregularities and violations that they find during the audit engagement. However, most of the employees of the State Audit Institution are trained economists who may not have sufficient qualifications to write accurate and clear charges that would ensure that the court process does not end with the rejection. If the general state auditor concludes that the evidence from audit reports indicates a suspicion that a misdemeanor or a criminal charge has been committed by the subject of the audit, he is obliged to submit a request for the initiation of misdemeanor proceedings, a criminal complaint, to the competent authority without delay. The supreme state auditor is obliged to inform the general state auditor about cases where the action of the entity who is the subject of audit, has caused damage to state property, about which he also informs the public advocate.

At the same time, Article 36 defines that if sufficient evidence has been obtained through the audit of the response report to express the opinion that the response report is not credible, the general state auditor files a report against the responsible person of the subject of the audit due to the suspicion that he has committed a criminal offense by confirming the response report. The request for the initiation of misdemeanor proceedings must contain all the information required in connection with its initiation in the Law on Misdemeanors, because otherwise it cannot be determined whether there are conditions for the initiation of misdemeanor proceedings. This means that the request for initiation of misdemeanor proceedings must necessarily contain the place, time, and manner of the act for which the applicant charges the defendant.

Difficulties in misdemeanor proceedings are represented by insufficient data on the defendant, whether the defendant is a legal entity, a responsible person in a legal entity or a natural person, as well as an entrepreneur (Spasenić, et al., 2019). The seriousness of this problem is particularly pronounced in the case of legal entities, due to the numerous changes that occur due to mergers, separations, or changes in legal subjectivity on any other basis and given that the offense was committed at a time when the perpetrator was working or was obliged to work, regardless of when the consequence occurred. When the request for initiation of misdemeanor proceedings contains everything necessary, that is, when it is comprehensible, orderly, contains all the necessary data and is submitted in a sufficient number of copies, only then does the first-instance judge assess whether the conditions for initiating misdemeanor proceedings have been met. Since the statute of limitations is (absolute) two years from the date of the offense committed, the request for initiation of misdemeanor proceedings should be submitted as soon as possible after the

offense has been committed, so that the first-instance judge can assess whether the conditions for initiation of proceedings have been met and possibly, in this sense, intervene with the applicant requests that the request be supplemented, and after that supplement be made a conclusion on the initiation of the procedure, because a conclusion made after one year from the commission of the misdemeanor does not mean anything, since the statute of limitations for the initiation of the misdemeanor procedure has expired. The subject of the paper is to analyze the views of persons engaged in accounting and auditing in the Republic of Serbia on the writing of criminal and misdemeanor charges in public sector audits. An analysis of the results was carried out using the SPSS 28 software package. Descriptive statistics have been used in order to analyze the characteristics of the sample. The Mann-Whitney U test was conducted in order to compare two independent groups in regards to an observed scale variable. The p value is used to indicate if the differences between two particular A groups that were in this research are statistically significant (where  $p < 0.05$  is considered statistically significant at the 95% confidence level).

## **2 Literature overview**

The authors (Flasher, et al., 2022) looked at how auditors in the public sector use the available powers, with the intention of examining the relationship behind the judicial authorities and to provide an answer to the question of what the role of the auditor in the system of financial reporting and fraud investigation in the public sector is. They claim that significantly better results are achieved when state auditors are competent both to conduct audits of financial statements and to investigate fraud. The author (Krom, 2016) investigated the measures that were taken against certified accountants from the territory of America. He established that more than half of the initiated procedures were completed with the determination of measures and that they were predominantly of a non-monetary nature. It is essentially an activity that should be within the competence of the court for accounting and auditing.

For the job of writing irregular financial reports, political neutrality can be important as a quality that can ensure the independence of the person writing the reports (Jakovljević, 2022). The author (Jakovljević, 2021) believes that auditors must maintain their neutrality towards political influence to perform their audit activities impartially. It is essential that the persons engaged in auditing work should be politically neutral to be able to find irregularities in the financial statements and business operations of the entities that are the subject of audit engagement, and so that the reports written on the basis of their reports are appropriate for the effective implementation of the judicial process.

### 3 Research

The research was conducted by creating a short questionnaire about examining persons engaged in accounting and auditing in the Republic of Serbia on the writing of criminal and misdemeanor reports in public sector auditing. The questionnaire was sent to the addresses of more than 200 randomly selected respondents in the Republic of Serbia, and instructions for filling out the questionnaire were also sent with it. The questionnaire was available for filling during the second week of November 2022. A total of 114 complete responses were received, which were assessed as sufficient and relevant for further analysis. The answers were analyzed using the graphic method and through the textual description and graphs are presented in the continuation of the paper.

The targeted groups of respondents were economists and lawyers engaged in audit work or work related to audit, such as managers, consultants, commercial judges and prosecutors, lawyers and others. A total of 20 statements were created in the form of a questionnaire with answers in the form of a five-point scale and distributed to respondents via social networks. The first 6 questions related to the collection of information on the structure of respondents based on data on gender, age and work experience. Statements are provided below.

**Table 1:** Statements for the research

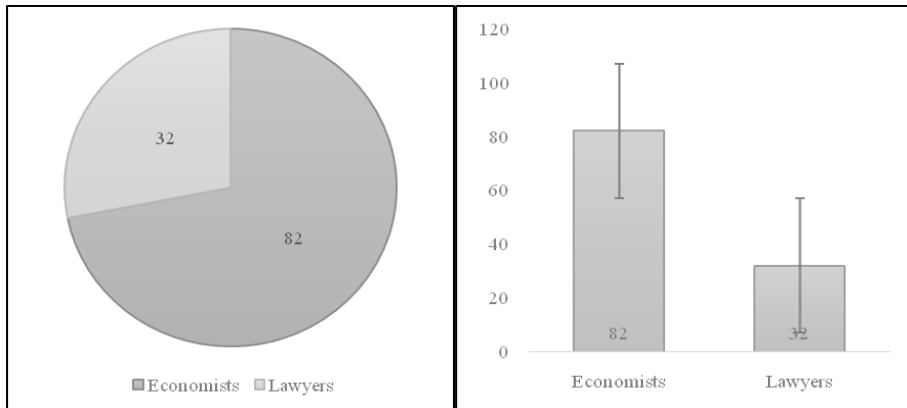
no.	statement text
7	I believe that counterfeiters are rapidly changing their lifestyles in terms of consumption - wardrobe, travel, cars, real estate...
8	I believe that counterfeiters rarely take vacations.
9	I believe that fraud occurs most often in the sphere of accounting.
10	I believe that most frauds are committed by lawyers.
11	I believe that accountants and internal auditors have great success in detecting and preventing fraudulent activities.
12	I believe that forensic auditors have great success in detecting fraudulent activities.
13	I believe that lawyers do not have enough prior knowledge in the areas of accounting, financial reporting and auditing.
14	I believe that criminal charges should be filed with the competent authority, if materially significant actions are discovered during the audit process that indicate the existence of elements of a misdemeanor or a criminal act.
15	Criminal and misdemeanor charges should be filed by state auditors (as economists by education), because they are instructed in the business of the entity that committed the misdemeanor or criminal offense?
16	Criminal and misdemeanor charges should be filed by lawyers employed by the prosecution, because they know the law and have experience in filing charges and conducting misdemeanor proceedings.
17	State auditors (as economists by education) are not competent to file criminal and misdemeanor charges because they have no knowledge in the field of law, nor experience in filing charges and conducting misdemeanor proceedings.

18	I believe that the penalties for misdemeanors in keeping business books should be toughened, especially for the management that is responsible for the company's operations.
19	I believe that an audit court should be established with the prosecutor's office, which would be responsible for initiating and conducting misdemeanor and criminal proceedings based on misdemeanors and criminal offenses discovered in the audit process.
20	I believe that an audit court should be established with the prosecutor's office, which would be responsible for initiating and conducting misdemeanor and criminal proceedings based on misdemeanors and criminal offenses discovered in the audit process.

Source: Authors.

The questionnaire does not collect confidential information about respondents. The estimated time for filling out the questionnaire is 2 minutes. The questionnaire consists of 20 short questions. We believe that by participating in this research, the respondents made a significant contribution to the scientific research activity in the Republic of Serbia. The research results do not meet the assumptions of normal distribution. We used tests that do not make assumptions about the distribution of the population, i.e. non-parametric tests, among which we especially singled out the Mann-Whitney test. Nonparametric tests are less sensitive to extreme values than parametric tests and generally have less power than parametric tests when the assumptions of parametric tests are met.

**Figure 1:** Ratio between Economists and Lawyers



Source: Authors.

The initial hypothesis is that both groups of respondents, economists and lawyers, have a high degree of agreement with the statements. An alternative hypothesis is that both groups of respondents, economists and lawyers, do not have a high degree of agreement with the statements, that is, that there are differences in the degree of agreement between economists and lawyers for certain statements. The average scores for each question and group are given in next table.

**Table 2:** Report 1

<b>Report</b>																
type/question(statement)	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
Economists	Mean	2.49	3.46	3.34	3.26	2.67	2.44	2.00	2.01	2.89	2.55	2.73	2.73	2.66	2.54	
	Std. Dev.	1.2	1.3	1.2	1.2	1.3	1.2	1.2	1.3	1.2	1.3	1.3	1.4	1.5		
Lawyers	Mean	3.41	4.11	3.44	3.81	3.63	3.48	3.44	3.07	3.52	1.78	1.85	1.67	1.56	1.56	
	Std. Dev.	1.1	0.8	1.0	1.0	0.9	1.1	1.1	1.4	1.1	1.3	1.3	1.2	1.2	1.2	

Source: Authors.

Since the data isn't normally distributed, we used Mann-Whitney test in order to compare differences in the level of agreement (for each individual statement) between economists and lawyers.

Regarding statement number 7, which reads, I believe that people who engage in counterfeiting quickly change their lifestyle in terms of consumption (wardrobe, travel, cars, real estate), a clear difference between the views of economists and lawyers is noticeable. At a significance level of 0.001, the Mann Whitney test showed that there is a statistically significant difference in the answers to question number 7, that is, that economists showed a higher degree of agreement with statement number 7 compared to lawyers. A similar difference between the attitudes occurs in questions number 8 ( $p=0,027$ ), 10 ( $p=0,033$ ), 11 ( $p=0,001$ ), 12 ( $p=0,000$ ), 13 ( $p=0,000$ ), 14 ( $p=0,001$ ) and 15 ( $p=0,029$ ). In statement number 9, the difference in respondents' answers is not statistically significant.

On the other hand, in statement number 16, which reads that criminal and misdemeanor charges should be filed by lawyers employed in the prosecution, because they know the law and have experience in filing charges and conducting misdemeanor proceedings, there is also a clear difference between the views of economists and lawyers, but in the other direction. Namely, at the significance level of 0.002, the Mann Whitney test showed that there is a statistically significant difference in the answers to question number 16, that is, that economists showed a lower degree of agreement with statement number 16 compared to lawyers. A similar difference between the views appears in questions number 17 ( $p=0,002$ ) and 18 ( $p=0,000$ ). However, there is a particularly interesting phenomenon in the answers to statements number 19 ( $p=0,000$ ) and 20 ( $p=0,001$ ), which directly refer to the question of the need to establish an audit court in the Republic of Serbia. Although the structure of the answers shows a significant degree of agreement with the statement among this group of respondents, the Mann-Whitney test showed that there is a statistically significant difference in the answers, i.e. that economists showed a lower degree of agreement with statements number 19 and 20 in relation to lawyers.

The grouping of questions into two categories, namely the first group called general attitudes from forensics consists of questions with serial numbers from 7 to 13, and the

second group called competence of the auditor and the audit court consists of questions with serial numbers from 14 to 20. Average values were created for both defined categories by age groups are given below.

**Table 3:** Report 2

Report		Group I	Group II
< 35	Mean	20.26	14.8947
	Std. Deviation	5.506	5.61639
< 45	Mean	20.00	18.3721
	Std. Deviation	3.395	5.39410
< 55	Mean	21.75	17.5000
	Std. Deviation	4.637	5.65685
< 65	Mean	22.81	16.6875
	Std. Deviation	3.710	5.86195

Source: Authors.

Differences by categories that are statistically significant are among respondents aged 35 to 45 for the group of questions called the competence of auditors and the audit court ( $p=0.005$ ) in favor of economists who agree more with the examined statements compared to lawyers and for a group of questions called general attitudes from forensics ( $p=0.006$ ) in favor of economists who agree more with the examined statements than lawyers.

**Table 4:** Report 3

Report															
		7	8	9	10	11	12	13	14	15	16	17	18	19	20
<	Mean	2.68	3.42	3.05	3.05	2.95	2.89	2.21	1.89	2.53	2.00	2.58	2.00	1.89	2.00
35	Std. Dev.	1.204	1.170	1.177	1.129	1.433	1.449	1.398	1.487	1.307	1.106	1.502	1.202	1.197	1.247
<	Mean	2.37	3.56	3.33	3.47	2.65	2.40	2.23	2.14	2.86	2.72	2.98	2.86	2.44	2.37
45	Std. Dev.	1.176	1.402	1.286	1.202	1.251	1.237	1.250	1.390	1.302	1.278	1.282	1.338	1.385	1.363
<	Mean	2.79	4.08	3.58	3.54	2.79	2.62	2.33	2.46	3.00	2.37	2.21	2.46	2.67	2.33
55	Std. Dev.	1.351	1.100	1.139	1.179	1.351	1.245	1.551	1.414	1.383	1.209	1.351	1.351	1.523	1.633
<	Mean	3.19	3.31	3.69	3.50	3.25	3.00	2.88	2.37	3.75	1.87	2.12	2.00	2.25	2.31
65	Std. Dev.	1.424	1.138	1.078	1.366	1.291	1.155	1.310	1.544	1.238	1.586	1.360	1.414	1.693	1.815

Source: Authors.

Statistically significant differences in questions 7 out of 20 by category are as follows. For questions 16 and 18 for groups of respondents up to 35 and up to 45 years old, for question 8 for groups of respondents up to 35 and up to 55 years old, for question 15 for groups of respondents up to 35 and up to 65 years old, for question 17, for groups of respondents up to 45 and up to 55 years old, for questions 7, 15, 16, 17 and 18, for groups

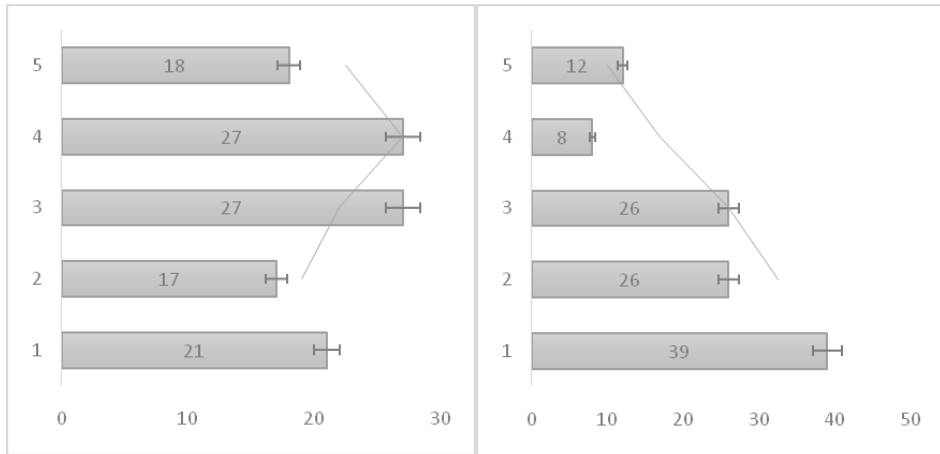
of respondents up to 45 and up to 65 years old and for question 8 for groups of respondents up to 55 and up to 65 years old. Ovaj pasus je OK, ne znam samo da li da im navodimo i detalje...

#### **4 Discussion**

The State Audit Institution of Serbia is obliged to submit a request for initiation of misdemeanor proceedings, and a criminal complaint to the competent authority if, during the audit process, it discovers materially significant actions that indicate the existence of elements of a misdemeanor or criminal offense. Relying on this, the subject of the research is to analyze the attitudes of accountants and auditors in the Republic of Serbia on the writing of misdemeanor and criminal charges in public sector audits. There is a noticeable trend of a sharp decline in the number of reports submitted in the last four years, and the structure of submitted reports is dominated by misdemeanor reports, while there are almost no criminal reports. Some experts express concern because the current situation is such that reports are approached by state auditors who are predominantly economists by education and do not know the law. 47.7% of respondents responded to statement number 14, which reads "I believe that criminal charges should be filed with the competent authority, if materially significant actions are discovered during the audit process that indicate the existence of elements of a misdemeanor or a criminal act" with I agree at all, 15.3% of respondents answered with I agree, 12.6% of respondents answered with I'm not sure, 12.6% of respondents answered with I do not agree and the remaining 11.7% of respondents responded with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement. This means that the respondents largely believe that reports should be submitted for irregularities determined by the audit.

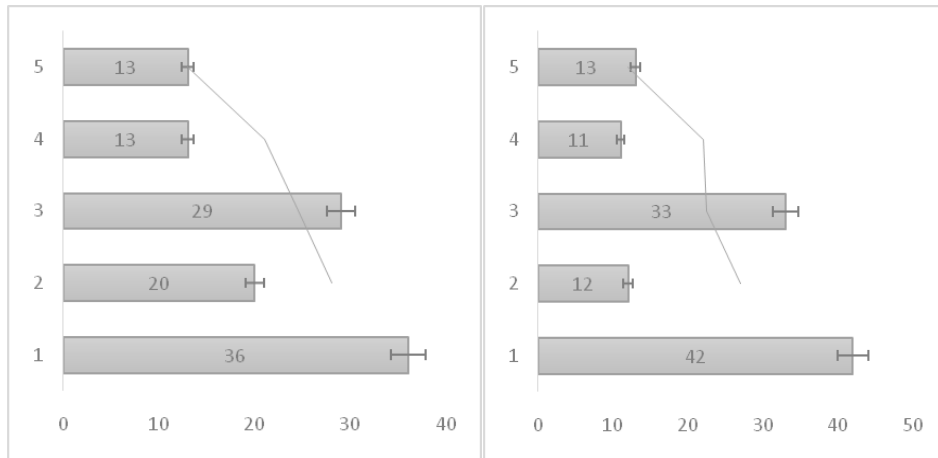


**Figure 2:** Answers on the 15th and 16th questions



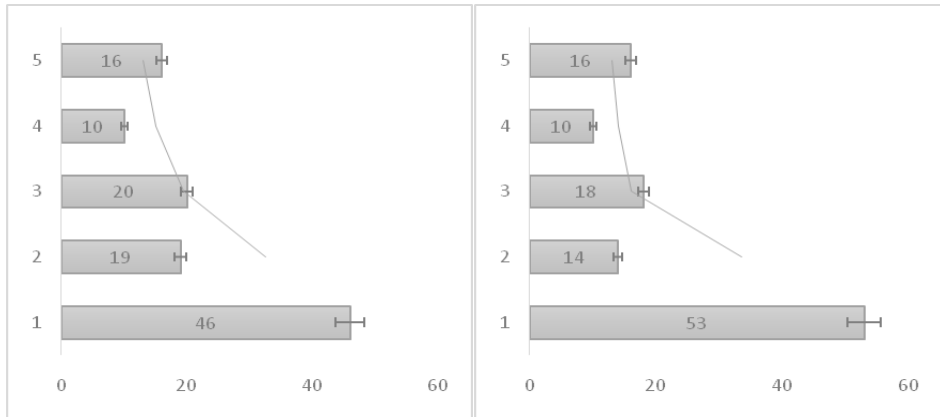
Source: Authors.

To statement number 15, which reads Criminal and misdemeanor charges should be filed by state auditors (as economists by education), because they are instructed in the business of the entity that committed the misdemeanor or criminal offense, 19.1% of respondents answered with I agree at all, 15.5% of respondents answered with I agree, 24.5% of respondents answered with I'm not sure, 24.5% of respondents answered with I do not agree and the remaining 16.4% of respondents answered with I do not agree at all. Such results show that there is a significant degree of disagreement among respondents with this statement. The majority of respondents believe that state auditors, as economists, should not file reports, which is followed by the answers to the next question number 16, which reads Criminal and misdemeanor charges should be filed by lawyers employed by the prosecution, because they know the law and have experience in filing charges and conducting misdemeanor proceedings, 35.1% of respondents answered with I agree at all, 23.4% of respondents answered with I agree, 23.4% of respondents answered with I'm not sure, 7.2 % of respondents answered with I do not agree and the remaining 10.8% of respondents answered with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement. Respondents believe that applications should not be written by economists but by lawyers.

**Figure 3:** Answers on the 17<sup>th</sup> and 18<sup>th</sup> questions

Source: Authors.

On statement number 17, which reads State auditors (as economists by education) are not competent to file criminal and misdemeanor charges because they have no knowledge in the field of law, nor experience in filing charges and conducting misdemeanor proceedings, 32.4% of respondents answered with I agree at all, 18% of respondents answered with I agree, 26.1% of respondents answered with I'm not sure, 11.7% of respondents answered with I do not agree and the remaining 11.7% of respondents responded with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement. To statement number 18, which reads I believe that the penalties for misdemeanors in keeping business books should be toughened, especially for the management that is responsible for the company's operations, 37.8% of respondents answered with I agree at all, 10.8% respondents answered with I agree, 29.7% of respondents answered with I'm not sure, 9.9% of respondents answered with I do not agree and the remaining 11.7% of respondents answered with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement.

**Figure 4:** Answers on the 19<sup>th</sup> and 20<sup>th</sup> questions

Source: Authors.

On statement number 19, which reads I believe that an audit court should be established with the prosecutor's office, which would be responsible for initiating and conducting misdemeanor and criminal proceedings based on misdemeanors and criminal offenses discovered in the audit process, 41.4% of respondents answered with I agree at all, 17.1% of respondents answered with I agree, 18% of respondents answered with I'm not sure, 9% of respondents answered with I do not agree and the remaining 14.4% of respondents answered with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement. On statement number 20, which reads I believe that an audit court should be established with the prosecutor's office, which would be responsible for initiating and conducting misdemeanor and criminal proceedings based on misdemeanors and criminal offenses discovered in the audit process, 47.7% of respondents answered with I agree at all, 12.6% of respondents answered with I agree, 16.2% of respondents answered with I'm not sure, 9% of respondents answered with I do not agree and the remaining 14.4% of respondents responded with I do not agree at all. Such results show that there is a significant degree of agreement among respondents with this statement.

The results of the research show that the conditions to confirm the initial hypothesis have not been met, and therefore we adopt its alternative hypothesis, which is that both groups of respondents, economists and lawyers, do not have a high degree of agreement with the statements, that is, with certain statements, there are differences in the degree of agreement between economists and lawyers, which was confirmed by applying the Mann-Whitney test.

The irrefutable statement is that respondents, as many as 98% of them, believe that it is necessary to write charges for violations and irregularities that the state audit institution

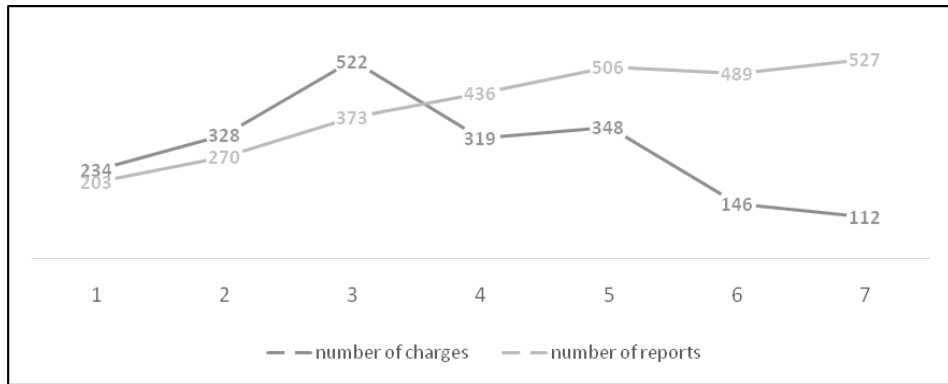
finds during the audit. This is an extremely high number of agreements, and it directly shows the huge expectations that respondents place on the State Audit Institution as an independent state organization that should act for the benefit of all citizens of the Republic of Serbia. The respondents therefore expect the State Audit Institution to employ qualified and professional persons with high ethical awareness and moral responsibility so that they can adequately audit the spending of public funds. Many respondents believe that economists should not write charges, but lawyers should, and that charges should not be written by the State Audit Institution of Serbia but should by the General Audit Court of Serbia. This point of view is significantly different from the current situation in the Republic of Serbia, which, unlike many other countries, does not have an Audit or Accounting Court, and charges were written by the State Audit Institution, where most employees are economic professionals. It is not surprising that the answers show that a significant part of the respondents, as many as 67% of them, believe that state auditors, as trained economists, are very unqualified or unqualified to write good charges. The presented results point to the existence of an extremely strong need to implement positive reforms in the state audit system in the Republic of Serbia, which would include the creation of the Audit or Accounting Court with the prosecution as the highest state authority for writing charges and conducting and resolving court disputes based on irregularities that state auditors determine during conducting audit engagements, which could, among other things, also carry out the certification of state auditors and private sector auditors according to the highest standards of internationally accepted practice, the notification of other diplomas and certificates, as well as publishing professional journals and realizing professional gatherings and professional seminars for a wider circle of professionals practitioners in the field of accounting, auditing and finance.

## 5 Conclusions

The representativeness of the sample, overly optimistic answers or answers that do not fully reflect the real attitudes of the respondents can be mentioned as potential key shortcomings of the research. Due to all the above, it is necessary to take the presented data with a great deal of caution when interpreting them and when using them officially. After the auditors send a request to initiate misdemeanor proceedings, the misdemeanor court can reject the request to initiate misdemeanor proceedings or pass a decision on the initiation of misdemeanor proceedings. If the misdemeanor court decides on the initiation of misdemeanor proceedings, it informs about the date for holding the hearing at which evidence, written or oral, will be presented. Thus, the auditors who wrote the applications must attend the hearing, and this may be a time when they are in the field in another city, conducting another audit engagement, and preparation for appearing in court may require additional time and exclusion from one audit engagement to returned to looking through the documents they had prepared for the application. The defendant will also be heard at the hearing. The misdemeanor court can suggest to the defendant that he can give his defense in writing, and after all the evidence has been presented, the misdemeanor court decides in the form of a verdict or decision. The court renders a verdict when it declares

the defendant guilty or when it acquits the defendant. The misdemeanor court decides in cases where there are legal reasons for suspending misdemeanor proceedings. When misdemeanor liability is established in misdemeanor proceedings, misdemeanor sanctions prescribed by the Law on Misdemeanors will be applied to the offender.

Analyzing the general reports of the State Audit Institution, the number of published reports and charges by type in the period from 2015 to 2021, it concludes that although the total number of reports increased significantly in the analyzed period, it was largely sampled by the reduction of combined audits, which were divided into financial statements audits and regularity audits, the number of which increased, which means that there is practically no substantial increase, while at the same time questionable qualitative determination of the very character of individual reports. However, the number of reports has significantly decreased during the analyzed period, especially the number of criminal reports, which may indicate a wrong selection of entities that are subject to audit, avoidance of important state authorities and circumvention of problems that are noticed, so that reports are not written, which may protect them some public officials, and perhaps audit employees, avoid writing applications due to lack of expertise. At the same time, it was noted, which can be clearly seen in the graph below, that the year 2018 is a turning point in the relationship between the total number of reports and the total number of applications. Before 2018, the total number of charges was greater than the total number of reports, and since 2018, the total number of charges is less than the total number of reports, and year after year that gap is getting bigger and bigger. Thus, a simple question arises: what happened negatively in 2018 in the practice of state auditing in the Republic of Serbia, which consequently led to a sharp deterioration in the ratio of the total number of reports to the total number of applications, and it is very likely that the answer to that question found in the new leadership that began its mandate in 2018 and that, with its moves, probably made a turning point in the analyzed relationship in 2018. All in all, the existing relationship certainly cannot be characterized as favorable, therefore, concrete steps are necessary that will increase the quality of the state audit in the Republic of Serbia.

**Figure 5:** Analysis of the written charges and audit reports

Source: General reports of the State audit institution of Serbia.

The main conclusion is that most respondents, as many as 98% of them, believe that it is necessary to write charges for violations and irregularities that the state audit institution finds during the audit. However, the majority of respondents also believe that state auditors, as trained economists, are unqualified to write good charges and that charges should be written by the General Audit Court, which indicates the existence of an extremely strong need to implement positive reforms in the system of state audit in the Republic of Serbia, which would include the creation of the Audit or Accounting Court with the prosecution as the highest state authority for writing charges and conducting and resolving court disputes based on irregularities that state auditors determine during the implementation of audit engagements, which could also perform other tasks of importance for the accounting and auditing profession and the entire system of state administration.

## References:

- Flasher, R., Shirley, S. & Higgins, J. P. (2022) The Structure of State Auditor Functions in the Fight Against Corruption, *Current Issues in Auditing*, 16(1), pp. A18–A26, <https://doi.org/10.2308/CIIA-2020-044>.
- Jakovljević, N. (2022) Analiza problematike sertifikacije lica u revizorskoj profesiji u javnom sektoru u Republici Srbij, *Ekonomski pogledi*, 24(1), pp. 229–247, <https://doi.org/10.5937/ep24-37934>.
- Jakovljević, N. (2021) Political neutrality in the audit profession: attitudes of respondents in the Republic of Serbia, *BizInfo (Blace) Journal of Economics, Management and Informatics*, 12(2), pp. 23–38, <https://doi.org/10.5937/bizinfo2102023J>.
- Krom, C. L. (2016) Disciplinary Actions by State Boards of Accountancy 2008–2014: Causes and Outcomes, *Accounting & the Public Interest*, 16(1), pp. 1–27, <https://doi.org/10.2308/apin-51609>.

- Zakon o Državnoj revizorskoj instituciji, *Sl. glasnik RS*, br. 101/2005, 54/2007, 36/2010 i 44/2018 - dr. zakon, available at: [https://www.dri.rs/upload/documents/Opsti\\_dokumenti/zakon\\_o\\_dri.pdf](https://www.dri.rs/upload/documents/Opsti_dokumenti/zakon_o_dri.pdf) (August 24, 2022).
- Poslovnik o Državnoj revizorskoj instituciji, *Sl. glasnik RS*, br. 9/2009, available at: [https://www.dri.rs/upload/documents/Opsti\\_dokumenti/Poslovnik\\_DRI.pdf](https://www.dri.rs/upload/documents/Opsti_dokumenti/Poslovnik_DRI.pdf) (August 27, 2022).
- General Report of the SAI of Serbia for 2021*, available at: <https://www.dri.rs/php/document/download/4724/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2020*, available at: <https://www.dri.rs/php/document/download/3633/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2019*, available at: <https://www.dri.rs/php/document/download/3103/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2018*, available at: <https://www.dri.rs/php/document/download/1549/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2017*, available at: <https://www.dri.rs/php/document/download/1177/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2016*, available at: <https://www.dri.rs/php/document/download/927/1> (August 24, 2022).
- General Report of the SAI of Serbia for 2015*, available at: <https://www.dri.rs/php/document/download/724/1> (August 24, 2022).
- Spasenić, Ž., Benković, S. & Dmitrović, V. (2019) Potentials for Improving Financial Management Capacities in Serbian Public Administration, *Lex Localis - Journal of local self-government*, 17(3), pp. 435-451, <https://doi.org/10.4335/17.3.435-451> (2019).





## Optimisation of Insurance Capital and Reserve Using Catastrophe Bonds

MADHU ACHARYYA & AHMED ABDULLAH ABDELKARRIM ABDULLAH ZARROUG

**Abstract** The study proposed a model to optimise the size of catastrophe bonds within firms' capital structure and minimize the cost of capital within the scope of Insurative Model proposed by Shimpi (2001, 2002). To do so, a linear optimisation model has been developed, considering the Solvency 2 ratio as a constraint. The linear optimisation model suggests two mixes of the capital structures, one with a size of CAT-BOND 1.24% and the other 55.34% of the capital. In addition, the study concluded to the optimum allocation of CAT-BOND adds value to insurance companies.

**Keywords:** • catastrophe bonds • insurative model • linear optimisation • capital structure • solvency 2 • cost of capital • firm value

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## 1 Introduction

As Weston *et al.* (1996:583) defines the target (optimal) capital structure as ‘The percentages of debt, preferred stock, and common equity that will maximise the price of the firm’s stock’. Apart from these sources of capital mentioned in the definition, there are other sources of capital. For example, the contingent convertible bonds (CoCo-bond), which used by the financial firms such as the banks to transfer the speculative risks. Another source of capital can be the insurance-linked securities (ILSs) such as the CAT-BOND used by the insurance companies.

This research primarily focuses on how to optimise the capital structure of the insurance companies using the CAT-BOND. Obviously, the decision of hedging the risk that associated with the catastrophe events is a risk management decision. Shimpi (2001) describes two models for capital structure; the standard model, which addresses only the paid-up capital. The other model is the insurance model that focuses only on the risk being transferred and the associated cost. Contrasting these two models, the standard model does not specifically accommodate the elements of risk and the insurance is not directly specified. Thus, Shimpi Insurative model, which combine both the standard and the insurance model is considered as a primary model for this study. Essentially, The Insurative model integrates the capital management with the risk management in the concept of the integrated corporate risk management (Shimpi, 2001).

### 1.1 Significance and Motivation of the Study

Until recently, few studies e.g., Cummins and Phillips (2005); Smith and Exley (2006) have highlighted factors that are associated with the capital structure and the cost of capital. Particularly, these studies focused on the capital structure of the banking systems. On one hand, minimising the cost of capital and optimising the structure has been investigated intensively (Philosophov and Philosophov, 1999). The cost of capital according to Weston *et al.* (1996) is the combination of the interest rate and required return on equity. The cost of capital can be minimised by mixing the sources of capital. Mixing the sources of capital depend on the industry and the business lines. For example, the insurance companies mixing their capital so that both the cost of the capital the risk are minimum. Insurers traditionally minimise the risk by transferring the risk through reinsurance. Consequently, re(insurance), in general, is a source of capital (Shimpi, 2004).

Scholars e.g., Philosophov and Philosophov (2005) focused on the optimisation of capital in financial firms and developed a model to estimate the optimum capital taking the probability of bankruptcy as a factor that the affect the mix of capital sources. They studied and developed models to estimate the optimum capital. However, the missing point in the literature is that to what extent the insurance firms can use ILSs to hedge its capital or to be used as a contingent capital. Traditionally, hedging capital is used as a

risk management technique or strategy to eliminate the probability of loss or fluctuation in profit because of investing in the uncertain environment or risky investment (Hull, 2012). However, the contingent capital is an asset reserved and can be used when a pre-defined event or events happen. To differentiate between the ILS and the Contingent Convertible bonds, the latter is the general term form of any bonds that converts to equity when a pre-defined event occurs. However, the ILS is an insurance contract in the form of a bond, although it converts to equity, the risk that these Bond covers is the systematic risk in the form of catastrophe. Essentially, the Contingent convertible bonds cover the speculative risks, arises from the fluctuation of the market in term of opportunity and loss the speculative risk as defined by (Diacon and Carter, 1992), characterizing it as an insurance-capital market financial product.

If the insurance companies are defined as the external entity that the firms and individuals are transferring their risk to, then insurance companies need to hedge their capital. As Philosophov and Philosophov (1999), state that the optimum capital structure must maximise the corporate share value, and as Shimpi (2001) claimed that insurance is part of the capital, then optimising the insurance capital using insurance add value to the firm. This study focuses on to answer the question, what is the optimum amount of CAT-BOND the insurer can use in their capital. To clarify this issue, we need to define the CAT-BOND and its properties first then specify the importance of the optimal capital structure and the significance of this study.

Vaugirard (2003) Defines the properties of the CAT-BOND for the purpose of developing a pricing model. According to Vaugirard (2003) the probability of the occurrence of the catastrophe such as hurricanes, very low if we consider the occurrence from an objective and statistics point of view. However, the severity might be high in term of loss. The properties of this CAT-BOND as Vaugirard describe them; it price is greater than the risk-free rate, and the principal plus the premium converts to equity if the pre-specified natural hazard happened. This definition of the CAT-BOND derives the decision of using risk management involvement. For the meantime, the risk management decision of using the insurance-linked securities (ILSs) as a source of capital, as Shmipi (2001) explained in his Insurative model require analysis of its impact on the capital structure.

## 1.2 Impact of this Study

The global warming and the dramatically change of the weather and nature; make the catastrophe that rare in one place more probable to happen (Houghton, 2009). The principle of insurance is guided by the law of large numbers, and not all individuals will suffer losses at the same time. Systematic risk is defined as the risk that cannot be diversified (Weston, 1996), and also the risk that affects the overall market, not just a particular industry (Diacon and Carter, 1992). Taking the risk of natural events as a systematic one, and specifically the catastrophe, which might make a severe loss to the insurance company, to the extent that the firm may not be able to meet its obligations.

Thus, the insurer needs to hedge their business risks from that unexpected systematic losses. The investors, who buy this bond, on the other hand, they take the risk as this Cat-Bond acts as an insurance contract. According to Shimpi (2001), by providing a premium above the interest of the bond ( the price of the cat-bond). Thus, the investor will be subject to uncertainty (e.g., Act of God) since the catastrophe can happen without warning, although the probability might be low.

Insurance companies should ensure that using cat-bond as a source of capital, it should optimise the capital and reserve of the firm. From the definition of the optimum capital structure mentioned previously and for the insurance capital to be optimised, cat-bond must help minimise the cost of capital. According to Meyricke and Sherris (2014), the cost of capital is a major factor in determining the premiums charged by the insurers. In insurance business the cost of the service or the product is related to the cost of capital. In other words, the firm, as the first condition of optimisation, needs to understanding the cost of capital of the CAT-BOND on the capital structure. The second condition for the optimisation, considering CAT-BOND as a source of capital, it has to minimise the risk as well, which might be dependent on the risk attitude and appetite of the firm.

### 1.3 Aim and Objectives of this Study

The aim of this study is to optimise insurer's capital structure with the use of CAT-BOND. The optimum amount of cat-bond that can be used to optimise the capital structure of the firm can be a benchmark, considering the insurer is a risk neutral entity. However, the amount of cat-bond can vary according to the risk appetite of the insurer, the risk appetite according to Ward (2005) is the willingness of taking the risk. As they can exceed this amount, but the optimum should be addressed first.

To achieve the aim of this study, we need first to choose the suitable framework that considers, debts, equity, contingent capital, and the insurance as sources of capital. The framework will be used to develop the general equation, and the constraints of the equation need to be derived from the regulation bodies. Then will develop the optimisation model that will give the optimum amount of cat-bond that minimises the cost of capital.

The aim will be achieved by addressing the following objectives.

- First to analyse the Insurative model. The Insurative model as a holistic framework that lists all the sources of capital and also integrating the risk management and the capital management is the suitable framework that can help estimate the optimum capital structure using the cat-bond (Shimpi, 2004).
- Second, to analyse the ORSA (Own Risk and Solvency Assessment). Solvency II can contribute to developing the constraints for the optimisation model. ORSA establishes a direct relationship between risk management and capital management,

that out the OSRA in line with the insurative model Ozdemir (2015). According to Fairall and Murphy (2013) ORSA helps insurers to understand the risk related to the insurance business and allow them to plan their strategy and capital planning. Thus, the minimum required capital under Solvency II is vital important when deciding to mix the capital in term of debts and equities to minimise the cost of capital. The insurative model, on the other hand, is a combination of the standard model and the insurance model. By combining standard and insurance models together in the insurative model, the insurer has more capital sources than before, thus make the Solvency 2 more important to reduce the potential risk of adequate capital.

- Third, to develop the optimisation model.
- Fourth, to empirically test the optimisation model empirically using the data obtained from the Bloomberg and DataStream. This testing can be used for the purpose of developing the model.

#### **1.4 Structure of the paper**

This paper is structured into five sections including this introduction Section 1. The second section, literature review, where we discuss and develop the understanding of the topic, developing the hypothesis, and pointing the gap in the research in this subject. Pointing the gap in the research, in turn, help to confirm the aim and the objectives of the study. In this second section we will also discuss the problem and the issues in estimating and calculating the optimum capital structure. In section three, we discuss the methodology and the method of the research, which it is based on the comparison of the literature review held previously and the aim and objective been confirmed. In section four, we discuss the data analysis technique and the Insurative model as well as developing the model of optimising the capital and reserve in insurance companies in details. Moreover, we will use secondary data obtained from the Bloomberg and DataStream to test the model. The results will be furnished in this section. In section five, we analysis the results from section four and draw out findings. Finally, in Section 6 we draw conclusion of the study, where we put the recommendation, limitation, and the outcome of the study in general.

### **2 Section 2: Literature Review**

The literature of insurers' risk and capital is limited to three interrelated topics i.e., capital structure, cost of capital and the contingent capital.

The capital structure of the insurance companies, those underwrite long tail natural catastrophe risks, is complex. This is mainly because of the high level of uncertainty in both the frequency and the severity associated with the catastrophe risks during the currency of policies. Catastrophe risks are usually financed by insurance linked securities (ILS). Catastrophe bonds is a security that comes from the contingent convertibles capital (CoCo), as an ILSs the cat-bond has its properties that distinguish it

from other mezzanine debts. The mezzanine finance as defined by (Investopedia, 2003), is a hybrid debt that might transform into equity. The CAT-BOND covers the risk of catastrophes. The severity and the frequency of the catastrophe can be considered as the properties of the event. Thus, the pricing of the bonds that covers this kind of event depends heavily on the predefinitions of the event, the probability, and the severity of the catastrophe (Čížek et al., 2011).

The cost of capital as defined is the interest associated with the debts and the required return on the equity (Weston, 1999). In other words, the cost of capital means the expenses of having a capital whatever the source of that capital. The capital, in general, is a mix of equity and debts, as the cost of each one is deferent; that derive the decision maker from thinking of mixing these sources to minimise the cost, that optimises the capital. Hence, the optimisation of capital requires an understanding of what sources are available. Contingent capital, for example, is an off-balance sheet capital (Shimpi, 2001). Taking the Contingent Convertible Bond as an example of contingent capital, it has a general two forms; one meant to cover the speculative Risk, which used in the banking system as a tool to raise and optimise the capital. Goes et al. (2016) investigated the effect of this source of capital to prove its suitability as a source of capital. The other form of contingent capital is the CAT-BOND. Insurers for example using CAT-BOND to transfer, a systematic risk, and specifically the catastrophes. Shimpi (2001) claims that insurance, in general, is a source of capital. This assertion gives the inspiration to think how to optimise the capital structure and minimise the risk using the CAT-Bond.

The valuation of a firm is closely linked to its cost of capital. The Value of the firm is a combination of the market value of common stock, preferred equity, and market value of debt. From this definition, the cost of capital affects the values of this component because of all these expenses of capital as defined previously is also the combination of the cost of Equity and the cost of the debts. Michalak (2014) elaborated more on the capital structure and the value of the firm and argued that the value of the enterprise can be calculated as the proportion of the earnings before interest and tax (EBIT) to the WACC.

$$VU = VL = \frac{EBIT}{WACC} = \frac{EBIT}{CeU}$$

[Equation 1: Firm Value]

Where,  $VU$  is the value of company not using foreign capital (unlevered firm),  $VL$  the value of the company using foreign capital (levered firm),  $CeU$  the cost of equity capital of company not using foreign capital (unlevered firm),  $EBIT$  is the net operational income (earnings before income tax) and  $WACC$  is the weighted average cost of capital.

Therefore, the firm value depends on the cost of capital (Eskandari & Zadeh, 2012). We used this assumption to calculate the firm value within the scope of the Insurative model while estimating the cost of capital of an insurance company.

Furthermore, the optimisation of capital structure can be studied from two perspectives. The first perspective is the cost of capital. Weston et al., (1996) define the capital components as the types of capital used by firms to raise money. This definition raises the arguments about what is the types of capital, which in turn can be a key factor when deciding to mix and structure the capital of the firm. Since sources of capital vary in term of cost, such as the interest rate of the bonds issued, the cost of preferred shares. The mix that minimises this cost considered to be the optimum. The second perspective is what the effect of the capital component of the optimum capital structure. This point of view, investigate the deferent sources of capital to verify its impact on the structure of the capital.

## 2.1 The Cost of Capital

The capital structure of insurance companies is distinct from other financial services firms. Smith and Exley (2006) investigated the influence of some factors on the capital structure of banking system and insurance. They state that the increase in the cost of capital affect the structure of the capital as the firm tend to use 'less capital'. The term less capital is very controversial; less capital can mean decreasing the amount of capital, while less capital also can mean revising the sources of capital. Revising capital structure is an issue need to be studied because the question of what is the optimum capital structure is very subjective although many attempts to quantify this problem (Philosophov & Philosophov, 1999).

The classical theories of the cost of capital proposed by Smith and Exley (2006) helps to understand the deferent factors that have implications for product pricing, performance measurement and capital structure optimisation. In essence, they hypothesised that required return on the assets that have been financed through debts are the factor of setting the target profit. Breaking this hypothesis into two parts, the first part is the required rate of return and the second part is the debts, we can confirm this assumption as a very similar to the fact that, the cost of capital is negatively related to the firm value. They used WACC (Weighted Average Cost of Capital) in determining the capital structure and the sources of the capital while estimating the cost of capital. Nonetheless, the effect of ILSs on the capital structure and specifically the CAT-BOND was not studied in the literature.

Shimpi (2004) presents the insurative model that deals with the estimation of the cost of capital and the capital structure in the insurance companies. Also, it tackles the problem of overestimation of the cost of capital, as reinsurance or insuring part of the capital; decreasing the cost of capital, since it releases capital. Doherty (2005) critically examined the cost of capital and to test whether the insurative model underestimates the cost of

capital. They concluded to that, the concepts of Shimpi's approach accurately estimate the cost of capital when there is part of the capital hedged using insurance contract. The noticeable thing in Shimpi's model is that it divides the capital into three sections, paid up, contingent capital, and ILSs, while Smith and Exley (2006) in their study they define the capital as components, as every component has its cost. In Shimpi's opinion, Insurance is a form of capital; he argues that insurance release an amount of capital, and without integrating the capital management and the risk management, the cost of capital may not be estimated or calculated accurately.

Comparing the cost of capital using the weighted average cost of capital, with the average total cost of capital:

$$TACC = WD * Cost\ of\ Debts + WE * Cost\ of\ Equities + WI * Cost\ of\ Insurance$$

[Equation 2: Total Cost of Capital]

W represent the weight of capital source, and can be calculated as:

$$W = Cost\ of\ Capital\ Source * \left[ \frac{Course\ of\ Capital}{Total\ Capital} \right]$$

[Equation 3: Total Average Cost of Capital]

From this equation (3) it is clear that insurance is a part of the capital structure where insurance takes the form of contingent Capital (contingent convertible securities) that itself has two forms. The first is the CoCo bonds, which hedge the speculative risk. The second form is the ILSs (the insurance-linked securities) in term of Catastrophe bonds, which can be a reinsurance against systematic risk, specifically the natural disasters as an example. The probability of this systematic risk is very low with a severe impact. Thus, the part that this Insurative model does not cover is to what extend the cat-bond can help maximise the capital of insurance companies.

## 2.2 Optimisation of Capital

Yeh (2011) attempted to test whether the low agency cost can increase the firm performance through optimisation of capital, while Smith and Exley (2006) demonstrate that the equity capital is in positive correlation with the agency cost. However, Yeh (2011) concluded to the key result is that the optimal capital is something subjective, and stating that, the optimal structure can be decided by the manager to combat the agency cost.

The capital structure in perspective of Shimpi (2001) consists of three parts, off-balance sheet capital, paid-up capital, and the insurance-linked securities (ILSs). Goes *et al.* (2016) found the impact of contingent convertible bonds (CoCo) on the capital structure



of the regulations of BASEL III. They found that CoCos could optimise the capital structure. Contrasting this conclusion with the insurative model (Shimpi, 2004), we can notice that CoCo, is part of the capital, which considered in the model as an off-balance sheet capital. They based their results on three key conditions:

The first condition is the value of bank with CoCo need to be higher than the value of Bank with subordinated debt. The second condition is the maximisation of the value of the bank, where the subordinated debt optimal coupon must be lower than the CoCo optimal coupon. The probability of insolvency of contingent convertible (CoCo) has to be lower than the subordinated one; this last condition put the argument of this study in line with the risk management decision as proposed by Shimpi (2001) i.e.,

$$\text{Required Capital} = \text{Capital Requires to Cover Firm's Risk}$$

This equation justifies the condition of optimum capital when using CoCo that Goes *et al.* (2016) put to verify the effect of CoCo Bond on the capital structure of the banks in Brazil. The hedging tools and the insurance of the capital can maximise the capital structure, but the issue is what is the right amount and the weight of this source of capital in the structure.

On the other hand, Philosophov and Philosophov (2005) were interested in the optimal capital structure and they consider the capital structure a central problem of corporate finance. They agreed with Shimpi on that optimum capital structure is an application of decision making in the organisation. In essence, risk management and capital management are two faces of the same coin (Shimpi, 2001). A similar research about the optimum capital structure by Philosophov and Philosophove (1999) using Bayesian approach, demonstrates that the ratio of Debt to Equity as a prognosis to estimate the optimum capital structure. This model is taking into account only the debts and equity as two main sources of capital. The argument of this model is that the optimum ratio of the debt to equity maximise the firm value. Comparing this model with the insurative model, one can notice that Philosophov and philosophov model are considering a small part of the capital that the insurative model introduce as the paid-up capital.

Considering Philosophov and Philosophov's (2005) hypothesis i.e., the probability of bankruptcy restricts the amount of borrowed capital (debt), we can assume that the amount of debt defines the capital structure while the probability of bankruptcy defines the firm's value. In this respect, there is essentially no difference between this assumption and Goes *et al.*, (2016) hypotheses. However, both of them are based on the standard WAthe CC model with limitation that they did not consider the release of capital from insurance that Shimpi's (2001) model exceptionally considered.

In the insurance field Karabey (2012) investigated risk capital allocation methods for both life and non-life insurance. Comparing this aim with the aim of this study, it is observed that the allocation of the risk capital is similar to the allocation of ILSs to optimise the

capital. The risk capital as it defined by the ORSA (Own Risk and Solvency Assessment) is the equity capital of a firm that used for the recovery from losses, and impact of taking risks and uncertainty (Ozdemir, 2015). Furthermore, Karabey (2012) found that the analysis of solvency capital and risk factor contributions provide powerful signals for long-term risk management of the insurance companies. In the literature, hedging as mentioned is a part of the capital Karabey (2012) with an impact on the risk capital, which in turn affects the structure of the capital. Taking the cost of capital from the different perspective scholars e.g., Upreti (2013) found deferent factors that have implications for product pricing, performance measurement, capital structure optimisation and the cost of the equity capital of non-life insurance companies. they concluded to that reinsurance in the UK non-life insurance markets have a comparatively lower cost of equity than their counterparts without any reinsurance cover, and also leverage and liquidity are found to be positively related to the cost of equity. These findings appreciate the importance to corporate risk management and its effect on firm value.

### **2.3 The Contingent Convertible (CoCo) Bonds**

The Contingent Convertible Capital is defined as “bonds that convert to equity, or are written off, after some triggering event such as a decline in a bank’s capital below a threshold” (Pennacchi et al., 2014). Shimpi (2001) defines the contingent convertible bonds as a source of capital; he justifies that as CoCo can release part of the capital. Doherty, (2005) confirm Shimpi’s claim about the contingent capital as a source of capital. Doherty (2005) assumed that the Insurative model and specifically the Total Cost of Capital (TACC) underestimates the cost of capital. However, he concluded to that the Total Cost of Capital takes into account the insurance and contingent capital as a source of capital. That why it releases part of the capital, which in turn reduce the cost of capital, whereas the WACC or the standard model takes into account the equity and the debts as the sources of the capital.

### **2.4 The ORSA Insurative Model and Cost of Capital**

As discussed earlier, the insurative model is combining two classical cost of capital models. The first model is the standard model which considering the capital as debts and equities, while the insurance model focuses on the insurance, this combination links the risk management and the capital management together (Shimpi, 2004). The insurative model not only releases capital and propose new sources of capital (Doherty, 2005), the risk of the insurer not be able to meet its obligations that an issue need to be managed. The ORSA (Own Risk & Solvency Assessment) it an internal self-assessing framework for the firm’s risk profile as outlined in Figure 1 (Ozdemir, 2015). The ultimate aim of the ORSA framework is to ensure that the insurer has an adequate capital as a buffer of risk. Solvency 2 minimum capital required can be estimated as the ratio of the profit to the debts as follows:

$$\text{Solvency II} = \left[ \frac{\text{Net Profit} + \text{Depreciation}}{\text{Short}_{\text{Term}}\text{Debts} + \text{Long}_{\text{Term}}\text{Debts}} \right]$$

[Equation 4: Solvency Ratio]

Key elements (or steps) of ORSA framework for capital and business optimization are (a) governance and control; (b) capital management, measurement and allocation; (c) capital planning, performance management and risk appetite; (d) risk strategy and core strategy (Ozdemir, 2015).

## 2.5 Solvency Ratio and Liquidity Ratio

Theoretically, solvency ratio is the ratio of “own funds”. Essentially, it is the capital available to cover losses, as prescribed by the solvency capital requirement (SCR). Scholars e.g., Zhou-Richter and Kuschel (2012) investigated the Solvency 2 as an indicator of insurance companies’ financial ability to handle the risk related to their businesses. Philosophov and Philosophov (2005) has taken the liquidity ratio as a prognosis to manage the bankruptcy. In this research, we replace the solvency ratio with the liquidity ratio appreciating that the fact that solvency ratio is slightly different from the liquidity ratio. However, when defining the liquidity ratio as the ability of the company to meet its obligations, we can take the risk as an obligation if the unfavourable event happened. Thus, liquidity ratio can fit and replace the solvency ratio; more specifically liquidity ratio can act as a constraint in the Optimisation model so that the company can still have the ability to meet its obligations.

$$\begin{aligned} \text{Solvency II} &= \left[ \frac{\text{Net Profit} + \text{Depreciation}}{\text{Short}_{\text{Term}}\text{Debts} + \text{Long}_{\text{Term}}\text{Debts}} \right] \\ &\approx \text{Liquidity} = \left[ \frac{\text{Short}_{\text{Term}}\text{Debts} + \text{Long}_{\text{Term}}\text{Debts}}{\text{Total Equity}} \right] \end{aligned}$$

[Equation 5: Solvency and liquidity]

## 2.6 Research Gap

The aim of this study is to optimise insurers’ capital structure with the use of CAT-BOND. We achieve the aim by considering several steps. First, we analyse the Insurative model of Shimpi (Shimpi, 2004). From the previously analysis of the literature, the Insurative model, covers all the aspects of the capital components, and can better estimate the cost of insurance capital (Doherty, 2005). Second, we analyse the ORSA (Own Risk and Solvency Assessment). For the purpose of this study we considered Solvency II regulation (following Goes et al. (2016) optimisation model on the BASEL III regulation) as a benchmark of the insurance optimum capital structure. Based on the Insurative model

and the ORSA we develop the optimisation model with constraints. Finally, with empirically test the model with industry data.

Our study is heavenly motivated by Shimpi (2004) that aims to link the firm's cost of capital to the ERM decision within the firm as integrating corporate risk management. The objectives of his research start with stating the problem by defining the firm as a collection of risky productive activity. Then building an integrated framework based on his assumption that Insurance is a form of capital. This objective also linked to our study since it considers that the ILs can help add value to insurance. Finally, we analyse and develop the Insurative model, define the Insurative model, and show how it addresses the problem of the relationship between the risk management and the capital structure).

As discussed earlier Shimpi's (2004) Insurative model deals with the estimation of the cost of capital and links risk management with the capital management. This Insurative model along with the integrated risk management and the capital management concepts cover a wide area of the topic of the research. However, it does not answer a key question i.e., what is the optimum insurance the firm can use to minimise the cost of capital?

To understand reducing the cost of capital and its implications, Exely and Smith (2006) on the other side aim to understand the deferent factors that have an impact on product pricing, performance measurement and capital structure optimisation. They describe the classical theories of the cost of capital in the financial firms and apply these theories of the cost of capital to banking and financial firms such as insurance companies. They reflect their experience and knowledge when they define the cost of capital. Their study focuses on the financial firms, but they did not mention how the contingent capital affect the cost of capital. The other limitation of their research is the subjective definition of the cost of capital concept, although they run an empirical experiment. However, most scholars did not clearly answer is how to mix the capital components to minimise the cost of capital, the reinsurance and insurance cost capital and reserve, in particular.

## **2.7 Comparison of Philosophov vs Shimpi Models**

Philosophov and Philosophov (2005) developed a new probabilistic approach to estimate the optimum capital structure based on the probability of bankruptcy. Their model did not consider the subjective definition of the cost of capital as they look much deep on the financial ratios and the probability of bankruptcy to determine the optimum capital structure. They first analyses the prediction of the optimum capital structure and the prediction of the bankruptcy.

They proposed four financial ratios as prediction of bankruptcy [Modelling the probability of bankruptcy] and optimal capital structure existence.

$$\text{Group 1 } \left( \frac{\text{Interest}}{\text{Total Assets}}; \frac{\text{Current Liabilities}}{\text{Total Assets}} \right); \text{Group 2 } \left( \frac{\text{EBIT}}{\text{Total Assets}}; \frac{\text{Rate of Return}}{\text{Total Assets}} \right)$$

These four prognoses, two of them are to indicate the quantity and quality of debt (Group 1) while the others indicate the ability to pay the debt [Determining the value of the optimum debt to equity]. Taking the bankruptcy one hand, it clearly related to the optimum capital structure, and also one can assume that the systematic risk can cause a severe loss, which in turn can be a reason of bankruptcy. On the other hand, the model developed by Philosophov and Philosophov did not take into account all the capital component that Shimpi, (2004) proposed. This makes the effect of ILSs on the capital and the cost of the capital unsolved question. However, Shimpi (2004) consider the standard model for the capital structure not suitable for discussing the capital structure of the insurance firms as the insurance and other types of capital are neglected.

## 2.8 Summary of Goes (2016) paper

Goes et al. (2016) aim to verify the influence of using CoCos on banks risks, evaluating the effectiveness of this Basel III recommendations, and to compare them with the use of subordinated debts on capital. Considering the contingent convertibles as a source of capital, then Shimpi's Insurative model should be exercised. Goes et al. (2016) analysed the capital structure of the ten Brazilian banks. First they analyse net equity and subordinated debts. Then they compare the current structures in terms of BASEL III ratios and constraints. This comparison considers the subordinated debts with the structure proposed in Basel III and on the other hand, the impact of CoCos whether it meets the recommendations of Basel III. The constraints they developed for the optimisation of the capital is not adequate for the optimisation of the insurance capital optimisation. This because the Insurance capital structure is different from the banking structure. Also, the Contingent convertible bond is distinct from the catastrophe bond, because the catastrophe bond issued to cover the natural events, and the risk that it covers is not speculative as the CoCo bond.

## 2.9 Summary of Upreti (2013) paper

Upreti (2013) explains the effect of reinsurance on the cost of the equity of the insurers in terms of decision to reinsure and the extent of reinsurance. In other words, the aim is to examine the impact of reinsurance on the cost of the equity capital of UK non-life insurance companies. With this aim, Upreti first considered the key institutional features of the UK's non-life (re)insurance market that could influence the reinsurance – cost of equity relation. Then he selected a theoretical framework using an extensive review of the academic literature relating to the risk management and financing decisions of a firm. The conceptual framework helps to identify and select the suitable method to estimate the cost of equity of an insurer by reviewing the relevant accounting and finance literature.

Then he developed and tested his hypotheses empirically using univariate and multivariate (panel data) statistical analyses. Finally, he explains and evaluates the empirical results. We understand that Upreti's (2013) finding covers part of our study's assumptions.

Risk capital as defined by Shimpi (2001) is the amount of capital that can be used to cover the retained risk. By adding CAT-BOND, the amount of retained risk will be reduced (Shimpi, 2001). Whereas, (Karabey, 2012) aims from his thesis to investigate risk capital allocation methods for both life and non-life insurance. His objective for this aim is to examine the measurement of factor risk contribution to the portfolio loss and the allocation of risk capital methodologies. The risk capital, in general, can be defined as the capital to cover the expected loss (Shimpi, 2001). Thus, Karabey cover an important area of the topic, which deal with how much to hedge.

The ultimate conclusion of the papers discussed above is that there are several literature exists on CatBond in Capital Structuring. However, no study (other than Upreti) focuses exclusively on the insurance industry. Consequently, the gap not filled yet, which hedging strategy and what is the amount of insurance the firm need. Moreover, all the above researches are somehow depending on the standard model that neglect the insurance. Although Upreti's objectives are very straightforward, but his research generalised the reinsurance concept. Reinsurance can include the CoCo bond and the CAT-bond or the Sider-CAR. Also, the influence of the reinsurance on the cost-of-equity has a direct relation to the cost of capital, and that means the capital structure by somehow. The data analysis technique, on the other hand, statistical and the classical cost of capital model. For the purpose of the proposed study, the optimisation requires constraints and conditions.

In reviewing the existing literature (as above) we concluded the following three points:

1. The model for estimating the insurance optimum capital structure is not available in the literature.
2. The unsolved question is that the amount of insurance and ILSs that optimise the capital.
3. To develop the optimisation model, we need to develop the constraints of the model and the conditions first.

Thus, the objectives of this study are to analyse the Insurative model first, because the Insurative model takes into account the off-balance sheet items as sources of capital, such as the cat-bond. After that, analysing the ORSA to develop an adequate constraint for the optimisation model. Then designing and testing the model.

Based on the results from this optimisation model we will discuss the implications of using the cat-bond as a potential source of capital and also verify whether the cat-bond can help optimise the insurance capital and reserve.

At this point, taking the aim of the research on one hand. To maximise the amount of CAT-BOND that used to optimise the capital and reserve of insurance companies, we need the conditions for that to be verified. The first condition is the optimum capital structure must have the lowest cost of capital (Weston *et al.*, 1996). The second condition the optimum capital structure must maximise the firm value (Weston *et al.*, 1996). In addition, the optimum capital structure based on the Insurative model, and when considering the CAT-BOND as a source of capital, the CAT-BOND must maximise the risk leverage (Shimpi, 2004). The cat-bond must maximise the risk leverage because the cat-bond according to the (Diacon and Carter, 1992) CAT-BOND is a risk transfer tool, while according to Shimpi (2004) the risk leverage measure to what extent the firm retain or transfer the risk.

Our hypothesis assumes that the when using CAT-BOND to optimise the capital it adds value to the firm. On this hypothesis, the insurer and the investor both are risk neutral, as if this appetite changed to become risk taker or averse the situation might change significantly.

### 3 Section 3: Methodology

#### 3.1 Research Hypothesis

*H: Optimum allocation of capital using CAT-BOND add value to the insurance company.*

The previous literature review confirms that the cost of capital and the firm value are two faces of a coin. According to WACC, the cost of capital is the sum of the cost of all the capital components. Considering the CAT-BOND as a source of capital then, its cost can be added to the model above. From these facts, the hypothesis developed from the reviewing of the literature is that the Optimum allocation of capital using CAT-BOND adds value to insurance companies. This assumption can be broken down into two main parts. The first part is the optimisation of capital structure using the Cat-Bond as a source of capital. The second part is the firm value. Firm value and cost of capital are two faces of one coin (Shimpi, 2001). The challenging point is that the CAT-BOND will only be part of the capital when there is a catastrophe occurs.

To verifying the optimum amount of cat-bond that used to optimise the capital and reserve of insurance companies, we need to analyse the Insurative model proposed by Shimpi (2004). This Insurative model considered being suitable to estimate the cost of capital when the CAT-BOND, one of the capital sources, because the model has considered the ILSs as one of the capital components. After that, to understand the optimum mix of capital sources, we need to have a benchmark. The ORSA can help us to set the constraints of the model, as the solvency ratio in the insurance companies is necessary so that we analyse the ORSA framework. Developing the Optimisation model based on the

Insurative model and the ORSA framework will allow us to analyse an actual data testing the optimisation model.

### 3.2 Variables

**Table 1:** Variables and their definition

VARIABLE	DEFINITION
T.C.S	Total capital based on the standard model; the sum of equities, Short-term debts and long-term debts
T.C.S <sub>o</sub>	Optimised Total Capital based on the standard model
T.C	Total Capital based on the Insurative model
T.C <sub>o</sub>	Optimised Total Capital based on the Insurative model
EQ	Total Equities
EQ <sub>o</sub>	Optimised Total Equities
D	Short-term and Long-term Debts
D <sub>o</sub>	Optimised Short-term and Long-term Debts
C.B	Cat-Bond Size
C.B <sub>o</sub>	Optimised Cat-Bond Size
c.e	Cost of Equity
c.d	Cost of Debts
c.b	Cost of Cat-bond
WACC	Weighted Average Cost of Capital
TACC	Total Cost of Capital
TACC <sub>o</sub>	Optimised Total Cost of Capital
e.c.l	Expected Claim and Loss from the Catastrophe
p.c.b	Probability of the Catastrophe
Mat.	Maturity of the Cat-Bond
L	The Risk Leverage (Lambda)
S	Solvency ratio and the liquidity ratio
V <sup>c</sup>	Value of the Firm based on the Insurative model
V	Value of the firm
EBIT	Earnings Before Interest and Taxes

### 3.3 Developing Constraints for the Optimisation Model

The Insurative model projects the capital components of the insurance company as follow:

$$T.C. = EQ + D + C.B$$

[Equation 6: Insurative Model]



In line with ORSA (Ozdemir, 2015) and (Fairall and Murphy, 2013) we define Solvency 2 ratio as:

$$S = \frac{N.I}{D}$$

[Equation 7: Solvency Ratio]

Where, N.I. = Net Income After Tax

However, the liquidity ratio can give the same constraint for exceeding the optimum amount of DEBTs

$$LEQUIDITY\ RATIO = \frac{D}{EQ}$$

[Equation 8: Liquidity Ratio]

THE RISK LEVERAGE (L) is measured as:

$$L = \frac{C.B}{T.Co}$$

[Equation 9: Risk Leverage]

Weighted Average Cost of Capital is measured as:

$$WACC = \left[ \left( \left( \frac{D}{T.C.} \right) * c.d \right) + \left( \left( \frac{EQ}{T.C.} \right) * c.e \right) \right]$$

[Equation 10] Total Average Cost of Capital (TACC) is measured as:

$$TACC = \left[ (WACC) + \left( \left( \frac{C.B}{T.C} \right) * c.b \right) \right]$$

[Equation 11]

*THE OPTIMISED TACC is measured as:*

$$TACC_o = \left[ \left( \left( \frac{Do}{T.Co} \right) * c.d \right) + \left( \left( \frac{EQ_o}{T.Co} \right) * c.e \right) + \left( \left( \frac{C.B_o}{T.Co} \right) * c.b \right) \right]$$

[Equation 12]

The Optimised Model

$$MAXIMIZE \ C.B = T.C - EQ - D \dots$$

[Equation 13]

s.t:

$$TACC_o \leq TACC$$

$$S < 1$$

$$L < 1$$

#### **4 Section 4: Data Analysis and Results**

This chapter starts with describing the characteristics of the data, their sources and the technique used for the analysis. Also, this chapter will discuss the adequacy, sources and justification of the data suitability and their relevance to the aim and objectives of this research. Along with the appropriateness of the data, the validity and reliability of the data will also be discussed. These sections followed by the analysis, results and justification of the findings.

##### **4.1 The Types and Characteristics of Data**

Considering the aim and objectives of the study we collected data relevant to capital components such as the debts, equities, and the total capital, along with the cost of these sources of capital. They are required for the analysis of the Insurative model and developing the optimisation model, and compare the results, so that the hypothesis can be tested.

The first criteria we used to select data, is to identify the companies that have already issued CAT-BONDS and variables of the standard model of capital structure described by Shimpi (2004). The dataset consists of capital components of twenty-two insurance companies covers the period between 2006 until 2015. In particular, the dataset (collected from Bloomberg platform) included total capital, total equity, short term and long term debts, total liabilities, EBIT, and WACC. In addition, relevant data e.g., bond size, the

probability of the catastrophe events, expected loss, types of catastrophe, class, and price of the cat bond issued. about the cat-bond issued by these companies are also obtained. Furthermore, the solvency ratio (as recommended by Solvency 2 regulation) of the companies (cat Bond issuers) are also obtained.

These data required by the optimisation model (chapter two, section 4.4), in order to verify the optimum amount of CAT-BOND that can help optimise the capital structure are as follows:

The total capital, total liabilities, short-term and long-term debts, and the size of the CAT-BOND. While the objectives of the research require data about the Solvency 2 ratio, because this solvency ratio links the debts and the equities, and can act as a constraint when changing the values of the variable to find the optimum mix. Moreover, the CAT-Bond properties data, such as the cat bond price and the probabilities of the catastrophe. In addition to that, and in order to develop the optimisation model constraints, data about the cost of capital and cost of the cat-bond obtained as well.

The Table 2 (see Appendix 1) shows the summary statistics of the data related to the capital, short- and long-term debts, and the equity of twenty-four insurance company for the period between 2006 until 2015, while Table 3 [see Appendix 2] shows the data related to CAT-BOND.

## 4.2 Data Analysis Technique

This study aims to optimise the capital structure of the insurance companies using the cat-bond as a source of the capital. This goal justifies the optimisation techniques for analysing the data. Philosophov and Philosophov (1999, 2005) developed a non-linear<sup>1</sup> optimisation model to optimise the capital structure, taking into account the probability of the bankruptcy and the financial ratios as a prognosis. Unlike Philosophov and Philosophov (1999, 2005) and Goes et al. (2016) non-liners model we used linear optimisation model<sup>2</sup> to facilitate several important variables e.g., debts, equities, and cat-bond size.

The cat-bond properties are the probability of the trigger, the expected loss, the price of the cat-bond, and the maturity (Coval et al., 2009). The Maturity and the expected loss will be considered constants along with the probabilities of the Catastrophe<sup>3</sup>. These parameters deemed being constant, because in this research, aim to find out what is the maximum amount of CAT-BOND that optimises the capital structure when all these parameters are known. We used @RISK for linear modelling.

### 4.3 Data Analysis – results from the optimisation model and constraints

By analysing the capital structure of twenty-two insurance companies, initially, we found that the insurance companies considering the standard model of capital structure. This standard capital structure model as described by Shimpi (2004), it considers the (short-term and long-term debts and equity) as the sources and components of capital Table 2. Total Capital and Capital Structure as described by the standard model has the following equation:

$$\text{Total Capital} = \text{Total Equity} + \text{Short}_{Term} \text{Debts} + \text{Long}_{Term} \text{Debts} \dots$$

[Equation 14: Total capital according to the standard model]

The above equation 14 represents part of the Insurative Model (Shimpi, 2004).

Obviously, from Table 4 (see below), only three insurance companies have been changed significantly (Oriental Land Co., Swiss RE, and Tokio Marine), while the other companies remain unchanged. The model satisfies all the constraints<sup>4</sup> as seen in Table 5. It shows that for fourteen companies the liquidity ratio is less than 1, while the constraints failed to satisfy for the remaining six companies. These six companies i.e., AIG US Equity, ARGO LN Equity, CHUBB Group, DOMINION Reinsurance, East Japan Railway Company, and EDF) failed the optimisation test. These companies have a problem with Solvency Ratio, where the debts exceed the equities (see Table 4 in Appendix 3) shows that AIG US Equity has debts (108557.9) more than Equity (99991.5).

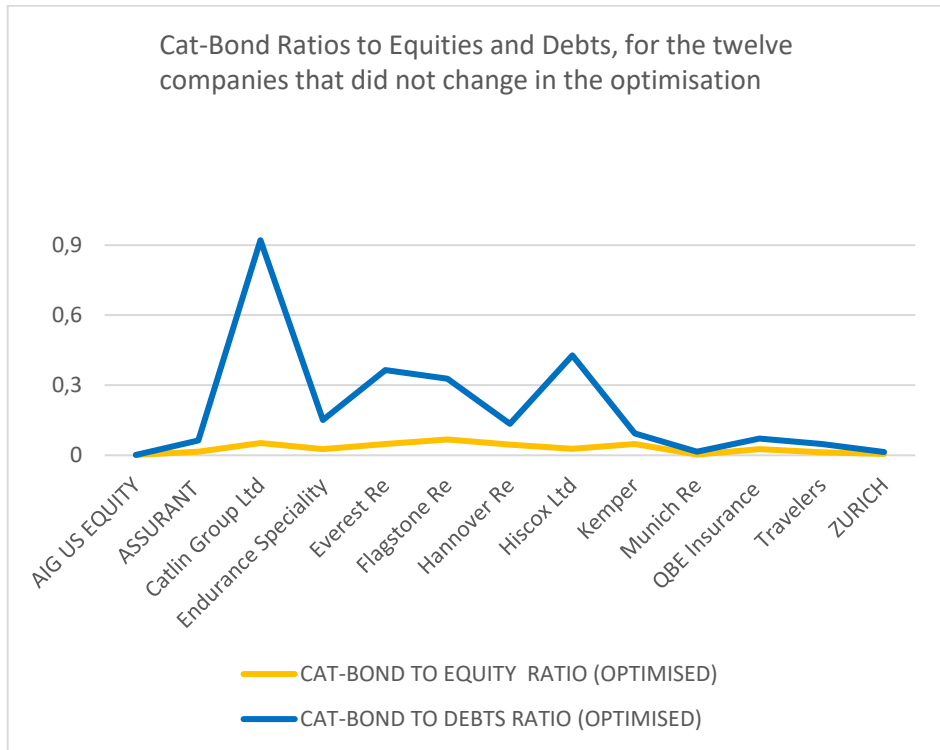
If we take the CAT-BOND as a debt, then in order to add more CAT-BOND to the portfolio the equities must be larger than the debts, so that the liquidity ratio (solvency regulation) is fulfilled.

Although these six companies failed to meet the model optimisation constraints (as *Liquidity Ratio* > 1), they might not affect the analysis significantly, thus excluded from the analysis. ARGO LN, has short-term and long-term debts equivalent to zero, that why the liquidity ratio equals zero, and the CAT-BOND to debts equals zero<sup>5</sup>.

### 4.4 Analysis of Optimisation Results

From Figure 2 below, we can see that the equities of all the thirteen companies exceed their debts. However, the ratio of the debts to equity (the liquidity ratio) are irregular, or in other words, every business has its ratio with irregular pattern to describe the relationship between the debts and the equity. The optimisation test results with all the constraints met, and the size of the CAT-BOND is the maximum refer to Table 5 (above) and Table 6 (below) shows that the size of the CAT-BOND didn't change. However,

**Figure 1:** Cat Bond Ratios



From the graph above Figure 2 it is evident that the equities are larger than the debts for twelve companies (from Table 5 the size of debts is less than equities). That is why the liquidity ratio already at the recommended level.

However, the size of the CAT-BOND is tiny (see Table 6; the average ratio of CAT-BOND to Equities is 3.1%). The ratios follow the irregular pattern and the difference between them are high (Figure 1 and Table 5 show that the variance the variance from the mean of the amount of debts is about 13% while the average is 24%). Thus, the variance between the ratio and its mean is massive.

**Table 5:** Descriptive Statistic for Companies [Cat-Bond size didn't change/

Descriptive statistics for the twelve companies that remained unchanged							
Variable	CAT-BOND TO EQUITY	CAT-BOND TO DEBTS	debts to equity	total capital	CAT-BOND SIZE	TOTAL EQUITIES	SHOT DEBT+LONG DEBT
Average	0.031641	0.219672	0.245522	12908.76	159.5175	9953.481	2795.766
Standard Deviation	0.020685	0.262036	0.134653	14530.15	99.71522	11014.48	3607.647

**Figure 2:** Capital Structure [Template 1]

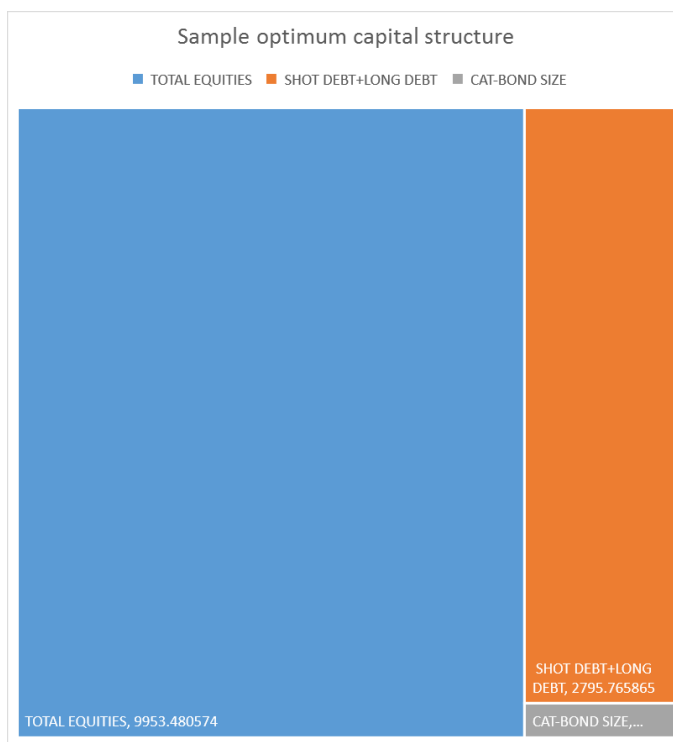


Figure 3 derived from Table 5 by calculating the average of the CAT-BOND, equities, and the debts. It illustrates the allocation of the CAT-BOND, where it is of course tiny size (159.5), which might not be able to cover the catastrophe that brings any loss exceeds the equity or the debts obligations. Nonetheless, the condition of minimising the cost has

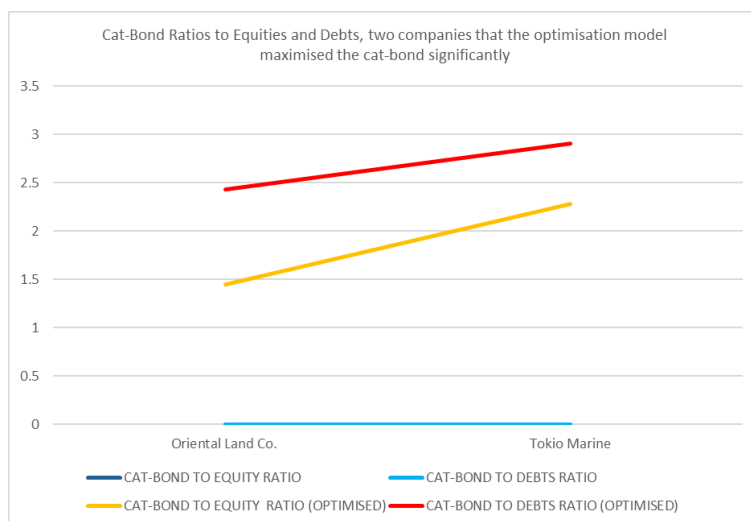
been satisfied Table 7 shows the cost of capital. From this, it is clear that the size of the CAT-BOND is the maximum that keeps the cost of capital optimum.

**Table 6:** Cost of Capital

Variavble	TACC	TACC FOR
Indicator	optimised	Original
<i>ASSURANT</i>	316.5118	316.5118
<i>Catlin Group Ltd</i>	300.8834	300.8834
<i>Endurance Speciality</i>	195.0471	195.0471
<i>Everest Re</i>	429.0709	429.0709
<i>Flagstone Re</i>	76.57604	76.57604
<i>Hannover Re</i>	346.2863	346.2863
<i>Hiscox Ltd</i>	89.04883	89.04883
<i>Kemper</i>	139.7738	139.7738
<i>Mitsui Sumitomo</i>	83.24998	83.24998
<i>Munich Re</i>	1792.719	1792.719
<i>QBE Insurance</i>	694.0569	694.0569
<i>Travelers</i>	1658.711	1658.711
<i>ZURICH</i>	2151	2036.116

Moving to the three companies where the model has maximised the CAT-BOND size significantly. Table 5 shows the size of the CAT-BOND compared with the other companies and with the other components. For example, the size of the CAT-BOND of Oriental Land Co. (412020.8), size of the CAT-BOND of Swiss RE (20775.286), and size of CAT-BOND of Tokio Marine is (5020268.1).

Figure 4 (see below), which derived from Table 8, shows how the cat-bond after optimisation exceeds the equity and the debts.

**Figure 3:** Cat-Bond Ratios to Debt and Equities

Swiss Re has been excluded from the graph above Figure 4 because the CAT-BOND size to DEBTs is much bigger than the other one for the other two companies (351.5649) compared to (2.9) and (2.4) for Tokio Marine and Oriental Land Co. respectively (see Table 8 below).

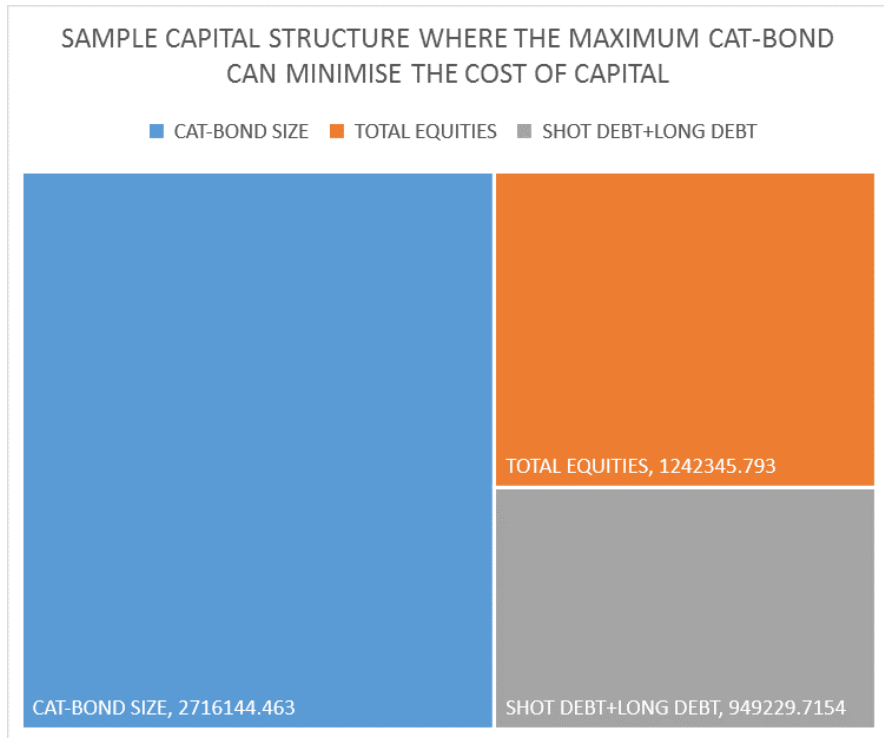
**Table 7:** Cat-Bonds [Optimised]

THE CAT-BOND THAT HAS BEEN MAXIMISED, RATIOS, DEBTS AND EQUITIES												
Variable	CAT-BOND SIZE	TOTAL EQUITIES	SHOT DEBT+LONG DEBT	original size of cat bond	original debts	original equities	CAT-BOND TO EQUITY	CAT-BOND TO DEBTS	CAT-BOND TO EQUITY	CAT-BOND TO DEBTS	TACC	ORIGINAL TACC
Indicator	optimised	optimised	optimised	mean	mean	mean	RATIO	RATIO	RATIO (OPTIMISED)	RATIO (OPTIMISED)	optimised	CALCULATED
Oriental Land Co.	412020.8	283721.49	169613.8	100	169613.8	412020.8	0.000243	0.00059	1.452202	2.42917	12940.78	19542.51
Swiss Re	20775.29	20775.286	59.093741	59.093741	20775.28569	29266.842	0.002019	0.002844	1	351.5649	1518.77	1689.552
Tokio Marine	5020268	2200970.1	1728845.6	179	1274760.2	2549858.2	7.02E-05	0.00014	2.280934	2.903827	169342.8	195794.2

Tokio Marine and Oriental Land Co. are the two companies that the optimisation model maximised the size of the CAT-BOND significantly. For example, the size of CAT-BOND of Tokio Marine has changed from 179 to 5020268. Figure (4) below derived from Table 6, representing the average of CAT-BOND, Debts and Equities of Tokio Marine and Oriental Land Co. shows, the size of the CAT-BOND compared to the equities and debts. The size of the CAT-BOND is larger than the equities or debts.



**Figure 4:** Capital Structure [Template 2]



The size of the CAT-BOND is far larger than needed, that if we take the probability and the expected loss into account. However, that size can represent the maximum amount of the CAT\_BOND by which the cost of capital is optimum. Also, the solvency ratio (liquidity ratio) is according to the constraints of the model. That means the companies have excess equity that can cover the obligations. For example, Table 6 shows that Tokio Marine Co. equities are (2200970.1) and the debts are (1728845).

## 5 Section 5: Findings from Data Analysis & Results

The successful optimisation resulted with two capital structure templates, Figures 2 & 3. Template 1 shows that the CAT-BOND can represent 1.24% of the total capital. Considering to decrease the full cost of capital, we can reduce the Size of the CAT-BOND, which in turn increase the amount of the retained systematic risk. Shimpi (2004) discussed the risk leverage (L) defined earlier in the literature review chapter, the risk leverage has a positive correlation with the insurance and the contingent capital, while it has a negative correlation with the total amount of paid-up capital.

Decreasing the amount of Total Debts, directly affect the solvency ratio and the minimum required capital, as well as increasing or decreasing the equities Equation 3 chapters two. Thus, considering higher or lower amount of CAT-BOND requires estimating and predicting the maximum expected loss in case of the occurrence of the catastrophe. This is in contrast with the second capital structure template as seen in Figure 4. Interestingly, from the template, we see that the CAT-BOND represent 55.34% of the capital. By taking the ratios of the CAT-BOND to Debts and Equities, are 2.7 and 1.9 respectively. That means the CAT-BOND should double the size of the debts and triple the size of the equity. According to Ozdemir (2015), economic capital is the capital required to stay solvent, while the risk capital refer to the capital that required for investments. The templates of the capital structure that have been concluded to (Figures 2 and 4) considering the issues with the solvency, as the ratio of the debts to the equity are always less than one (Table 5), which means that the firm can meet its obligations, while the cat-bond size covers the risk.

However, deciding between Figures 2 and 4 depend on the expected loss, because initially the CAT-BOND issued to cover an unexpected loss. Thus, according to Philosophov and Philosophov (2005) and Shimpi (2001) the decision of mixing the capital components requires decision making process. Shimpi's opinion is to integrate risk management with the capital management, these two opinions justify that both mix (Figures 2 and 4) can be viable, as the decision requires taking into account the expected loss from the catastrophes.

## 5.1 Hypothesis Testing

According to Michalak (2014) the value of the firm is a function of the cost associated with capital, whether the sources of the capital are external or internal.

$$VU = VL = \frac{EBIT}{WACC} = \frac{EBIT}{CeU} \quad 6$$

[Equation 15]

Although Goes et al. (2016) used a different method for estimating the value of the firm, this definition is suitable for this research because of the lack of the data and the simplicity of the equation. The Table 9 (see below) shows the variables that will be used for testing the hypothesis and the expected result from when we accept the hypothesis.

**Table 8:** Hypothesis Testing and Expected Result

PARAMETER	Description	EXPECTED RESULT	Justification
T.C.S <sub>0</sub> , T.C.S	cost of capital	$T.C.S_0 \leq T.C.S$	CAT-BOND minimise the Cost of Capital
V, V <sup>C</sup>	Value of insurance firm	$V < V^c$	Cat-Bonds adds value to insurance firm

**Table 9:** EBIT

Variable	EBIT	Variable	EBIT
Indicator	Mean	Indicator	Mean
AIG US EQUITY	1806	Hannover Re	331
ARGO LN Equity	0.688857	Hiscox Ltd	N/A
ASSURANT	265	Kemper	43.7
Catlin Group Ltd	379	Mitsui Sumitomo	N/A
Chubb Group	697.6667	Munich Re	N/A
Dominion Resources	3077.9	Oriental Land Co.	64762.27
East Japan Railway Company	398374.3	QBE Insurance	12.829
EDF	7938.4	SWISS RE	938
Endurance Speciality	93.45	Tokio Marine	6.006
Everest Re	212.5	Travelers	1003.5
Flagstone Re	33.5	ZURICH	8.79

Table 10 (see above) shows the EBIT of the twenty-two companies<sup>7</sup>.

Table 11: Firm Value<sup>8</sup>

Variable	TACC	EBIT	Firm Value after optimisation	TACC FOR OPTIMIATION	firm value before optimisation
Indicator	CALCULATED	MEAN	calculated	CALCULATED	calculated
AIG US EQUITY	6958.249	1806	0.259548059	6958.249	0.259548059
ARGO LN Equity	#DIV/0!	0.688857	#DIV/0!	0	#DIV/0!
ASSURANT	316.5118	265	0.837251491	316.5118	0.837251491
Catlin Group Ltd	300.8834	379	1.259624019	300.8834	1.259624019
Chubb Group	981.9498	697.6667	#NAME?	895.1431	0.779391174
Dominion Resources	1110.653	3077.9	2.771252238	1110.653	2.771252238
East Japan Railway Company	134821.4	398374.3	2.954830414	134821.4	2.954830414
EDF	2839.887	7938.4	2.795322622	2839.887	2.795322622
Endurance Speciality	195.0471	93.45	0.479114944	195.0471	0.479114944
Everest Re	429.0709	212.5	0.495256148	429.0709	0.495256148
Flagstone Re	76.57604	33.5	0.437473641	76.57604	0.437473641
Hannover Re	346.2863	331	0.95585656	346.2863	0.95585656
Hiscox Ltd	89.04883	N/A	#VALUE!	89.04883	#VALUE!
Kemper	139.7738	43.7	0.312647946	139.7738	0.312647946
Mitsui Sumitomo	83.24998	N/A	#VALUE!	83.24998	#VALUE!
Munich Re	1792.719	N/A	#VALUE!	1792.719	#VALUE!
Oriental Land Co.	12940.78	64762.27	5.004508918	19542.51	3.313917529
QBE Insurance	694.0569	12.829	0.018484076	694.0569	0.018484076
SWISS RE	1518.77	938	0.617604977	1689.552	0.55517669
Tokio Marine	169342.8	6.006	3.54665E-05	195794.2	3.06751E-05
Travelers	1658.711	1003.5	0.604987742	1658.711	0.604987742
ZURICH	2151	8.79	0.004086472	2036.116	0.004317043

Table 11 (see above) compares the firm value of the twenty-two companies. It is evident from the Table 11 that three companies i.e., Oriental Land Co. Swiss Re and Tokio Marine

increased their value after reducing the cost of capital and maximising the size of Cat-Bond. Michalak (2014) states that the value of the firm is proportion of the cost associated with the capital. In this consideration, the findings of the above analysis prove that the low cost of capital results with high value of the firm. Nonetheless, the taxation associated with the EBIT can be considered as fixed.

$$VALUE\ OF\ THE\ FIRM = \left[ \left( \frac{EBIT * (1 - TAX)}{COST\ OF\ CAPITAL} \right) \right]^9$$

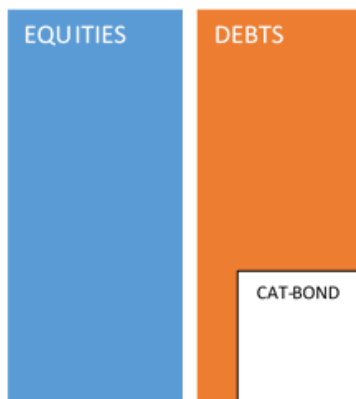
[Equation 16: Value of the Firm and Taxation]

The Equation 16 (see above) shows that whenever the cost of capital changed the value of the firm changes as negative relation. Taking the tax rate as fixed, which affect only the value of the EBIT, but anyway the influence of the cost of capital is obvious from Table 11 (the results derived from Equation 1: Firm Value).

Elaborating more about the EBIT and the maximum size of the CAT-BOND, any change in the capital structure affect the EBIT similar to the cost of the capital. Regarding the firm value, according to Modigliani and Miller cited from (Weston et al., 1996) the capital structure does not affect the firm value. However, the taxation benefit from the debts might affect the firm value (Weston *et al.*, 1996). Regardless, this test is quite enough to prove that the optimum allocation of the CAT-BOND can add value to the firm. According to Michalak (2014) equation (Equation 1: Firm Value) the cost of capital affect the firm value negatively. Thus, by allocating the CAT-BOND optimally, it adds value to the firm. Although the CAT-BOND is a defaultable debt and belongs to the contingent convertibles, it has its properties and attributions that make the allocation of this bond requires risk management decision.

Both the two templates (Figures 2 and 4) depend on the specifications of the anticipated catastrophe. For example, considering the Template 2 (Figure 4) while the expected loss represents 1% of the total capital, in this case the template is not suitable, and should consider the other template (Figure 2).

Revisiting the gap in the literature, which basically the ILSs as a source of capital within the scope of the Insurative model and the ORSA, the finding of this research covered the reasonably good part of it.

**Figure 5:** Capital Structure

Shimpi (2004) argues about considering the ILSs as sources of capital. This research investigated the viability of using the CAT-BOND as a source of capital, and what is the maximum amount that satisfies the principles of mixing the capital components and identifying the capital structure. The finding of this analysis, suggests that, there are two optimum capital structure that can fulfil the conditions of the optimum capital structure (see Figures 2 and 4)

Philosophove and philosophove (2005) developed a model to determine the optimum capital structure, taking the probability of bankruptcy as an issue. They also depend on the financial ratios as a prognosis. However, they did not take the off-balance sheet items as a source of capital as shimpi did. However, the gap in the literature regarding the capital structure and the off-balance sheet items, partially covered by this study. The two missing concepts in philosophov and philosophov (2005) are the Cost of Capital and the Firm Value, which both has been considered in this study. The data analysis concluded to the that, the CAT-BOND can be added to the capital portfolio while keeping the cost minimum and adding value to the firm.

In summary, in order to maximise the size of the CAT-BOND and to optimise the capital structure we used a linear optimisation model. The conclusion of the optimisation model and to minimise the cost of capital the CAT-BOND size are either to be around 1.2% or 55% of the total capital.

## 6 Conclusion

Insurance is a risk transfer tool that deals intensively with risk and uncertainty. From the perspective of risk management, insurance capital and the reserve is of vital importance, taking the insurance as a financial service industry, the classical definition of insurance as a hub, where individuals and other firm transfer their risk (Diacon and Carter, 1992). Insurance has always been to cover pure risk and unsystematic risk. However, the alternative risk transfer tool, such as ILSs, which Shimpi (2004) considers them to be sources of capital. The aim of this study is to allocate the CAT-BOND to the capital structure optimally. We set the first objective as to analysing the Insurative model, which accommodate the ILSs as a source of capital. The second objective was to understand the ORSA framework to develop a condition and constraint for the optimisation model. Both objectives are a complement for developing the optimisation model. We set the last two objectives are developing the optimisation model and analysing the data to test the hypothesis.

### 6.1 Research agenda

The optimum capital structure that has been studied previously in the literature review chapter depends on the understanding of the cost of capital, that on one hand. In addition to that, the optimum capital structure is determined by issues related to business lines, such as bankruptcy, speculative risk, and systematic risk.

Regarding the speculative risk, and contingent convertible bonds, they have been studied intensively (Wilkens and Bethke, 2014; Ammann et al., 2016). For example, in (see Chapter 2: Literature Review), where the allocation of the contingent convertible for the banking system within the scope of Basel 3 regulation (Goes et al., 2016), has been discussed. The influence of Contingent Capital on the capital structure has been confirmed as it adds value to the firm (Goes et al., 2016). However, in this study, we tested the the effect of the cat-bond on the value of the firm.

Although the contingent capital and the CAT-BOND have the same properties, CAT-BOND is different from the CoCo, because the CAT-BOND covers pure risk and specifically the systematic one. However, the allocation of CAT-BOND has not been studied in the previously literature, and specifically within the Insurative model scope as it combines both the standard and insurance models. Thus this model accommodates the ILSs and the off-balance sheet items. The equation used in the linear optimisation model derived from this Insurative model.

This study attempts to maximise the amount of CAT-BOND that can be part of the capital in the Insurative model. Through the identification of the optimum allocation of the CAT-BOND, this research might fill part of the gap in the literature in this subject area, where the distribution of CAT-BOND has not been studied intensively yet.

## 6.2 Collection and Analysis of Data

We began data analysis (Section 4) with descriptive statistics, to extract the mean, median and the variance, this descriptive helps in understanding the robust of the data of each company. The variance shows how the companies' data changes over time, because the data represent 10 years' period, while the mean used in the analysis, as this technique used by Goes et al. (2016).

The finding of this analysis shows that the allocation of CAT-BOND is a risk management decision, as the optimisation model resulted with two templates for the capital structure with CAT-BOND. The gap in the literature, show that there is lack investigation on how to allocate the CAT-BOND to the capital structure adequately. Thus, the result from the analysis covers this gap to the extent that a general view of where the CAT-BOND can be in the structure.

The hypothesis of this study is the optimum allocation of CAT-BOND adds value to insurance firms. The research confirms that this hypothesis is true, by comparing the value of the firm after the optimisation with the original one. This finding is similar to the conclusion of Goes et al., (2016) who tested whether the CoCo can add value to the firm or not.

## 6.3 Limitation and Recommendation

As mentioned earlier this study focuses on the CAT-BOND and how to be allocated optimally in the capital structure. There are other off-balance sheet items that can be considered as a source of capital, such as CoCo Bonds and the insurance contracts (Shimpi, 2004). This research did not examine these items because the limited time allocated to the research and the availability of the data related to insurance companies and their off-balance sheet items.

The results of this research can be taken to further studies on the same topic, bearing in account the CoCo bond and the insurance contracts along with the ILSs. For all these items to be considered in the capital structure, more sophisticated optimisation model need to be considered. Goes et al. (2016) used the stochastic optimisation technique. However, the optimisation technique used by Goes et al. (2016) one of its limitation is that it accommodates only one type; either optimise the coco size or the subordinated bond, but not both. Therefore, a new optimisation model needs to be developed to accommodate all sources of capital components within the scope of shimpi's Insurative model. Also, single or multiple case studies might be more efficient than taking the research as a literature review because of the lack of data.



To conclude from above, the future studies on the same topic may focus on a particular firm because it can insure the availability of the data. Moreover, developing a stochastic optimisation model that accommodate all the relevant sources of capital that Shimpi (2001, 2004) mentioned considering the change of EBIT with the change in the capital structure.

#### **6.4 Originality of this study**

The study developed two templates of capital structure and as they describe the amount of CAT-BOND that can be optimally embedded in the structure.

The new feature of this study is the optimisation model that has been used. The previous studies used simulation and stochastic optimisation, while this study uses a simple linear optimisation. The linear optimisation model that has been used is restricted in its constraint, which means that the constraints used in the model are not flexible, but they define the requirements of the optimum capital structure accurately. Also, the two templates that have been developed are simple in the sense that gives a general view of describing the location of the CAT-BOND and its size in within the portfolio.

The finding of this study is that the optimum allocation of the CAT-BOND adds value to the insurance firms. In addition to that, the ultimate achievement of this research can be divided into two parts:

Firstly, the research confirms the strong link between the capital management and the risk management. This concept has been developed by Shimpi (Shimpi, 2001) in his studies, where he talked about the importance of linking both the risk management and the capital management as integrated risk management. The two templates developed in this research can be applied in practice if it needs an intensive risk management decision about whether to be conservative or risk taker.

Secondly, both templates can help to maintain the optimum cost of capital. According to Exley and Smith (2006) cost of capital related to the price of products. Thus, the optimum cost of capital can help Insurance firms to compete in the market efficiently. Also, the optimum allocation of the CAT-BOND can help release capital (Doherty, 2005), which allow the firm to expand its insurance pool.

In general, we find that the outcome of this research is simple and understandable for a managerial level.

## Notes:

<sup>1</sup> Non-linear optimisation according to Bazaraa and Shetty (1979) is optimisation model where, one or more of the constraints are non-linear. Non-linear means no direct relation between the variables. The model proposed in this study is a linear one; its purpose is to find the optimum mix of the equities, debts and the CAT-BOND with constraints that has a linear relation, such as the liquidity ratio.

<sup>2</sup> Linear programming is a powerful mathematical tool for the optimisation of an objective under a number of constraints in any given situation. Its application can be in maximising profits or minimising costs while making the best use of the limited resources available (Coval et al., 2009).

<sup>3</sup> Refer to the literature review; the aim of the research is allocating the cat-bond, after defining its properties.

<sup>4</sup> The liquidity ratio, act as a constraint, because when mixing the components of the capital portfolio, the ratio of debts to equity must be less than 1. In other words, the equities must be larger than debts.

<sup>5</sup> CAT-BOND to DEBTS is equal to infinity, but the result from the software shows an error that we can consider as Zero.

<sup>6</sup> Refer to chapter two the literature review section 2.3 Equation 1 firm value.

<sup>7</sup> The EBITs of Hiscox Ltd. Mitsui Sumitomo, and Munich Re, were not available on Bloomberg. Hence, tested only nineteen remaining companies.

<sup>8</sup> The error on cell due to the missing data, however, these companies are excluded from the hypothesis testing.

<sup>9</sup> The value of firm equation cited (Michalak, 2014) page 26.

<sup>10</sup> This table shows the capital components of 24 companies, it shows the descriptive statistics: The mean (average), the median and the Variance. The average will be used in the analysis.

<sup>11</sup> This table shows the CAT-BOND properties in term of (size, probability of the catastrophe, maturity, expected loss and the price.

## References:

- Ammann, M., Blickle, K. & Ehmann, C. (2016) Announcement Effects of Contingent Convertible Securities: Evidence from the Global Banking Industry, *European Financial Management*, 23(1), pp. 127-152.
- Bermúdez, L., Ferri, A. & Guillén, M. (2014) On the use of risk measures in solvency capital estimation, *International Journal of Business Continuity and Risk management*, 5(1), pp. 4-13.
- Coval, J., Jurek, J. & Stafford, E. (2009) Economic Catastrophe Bonds, *American Economic Review*, 99(3), pp.628-666.
- Cummins, J. & Phillips, R. (2005) Estimating the Cost of Equity Capital for Property-Liability Insurers, *Journal of Risk and Insurance*, 72(3), pp.441-478.
- Damodaran, A. (2002) *Investment valuation* (New York: Wiley).
- Diacon, S. & Carter, R. (1992) *Success in insurance* (London: Murray).
- Doherty, N. (2005) Risk Management, Risk Capital, and the Cost of Capital, *Journal of Applied Corporate Finance*, 17(3), pp.119-123.
- Donkor, E. & Duffey, M. (2013) Optimal Capital Structure and Financial Risk of Project Finance Investments: A Simulation Optimization Model with Chance Constraints, *The Engineering Economist*, 58(1), pp.19-34.

- Edesess, M. (2015) *Catastrophe Bonds: An Important new financial instrument*, available at: [https://www.caia.org/sites/default/files/AIAR\\_Q4\\_2015-02\\_Edesesses\\_CatBonds.pdf](https://www.caia.org/sites/default/files/AIAR_Q4_2015-02_Edesesses_CatBonds.pdf) (June 29, 2018).
- Eskandari, A. & Zadeh, F. (2012) A Case Study of Examining and Analyzing Weighted Average Cost of Capital in Traditional and New Approach for Calculating the Value of Firm, *International Journal of Business and Social Science*, 3(19), pp.193-196.
- Exely, C. J. & Smith, A. D. (2006) The cost of Capital of financial firms, *British Actuarial Journal*, 12(1), pp. 229-283.
- Fairall, C. & Murphy, M. (2013) *Solvency II ORSA: ORSA for Solvency II Standard Formula firms*, available at: <https://www.actuaries.org.uk/.../documents/pdf/c03solvencyii-orsa.pdf> (June 29, 2018).
- Ferriero, A. (2016) Solvency capital estimation, reserving cycle and ultimate risk, *Insurance: Mathematics and Economics*, 68(5), pp.162-168.
- Goes, K., Sheng, H. & Schiozer, R. (2016) Contingent Convertibles and their Impacts on the Optimization of the Capital Structure of Brazilian Banks Under Basel III, *Revista Contabilidade & Finanças*, 27(70), pp. 80-97.
- Gurenko, E. N. & Itigin, A. (2013) Reinsurance as Capital Optimization Tool under Solvency II, *World Bank Group, Policy Research Working Paper*, available at: <https://openknowledge.worldbank.org/bitstream/handle/10986/12188/wps6306.pdf?sequence=1&isAllowed=y> (June 29, 2018).
- Hull, J. (2012) *Risk management and financial institutions* (Hoboken, N.J.: John Wiley).
- Jean, K. W. (2003) The Role of Insurance in Corporate Risk Finance, *Review of Business*, 24(4), pp. 36-40.
- Karabey, U. (2012) *Risk Capital Allocation and Risk Quantification in Insurance Companies*, [PhD thesis] (Heriot-Watt University).
- Laas, D. & Siegel, C. (2016) Basel III Versus Solvency II: An Analysis of Regulatory Consistency Under the New Capital Standards, *The Journal Risk and Insurance*, 84(4), pp. 1231-1267.
- MacMinn, R. D. (1987) Insurance and Corporate Risk Management, *Journal of Risk and Insurance*, 54(4), pp. 658-678.
- McShane, M., Nair, A. & Rustambekov, E. (2011) Does Enterprise Risk Management Increase Firm Value?, *Journal of Accounting, Auditing & Finance*, 26(4), pp. 641-658.
- Michalak, A. (2014) Theoretical Conceptions of Optimal Capital Structure, *Journal of Business and Economics*, 5(12), pp. 2246-2254.
- Ozdemir, B. (2015) *ORSA: Design and Implementation* (London: Risk Books, a Division of Incisive Media Investments Ltd).
- Philosophov, L. & Philosophov, V. (1999) Optimization of corporate capital structure A probabilistic Bayesian approach, *International Review of Financial Analysis*, 8(3), pp.199-214.
- Philosophov, L. & Philosophov, V. (2005) Optimization of a firm's capital structure: A quantitative approach based on a probabilistic prognosis of risk and time of bankruptcy, *International Review of Financial Analysis*, 14(2), pp. 191-209.
- Selim, M. & Aymen, B. (2016) Interactions Between Risk Taking, Capital, and Reinsurance for Property–Liability Insurance Firms, *Journal of Risk and Insurance*, 83(4), pp. 1007-1043.
- Shapiro, A. (1978) Financial Structure and Cost of Capital in the Multinational Corporation, *The Journal of Financial and Quantitative Analysis*, 13(2), pp. 211-226.
- Shimpi, P. (2001) *Integrating Corporate Risk Management*, 1st edition (New York: Texere).
- Shimpi, P. (2002) Integrating Risk Management and Capital management, *Journal of Applied Corporate Finance*, 14(4), pp. 27-40.

- Shimpi, P. (2004) *Leverage and cost of Capital in the Insurative Model*, available at: <http://www.actuaries.org/AFIR/Colloquia/Boston/Shimpi.pdf> (June 29, 2018).
- Shiu, Y-M. (2011) Reinsurance and Capital Structure: Evidence From the United Kingdom Non-Life Insurance Industry, *The Journal of Risk and Insurance*, 78(2), pp. 475-494.
- Tang, S. (1999) *Linear Optimisation in Applications* (Hong Kong: Hong Kong University Press).
- Trottier, D. & Lai, V. (2017) Reinsurance or CAT Bond? How to Optimally Combine Both, *The Journal of fixed income*, 27(2), pp. 65-87.
- Upreti, V. (2013) *Reinsurance and the Cost of Equity in the United Kingdom's Non-Life Insurance Market* [PhD thesis] (University of Bath).
- Weert, D. D. (2011) *Bank and Insurance Capital Management* (Chichester, West Sussex: John Wiley & Sons Inc).
- Wilkens, S. & Bethke, N. (2014) Contingent Convertible (CoCo) Bonds: A First Empirical Assessment of Selected Pricing Models, *Financial Analysts Journal*, 70(2), pp.59-77.
- Yeh, T. (2011) Capital structure and cost efficiency in the Taiwanese banking industry, *The Service Industries Journal*, 31(2), pp. 237-249.
- Zhou-Richter, T. & Kuschel, N. (2012) Cost of capital under Solvency II Reinsurance and capital market instruments, *Solvency Consulting Knowledge Series*, (München: Munich RE), pp. 1-8, available at: [https://www.munichre.com/site/corporate/get/documents\\_E546571561/mr/assetpool.shared/Documents/5\\_Touch/\\_Publications/302-07361\\_en.pdf](https://www.munichre.com/site/corporate/get/documents_E546571561/mr/assetpool.shared/Documents/5_Touch/_Publications/302-07361_en.pdf) (June 29, 2018).

## Appendix:

Table 2: Capital Components<sup>10</sup> [Appendix 1]

Variable Indicator	TOTAL CAPITAL			TOTAL EQUITY			SHORT DEBT+LONG DEBT			WACC			EQUITY WACC		
	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D
AIGUS EQUITY	208549.4	204899.5	71449.371	99991.5	103717	14833.789	108557.9	92605	73700.059	6.66	0	0	13.51713	13.05925	3.7506472
ARGOLN EQUITY	33.861	28.495	9.7978052	33.861	28.495	9.7978052	0	0	0	5.8011714	5.6578	2.0907919	5.8011714	5.6578	2.0907919
ASSURANT EQUITY	5671.5572	5795.584	616.86928	4566.286	4807.008	532.69441	1085.2712	988.07	209.74489	7.51	10.42909	0	10.42909	9.7766	1.5403358
Catlin Group Ltd	3384.1524	3390	475.73396	3201.8917	3298	622.8541	187.26078	105	225.40184	10.016789	8.6448	2.5184502	10.987544	10.4274	2.8985634
Chubb Group	18699.889	19397	1192.8354	15188.667	15574	1019.7027	3511.2222	3575	479.28952	8.18321	8.11685	0.9099216	9.11473	8.75265	1.3281439
Dominion Resources	32592.3	32407.5	4880.8811	11701.4	11829.5	1197.2433	20890.9	20144	4043.9839	5.7888	5.84565	0.912772	8.18715	8.0732	1.1707734
East Japan Railway Company	5315226	5243379	236765.28	1834745.5	1821051	291535.08	3480480.5	3438953	118707.88	4.38855	4.3941	0.7749994	9.13567	8.8787	2.3554707
EDF	81790.8	86607.5	19054.276	33400.1	33669.5	5943.0739	48390.7	49718	9980.6136	6.42002	6.48555	1.9529705	10.51312	10.7175	0.7873449
Endurance Specialty	3431.4087	3236.4415	903.49912	2917.0417	2748.94	826.81113	514.367	525.478	81.568762	8.06315	7.97305	1.3557914	9.09197	8.56235	1.0951331
Everest Re	7288.3634	7135.6415	924.14967	6424.2665	6192.6195	1107.5286	864.0969	843.1105	232.5371	8.01619	7.97205	0.8547842	8.73994	8.5686	1.0523616
Flagstone Re	1370.1515	1441.8775	279.19981	1135.3645	1190.029	248.27577	234.787	251.762	48.125152	8.5463667	8.4521	0.4063733	9.7475667	9.6718	0.5253059
Hannover Re	7468.6168	7357.865	2247.4291	5601.5393	5362.2615	1932.8643	1867.0775	1866.3735	421.02176	7.93933	7.37635	1.6036059	9.96448	9.12835	2.2556351
Hitachi Ltd	1262.9476	1272.8695	288.8991	1185.8576	1261.0065	284.22059	77.09	55.882	90.680438	8.49638	8.76645	1.5309875	8.67151	8.81875	1.440955
Kemper	3134.73	2943.7	522.14375	2066.75	2102.05	186.96155	1067.98	841.65	493.42449	8.59575	8.44935	1.2356714	12.04974	11.5477	2.4018594
Mitsui Sumitomo	1262.9476	1272.8695	288.8991	1185.8576	1261.0065	284.22059	77.09	55.882	90.680438	8.49638	8.76645	1.5309875	8.67151	8.81875	1.440955
Munich Re	31529.2	31207	2880.9787	25638.1	25823	3301.6537	5891.1	5750.5	866.87811	8.37914	8.43396	1.2849331	9.98897	9.41455	1.8025494
Oriental Land Co.	581634.6	561506	5725.1653	412020.8	384042	66786.023	169613.8	161455	80265.063	6.19303	6.5578	1.7765415	7.433	7.24075	2.1615974
QBE Insurance	12969.93	13560	2904.8574	9505.1696	10398	2021.7304	3464.76	3380.3143	1138.1074	9.93873	9.1185	1.8636703	11.19675	11.26355	2.3229982
SWISS RE	50042.128	51736	7303.3499	29266.842	29669.468	5228.839	20775.286	20283	7629.3107	6.53105	5.9458	1.5499533	11.52347	10.9778	4.57772
Tokio Marine	3824618.4	3898781.5	581737.63	2549858.2	2471261	685558.52	1274760.2	1358054.5	565538.4	9.05603	9.1709	1.6013545	14.17895	14.2052	4.2022956
Travelers	31638.7	31342.5	1116.4962	25307.2	25227	1070.6822	6331.5	6347.5	247.0786	8.27775	8.22855	0.8029603	9.47727	9.4485	0.8205819
ZURICH	43841.2	44558	4327.6327	31872.3	33072.5	4568.0865	11968.9	12210.5	758.27384	8.54058	8.4515	1.6220219	10.81074	10.89555	2.1850138

THE SOURCE OF THE DATA: BLOOMBERG

**Table 3:** Cat-Bond data<sup>11</sup> [Appendix 2]

Variable	Size of CatBond \$m			Expected Claims Loss (CatBond) \$m			CatBond Trigger Prob			CatBond Maturity (years)			CatBond Coupon (or price)		
	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D	Mean	Median	S.D
<b>AIG US EQUITY</b>	165.625	132.5	85.667026	2.7639375	1.957	2.0354625	0.0205125	0.01635	0.0087553	3	4	2	0.064375	0.065	0.0108356
<b>ARGOLIN Equity</b>	74.4	75	30.648002	3.4803	3.765	1.8796387	0.04785	0.05265	0.0268574	4	5	2	0.1325	0.12	0.0401559
<b>ASSURANT</b>	68.333333	75	29.047375	1.0653333	1.014	0.3668836	0.0369429	0.0233	0.0144091	3	3	0	0.077	0.08	0.043901
<b>Catlin Group Ltd</b>	167.9	137.5	94.880732	5.805125	1.748125	9.114585	0.0349286	0.014	0.053528	3	3	0	0.0656429	0.0695	0.037365
<b>Chubb Group</b>	145.41667	125	81.755131	1.887	1.512	0.7647316	0.020025	0.01515	0.0173531	4	4	1	0.0600833	0.06125	0.0357655
<b>Dominion Resources</b>	50	50	0	0.67	0.67	0	0.028	0.028	0	1	1	0	0.025	0.025	0
<b>East Japan Railway Company</b>	260	260	0	1.222	1.222	0	0.0071	0.0071	0	5	5	0	0.0275	0.0275	0
<b>EDF</b>	115.4	104.95	33.780107	2.03183	1.3583235	2.4170159	0.04715	0.04715	0.0210011	5	5	1	0.050925	0.04825	0.0323051
<b>Endurance Specialty</b>	78	60	41	1	1	1	0.0171667	0.0149	0.0089187	2	2	0	0.0783333	0.08	0.0028868
<b>Everest Re</b>	315	300	114.01754	7.425	7.3	4.49054	0.03302	0.0226	0.0174932	4	4	0	0.058	0.0475	0.0222486
<b>Firestone Re</b>	77	75	14.832397	2.7459	2.375	1.3093136	0.03195	0.03195	0.01492	4	4	1	0.12406	0.1231	0.0288959
<b>Hannover Re</b>	252.5175	265	88.992413	3.6535729	2.37	2.0969616	0.0173667	0.01805	0.0072398	3	3	0	0.0512857	0.0525	0.0126914
<b>Hiscox Ltd</b>	33	33	0	0.3762	0.3762	0	0.0155	0.0155	0	3	3	0	0.0675	0.0675	0
<b>Kemper</b>	100	100	0	0.5	0.5	0	0.012	0.012	0	3	3	0	0.0369	0.0369	0
<b>Mitsui Sumitomo</b>	130	90	50.33223	1.365	0.954	0.57514	0.0171	0.0113	0.0033486	5	5	0	0.0375	0.0315	0.0041633
<b>Munich Re</b>	91.309048	100	43.395611	1.8112408	1.686896	1.3247081	0.0268889	0.0236	0.0112751	3	3	1	0.0635368	0.065	0.0328531
<b>Oriental Land Co.</b>	100	100	0	0.42	0.42	0	0.0062	0.0062	0	5	5	0	0.031	0.031	0
<b>QBE Insurance</b>	250	250	0	3.375	3.375	0	0.0152	0.0152	0	4	4	0	0.0375	0.0375	0
<b>SWISS RE</b>	59.093741	50	49.340339	1.6920479	0.95	2.431381	0.0352885	0.0245	0.0351941	3	2	1	0.0985267	0.075	0.0801973
<b>Tokio Marine</b>	179	200	88.769364	1	0	1	0.00928	0.0041	0.0085183	4	4	1	0.03236	0.025	0.0147859
<b>Travelers</b>	308.33333	275	97.039511	2.8705	2.7215	0.8983827	0.01139	0.01128	0.002446	3	3	1	0.05	0.05375	0.009083
<b>ZURICH</b>	172.81667	190	77.9269	2.2799317	1.596	2.0053233	0.0376167	0.01835	0.0090572	3	3	1	0.0659167	0.07125	0.0165542

SOURCE OF DATA : DR MADHU ACHARYAH

**Table 4:** Optimised Cat-Bond (Appendix 3)

Variable	CAT-BOND SIZE	TOTAL EQUITIES	SHOT DEBT-LONG DEBT	OPTIMISED CAT-BOND AND THE OTHER CAPITAL COMPONENTS						CAT-BOND TO EQUITY	CAT-BOND TO DEBTS	CAT-BOND TO EQUITY	CAT-BOND TO DEBTS
				original size of cat bond	original debts	original equities	RATIO	RATIO	RATIO				
<b>Indicator</b>	<b>optimised</b>	<b>optimised</b>	<b>optimised</b>	<b>mean</b>	<b>mean</b>	<b>mean</b>	<b>RATIO</b>	<b>RATIO</b>	<b>RATIO</b>	<b>RATIO (OPTIMISED)</b>	<b>RATIO (OPTIMISED)</b>	<b>RATIO (OPTIMISED)</b>	<b>RATIO (OPTIMISED)</b>
AG US EQUITY	165.625	99991.5	108557.9	165.625	108557.9	99991.5	0.001656391	0.001525684	0.001656391	0.001525684	#DIV/0!	0.001525684	0.001525684
ARGOLIN Equity	74.4	33.861	0	74.4	0	33.861	2.197218038	#DIV/0!	2.197218038	2.197218038	#DIV/0!	2.197218038	#DIV/0!
ASSURANT	68.333333	4586.286	1085.2712	68.333333	1085.2712	4586.286	0.014899492	0.062964293	0.014899492	0.062964293	0.014899492	0.062964293	0.062964293
Callin Group Ltd	167.9	3201.891667	182.260778	167.9	182.26078	3201.8917	0.001656391	0.921207525	0.001656391	0.921207525	0.052437752	0.921207525	0.921207525
Chubb Group	145.41667	15188.66667	3511.222222	145.41667	3511.2222	15188.667	0.009574024	0.041414829	0.009574024	0.041414829	0.009574024	0.041414829	0.041414829
Dominion Resources	50	11701.4	20890.9	50	20890.9	11701.4	0.0042727993	0.002393387	0.0042727993	0.002393387	0.0042727993	0.002393387	0.002393387
East Japan Railway Company	260	1834745.5	3480480.5	260	3480480.5	1834745.5	0.000141709	7.47023E-05	0.000141709	7.47023E-05	0.000141709	0.0000747023	0.0000747023
EDF	115.4	33400.1	48390.7	115.4	48390.7	33400.1	0.003455079	0.002384756	0.003455079	0.002384756	0.003455079	0.002384756	0.002384756
Endurance Specialty	78	2917.0417	514.367	78	514.367	2917.0417	0.026739419	0.151642699	0.026739419	0.151642699	0.026739419	0.151642699	0.151642699
Everest Re	315	6424.2665	864.0969	315	864.0969	6424.2665	0.049032835	0.364542449	0.049032835	0.364542449	0.049032835	0.364542449	0.364542449
Flagstone Re	77	1135.3645	234.787	77	234.787	1135.3645	0.06781963	0.327956829	0.06781963	0.327956829	0.06781963	0.327956829	0.327956829
Hannover Re	252.5175	5601.5393	1867.0775	252.5175	1867.0775	5601.5393	0.045080019	0.135247466	0.045080019	0.135247466	0.045080019	0.135247466	0.135247466
Hiscox Ltd	33	1185.8576	77.09	33	77.09	1185.8576	0.027827962	0.428071086	0.027827962	0.428071086	0.027827962	0.428071086	0.428071086
Kemper	100	2066.75	1067.98	100	1067.98	2066.75	0.048385146	0.093634712	0.048385146	0.093634712	0.048385146	0.093634712	0.093634712
Mitsui Sumitomo	130	1185.8576	77.09	130	77.09	1185.8576	0.109625304	1.686340641	0.109625304	1.686340641	0.109625304	1.686340641	1.686340641
Munich Re	91.309048	25638.1	5891.1	91.309048	5891.1	25638.1	0.003561459	0.01549949	0.003561459	0.01549949	0.003561459	0.01549949	0.01549949
Oriental Land Co.	412020.8	283721.4904	169613.8	100	169613.8	412020.8	0.000242706	0.000589575	0.000242706	0.000589575	1.452201592	2.429170268	2.429170268
QBE Insurance	250	9505.16962	3464.76	250	3464.76	9505.1696	0.026301477	0.07215507	0.026301477	0.07215507	0.026301477	0.07215507	0.07215507
SWISS RE	20775.286	20775.28669	59.09374101	59.093741	20775.286	29766.842	0.002019136	0.002844425	0.002019136	0.002844425	1	351.5648092	351.5648092
Tokio Marine	5020268.1	2200970.095	1728845.631	179	172760.2	2549858.2	7.02E-05	0.000140419	2.280934274	2.280934274	2.280934274	2.903826713	2.903826713
Travelers	308.33333	25307.2	6331.5	308.33333	6331.5	25307.2	0.012183621	0.048698307	0.012183621	0.048698307	0.012183621	0.048698307	0.048698307
ZURICH	172.81667	31872.3	11968.9	172.81667	11968.9	31872.3	0.005422159	0.014438809	0.005422159	0.014438809	0.005422159	0.014438809	0.014438809





## Greenium: Myth or Reality - Do Green Bonds have Lower Yields?

MILO IVANCEVIĆ

**Abstract** This paper investigates the yields of green and brown bonds by employing regression analysis and controlling for the sector and several other conventional variables that may influence yield. The study is conducted on a sample of over 5,000 bonds, with more than 650 green bonds. All bonds are collected from the investment grade government, supranational, and/or corporate bond universe, issued in currency EUR. The study results showed that there is no significant difference between the yields on green and conventional bonds, for the government and corporate sector. For these sectors, green and conventional bonds are seen as perfect substitutes. However, green bonds of supranational institutions seem to have significantly lower yields than conventional bonds.

**Keywords:** • green bonds • yields • greenium • conventional bonds

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## 1 Introduction

Green bonds, as novel financial instruments, are gaining increasing attention in both professional and academic discourse. Green bonds are fixed income instruments, quite similar to conventional bonds. Same as with conventional bonds, an issuer of a green bonds is obligated to repay the principal at maturity, known as face value, and periodical coupons. The only difference between the two is that money collected from green bonds is to be used for projects, assets, and business activities that are considered to be “green“, i.e. to have a positive effect on the environment (Ketterer et al, 2019). Other actors and financial institutions in the international financial market engage in these transactions as they wish to be responsible, but also to signal their green orientation. Due to these differences, there are anecdotal claims, especially among practitioners, that the yields of green bonds are lower than those of conventional bonds.

This study aims to evaluate if the positive effects resulting from the Corporate Social Responsibility and/or Environmental, Social and Governance orientation of companies have any additional benefit for investors in the international financial market. That is, the study will raise the question if investors, while evaluating different asset classes, implement sustainability in this process, besides the core variables of financial assets such as risk and return. The premium that is achieved by green bonds over conventional bonds with the same characteristics is recognized as “greenium“ (i.e. green premium) (Alessi et al, 2019). On that note, Fama and French (2007) suggested that tastes and disagreements could affect asset prices, and that investors do not hold and value their assets only based on the expected payoffs. Moreover, these effects are not only temporary but, in contrast to conventional economics, they could persist in the long term.

In order to achieve the goal of investigating the potential difference in yields between green and conventional bonds, the study analysed a sample of over 5,000 bonds from the government, supranational, and/or corporate sector. About 15% of bonds in the sample are recognized as green bonds. The research used a quantitative method, that is, regression analysis in which the yield is regressed on a number of variables. The dummy variable is used for the qualitative characteristic of bond being green, in order to evaluate if there is any effect of this variable on the yields of different bonds. The following chapter will depict some of the main theoretical and empirical studies on the topic, followed by the methodological considerations and analysis of results. A discussion of the crucial results will be presented at the end of this study.

## 2 Literature review

The first green bond was issued by the European Investment Bank (EIB) in 2007, with a tenor of 5 years and it amounted to 600 million euros (Fatica et al, 2021). Afterward, the issuance of green bonds on the international financial market was on a constant rise. According to the Climate Bond Initiative (CBI, 2022) in 2021, the total amount of green bond issuance was almost 600 billion USD, which is almost double the figure from a year

before (in 2020 it was just above 300 billion USD). The highest amount is issued in currency EUR (248 billion), followed by USD (152 billion), and CNY (63 billion). The highest amount of bonds is issued by a corporate sector (non-financials and financials almost equally distributed), to be followed by the governments and government backed entities (CBI, 2022). According to the definition of the CBI, they calculated only bonds that are entirely green, that is, 100% of raised money is used for green purposes. Bearing in mind this immense growth, it is suggested that this topic is highly important in contemporary theoretical and empirical discourse.

Traditionally, the question of calculating bond yields was a technical issue primarily considered by financial statistics (Larsen, 1945). Price is calculated as the discounted value of all future cash flows. However, the discounted rate is not always known, and it should reflect the number of risk factors. Theoretical, but also empirical work suggests that a distinct set of risk factors influence different types of bonds, i.e. government bonds (Poghosyan, 2014), municipal bonds (Hastie, 1972), or corporate bonds (Liu et al, 2009).

Having that in mind, such studies seem to have a similar line of thought, where the bond yields are calculated on the basis of discounting process, while the discount factor includes different types of risks. The thought that there might be greenium, just because of the bond's inherited characteristic of being green, without any reasonable and apparent influence on risk (thus discount factor) seems to be an alternative view to this perspective. Thus, if the greenium exists, there might be some other factors that influence the price/yield on the financial market, outside the traditional view of the risk-return model. Such factors could be related to the Fama and French (2007) discussion on the disagreements and tastes in asset pricing. Specifically, this paradigm suggests that investors are engaged in socially responsible investing, a goal beyond profit, and assume certain tastes for asset classes similar to those in consumption goods (Fama and French, 2007). The second line of thought suggests that green bonds have a lower risk compared to conventional bonds (Fama, 1998). This decreased risk comes from regular monitoring of green bond allocation by third parties that should verify their green label (Löffler et al, 2021). Moreover, there is also an increased risk of conventional bonds due to certain climate change risks (e.g. carbon tax, risk of bad reputation from not doing business in a 'green' way, etc.), which ultimately changes the bond risk profile (Löffler et al, 2021). Thus, if the greenium exists there are two possible theoretical explanations. The first one is the tastes of investors differ, resulting in different prices of assets; and the second is that though these assets are similar in a number of contexts, they inheritably have different risk profiles, and consequently they carry different risks.

However, empirical studies examining the effect of green versus conventional bonds on yields, could not be delivered until a sufficient amount of green bonds is issued, enabling researchers to test this with appropriate models and sample size. As a result of the huge growth of green bond issuance, an increasing number of studies on the topic have been conducted in the last few years. Still, it does not seem that researchers made a definite

agreement on green bond yield i.e. if green bonds have lower, higher, or yield that is the same as conventional.

Baker et al (2018) conducted research on the U.S. corporate and municipal bond market, in order to evaluate the difference between green and conventional bonds. Their result suggested that, indeed, there is greenium. According to Baker et al (2018) the yield on green bonds is about 6 basis points lower than the yield on conventional bonds. Based on the panel data of about 200 bonds, Bachelet et al (2019) studied liquidity and premium on green bonds. This study showed lower yield (thus greenium) and higher liquidity of green bonds on the financial market, though this is only the case if the third party verifies the sustainability of a bond. If that is not the case, it seems that investors are penalising potential 'greenwashing' practices, actually resulting in reverse case where green bonds have lower price than conventional bonds. Kapraun et al (2021) investigated greenium on a large number of green bonds and found that the existence of greenium depends on some preconditions. Namely, they found evidence of greenium for bonds of government and supranational entities, and of corporate bonds with large issue size. Authors pointed out that creditability is an important factor for this premium, thus, these are entities that are considered more credible among the investors in their statements of green practices. Zerbib (2019) also found some evidence of the greenium. The author suggested that the premium on green bonds is significant, albeit small, and equals to 2 basis points. However, Zerbib (2019) recognized one of the main limitations of the study. Namely, in order to achieve a higher sample size, the author collected prices and yields also from some not frequently traded bonds. Thus, they might not accurately reflect their fair value, and consequently, it may lead to biased results for the greenium.

The yield difference between green and conventional bonds was also evaluated by Ehlers and Packer (2017). Authors found that at the primary market, green bonds were priced at greenium of about 18 basis points, relative to conventional bonds. However, they also examined the secondary market and found that there is no significant difference between the yields of green and conventional bonds. Likewise, Lau et al (2022) investigated the existence of greenium on, reportedly, one of the largest databases. They found very modest greenium, of only about one basis point. Having said that, the authors claimed that the greenium varies significantly with respect to different individual bonds, and the biggest factor for that is the risk of greenwashing. Hu et al, (2022) investigated the issue on the Chinese bond market. They found the evidence of a large greenium, essentially higher than that found on the international green bond market, both on the primary and the secondary market.

Larcker and Watts (2019) could attest to the claim that there is no consensus on this issue. Namely, these authors suggested that there is no significant difference between the price and yield of green and conventional bonds. If the risk and cash flows are controlled for, the green bond is a perfect substitute for the conventional bond, leaving no room for any form of greenium. That is, authors claim that investors are completely unwilling to trade any wealth in order to invest in sustainable projects (Larcker and Watts, 2019). On the

other hand, Karpf and Mandel (2017) presented opposing results to those that found greenium. Their study on the U.S. municipal bonds showed that the market is penalising green nature of the bond. This means that green bonds have a higher yield than comparable conventional bonds, calculating that the difference is about 8 basis points.

The overall review of the empirical literature suggests no consensus. Some studies found that the greenium is significant and relatively high (Hu et al, 2022; Ehlers and Packer, 2017; Baker et al, 2018), other authors found that this effect is relatively modest to low (Zerbib, 2019; Lau et al, 2022), while some authors claim that the greenium does not exist or it is negative, especially as a result of investors being repulsed by potential greenwashing practices (Larcker and Watts, 2019; Karpf and Mandel, 2017).

### 3 Methodology

In order to investigate the effect of the nature of sustainability of the bonds on the yield, the author of this study develops the standard equation for bond yields implemented by a number of authors in previous studies, such as Karpf and Mandel (2017), Baker et al (2018) or Fatica et al (2021). The study, however, includes a larger set of control variables, in an econometric model as follows:

$$Yield_i = \beta_0 + \beta_1 * Green_i + \beta_2 X_i + \dots + \beta_n X_n + u \quad (1)$$

Where  $Yield_i$  is the variable that represents the yield of each individual bond used in the sample, and  $Green$  dummy variable that takes the value of 1 in the case that the bond is green, and 0 otherwise. Besides these variables, a number of control variables that theoretically could influence the yield is used. Thus, the variables that are used are:

- *Yield*, a dependent variable that represents the yield of each individual bond used in the sample,
- *Green*, binary (dummy) variable that takes the value 1 if the bond is green and 0 otherwise. The sign and significance of this variable is what has been investigated in the study.
- *Duration*, representing modified duration of the bond. This is a measure of risk that represents the change in the value of the bond in the case that the interest rate changes, that is, it measures the sensitivity of the bond to interest rate changes. As such, we expect a positive sign for this variable, having in mind that the higher sensitivity (but also usually longer tenor bonds) requires higher yields in order to be attractive to investors.
- *Coupon*, represents the current period coupon. When the period coupon increases, the price of the bond decreases, meaning that the yield will increase. Thus, coupon is expected to have positive sign.
- *Rating*, this is the variable that quantifies the rating of the bond. Namely, if the bond has a rating of AAA, it has been assigned the highest value (in this study 11), if it has one notch lower rating, AA1, it is assigned a lower number (in this study that is

10), and so on. The lowest rating bond has a rating of BB2. Having in mind that, when the variable rating is increasing, we would expect that the yield is decreasing, thus, expecting a negative sign for this variable.

- *Option*, is the binary variable taking the value of 1 if the bond has a call option, and 0 if it doesn't (that is if the option is plain vanilla – bullet, having in mind that there weren't any bonds with the put option in the sample). One would expect a positive sign with this variable, having in mind that when this option exists, there is a higher risk for investors, which, thus, seek higher yield.
- *SubType*, referring to the subordination type of a bond. This is a quantitative representation of the variable, where it records higher value when the bond is secured and lower numbers when it is subordinated/unsecured (at different levels assigning them different values). Thus, having in mind that the higher number means lower risk for the investor, it will also mean lower yield, suggesting that one can expect a negative coefficient with this variable.
- *FaceValue*, which is a variable that represents the total outstanding value of the bond. It is usually reported that this could be a signal for liquidity of the bond, which results in lower risk with higher face value, suggesting that this variable has a negative sign of the coefficient.
- *AI*, which stands for accrued interest, recording the amount of coupon that is collected from the last coupon period until the date of data collection. The effect of accrued interest on yield is not straightforward, but it is suggested that the higher accrued interest (as cash flow received at present time) carries a lower risk, thus, it would be associated with the lower yield. This means that the accrued interest is expected to have a negative sign of the coefficient.

This study is conducted on a sample consisted of over 5,000 bonds from the investment grade government, supranational, and/or corporate bond universe, issued in EUR currency. About 15% of these bonds are recognized as green bonds, and the remainder just below 85% are conventional bonds. All bonds are collected from six indices of Bank of America, which are:

- GREN – ICE BofA Green Bond Index. This is the only index that is modified for the purpose of this study. Namely, only bonds that are issued in the currency EUR are collected, while those in other currencies (USD, CAD, etc.) are disregarded. This was done because all other bonds are bonds issued in EUR.
- E5AS – ICE BofA 1-10 Year All Euro Government Index, thus, government bond index.
- EB05 – ICE BofA 1-10 Year Euro Financial Index, an index of corporate bonds, where only financial companies are taken into account.
- EQ05 – ICE BofA 1-10 Year Euro Quasi-Government Index, which is an index of supranational institutions.
- EJ00 – ICE BofA Euro Industrials Index, and EK00 – ICE BofA Euro Utility Index, are both indices that are used for non-financial bond evaluation.

Based on that sample, this study will test five forms of the model (1). First will take into account all bonds in the sample, thus, 656 green bonds and 4,653 conventional bonds. Having tested the complete datasets, it seemed necessary also to test different types of bonds and this possible effect on yield. Thus, there were four additional models:

- For government bonds, consisted of 59 green and 254 conventional bonds,
- Supranational bonds, consisted of 125 green and 933 conventional bonds,
- Non-financial corporate bonds, consisted of 297 green and 2,341 conventional bonds, and
- Financial corporate bonds, consisted of 175 green and 1,125 conventional bonds.

Data was collected for the end of the day on 15 September 2022. Moreover, while indices were used to collect bonds and other information on them, each individual bond needed to be checked for non-green indices in order to check it, as bonds in generic indices could also be green bonds.

#### **4 Results of analysis**

Prior to elaborating on the regression results, some of the main descriptive statistics of the variables used in the model will be presented. This is outlined in the table 1-3, showing the mean and standard deviations of some of the main variables for the complete dataset and subsamples. It seems that there are no significant differences in average yields in each of these cases, except with non-financial corporate bonds, where the average yields on the green bonds are higher than the average yields on conventional bonds. Almost as a rule, the average duration of green bonds is higher than the average duration of conventional bonds, except in the case of financial corporate bonds. While average coupons are relatively close, the outstanding value of issuance is more or less similar, except in the case of government bonds, where larger issuance is recorded within green bonds (for other types, larger issuance is higher with conventional bonds). Reviewing the data on subordination type and maturity type, it seems that there are no significant differences between the dataset of green and conventional bonds. One significant difference for average rating seems to be for non-financial bonds. In summary of this segment, it seems that the only difference is a higher average rating of green non-financial corporate bonds (compared to conventional non-financial corporate bonds), but also the higher average yield. Additional regression analysis will shed more light on this issue.

**Table 5:** Descriptive statistics for complete dataset

		<b>Complete dataset</b>	
		Green	Conventional
<b>Count</b>		<b>656</b>	<b>4,653</b>
<b>Yield</b>	<b>Mean</b>	<b>3.353</b>	<b>3.250</b>
	St. Dev.	1.090	1.026
<b>Modified duration</b>	<b>Mean</b>	<b>5.776</b>	<b>4.711</b>
	St. Dev.	4.112	2.930
<b>Coupon</b>	<b>Mean</b>	<b>1.128</b>	<b>1.366</b>
	St. Dev.	1.011	1.171
<b>Outstanding Value</b>	<b>Mean</b>	<b>2,501</b>	<b>1,713</b>
	St. Dev.	6,467	4,407
<b>Accrued interest</b>	<b>Mean</b>	<b>0.501</b>	<b>0.672</b>
	St. Dev.	0.525	0.752
<b>Rating</b>	<b>Mean</b>	<b>5.454</b>	<b>5.617</b>
	St. Dev.	2.750	2.771
<b>Subordination type</b>	<b>Mean</b>	<b>4.738</b>	<b>4.739</b>
	St. Dev.	0.670	0.791
<b>Option</b>	<b>Mean</b>	<b>0.512</b>	<b>0.509</b>
	St. Dev.	0.500	0.500



**Table 6:** Descriptive statistics for government and supranational bonds

		<b>Government bonds</b>		<b>Supranational bonds</b>	
		Green	Conventional	Green	Conventional
<b>Count</b>		<b>59</b>	<b>254</b>	<b>125</b>	<b>933</b>
<b>Yield</b>	<b>Mean</b>	<b>2.249</b>	<b>2.230</b>	<b>2.484</b>	<b>2.489</b>
	St. Dev.	0.638	0.692	0.407	0.664
<b>Modified duration</b>	<b>Mean</b>	<b>5.839</b>	<b>4.731</b>	<b>8.123</b>	<b>4.516</b>
	St. Dev.	5.147	2.533	6.037	2.387
<b>Coupon</b>	<b>Mean</b>	<b>1.512</b>	<b>1.554</b>	<b>0.635</b>	<b>0.881</b>
	St. Dev.	1.721	1.795	0.640	1.134
<b>Outstanding Value</b>	<b>Mean</b>	<b>19,970</b>	<b>15,372</b>	<b>1,336</b>	<b>1,635</b>
	St. Dev.	11,028	11,952	1,793	1,785
<b>Accrued interest</b>	<b>Mean</b>	<b>0.613</b>	<b>0.679</b>	<b>0.292</b>	<b>0.454</b>
	St. Dev.	0.902	1.029	0.335	0.712
<b>Rating</b>	<b>Mean</b>	<b>6.712</b>	<b>6.890</b>	<b>9.224</b>	<b>9.032</b>
	St. Dev.	3.226	3.283	2.116	2.623
<b>Subordination type</b>	<b>Mean</b>	<b>5.000</b>	<b>5.000</b>	<b>5.000</b>	<b>5.009</b>
	St. Dev.	0.000	0.000	0.000	0.139
<b>Option</b>	<b>Mean</b>	<b>0.000</b>	<b>0.000</b>	<b>0.016</b>	<b>0.025</b>
	St. Dev.	0.000	0.000	0.125	0.155

**Table 7:** Descriptive statistics for corporate bonds

		<b>Non-financial bonds</b>		<b>Financial bonds</b>	
		Green	Conventional	Green	Conventional
<b>Count</b>		<b>297</b>	<b>2,341</b>	<b>175</b>	<b>1,125</b>
<b>Yield</b>	<b>Mean</b>	<b>3.771</b>	<b>3.485</b>	<b>3.635</b>	<b>3.623</b>
	St. Dev.	1.065	1.029	0.971	0.844
<b>Modified duration</b>	<b>Mean</b>	<b>5.911</b>	<b>5.173</b>	<b>3.848</b>	<b>3.905</b>
	St. Dev.	3.169	3.423	1.912	1.952
<b>Coupon</b>	<b>Mean</b>	<b>1.304</b>	<b>1.498</b>	<b>1.051</b>	<b>1.449</b>
	St. Dev.	0.812	1.029	1.066	1.196
<b>Outstanding Value</b>	<b>Mean</b>	<b>629</b>	<b>697</b>	<b>621</b>	<b>807</b>
	St. Dev.	233	297	242	402
<b>Accrued interest</b>	<b>Mean</b>	<b>0.596</b>	<b>0.752</b>	<b>0.452</b>	<b>0.684</b>
	St. Dev.	0.485	0.704	0.477	0.769
<b>Rating</b>	<b>Mean</b>	<b>6.016</b>	<b>4.298</b>	<b>4.931</b>	<b>5.244</b>
	St. Dev.	3.269	1.748	1.709	1.859
<b>Subordination type</b>	<b>Mean</b>	<b>4.879</b>	<b>4.940</b>	<b>4.223</b>	<b>4.037</b>
	St. Dev.	0.498	0.428	0.945	1.240
<b>Option</b>	<b>Mean</b>	<b>0.892</b>	<b>0.806</b>	<b>0.394</b>	<b>0.410</b>
	St. Dev.	0.310	0.396	0.489	0.492

**Table 8:** Regression results

	<b>Complete dataset</b>	<b>Government bonds</b>	<b>Supranational bonds</b>	<b>Non-financial bonds</b>	<b>Financial bonds</b>
<b>Constant</b>	<b>5.220***</b> (0.000)	<b>3.037***</b> (0.000)	<b>4.657***</b> (0.000)	<b>6.095***</b> (0.000)	<b>4.457***</b> (0.000)
<b>Green</b>	<b>0.017</b> (0.573)	<b>-0.097*</b> (0.065)	<b>-0.153***</b> (0.001)	<b>0.064</b> (0.211)	<b>-0.006</b> (0.899)
<b>Duration</b>	<b>0.080***</b> (0.000)	<b>0.081***</b> (0.000)	<b>0.046***</b> (0.000)	<b>0.099***</b> (0.000)	<b>0.173***</b> (0.000)
<b>Coupon</b>	<b>0.076***</b> (0.000)	<b>0.031</b> (0.103)	<b>0.061**</b> (0.024)	<b>0.130***</b> (0.000)	<b>0.117***</b> (0.000)
<b>Rating</b>	<b>-0.188***</b> (0.000)	<b>-0.164***</b> (0.000)	<b>-0.140***</b> (0.000)	<b>-0.277***</b> (0.000)	<b>-0.208***</b> (0.000)
<b>SubType</b>	<b>-0.294***</b> (0.000)		<b>-0.217*</b> (0.053)	<b>-0.421***</b> (0.000)	<b>-0.121***</b> (0.000)
<b>Option</b>	<b>0.171***</b> (0.000)		<b>0.843***</b> (0.000)	<b>0.231***</b> (0.000)	<b>0.128***</b> (0.000)
<b>Outstanding Value</b>	<b>-0.028***</b> (0.000)	<b>-0.002</b> (0.263)	<b>-0.021**</b> (0.013)	<b>-0.293***</b> (0.000)	<b>-0.206***</b> (0.000)
<b>AI</b>	<b>-0.057***</b> (0.006)	<b>-0.114***</b> (0.001)	<b>-0.139***</b> (0.001)	<b>-0.039</b> (0.242)	<b>0.020</b> (0.499)
<b>R squared</b>	<b>0.508</b>	<b>0.735</b>	<b>0.471</b>	<b>0.384</b>	<b>0.573</b>
<b>F test (prob.)</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>

Note: \*\*\*, \*\*, \* denote statistical significance at 1%, 5% and 10% level.

The table above depicts the main results of the study, suggesting about the nature of the greenium. As already mentioned, five regression models were tested, the model with the complete dataset, and models with separately (i) government bonds, (ii) supranational bonds, (iii) non-financial corporate bonds, and (iv) financial corporate bonds. These models have the same independent variables, except in the case of government bonds, where all bonds were of the same subordination type and having no call option. One can observe quite different levels of the explanatory power of the model. As such, non-financial bond yields were explained the least, with just above 38% of the variability of yield that is explained. On the other hand, government bond yields were explained quite

comprehensively, where six independent variables are able to explain more than 73% of the variability of yield.

It seems that most of the variables used are statistically significant in most of the models. As such, duration is highly significant in all of the models, with the sign in line with a theoretical explanation. This is also the case with rating, subordination type, accrued interest, and outstanding value (as a signal for liquidity of the bond) that with an increase are reducing risk, thus lowering yield. Variable rating is highly statistically significant and among the most important variables that are affecting yield, supporting some results of previous empirical studies (e.g. Zerbib, 2019). Therefore, all of the control variables are in line with theoretical expectation, while each model, suggested by F stat is highly significant. This could be a good indication that the models used are robust and inferences that are obtained regarding variable of interest - green, sound.

However, reviewing the results for the variable green, it could be seen that in three models this variable is not significant at any conventional level of significance. Moreover, for the model of government bonds, it is significant only at a 10% level of statistical significance. Thus, it could be claimed that for government, non-financial corporate, and financial corporate bonds, yields do not differ significantly between green and conventional bonds. Only for the model of supranational bonds, the variable green is significant and negative. This would mean that green supranational bonds have lower yields than conventional supranational bonds. As an effect, supranational institutions may be in a position to raise money for sustainable projects cheaper than for other projects. Also, these results support the theoretical claims that investors might have certain tastes and attitudes towards certain ways of investing in assets, as suggested by Fama and French (2007). On the other hand, investors might be reluctant to invest in other forms of green bonds (e.g. government or corporate), as they could mistrust the issuer or be afraid of greenwashing.

## 5 Conclusion

The international financial market records the growing amount of green bond issuance. In contrast to conventional bonds, green bonds are used for projects that have “green” agenda. The green and conventional bonds are, for most parts, homogenous, except in their stated purpose, which for green bonds is related to helping to achieve a sustainable environment. This paper examined if there is a greenium i.e., if the price of green bonds is higher than the price of conventional bonds to compensate for this additional benefit, which consequently means they have a lower yield. This would mean that issuers would have lower costs of borrowing for green projects; hence, it would serve as an additional incentive for investing in environmentally friendly projects.

This paper regressed the yields of bonds on a number of variables suggested by the theory, but also included the binary variable denoting if the bond is green or conventional. The study was done on the secondary market collecting the data from the investment grade government, supranational, and/or corporate bond universe, issued in currency EUR.

Results suggest that the government and corporate sector bonds are perfect substitutes, with no significant difference in yields. Greenium is, however, found for supranational institutions, where green bonds have significantly lower yields than their conventional counterpart.

## References:

- Alessi, L., Ossola, E. & Panzica, R. (2019) The Greenium matters: Evidence on the pricing of climate risk, *JRC Working Papers in Economics and Finance*, No. 2019/12, available at: [https://www.eba.europa.eu/sites/default/documents/files/document\\_library/Calendar/Conference-Workshop/2019/8th%20annual%20workshop%20documents/17%20The%20Greenium%20matters%20-%20Evidence%20on%20the%20pricing%20of%20climate%20risk.pdf](https://www.eba.europa.eu/sites/default/documents/files/document_library/Calendar/Conference-Workshop/2019/8th%20annual%20workshop%20documents/17%20The%20Greenium%20matters%20-%20Evidence%20on%20the%20pricing%20of%20climate%20risk.pdf) (October 15, 2022).
- Bachelet, M. J., Becchetti, L. & Manfredonia, S. (2019) The green bonds premium puzzle: The role of issuer characteristics and third-party verification, *Sustainability*, 11(4), <https://doi.org/10.3390/su11041098>.
- Baker, M., Bergstresser, D., Serafeim, G. & Wurgler, J. (2018) Financing the response to climate change: The pricing and ownership of US green bonds, *National Bureau of Economic Research*, No. w25194.
- CBI – Climate Bond Initiative (2022) *Sustainable debt global state of the market 2020*, available at: <https://www.climatebonds.net/market/data/> (October 15, 2022).
- Ehlers, T. & Packer, F. (2017) Green bond finance and certification, *BIS Quarterly Review September*, available at: [https://www.bis.org/publ/qtrpdf/r\\_qt1709h.htm](https://www.bis.org/publ/qtrpdf/r_qt1709h.htm) (October 28, 2022).
- Fama, E. F. (1998) Market efficiency, long-term returns, and behavioral finance, *Journal of financial economics*, 49(3), pp. 283-306.
- Fama, E. F. & French, K. R. (2007) Disagreement, tastes, and asset prices, *Journal of financial economics*, 83(3), pp. 667-689.
- Fatica, S., Panzica, R. & Rancan, M. (2021) The pricing of green bonds: are financial institutions special?, *Journal of Financial Stability*, 54, <https://doi.org/10.1016/j.jfs.2021.100873>.
- Hastie, K. L. (1972) Determinants of municipal bond yields, *Journal of financial and quantitative analysis*, 7(3), pp. 1729-1748.
- Hu, X., Zhong, A. & Cao, Y. (2022) Greenium in the Chinese corporate bond market, *Emerging Markets Review*, 53(C).
- Kapraun, J., Latino, C., Scheins, C. & Schlag, C. (2021) (In-)credibly green: which bonds trade at a green bond premium?, *Proceedings of Paris December 2019 Finance Meeting EUROFIDAI-ESSEC*, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3347337](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3347337) (October 28, 2022).
- Karpf, A. & Mandel, A. (2017) Does it pay to be green?, *SSRN Papers*, available at: [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2923484](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2923484) (October 29, 2022).
- Ketterer, J. A., Andrade, G., Netto, M. & Haro, M. I. (2019) *Transforming Green Bond Markets: Using Financial Innovation and Technology to Expand Green Bond Issuance in Latin America and the Caribbean*, vol. 751 (New York, Washington, D.C.: Inter-American Development Bank).
- Larcker, D.F. & Watts, E.M. (2019) Where's the Greenium, *SSRN Papers*, available at: <https://www.sciencedirect.com/science/article/abs/pii/S0165410120300148> (October 29, 2022).
- Larsen, H. D. (1945) On the Calculation of Bond Yields, *The American Mathematical Monthly*, 52(2), pp. 83-86.

- Lau, P., Sze, A., Wan, W. & Wong, A. (2022) The Economics of the Greenium: How Much is the World Willing to Pay to Save the Earth?, *Environmental and Resource Economics*, 81(2), pp.379-408.
- Liu, S., Shi, J., Wang, J. & Wu, C. (2009) The determinants of corporate bond yields, *The Quarterly Review of Economics and Finance*, 49(1), pp. 85-109.
- Löffler, K. U., Petreski, A. & Stephan, A. (2021) Drivers of green bond issuance and new evidence on the “greenium”, *Eurasian Economic Review*, 11(1), pp. 1-24.
- Poghosyan, T. (2014) Long-run and short-run determinants of sovereign bond yields in advanced economies, *Economic Systems*, 38(1), pp. 100-114.
- Zerbib, O. D. (2019) The effect of pro-environmental preferences on bond prices: Evidence from green bonds, *Journal of Banking & Finance*, 98, pp. 39-60.

## Financial Development, Banking Sector and Economic Growth in BiH: An Empirical Analysis

BRANKA TOPIĆ PAVKOVIĆ, SLAVIŠA KOVAČEVIĆ & DRAGO KURUŠIĆ

**Abstract** Achieving sustainable economic growth is one of the main goals of economic policy in modern countries. As previous research has shown, the development of financial system has a significant influence on economic growth. The importance of the banking sector in developing countries becomes particularly important due to the insufficient evolvent of other parts of the financial system. The subject of this paper is the analysis of the impact of the banking sector of Bosnia and Herzegovina on economic growth in the period from 2000 to 2021. The aim of the study is to quantify this relationship. The regression relationship between the observed variables was tested, as well as the presence of causality. The results show that the increase in total loans granted by the banking sector to companies from the non-financial sector has a direct positive impact on the development of GDP. Namely, a 1% increase in total bank credit to non-financial private sector firms leads to an increase in GDP of about 0.46%.

**Keywords:** • financial development • banking sector • economic growth • capitalisation • liquidity

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## 1 Introduction

Financial development and economic growth, as well as the interdependence between these two categories, can be considered as one of the most important topics in contemporary economic theory. Financial markets help to direct the flow of investment and savings in the economy in ways that facilitate capital accumulation and the production of goods and services. They provide the opportunity to create a sufficient number of transactions necessary for the realization of investment and economic growth (Stiglitz & Weiss, 1983; Diamond, 1984). Recent studies have considered the relationship between the development of the financial system and economic growth, assessing the level of implications of the development of the banking sector and the movement of GDP. In the vast literature, we also find authors who attribute a lesser role to finance in economic growth (Robinson, 1952; Lucas, 1988) or claim that finance is not a factor in economic growth (Shan, 2005), i.e., financial development leads to disturbances in the economy (Wijnberg, 1983; Buffie, 1984).

Since the first relevant study by Goldsmith (1969) pointing out the importance of financial development in the process of economic growth, there have been numerous studies addressing this relationship. King & Levine (1993), looking at the breadth of financial instruments, the relative importance of commercial banks to the central bank, the percentage of credit extended to private firms, and the percentage of credit to private firms to GDP, show that these measures of financial development are strongly related to growth in real GDP per capita. Financial intermediation is positively related to economic growth (Levine, 2000), and Beck et al (2000) show that the breadth of financial intermediation has a positive impact on economic growth via higher productivity, while overall financial development may be positively correlated with economic growth (Neusser & Kugler, 1998; Rousseau & Wachtel, 2002; Malarvizhi et al; 2019).

Achieving stable economic growth requires the coherence of determinants that create the conditions for long-term growth. The development and stability of the financial sector is one of the determinants that constitute an important factor in creating economic growth and increasing the country's GDP level. The financial system, as an integral part of the economic system, plays a key role in the process of allocation of financial resources. The financial system has a complex structure, the elements of which enable the smooth flow of financial resources at the national and global levels.

One of the main pillars of the country's financial system is the banking sector. The importance of the development and stability of the banking sector in developing countries is particularly evident in the underdevelopment of other parts of their financial sector. A sound financial system dominated by the banking sector can influence economic growth. In this paper, we examine the relationship between BiH's banking sector and its impact on economic growth. The period we observe through empirical research covers the period from 2000 to 2021.



The aim of this research is to quantify the relationship between loans granted to companies from the non-financial sector and economic growth. Therefore, the main hypothesis to be proven is: the increase in loans to companies from the non-financial sector increases the economic growth of BiH. It is undeniable that the banking sector in BiH has expanded in terms of number, diversity of activities and provision of financial services. Nevertheless, the role of banking sector development in influencing economic growth is largely under-researched. This study addresses the question of whether banking sector development stimulates economic growth in BiH. Our major contribution to this debate lies in identifying the role that banks play in fostering economic growth.

## 2 Literature overview

Since the first studies pointed out the impact of financial development on economic growth, numerous researches have emerged to address this relationship. There are attempts by authors to explain, through relevant research, the relationship between the financial system of countries and the impact on GDP (Hoshi et al., 1991; Weinstein & Yafeh, 1998; Arestis et al., 2001). Financial structure also has a significant impact on GDP performance, but country characteristics have a unique influence on this relationship (Arestis et al., 2008). This is particularly evident in economies that do not have a developed financial market as a whole, as well as in individual parts of the financial market. In economies where firms exist under conditions of a poorly developed financial market, they rely largely on bank credit to finance further development and output growth. Therefore, Jayaratne (1996) finds that bank loans to firms that do not have access to the broader financial market are engines of growth. Rajan & Zingales (1998) examined the relationship between financial development and specific industries at the industry level. They calculated an index for each industry that observes a specific industry's needs related to finance and concluded that the higher the industry index they constructed, the greater the need for more developed financial markets. The implication of this work is that countries that depend on industries that need financial development need adequate financial development to achieve economic growth.

Most changes in financial markets are aimed at making the role of credit in the economy more efficient (Bernanke et al., 1998). Credit plays an important role in creating economic growth and countries that increase credit to the private sector while taking financial risks achieve faster growth, while such extensive credit policies, especially towards the financial and real estate sectors, can be the cause of financial crises (Bezemer, 2012). Therefore, it is necessary to balance credit policies and unify legal regulations in the banking sector to achieve economic growth. Expansionary credit policies are positively related to economic growth in growing economies (Estrada et al., 2018), while the situation in financially developed economies, which are less unstable, is such that they achieve higher economic growth even in the presence of credit constraints (Aghion et al., 2005). When we talk about credit constraints, credit tightening has similar effects on small

and large firms, but has a negative impact on investment and employment only for small firms (Bottero et al., 2020). Which is somewhat related to Schumpeter's growth theory that small firms are the carriers of economic growth, mainly through innovation, so credit to the population creates funds available to successful entrepreneurs (Lindholm, 1964). However, small businesses have a very difficult time accessing the broader financial markets, with the exception of financing from the banking sector, and for this reason one can conclude why small businesses are more sensitive to credit contractions.

Garcia-Escribando et al. (2015) find that there is a significant effect of credit growth on real economic activity, depending on the type of credit. That is, credit to the private sector affects GDP through investment, while consumer credit is related to private consumption. In relevant studies in this area, the ratio of credit directed to the private sector to GDP is considered as an independent variable when examining the impact of financial development, mainly through commercial bank credit (King & Levine, 1993; Levine, 1997; 2000; Saci et al. al, 2009). Guru & Yadav (2019) examined the relationship between financial sector development and economic growth during the period from 1993 to 1994 using BRICS countries as an example. They included four independent variables in the study: the breadth of financial intermediaries as a percentage of bank liquid assets to GDP, the ratio of commercial banks' assets to deposits increased by central bank assets, the ratio of loans to deposits, and loans to the private sector to GDP. With the application of the dynamic panel model, the authors showed that the previously listed indicators of the development of the banking sector in a positive relationship determine the movement of economic growth, with the significance of the calculated parameters. Grbić & Luković (2020), using Serbia as an example, show that there is a one-way cause-and-effect relationship between the credit activity of banks directed to economic growth. In this work, the authors observed the influence of the share of loans extended to households and the share of loans extended to businesses, and the causal relationship was confirmed in both cases.

Gaytan & Ranciere (2003) show that medium-developed countries need to find an optimal measure of vulnerability to liquidity crises, while underdeveloped and rich countries should develop financial system protection. For this reason, medium-developed countries may face a crisis in the banking sector as they develop. Matei (2020) finds that financial development has a positive impact on growth only in the long run. The empirical results suggest that there is some threshold in the relationship between financial development and economic growth. The impact of financial development on economic growth has a positive effect up to a certain level (Law & Singh, 2014). This has been shown by relevant research in this area (Deida & Fattouh, 2002; Huang & Lin, 2009; Chechetti & Kharroubi, 2012; Arcand et al, 2015; Ductor & Grechyna, 2015; Samargandi et al, 2015; Md & Wei, 2018; Ho & Saadaoui, 2022). while on the other hand, the impact of liquidity has a positive effect on bank assets and liabilities (Diamond & Dybvig, 1983). Berger & Sedunov (2016) find that the impact of liquidity is greater in industries that are more

dependent on banks. The impact of liquidity on growth can be found in relevant studies (Greenwood & Jovanovic, 1990; Bencivenga & Smith, 1991; Levine & Zervos, 1996). The stability of the banking sector contrasts with the banks' expansionary credit policy. The capitalization ratio is an indicator that provides information on the ratio of capital to bank assets. The higher the capital-to-assets ratio, the more restrictive the banking system is in lending. In this way, capital regulation plays an important role in increasing the stability of the financial system (Craig & Koepke, 2012). Increasing capital and property raids have a temporary negative impact on lower investment, consumption, and production, which can lead to short-term recessions (Eickmeier et al., 2018). In this way, economic growth is sacrificed to some extent at the expense of increasing capital in the banking sector (Majcher, 2015). Fraisse et al. (2017) show that a 1% increase in the capitalization rate reduces bank lending by 10%. By reducing bank lending, especially to users that rely on bank credit, such as small businesses, this can lead to a decline in economic growth. An increase in the capitalization rate leads to heterogeneous responses across economic sectors, resulting in a decline in lending for commercial real estate, businesses, and households (Bridges et al., 2014). There is a significant contribution in the literature to the study of the correlation between the financial stability of the banking system through the relationship between capital and bank assets and performance in the real economy (Blum, 1999; Diamond & Rajan, 2002; Kopecky & VanHoose, 2006; Hakenes & Schnabel, 2011; Fratzscher et al, 2016; Gorton & Winton, 2017; Agenor & Pereira da Silva, 2021).

Depending on who plays the main role in financing firms, two models of financial system are distinguished in developed market economies: market-based and bank-based financial systems. This is the traditional approach to classifying financial systems, known as the classical dichotomy (Veysov & Stolbov, 2012). Banks are thought to have an advantage over the securities market in the early stages of economic development when the institutional environment is not efficient enough to support securities market activities (Grbić & Jovanović, 2020).

According to authors Hassan et. al (2017), positive effects on the banking sector in Bosnia and Herzegovina were achieved through the penetration of foreign capital into the banking system, which led to better credit supply and higher quality of banking services. This made it possible to improve the management of banks, increase customer satisfaction, introduce new business technologies, improve the infrastructure of the financial system, and attract foreign direct investment. All this ultimately led to the growth of GDP in BiH.

The stability of the banking system should not be overestimated under conditions of stable economic growth and is even more important for economies in transition. The relationship between the banking system and other economic movements is used by many researchers to define banking stability, as the banking system has a great importance for the overall economy. This is due to the immensely important function of banks as financial

intermediaries. The dependence of other sectors on the banking sector underscores its importance to the overall economy. A stable and healthy banking sector, in conjunction with the balance of public finances, can contribute to the stability and growth of the entire economic system.

In the economic environment of developing countries such as BiH, which is characterised by the underdevelopment of its financial market for securities, the role of commercial banks in the economy plays an important role. These market conditions lead to the fact that banks play a prominent role in the processes of resource allocation, which means that the credit policy of the banking sector becomes a crucial factor influencing the macroeconomic efficiency, economic growth and social development (Bašić & Čurić, 2021).

### **3 The specificity of the banking sector in BiH**

If we look at the financial sector of Bosnia and Herzegovina, we can see that it is predominantly based on commercial banks. The banking sector represents one of the most important components of the modern financial market, mainly because of the volume of assets it holds, especially in developing countries. Therefore, the fundamental characteristic of the financial system in BiH is the dominant position of banks and the banking sector compared to other sectors of the financial system.

The banking sector in Bosnia and Herzegovina is characterized by the activity of a total of 24 banks. Of these, 8 banks are registered in the Republic of Srpska, while 16 banks are registered in the Federation of Bosnia and Herzegovina. In the end of 2021, in financial market of Bosnia and Herzegovina, in the sector of non-banking financial institutions includes, 25 insurance companies and one reinsurance company, 32 investment funds, 4 leasing companies, 26 microcredit organisations, 8 broker companies and 2 stock exchanges (Central Bank of Bosnia and Herzegovina, 2022).

**Figure 1:** Number of Financial Institutions in BiH

<i>Financial institutions in BH</i>	<i>31 December 2020</i>			<i>30 June 2021</i>			<i>31 December 2021</i>		
	<b>FBiH</b>	<b>RS</b>	<b>Total</b>	<b>FBiH</b>	<b>RS</b>	<b>Total</b>	<b>FBiH</b>	<b>RS</b>	<b>Total</b>
<i>Banks*</i>	16	8	24	16	8	24	15	8	23
<i>Investment funds</i>	16	19	35	16	19	35	16	16	32
<i>Insurance and reinsurance companies</i>	12	14	26	12	14	26	12	14	26
<i>Broker's houses</i>	4	4	8	4	4	8	4	4	8
<i>Leasing companies</i>	4	0	4	4	0	4	4	0	4
<i>Microcredit organizations</i>	14	14	28	13	14	27	13	13	26
<i>Stock exchanges</i>	1	1	2	1	1	2	1	1	2
<b>Total</b>	<b>67</b>	<b>60</b>	<b>127</b>	<b>66</b>	<b>60</b>	<b>126</b>	<b>65</b>	<b>56</b>	<b>121</b>

\* *Razvojna banka FBiH is included*

Source: Central Bank of Bosnia and Herzegovina, 2022. Available at: <https://www.cbbh.ba/Content/Read/8>.

The total financial sector assets in Bosnia and Herzegovina in the end of 2021 amounted to KM 43.3 billion, which is higher by KM 2.9 billion or by 7.1% compared to the positions recorded in the end of 2020. The largest share still belonged to banks accounting for 88.4% of the total financial sector assets. Insurance and reinsurance companies accounted for KM 2.3 billion, i.e. 5.4% of the total financial sector assets.

**Figure 2:** The financial sector assets in Bosnia and Herzegovina in the end of 2021

<i>Financial institutions in BH</i>	<i>12/2020</i>		<i>06/2021</i>		<i>12/2021</i>		<i>Assets growth index</i>	
	<i>Assets</i>	<i>Share (%)</i>	<i>Assets</i>	<i>Share (%)</i>	<i>Assets</i>	<i>Share (%)</i>	<i>12.2021/ 12.2020</i>	<i>12.2021/ 06.2021</i>
<i>Commercial banks</i>	35.790,84	88,59	37.040,81	88,61	38.279,64	88,45	106,95	103,34
<i>Investment funds</i>	2.189,48	5,42	2.279,49	5,45	2.326,68	5,38	106,27	102,07
<i>Insurance and reinsurance companies</i>	820,22	2,03	835,29	2,00	943,41	2,18	115,02	112,94
<i>Broker's houses</i>	1.161,03	2,87	1.176,05	2,81	1.246,74	2,88	107,38	106,01
<i>Leasing companies</i>	416,48	1,03	444,70	1,06	458,03	1,06	109,98	103,00
<i>Microcredit organizations</i>	11,64	0,03	13,62	0,03	14,14	0,03	121,52	103,84
<i>Stock exchanges</i>	10,47	0,03	11,03	0,03	10,46	0,02	99,88	94,81
<b>Total for sector</b>	<b>40.400,16</b>	<b>100,00</b>	<b>41.801,01</b>	<b>100,00</b>	<b>43.279,11</b>	<b>100,00</b>	<b>107,13</b>	<b>103,54</b>

Source: Central Bank of Bosnia and Herzegovina, 2022. Available at: <https://www.cbbh.ba/Content/Read/8>.

As the banking sector holds a dominant position in the financial sector of Bosnia and Herzegovina, the situation in this sector is of particular importance for the overall economic development of country. In Table 1, we find the main indicators for the observed period.

**Table 1:** Main indicators of banking sector in BiH (2000-2021.) (Author's adaptation)

Year	Total placed loans (in billions BAM)	Banking sector capital (in billions of BAM)	Total assets of the banking sector (in billions of BAM)	Credit share in GDP	Share of liquid assets in total assets	Capitalization rate
2000	3,02	1,10	4,27	25,59	37,30	25,70
2001	3,34	1,12	5,57	26,41	44,60	20,07
2002	4,28	1,21	6,35	30,70	33,80	19,13
2003	5,12	1,31	7,69	34,86	35,10	16,98
2004	5,93	1,47	9,40	37,05	35,70	15,66
2005	7,54	1,71	11,87	43,87	36,10	14,42
2006	8,81	1,60	14,36	45,36	35,90	11,11
2007	11,50	1,97	19,25	52,50	37,70	10,23
2008	14,14	2,27	20,74	56,58	29,50	10,95
2009	13,68	2,32	20,64	55,23	30,30	11,24
2010	14,15	2,51	20,78	55,81	28,50	12,07
2011	14,90	3,05	21,49	56,86	27,00	14,17
2012	15,54	3,19	21,93	59,34	25,30	14,56
2013	16,03	3,35	23,07	59,93	26,20	14,52
2014	16,47	3,41	24,05	60,33	26,60	14,17
2015	16,87	3,55	24,95	59,00	26,20	14,25
2016	17,20	3,77	26,10	57,53	26,90	14,46
2017	18,42	4,01	28,24	58,72	28,10	14,19
2018	19,49	4,13	30,96	58,26	29,30	13,34
2019	20,77	4,37	33,38	58,85	29,20	13,09
2020	20,35	4,32	33,81	59,40	28,60	12,79
2021	21,08	4,43	36,38	56,86	30,70	12,17

With the introduction of a more efficient system of banking supervision and conditions for independent market operations, the banking sector became the most stable part of the economy of Bosnia and Herzegovina. The greatest changes occurred in the ownership

structure when state property and capital were transferred to private ownership. At the same time, Bosnia and Herzegovina has introduced better administration and the application of new laws based on international standards. For the banking sector, this meant reform, restructuring and consolidation. This was the first step toward its further rapid development.

#### 4 Research

Based on the research objective, i.e., quantifying the relationship between the variables of the banking sector of BiH and economic growth, we have singled out three variables that we will observe. In the relevant literature, the mentioned variables have been recognized as crucial factors for the study of this issue. The empirical analysis that we conduct in the study considers the period from 2000 to 2021. The independent variables in the study are divided into financial variables, while we consider GDP as the dependent variable. The following table provides a specification of the variables that are the subject of the study:

**Table 2:** Specifics of the research variables (Source: Author's presentation)

Variables	Label	Type	Source
Gross domestic product	<i>GDP</i>	Dependent	International Monetary Fund
Total loans of the banking sector to non-financial private companies	<i>CPS</i>	Independent	Central Bank of BiH
Liquidity of the banking sector	<i>LIQUID</i>	Independent	Central Bank of BiH
Market capitalization of the banking sector	<i>CAP</i>	Independent	Central Bank of BiH

The dependent variable *GDP* is observed as the nominal gross domestic product shown in levels, in local currency and the variable *CPS* is the level of bank placements to non-financial companies, also shown in levels and in local currency. The variable *LIQUID* observes the total liquid assets of commercial banks as a percentage of total bank assets and variables *CAP* is the ratio of bank capital of commercial banks to bank assets.

To establish a proportional relationship between GDP and the variables CPS, single linear regression is used, a technique most commonly used to determine the correspondence between two variables when there is a dependent variable and an independent variable. The single linear regression is presented as follows:

$$Y_i = \beta_0 + \beta_1 x_i + e_i, \quad i = 1, 2, \dots, N \quad 1$$

where  $Y_i$  is the dependent variable,  $x_i$  is the independent variable,  $\beta_0$  and  $\beta_1$  are the regression parameters,  $e_i$  is the stochastic term of the regression and where  $N$  is the population size. In our research, we created a single regression model using the data from the sample, which was presented in logarithmic transformation:



$$\log GDP = b_0 + b_1 \log CPS \quad 2$$

where  $b_0$  and  $b_1$  are unknown regression parameters that we estimate from sample data. Using linear regression, we will determine the fitted line with the least square error of the regression against the sampled data to determine the intensity and direction of interdependence between the independent and dependent variables.

## 5 Results and Discussion

In this chapter, we present the results obtained by examining the relationship between banking sector variables and economic growth in BiH. Based on the methodology presented, the following table contains descriptive statistics on the variables we observed during the research:

**Table 3:** Descriptive statistics (Source: Author's calculations)

	GDP	CPS	CAP	LIQUID
Mean	24.50	5.86	14.51	31.30
Median	25.76	7.03	14.17	29.40
Maximum	37.07	9.03	25.70	44.60
Minimum	11.79	0.87	10.22	25.30
Std. Dev.	7.65	2.78	3.49	4.99
Skewness	-0.16	-0.67	1.66	0.91
Kurtosis	1.94	1.92	6.01	3.19
Jarque-Bera	1.12	2.72	18.41	3.11
Probability	0.57	0.25	0.00	0.21
Sum	539.07	12.86	319.24	688.60
Sum Sq. Dev.	1230.53	1.62E+08	256.36	524.44
Observations	22	22	22	22

Among the variables we observe in the study, first we determine the direction in which the observed variables move. In determining the correlation, we use Pearson's correlation coefficient. The correlation results are presented in the following table:

**Table 4:** Correlation matrix (Source: Author's calculations)

	GDP	CPS	CAP	LIQUID
GDP	1	-	-	-
CPS	0.97	1	-	-
CAP	-0.61	-0.76	1	-
LIQUID	-0.74	-0.84	0.42	1

According to the correlation results obtained, we can confirm the existence of a positive linear relationship between GDP and total banking sector loans to non-financial companies in Bosnia and Herzegovina, with a high correlation coefficient of 0.97. The results of the correlation also support an inverse relationship between GDP as an dependent variable in the research and the ratio of capital and assets of the banking sector, i.e., the capitalization of the banking sector and the liquidity of the banking sector in Bosnia and Herzegovina. The correlation coefficient between the movement of capitalization and GDP is -0.61 and between the development of GDP and banking sector liquidity this is -0.74. These results prove the existence of a inverse relationship between the development of GDP, on the one hand, and capitalization and liquidity, on the other. In the correlation matrix, we can also see that there is a multicollinearity between the independent variables capitalization and liquidity and banking sector credit as the third independent variable in the research.

Now we present results demonstrating a linear relationship between total banking sector credit to nonfinancial private firms and economic growth. The relationship, which we tested with statistical software, is expressed in the results of the following table:

**Table 5:** Linear regression results (Source: Author's calculations)

Dependent Variable: LOG(GDP)				
Method: Least Squares				
Date: 08/28/22 Time: 09:37				
Sample: 2000 2021				
Included observations: 22				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.75	0.23	-3.19	0.005
LOG(CPS)	0.46	0.02	16.59	0
R-squared	0.93	Mean dependent var		3.14
Adjusted R-squared	0.92	S.D. dependent var		0.34
S.E. of regression	0.09	Akaike info criterion		-1.83
Sum squared resid	0.17	Schwarz criterion		-1.73
Log likelihood	22.18	Hannan-Quinn criter.		-1.81
F-statistic	275.41	Durbin-Watson stat		0.14
Prob(F-statistic)	0			

Based on the results presented in the previous table, we see a positive relationship between the total number of commercial banks' loans to non-financial companies in the BiH economy and economic growth. As evidenced by the research results, a 1% increase in the banking sector's loans to non-financial companies implies a 0.46% increase in GDP. The coefficient test shows the statistical significance of the estimated linear regression coefficients. The coefficient of determination is 0.932, which means that fluctuations in the change in the level of GDP can be explained by 93.23% changes in the level of total banking sector credit to non-financial firms.

We will test the presence of causality between the independent and dependent variables based on the methodology proposed by Granger (1969). In order to determine the optimal length of the historical values that we will use to test the presence of causality between the observed variables, we will use the VAR model. Based on the VAR model and the information criteria for determining the optimal length of lags, the smallest value of the criteria for choosing the optimal number of lags is considered when testing causality. The results show that using the lag length of the three previous values in the VAR model is optimal, as shown in the following table:

**Table 6:** Selection of the optimal number of previous values (Source: Author's calculations)

VAR Lag Order Selection Criteria						
Endogenous variables: LOG(GDP) LOG(CPS) LOG(LIQUID) LOG(CAP)						
Exogenous variables: C						
Date: 08/28/22 Time: 09:22						
Sample: 2000 2021						
Included observations: 19						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	58.1793	NA	3.92E-08	-5.703085	-5.504255	-5.669435
1	151.2083	137.0954	1.24E-11	-13.8114	-12.81725	-13.64315
2	168.4985	18.20024	1.43E-11	-13.94721	-12.15775	-13.64436
3	221.1914	33.27970*	7.35e-13*	-17.80962*	-15.22484*	-17.37217*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

For the previously estimated VAR model, Appendix 1 provides evidence that there is no autocorrelation for the specified number of layers. Based on the previously established number of optimal lags and the above methodology for testing causality between the time series, in the following table, Granger causality was tested between the observed variables GDP, CAP, CRED and LIQUID and the following results were obtained:

**Table 7:** Results of the causality test (Source: Author's calculations)

Pairwise Granger Causality Tests			
Date: 08/28/22 Time: 09:26			
Sample: 2000 2021			
Lags: 3			
Null Hypothesis:	Obs	F-Statistic	Prob.
LOG(CPS) does not Granger Cause LOG(GDP)	19	0.23826	0.868
LOG(GDP) does not Granger Cause LOG(CPS)		0.05447	0.9825
LOG(LIQUID) does not Granger Cause LOG(GDP)	19	5.12129	0.0165
LOG(GDP) does not Granger Cause LOG(LIQUID)		0.34167	0.7957
LOG(CAP) does not Granger Cause LOG(GDP)	19	4.6504	0.0222
LOG(GDP) does not Granger Cause LOG(CAP)		0.65372	0.5958
LOG(LIQUID) does not Granger Cause LOG(CPS)	19	6.02535	0.0096
LOG(CPS) does not Granger Cause LOG(LIQUID)		1.56339	0.2494
LOG(CAP) does not Granger Cause LOG(CPS)	19	3.06906	0.0589
LOG(CPS) does not Granger Cause LOG(CAP)		4.35068	0.0272
LOG(CAP) does not Granger Cause LOG(LIQUID)	19	7.72309	0.0039
LOG(LIQUID) does not Granger Cause LOG(CAP)		0.90206	0.4687

As the presented results of the causality test show, at 1% significance, it is possible to conclude that the development of capitalization and liquidity in the banking market of BiH causes the development of the domestic product. The nature of the relationship in both cases is unilateral, which means that the development of GDP does not cause the movement of the other two variables. Similarly, the existence of a unilateral causal relationship was confirmed in the case of liquidity development and the movement of loans granted to non-financial companies, where the relationship is also one-sided. The

causal relationship between the evolution of lending and the capitalization rate can be considered two-sided, because based on the F-statistic and probability, we can conclude that there is a two-way influence of these two variables in the sense of Granger causality. There is also a causal relationship in the relationship between capitalization and liquidity, and it is unilateral. In the other cases we tested, the causal relationship between the observed variables was not confirmed.

## 6 Conclusion

Given the fact that the banking sector has a multidimensional impact on the development of the national economy, there has been a significant increase in interest in studying and clarifying the nature of their interconnectedness. The paper focuses on the issue of whether and to what extent the development of the banking sector stimulates economic growth in Bosnia and Herzegovina in the period from 2000 to 2021. The aim of this research was to determine the cause-effect relationship and the intensity of dependence between the quality of the banking sector and economic growth.

The development of the banking sector in Bosnia and Herzegovina was mainly focused on the opening of the banking system to foreign banks. The acquisition of the new banks led to increased competition, which, together with a higher level of prudential supervision, resulted in an overall improvement in the quality of the banking sector's operations. It is undeniable that the banking sector in Bosnia and Herzegovina has expanded in terms of number, diversity of activities and provision of financial services. Due to strong competition, customers have more choices when selecting their bank.

Quantitative analysis has shown that in BiH a strong positive correlation can be expected between the development of the banking sector and the gross domestic product. The obtained results indicate a positive linear relationship between GDP and total banking sector loans to non-financial companies in BiH, with a high correlation coefficient of 0.97. The correlation results also support the existence of a negative relationship between GDP as an dependent variable in the study and the ratio of banking sector capital and assets, i.e. banking sector capitalization and banking sector liquidity in BiH.

The banking sector plays a key role in securing sources of financing for the purpose of economic growth. The research findings are consistent with previous studies and are essential for developing countries such as Bosnia and Herzegovina that seek long-term economic growth. The development of the banking sector increases the value of the entire financial system and helps to ensure financial stability. At the same time, it promotes the development of production and a growing economy.

## References:

- Agénor, P.-R. & Pereira da Silva, L. A. (2021) Capital requirements, risk-taking and welfare in a growing economy, *Journal of Regulatory Economics*, 60, pp. 167-192, <https://doi.org/10.1007/s11149-021-09438-z>.
- Aghion, P., George-Marios, A., Abhijit, B. & Manova, K. (2005) Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment, *NBER Working Paper*, No. 11349, <https://doi.org/10.3386/w11349>.
- Arcand, J. L., Berkes, E. & Panizza, U. (2015) Too much finance?, *Journal of Economic Growth*, 20(2), pp. 105-148, <https://www.jstor.org/stable/44113443>.
- Arestis, P., Demetriades, P. O. & Luintel, K. B. (2001) Financial Development and Economic Growth: The Role of Stock Markets, *Journal of Money, Credit and Banking*, 33(1), pp. 16-41, <https://doi.org/10.2307/2673870>.
- Luintel, K. B., Khan, M., Arestis, P. & Theodoridis, K. (2008) Financial structure and economic growth, *Cardiff Economics Working Papers*, No. E2008/3 (Cardiff: Cardiff University, Cardiff Business School), available at: <https://www.econstor.eu/bitstream/10419/83908/1/558750761.pdf> (September 5, 2022).
- Bašić, D. & Ćurić, P. (2021) Credit policy of banks in the function of developing the economy of Republic of Srpska, *Acta Economica*, 19(34), pp. 225-238, <https://doi.org/10.7251/ACE2134225B>.
- Beck, T., Levine, R. & Loayza, N. (2000) Finance and the sources of growth, *Journal of Financial Economics*, 58(1-2), pp. 261-300, [https://doi.org/10.1016/S0304-405X\(00\)00072-6](https://doi.org/10.1016/S0304-405X(00)00072-6).
- Bencivenga, V. R. & Smith, B. D. (1991) Financial Intermediation and Endogenous Growth, *The Review of Economic Studies*, 58(2), pp. 195-209, <https://doi.org/10.2307/2297964>.
- Berger, A. N. & Udunov, J. (2016) Bank liquidity creation and real economic output, *Journal of Banking & Finance*, 81, pp. 1-19, <https://doi.org/10.1016/j.jbankfin.2017.04.005>.
- Bernanke, B. S. & Blinder, A. S. (1998) Credit, Money, and Aggregate Demand, *American Economic Review*, 78(2), pp. 435-439.
- Bezemer, D. J. (2012) Finance and Growth: When Credit Helps, and When it Hinders, Paper presented at the "Paradigm Lost" INET conference in Berlin, April 12-15.
- Blum, J. (1999) Do capital adequacy requirements reduce risks in banking?, *Journal of Banking and Finance*, 23(5), pp. 755-771, [https://doi.org/10.1016/S0378-4266\(98\)00113-7](https://doi.org/10.1016/S0378-4266(98)00113-7).
- Bošnjak, A., Hassan, A. & James, K. (2017) Analysis of the Banking Sector Performance in Bosnia and Herzegovina, Montenegro and Serbia Before and After the Global Financial Crisis, *Economics, Sciend*, 5(2), pp. 83-101, <https://doi.org/10.1515/eoik-2017-0029>.
- Bottero, M., Lenzu, S. & Mezzanotti, F. (2020) Sovereign debt exposure and the bank lending channel: Impact on credit supply and the real economy, *Journal of International Economics*, 126, <https://doi.org/10.1016/j.jinteco.2020.103328>.
- Bridges, J., Gregory, D., Nielsen, M., Pezzini, S., Radia, A. & Spaltro, M. (2014) The impact of capital requirements on bank lending, *Bank of England Working Paper*, No. 486.
- Buffie, E. F. (1984) Financial repression, the new structuralists, and stabilization policy in semi-industrialized economies, *Journal of Development Economics*, 14(4), pp. 305-322, [https://doi.org/10.1016/0304-3878\(84\)90061-0](https://doi.org/10.1016/0304-3878(84)90061-0).
- Central Bank of Bosnia and Herzegovina (2022) *Comment on Trends in the Sector of Non-banking Financial Institutions*, available at: <https://www.cbbh.ba/home/GetTableAttachment?contentId=7a7c82f1-a559-4f0f-a2c1-673dc88491ee&lang=en> (September 5, 2022).

- Cecchetti, S. & Kharroubi, E. (2012) Reassessing the impact of finance on growth, *BIS Working Papers*, No 381.
- Craig, B. R. & Koepke, M. (2012) *Bank Capitalization*, available at: <https://www.clevelandfed.org/newsroom-and-events/publications/economic-trends/2012-economic-trends/et-20120501-bank-capitalization.aspx> (July 28, 2022).
- Deidda, L. & Fattouh, B. (2002) Non-linearity between finance and growth, *Economics Letters*, 74(3), pp. 339-345, [https://doi.org/10.1016/S0165-1765\(01\)00571-7](https://doi.org/10.1016/S0165-1765(01)00571-7).
- Diamond, D. W. (1984) Financial Intermediation and Delegated Monitoring, *The Review of Economic Studies*, 51(3), pp. 393-414, <https://doi.org/10.2307/2297430>.
- Diamond, D. W. & Dybvig, P. H. (1983) Bank Runs, Deposit Insurance, and Liquidity, *Journal of Political Economy*, 91(3), pp. 401-419, <https://www.jstor.org/stable/1837095>.
- Diamond, D. & Rajan, R. (2002) A theory of bank capital, *Journal of Finance*, 55(6), pp. 2431-2465, <https://doi.org/10.1111/0022-1082.00296>.
- Ductor, L. & Grechyna, D. (2015) Financial development, real sector, and economic growth, *International Review of Economics & Finance*, 37, pp. 393-405, <https://doi.org/10.1016/j.iref.2015.01.001>
- Eickmeier, S., Kolb, B. & Prieto, E. (2018) The Macroeconomic Effects of Bank Capital Requirement Tightenings: Evidence from a Narrative Approach, *CAMA Working Paper*, No. 42/2018, <https://dx.doi.org/10.2139/ssrn.3250499>.
- Estrada, G. E., Erce, A., Park, D. & Rojas, J. (2018) Skewed Credit and Growth Dynamics after the Global Financial Crisis, *ADB economics working paper series*, no. 562.
- Fraisse, H., Lé, M. & Thesmar, D. (2017) The real effects of bank capital requirements, *ESRB Working Paper Series*, No 47.
- Fratzscher, M., König, B. J. & Lambert, C. (2016) Credit provision and banking stability after the great financial crisis: The role of bank regulation and the quality of governance, *Journal of International Money and Finance*, 66, pp. 113-135, <https://doi.org/10.1016/j.jimonfin.2016.02.015>.
- Garcia-Escribando, M. & Han, F. (2015) Credit Expansion in Emerging Markets: Propeller of Growth?, *IMF Working Paper*, No. 2015/212.
- Gaytan, A. & Rancière, R. (2003) Banks, liquidity crises and economic growth, *Economics Working Papers*, 853.
- Goldsmith, R. W. (1969) *Financial Structure and Development* (New Haven Conn: Yale University Press).
- Gorton, G., & Winton, A. (2017) Liquidity provision, bank capital, and the macroeconomy, *Journal of Money, Credit and Banking*, 49(1), pp. 5-27, <https://doi.org/10.1111/jmcb.12367>.
- Granger, C. W. (1969) Investigating Causal Relations by Econometric Models and Cross-spectral Methods, *Econometrica*, 37(3), pp. 424-438, <https://doi.org/10.2307/1912791>.
- Grbić, M. & Luković, S. (2020) The Relationship Between Banks' Credit Activity and Economic Growth: An Empirical Research for the Republic of Serbia, *Industrija*, 48(2), pp. 37-53, <https://doi.org/10.5937/industrija48-27225>.
- Grbic, M. & Jovanovic, D. (2020) Comparative financial systems: Implications for economic growth, *Oditor - casopis za Menadzment, finansije i parvo*, 6(1), pp. 49-65, available at: <https://scindeks.ceon.rs/Article.aspx?artid=2217-401X2001049G> (May 21, 2022).
- Greenwood, J. & Jovanovic, B. (1990) Financial Development, Growth, and the Distribution of Income, *Journal of Political Economy*, 98(5), pp. 1076-1107, <https://www.jstor.org/stable/2937625>.



- Guru, B. K. & Yadav, I. S. (2019) Financial development and economic growth: panel evidence from BRICS, *Journal of Economics, Finance and Administrative Science*, 24(47), pp. 113-126, <https://doi.org/10.1108/JEFAS-12-2017-0125>.
- Hakenes, H. & Schnabel, I. (2011) Capital regulation, bank competition, and financial stability, *Economics Letters*, 113(3), pp. 256-258, <https://doi.org/10.1016/j.econlet.2011.07.008>.
- Ho, S.-H. & Saadaoui, J. (2022) Bank credit and economic growth: A dynamic threshold panel model for ASEAN countries, *International Economics*, 170, pp. 115-128, <https://doi.org/10.1016/j.inteco.2022.03.001>.
- Hoshi, T., Kashyap, A. & Scharfstein, D. (1991) Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups, *The Quarterly Journal of Economics*, 106(1), pp. 33-60, <https://doi.org/10.2307/2937905>.
- Huang, H.-C. & Lin, S.-C. (2009) Non-linear finance–growth nexus, *The Economics of Transition*, 17(3), pp. 439-466, <https://doi.org/10.1111/j.1468-0351.2009.00360.x>.
- Jayaratne, J. & Strahan, P. E. (1996) The Finance-Growth Nexus: Evidence from Bank Branch Deregulation, *The Quarterly Journal of Economics*, 111(3), pp. 639-670.
- King, R. G. & Levine, R. (1993) Finance and Growth: Schumpeter Might be Right, *The Quarterly Journal of Economics*, 108(3), pp. 717-737, <https://doi.org/10.2307/2118406>.
- Kopecky, K. J. & VanHoose, D. (2006) Capital regulation, heterogeneous monitoring costs, and aggregate loan quality, *Journal of Banking and Finance*, 30(8), pp. 2235-2255, <https://doi.org/10.1016/j.jbankfin.2005.07.018>.
- Law, S. H. & Singh, N. (2014) Does too much finance harm economic growth?, *Journal of Banking & Finance*, 41, pp. 36-44, <https://doi.org/10.1016/j.jbankfin.2013.12.020>.
- Levine, R. (1997) Financial Development and Economic Growth: Views and Agenda, *Journal of Economic Literature*, 35(4), pp. 688-726, <https://www.jstor.org/stable/2729790>.
- Levine, R. & Zervos, S. (1996) Stock Market Development and Long-Run Growth, *The World Bank Economic Review*, 10(2), pp. 323-339, <https://www.jstor.org/stable/3990065>.
- Levine, R., Loayza, N. & Beck, T. (2000) Financial intermediation and growth: Causality and causes, *Journal of Monetary Economics*, 46(1), pp. 31-77, [https://doi.org/10.1016/S0304-3932\(00\)00017-9](https://doi.org/10.1016/S0304-3932(00)00017-9).
- Levine, R., Loyaza, N. & Beck, T. (2000) Financial intermediation and growth: Causality and causes, *Journal of Monetary Economics*, 46(1), pp. 31-77, [https://doi.org/10.1016/S0304-3932\(00\)00017-9](https://doi.org/10.1016/S0304-3932(00)00017-9).
- Lindholm, R. W. (1964) Consumer Credit and Economic Growth, *Challenge*, 13(2), pp. 20-22, <https://doi.org/10.1080/05775132.1964.11469764>.
- Lucas, R. E. (1988) On the mechanics of economic development, *Journal of Monetary Economics*, 22(1), pp. 3-42, [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7).
- Majcher, P. (2015) Increased Bank Capital Requirements: Neither Panacea nor Poison, *Procedia Economics and Finance*, 25, pp. 249 – 255.
- Malarvizhi, C. A., Zeynali, Y., Al Mamun, A. & Bin Ahmad, G. (2019) Financial Development and Economic Growth in ASEAN-5 Countries, *Global Business Review*, 20(1), pp. 57-71, <https://doi.org/10.1177/0972150918802684>.
- Matei, I. (2020) Is financial development good for economic growth? Empirical insights from emerging European countries, *Quantitative Finance and Economics*, 4(4), pp. 653-678, <https://doi.org/10.3934/QFE.2020030>.
- Md, Q. & Wei, J. (2018) Investigation of the asymmetric relationship between financial innovation, banking sector development, and economic growth, *Quantit Financ Econ*, 2(4), pp. 952-980, <https://doi.org/10.3934/QFE.2018.4.952>.

- Neusser, K. & Kugler, M. (1998) Manufacturing Growth And Financial Development: Evidence From OECD Countries, *The Review of Economics and Statistics*, 80(4), pp. 638-646.
- Rajan, R. & Zingales, L. (1998) Which Capitalism? Lessons from the East Asian Crisis, *Economics*, <http://dx.doi.org/10.2139/ssrn.137550>.
- Robinson, J. (1952) *The Generalisation of the General Theory and other Essays* (London: Palgrave Macmillan).
- Rousseau, P. L. & Wachtel, P. (2002) Inflation thresholds and the finance–growth nexus, *Journal of International Money and Finance*, 21(6), pp. 777-793, [https://doi.org/10.1016/S0261-5606\(02\)00022-0](https://doi.org/10.1016/S0261-5606(02)00022-0).
- Saci, K., Giorgioni, G. & Holden, K. (2009) Does financial development affect growth?, *Applied Economics*, 41(13), pp. 1701-1707, <https://doi.org/10.1080/00036840701335538>.
- Samargandi, N., Fidrmuc, J. & Ghosh, S. (2015) Is the Relationship Between Financial Development and Economic Growth Monotonic? Evidence from a Sample of Middle-Income Countries, *World Development*, 68, pp. 66-81, <https://doi.org/10.1016/j.worlddev.2014.11.010>.
- Shan, J. (2005) Does financial development 'lead' economic growth? A vector auto-regression appraisal, *Applied Economics*, 37(12), pp. 1353-1367, <https://doi.org/10.1080/00036840500118762>.
- Stiglitz, J. E. & Weiss, A. (1983) Incentive Effects of Terminations: Applications to the Credit and Labor Markets, *The American Economic Review*, 73(5), pp. 912-927, <https://www.jstor.org/stable/1814662>.
- Veysov, A. & Stolbov, M. (2012) Financial System Classification: From Conventional Dichotomy to a More Modern View, *MPRA Paper*, No. 40613.
- Weinstein, D. E. & Yafeh, Y. (1998) On the Costs of a Bank-Centered Financial System: Evidence from the Changing Bank Relations in Japan, *The Journal of Finance*, 53(2), pp. 635-672, <https://www.jstor.org/stable/117364>.
- Wijnberg, S. V. (1983) Interest rate management in LDCs, *Journal of Monetary Economics*, 12(3), pp. 433-452.

## Appendix:

### Annex 1: Autocorrelation test result

The results of the autocorrelation test provide us with the conclusion that the VAR model, on the basis of which we determined the optimal number of previous values when testing Granger causality, is free from the existence of autocorrelation.

VAR Residual Serial Correlation LM Tests						
Date: 08/28/22 Time: 09:24						
Sample: 2000 2021						
Included observations: 20						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	19.65964	16	0.2359	1.359143	(16, 12.9)	0.2926
2	15.03907	16	0.5218	0.910166	(16, 12.9)	0.577
3	15.88546	16	0.461	0.98479	(16, 12.9)	0.5191
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	19.65964	16	0.2359	1.359143	(16, 12.9)	0.2926
2	NA	32	NA	NA	(32, NA)	NA
3	NA	48	NA	NA	(48, NA)	NA
*Edgeworth expansion corrected likelihood ratio statistic.						



## Financing of Wind Energy Projects in Serbia: Current Status and Future Prospects

ŽELJKO SPASENIĆ, SLADANA BENKOVIĆ & SLADANA SREDOJEVIĆ

**Abstract** In recent years, renewable energy deployment is becoming an important goal for increasing number of countries including Serbia. Owing to an outdated energy infrastructure that is inherited from Socialist Federal Republic of Yugoslavia and a slow pace of energy transition, approximately 66% of Serbia's electricity is still generated by coal-fired power plants. Serbia's energy strategy is oriented toward clean energy, whereby wind energy has increasing role for energy transition. This study investigates the current practice of wind energy project finance in Serbia based on a case study approach. We conclude that significant progress has been made over the last decade. However, future development is strongly dependent on the update of national legislation, energy sector stability and the availability of suitable financing sources to support new projects.

**Keywords:** • renewable energy • energy transition • energy investment • project finance • project risk

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## 1 Introduction

To reduce greenhouse gas emissions and energy dependency, the European Union (EU) and non-EU countries have committed to enhancing energy production from renewable energy sources (RES). According to Eurostat data (2022) the share of energy from RES reached 22% in gross final energy consumption at the EU level in 2020. In Europe, Iceland accounts for the highest RES share (84%) followed by Norway (77%), Sweden (60%) and Finland (44%). At the bottom of RES share in energy consumption are Bulgaria (13%), Hungary (12%) and the Netherlands (11%).

With 17 GW of new wind capacity addition and 236 GW of total wind capacity (207 GW and 28 GW is onshore and offshore wind capacity, respectively) wind energy satisfies 15% of Europe's electricity demand in 2021. Traditionally, wind capacity in Europe is highest in Germany, followed by Spain, the United Kingdom, France, and Sweden. Countries with more than 5 GW installed capacity are Italy, Turkey, the Netherlands, Poland, Denmark, Portugal, and Belgium (WE, 2022a). The size of turbines installed in Europe varies from the average of 2.6 MW in Greece to 5.1 MW in Turkey. The data for the most contributing countries in Europe with the respect to wind energy are presented in table 1.

**Table 1:** Wind capacity in Europe for selected countries (WE, 2022a)

Country	Capacity (GW) in 2021	% of electricity production	Expected capacity (GW) in 2025
Germany	64	23%	85
Spain	28	24%	36
United Kingdom	26,7	22%	42
France	19	8%	31
Sweden	12	19%	19
Italy	11	7%	14
Turkey	11	10%	16
Netherlands	8	15%	13
Poland	7	9%	11
Denmark	6	44%	8
Portugal	6	26%	6
Belgium	5	13%	7

According to Spasenić et al. (2022a), energy infrastructure of post-Yugoslav countries is inherited from Socialist Federal Republic of Yugoslavia, and it was dominantly relied on outdated coal-fired thermal power plants. Consequently, the most of electricity in Serbia is generated from conventional energy sources such as fossil fuels (>68%), followed by RES such as hydropower (27%) and wind (2,5%) while the reminder is produced by

combined heat and power plants and small power plants. Đurašković et al. (2021) emphasized that Serbia has significant RES potential that consist roughly of 63% of biomass, 14% of hydropower, 14% of solar energy, 5% of wind energy and 4% of geothermal energy.

The early research on wind power capacity in Serbia dates back in 2002 and it is conducted for the needs of the Electric Power Industry of Serbia. The research is based on measurements of wind speed from 20 meteorological stations. In 2008, the first *Wind Atlas of Serbia* is prepared by Faculty of technical sciences, University of Novi Sad and it in details covers the territory of Vojvodina (Faculty of Technical Sciences, 2008). According to the *Atlas*, the best wind energy potential exists in Pannonia lowland north from Danube and Sava rivers, East Serbia (Stara planina, Vlasina, Ozren, Rtanj, Deli Jovan, Crni Vrh) and mountain areas in West Serbia (Zlatibor, Kopaonik, Divčibare). Additional study from 2011 focused on 16 potential macro locations and showed that Serbia could produce ~50% of the annual energy needs from RES and stressed that wind energy parks and small hydropower plants are the most cost-effective facilities for RES deployment (Potić et al., 2021). The prevailing conclusion based on conducted studies is that the majority of wind energy potential exist in Vojvodina (North Serbia) and East Serbia (around Municipality of Knjaževac).

Despite significant wind energy potential there are only 8 operational wind power parks in Serbia with total combined capacity of 398 mW. Devreč 1 is the first wind park consisting of only one wind turbine that is installed in Leskova village, municipality of Tutin. The turbine is installed in 2012. The first Serbian wind park that has more than one turbine was built near the city of Kula in 2016 while significant wind capacity is added in 2019 when 3 new parks are constructed.

While there are numerous studies that deal with wind energy potential in Serbia and evolution of national legislation (see Literature review section), the literature is very scarce on current practice related to financing of wind energy projects in Serbia. Following the identified research gap, this study contributes to the existing literature in at least twofold: (i) it offers a detailed overview of the current wind farms in Serbia from the perspective of financing sources used for development and (ii) it confirms the importance and contribution of project finance structure for RES harvest, particularly wind energy, in developing countries.

After the introduction, the reminder of this paper is divided into following four sections; Section 2 is literature review; Section 3 explains the research method in detail; Section 4 analyzes the existing wind energy projects in Serbia according to the chosen criteria; finally, the last section presents conclusions, policy implications and research limitations.

## 2 Literature review

The public company Electric Power Industry of Serbia (EPS) is the trailblazer in wind energy research. The study from 2002 showed that Serbia has considerable potential for wind farms development (Zlatanović, 2009). On contrary, scholarly interest in wind energy potential in Serbia intensified during the last decade.

The research of Golusin et al. (2010) showed that geothermal energy and energy from biomass in Serbia might be considered as priority while other RES are also available for deployment but would require substantial foreign investments that may be attracted by stimulative and updated legislation. Many other studies show that the current potentials for energy production from RES in Serbia, and particularly from wind, are favorable. Micić et al. (2014) and Pekez et al. (2016) confirm that region of Vojvodina has the highest wind power potential. Similar conclusions are derived by Đurišić & Mikulović (2012) who showed that the region of South Banat in Vojvodina has good wind energy potential that must be utilized with future energy infrastructure development. The model that helps investors to choose the optimal micro-location for the installation of wind power plant is developed by Gigović et al. (2017). According to multicriteria optimization model, the authors claim that the most favorable locations are in the vicinity of the Laudonovac village while additional area of 321 km<sup>2</sup> in Vojvodina has considerable potential for the development of wind farms.

While Vojvodina region is undoubtedly in research focus when searching for the most suitable locations for the installation of wind turbines, Potić et al. (2021) combined analytic hierarch process and geographic information system to identify the most appropriate macro sites in Municipality of Knjaževac. Contrary to the results of previous studies, the authors revealed very limited and geographically narrow wind potential to produce energy confirming that Vojvodina has the strongest wind potential in Serbia.

Except obvious positive impacts on energy mix and reduction of greenhouse gas emission, wind energy deployment may cause damage on the environment and society. The possible impacts during the construction and exploitation phase of wind farm with special focus on environmental impact sare analyzed by Josimović & Pucar (2010) and Josimovic et al. (2014). The authors indicated that the greatest impact of wind farms is on the most frequent species of birds flying at critical heights over the area of where wind turbines are installed. Project design (i.e. optimal micro-location of wind turbines within the boundaries of wind park) is of paramount importance to develop environmental friendly plant that is, at the same time, able to maximize energy production.

Legal framework is thoroughly analyzed by Ljubojev et al. (2018). The study is focused on the harmonization of Serbia's legal framework with EU countries as well as RES targets accepted from international documents ratified as a part of EU integration process. Research results show that utilization of wind energy in Serbia is insufficient due to



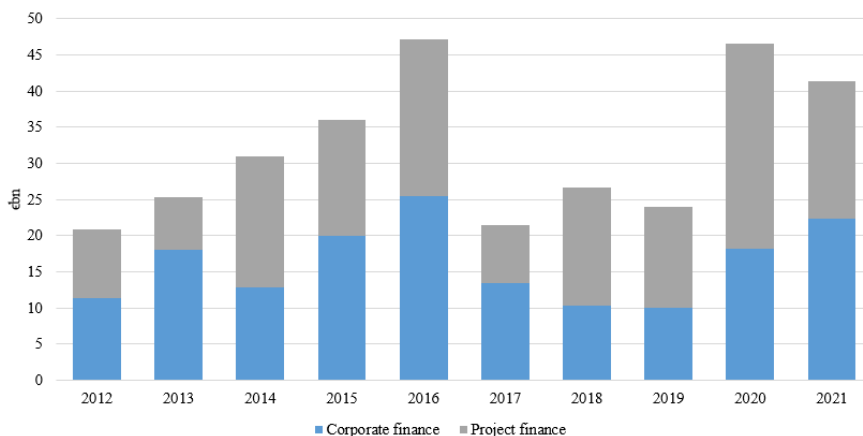
numerous economic, political, and social barriers. The authors believe that there are enough prospective investors, but they are faced with unfavorable investment environment that may be improved only if multidimensional set of measures is employed such as legal and administrative measures, financial measures, awareness raising and permanent education. Certain progress is made during the last decade but significant room for improvement in legislative framework still exist (Sabic et al., 2017).

More recent studies deal with the other aspects of wind energy utilization. Podrascanin & Djurdjevic (2020) analyzed the influence of future climate change on wind energy potential and showed that the annual wind speed will decrease in Serbia compared to period 1971-2000 that was used as a reference. Again, Josimović et al. (2021) stressed the importance of strategic environmental assessment in the early stages of project development to successfully identify and manage environmental risks. While the environmental concerns of wind projects are becoming more important globally (Hamed & Alshare, 2022) in Serbia it seems that other RES such as small hydropower plants are in more severe conflict with the nature (Spasenic et al., 2022; Spasenic et al., 2022a).

Based on literature review it may be concluded that the main research streams are related to the optimal choice of location for wind farm and the evolution and status of national legislation. The study that deals with financing of wind projects is done by Loncar et al. (2017). The authors employed compound real options valuation for investment project appraisal. To the authors best knowledge there are no studies that deal with the current practice of wind energy projects financing in Serbia.

### 3      **Methods**

Two main financing structures for RES projects are corporate finance and project finance (Steffen, 2018). In corporate finance transaction a company raises the capital on its own balance sheet to finance the construction of a wind farm. On contrary, project finance is non-recourse financing that is completely dependent on project performances. It means that the creditor is relied on the revenues generated by a single project as the only source of loan repayment (Spasenić et al., 2022). In Europe, corporate finance accounts for 50-70% of the capital raised for onshore wind farms and 10-30% for offshore wind farms. Generally, offshore wind farms are much larger than onshore wind farms what makes them to be better candidates for project finance. This stands because only minority of prospective developers can obtain the necessary funds on their own balance sheet (Barroco & Herrera, 2019). The share of corporate finance and project finance in financing wind energy projects in Europe is shown in figure 1.

**Figure 1:** Wind corporate and project financing in Europe 2012-2021 (WE, 2022a)

Project finance has increasing contribution to RES financing (Elie et al., 2021; Spasenic et al., 2022b). A typical structure of project finance in Serbian market includes a project company which will be the formal legal owner of the power plant and project finance debtor. Project finance in Serbia may be divided in 4 general phases.

- A. The first phase includes the analysis and final selection of the location for wind farm plant and acquiring all the necessary permits, licenses, and approvals from competent government authorities. The complete set of documents includes, but it is not limited to, technical documentation (feasibility study, conceptual design, and main design), energy permit and construction permit.
- B. The second phase is related to financing. The SPV, which is the owner of previously obtained permits submits a credit request for project financing of the plant. The creditor decision depends on the outcome of credit risk analysis. If project finance is supported the collateral is established on behalf of the creditor – a mortgage on the facility under construction and a pledge on future equipment and receivables. Most commonly, no third parties nor property outside of project structure is offered as collateral.
- C. The third phase includes construction works in compliance with the construction permit. When plant is constructed, an operation permit should be obtained.
- D. The fourth phase is exploitation phase. Upon obtaining operation permit, the investor applies for the status of a privileged power producer and concludes a power purchase agreement. The agreement is pledged on behalf of creditor and the produced electrical power is sold on agreed terms.

The above-described project finance structure in Serbia is in line with the research of Barroco & Herrera (2019) according to which financing in emerging economies may be

considered as project finance only if it meets the following five criteria: (i) there is a project company, (ii) the debtor is project company and not another entity such as mother company or affiliated company, (iii) the loan is non-recourse or limited recourse to related or third parties, (iv) credit collateral is project property, movable and immovable and (v) financing is classified as a project finance by a creditor. In case that some of those conditions are not met, the financing should be considered as corporate finance.

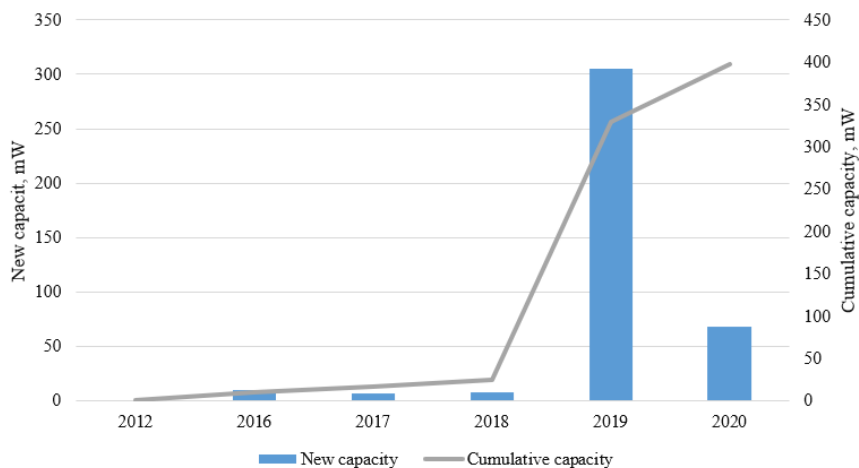
Following the approach of Spasenic et al. (2022a), we applied three out of five criteria defined by Barroco & Herrera (2019) that might be validated based on publicly available data to confirm if financing structure is project finance or corporate finance. *First*, if revenues of an operating plant are generated exclusively from sales of electricity it is strong evidence that the plant is SPV. *Second*, if bank loan is posted as balance sheet liability, we will consider that SPV is debtor. *Finally*, if property (i.e. equipment) and power purchase agreement are pledged by the bank it is concluded that the third condition related to collateral structure is fulfilled. The remaining two conditions (non-recourse or limited recourse nature of the loan and loan classification by the creditor) could not be validated based on publicly available data but, in our opinion, those conditions do not endanger the economic substance of project finance structure.

The main sources of information are: (i) Serbian Business Register Agency that provides comprehensive database of companies, financial statements and notes to the financial statements, pledges over movable property and rights, (ii) <https://www.checkpoint.rs/> platform that provides similar information as Serbian Business Register Agency (because it is used as one of sources) but offers additional set of information such as litigations and its outcomes or the list of issued bills of exchange, (iii) EPS' reports about the incentives paid to privileged electricity producers, (iv) wind energy companies' reports, and (v) articles in press.

## 4 Results

As mentioned above, the first wind park in Serbia is Devreč 1 with one wind turbine and installed capacity of 0,5 mW. The park is operative from 2012. The investor is Hidrowind limited liability company while total investment was ~1 million EUR and it is primarily financed from long term cross border loan – no more details are available. Having in mind that we found no pledges over company's property while there is almost no loan repayment since 2012 it may be concluded that provided loan is quasi equity. The financing structure is more like corporate finance than project finance.

Starting from 2016 there is more investments in wind energy infrastructure. A stronger investment cycle is started by the construction of wind park Kula, followed by La piccolina in 2017, Malibunar in 2018, Kovačica, Alibunar and Čibuk 1 in 2019 while the last project Košava is finished in 2020. New installations and total (cumulative) wind capacity are presented in figure 2.

**Figure 2:** New installations and cumulative wind capacity 2012-2020

Installed capacity of new investments varies from 6,6 mW for La piccolina to 158,5 Mw for Čibuk 1 which is at the moment the largest operative wind farm in Serbia. Consequently, total investment cost varies from 9 million EUR for La piccolina to 300 million euros for Čibuk 1. Applying the criteria defined in previous section yielded to the conclusion that all new wind developments are financed through project finance scheme. Data are summarized in Table 2.

**Table 2:** Financing wind capacities in Serbia

Project	Year	Location	Capacity in mW	Number off turbines	Financing structure	Creditors
Devreč 1	2012	Leskova, Tutin	0,5	1	CF	/
Kula	2016	Kula, Vojvodina	9,9	3	PF	Erste bank
La piccolina	2017	Vršac, Vojvodina	6,6	2	PF	UCI bank
Malibunar	2018	Alibunar, Vojvodina	8,0	4	PF	UCI bank
Kovačica	2019	Kovačica, Vojvodina	104,5	38	PF	Erste group EBRD
VE Alibunar	2019	Alibunar, Vojvodina	42	41	PF	UCI bank IFC
Čibuk 1	2019	Mramorak, Vojvodina	158,5	57	PF	EBRD, IFC
Košava	2020	Izbište, Vojvodina	68	20	PF	Erste group UCI group OeEB

Based on the data presented in table 2 the following conclusions may be derived:

1. The projects are concentrated in Vojvodina while the rest of Serbia remains neglected so far. This is in line with literature review section and findings of existing studies whose research focus is on geographical distribution of wind energy potential in Serbia.
2. All multi-turbine wind parks are financed through project finance structure. All project companies are established as limited liability companies except MK-FINTEL WIND joint stock company that is owner of Košava project.
3. Increasing the project cost that directly depends on project capacity requires involvement of foreign banks and international financing institutions. Local banks were focused on smaller projects (up to 10 mW capacity; up to 15 million EUR investment). Massive project are financed through syndicated loans with involvement of domestic and local banks that are part of the same banking group (Erste group, UniCredit group) and international financing institutions such as European Bank for Reconstruction and Development (EBRD), International Finance Corporation (IFC) and Austrian Development Bank (OeEB).
4. The most active local banks are Erste bank Serbia and UniCredit bank Serbia (UCI). This is in line with recent research that confirm activity of Erste bank and UCI in RES financing (Spasenic et al., 2022; Spasenic et al., 2022a). In Europe, the most active banks/financial institutions are Santander bank, UniCredit bank and ING group.

## 5 Conclusions

Wind farms are efficient way to increase electricity production from RES. Global growth of wind energy deployment did not bypass Serbia. With the aim to attract more investors, Serbia subsidized electricity from RES through a feed-in tariff system with a guaranteed purchase period of 12 years. The model of fixed purchase price is changed by auction model in 2022. As a result of state support and continuous changes in legal framework total installed capacity from wind energy increased from 0,5 mW in 2012 to 398 mW in 2020. Given the relatively underdeveloped financial market, the prevalent source of financing of wind farms are investor's equity contribution and bank loans extended through the project finance scheme.

The overall result of our study is that there is strong potential for energy production from RES that is large enough as substitution for fossil fuels. It is still open to discuss the adequate strategy for RES deployment and RES mix that is optimal for Serbia to provide stable energy supply. However, some challenges for more intensive RES deployment that are immanent to developing countries still remain (Pekez et al., 2016; Sredojevic, 2017; Josimović et al., 2021): (i) understanding of risks, their identification and proper allocation in the project finance structure, (ii) reliability of information and statistics for

RES, (iii) absence of a coherent RES policy, complex and changing legislation and (iv) environmental issues not properly assessed at the early stage of project development.

In the contest of RES financing, it is worth of mentioning the existence of the possibility of the public-private partnerships and concessions. This is a opportunity for the public sector to implement projects of public interest (including capital investment in RES capacities) engaging resources, technology, know-how and capacities of the private sector, of domestic or foreign origin (Sredojevic, 2016; Sredojevic, 2017). However, the further development of such projects is strongly dependent on banks' willingness to provide financial support through project finance scheme (Sredojević, 2016a). Also, certain improvements must be made in legal framework especially in (i) environmental protection, (ii) issuance of construction permits and (iii) adoption of bylaws that will precise and streamline the exploitation of RES.

The study has certain limitations which indicate potential directions for future research. First, the study is focused on wind energy in Serbia. It would be interesting to compare Serbia and neighbor countries with similar development of financial markets and similar availability of financing sources. Second, the study provides general overview of wind energy development in Serbia. Examining RES deployment from the perspective of specific stakeholder (for instance, developers or creditors) would provide valuable insights into the main barriers for future developments. Third, the study is limited to wind energy projects. Future research should analyze other RES project to more reliable predict expected capacity development and financing needs. Fourth, the study is based exclusively on secondary and publicly available data.

## References:

- Barroco, J. & Herrera, M. (2019) Clearing barriers to project finance for renewable energy in developing countries: A Philippines case study, *Energy Policy*, 135, <https://doi.org/10.1016/j.enpol.2019.111008>.
- Đurašković, J., Konatar, M. & Radović, M. (2021) Renewable energy in the Western Balkans: Policies, developments and perspectives, *Energy Reports*, 7, pp. 481–490, <https://doi.org/10.1016/j.egy.2021.07.104>.
- Đurišić, Ž. & Mikulović, J. (2012) Assessment of the wind energy resource in the South Banat region, Serbia, *Renewable and Sustainable Energy Reviews*, 16(5), pp. 3014–3023, <https://doi.org/10.1016/j.rser.2012.02.026>.
- Elie, L., Granier, C. & Rigot, S. (2021) The different types of renewable energy finance: A Bibliometric analysis, *Energy Economics*, 93, <https://doi.org/10.1016/j.eneco.2020.104997>.
- Eurostat (2022) *Share of renewable energy in gross final energy consumption*, available at: [https://ec.europa.eu/eurostat/databrowser/view/T2020\\_RD330/default/table](https://ec.europa.eu/eurostat/databrowser/view/T2020_RD330/default/table) (November 15, 2022).
- Faculty of Technical Sciences, University of Novi Sad (2008) *Wind atlas of Vojvodina* [In: Serbian: Atlas vetrova AP Vojvodine], available at: <http://www.psegs.vojvodina.gov.rs/rs/category/studije/> (November 15, 2022).

- Gigović, L., Pamučar, D., Božanić, D. & Ljubojević, S. (2017) Application of the GIS-DANP-MABAC multi-criteria model for selecting the location of wind farms: A case study of Vojvodina, Serbia, *Renewable Energy*, 103, pp. 501–521, <https://doi.org/10.1016/j.renene.2016.11.057>.
- Golusin, M., Tesic, Z. & Ostojic, A. (2010) The analysis of the renewable energy production sector in Serbia, *Renewable and Sustainable Energy Reviews*, 14(5), pp. 1477–1483, <https://doi.org/10.1016/j.rser.2010.01.012>.
- Hamed, T. A. & Alshare, A. (2022) Environmental Impact of Solar and Wind energy- A Review, *Journal of Sustainable Development of Energy, Water and Environment Systems*, 10(2), pp. 1–23, <https://doi.org/10.13044/j.sdewes.d9.0387>.
- Josimovic, B., Petric, J. & Milijic, S. (2014) The Use of the Leopold Matrix in Carrying Out the EIA for Wind Farms in Serbia, *Energy and Environment Research*, 4(1), <https://doi.org/10.5539/eer.v4n1p43>.
- Josimović, B., Cvjetić, A. & Furundžić, D. (2021) Strategic Environmental Assessment and the precautionary principle in the spatial planning of wind farms – European experience in Serbia, *Renewable and Sustainable Energy Reviews*, 136, <https://doi.org/10.1016/j.rser.2020.110459>.
- Josimović, B. & Pucar, M. (2010) The strategic environmental impact assessment of electric wind energy plants: Case study 'Bavanište' (Serbia), *Renewable Energy*, 35(7), pp. 1509–1519, <https://doi.org/10.1016/j.renene.2009.12.005>.
- Ljubojev, N., Pekez, J. & Radovanovic, L. (2018) Wind energy in Serbia: Harmonization with the legislation of the European Union, *Energy Sources, Part B: Economics, Planning, and Policy*, 13(9–10), pp. 375–382, <https://doi.org/10.1080/15567249.2018.1538270>.
- Loncar, D., Milovanovic, I., Rakic, B. & Radjenovic, T. (2017) Compound real options valuation of renewable energy projects: The case of a wind farm in Serbia, *Renewable and Sustainable Energy Reviews*, 75, pp. 354–367, <https://doi.org/10.1016/j.rser.2016.11.001>.
- Micić, T., Lukić, T., Djordjevic, J., Basarin, B., Bjelajac, D., Hrnjak, I., Marković, S., Djerčan, B., Bubalo-Živković, M., Pavić, D. & Lazić, L. (2014) Determination of wind energy potential and its implementation concept for the electricity market in the Vojvodina region (north Serbia): An overview, *Geographica Pannonica*, 18(1), pp. 6–17, <https://doi.org/10.5937/geopan1401006m>.
- Pekez, J., Radovanovic, Lj., Desnica, E. & Lambic, M. (2016) The increase of exploitability of renewable energy sources, *Energy Sources, Part B: Economics, Planning, and Policy*, 11(1), pp. 51–57, <https://doi.org/10.1080/15567249.2011.580318>.
- Podrascanin, Z. & Djurdjevic, V. (2020) The influence of future climate change on wind energy potential in the Republic of Serbia, *Theoretical and Applied Climatology*, 140(1–2), pp. 209–218, <https://doi.org/10.1007/s00704-019-03086-2>.
- Potić, I., Joksimović, T., Milinčić, U., Kićović, D. & Milinčić, M. (2021) Wind energy potential for the electricity production - Knjaževac Municipality case study (Serbia), *Energy Strategy Reviews*, 33, <https://doi.org/10.1016/j.esr.2020.100589>.
- Sabic, D., Secerov, V., Djordjevic, D. S., Filipovic, D. J., Vujadinovic, S. M. & Djordjevic, A. D. (2017) A review of the effects of wind farm investments on the energy policy of Serbia, *Energy Sources, Part B: Economics, Planning, and Policy*, 12(6), pp. 576–583, <https://doi.org/10.1080/15567249.2016.1248871>.
- Spasenic, Z., Makajic-Nikolic, D. & Benkovic, S. (2022) Integrated FTA-risk matrix model for risk analysis of a mini hydropower plant's project finance, *Energy for Sustainable Development*, 70, pp. 511–523, <https://doi.org/10.1016/j.esd.2022.08.024>.
- Spasenic, Z., Makajic-Nikolic, D. & Benkovic, S. (2022a) Risk assessment of financing renewable energy projects: A case study of financing a small hydropower plant project in Serbia, *Energy Reports*, 8, pp. 8437–8450, <https://doi.org/10.1016/j.egyr.2022.06.065>.

- Spasenic, Z., Milosavljevic, M. & Milanovic, N. (2022b) Project financing of renewable energy projects: a bibliometric analysis and future research agenda, *Fresenius Environmental Bulletin*, 31(8), pp. 7844-7851.
- Spasenić, Ž., Petrović, D. & Benković, S. (2022) Key Success Factors of a Shopping Mall Project: Creditors Perspective in Serbia, *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, <https://doi.org/10.7595/management.fon.2022.0006>.
- Sredojević, S. (2016) Investment opportunities in the field of renewable energy sources in the Republic of Serbia, *Bankarstvo*, no. 4. (2016), pp. 111-133, <https://doi.org/10.5937/bankarstvo1603114S>, available at: <https://scindeks-clanci.ceon.rs/data/pdf/1451-4354/2016/1451-43541604110S.pdf> (October 20, 2022).
- Sredojević, S. (2016a) Rastuća uloga banaka u realizaciji projekata energetske efikasnosti u Republici Srbiji [eng. Growing importance of the role of the banks in energy efficiency projects in the Republic of Serbia], *Bankarstvo*, no. 3 (2016), pp. 114-136, <https://doi.org/10.5937/bankarstvo1603114S>, available at: <https://scindeks-clanci.ceon.rs/data/pdf/1451-4354/2016/1451-43541603114S.pdf> (October 20, 2022).
- Sredojevic, S. (2017) Analysis of the Public-Private Partnership Market in the Western Balkan Region: Lessons Learned and Perspectives, *International Scientific Conference Proceedings on Economic Policy for Smart, Inclusive and Sustainable Growth, 15-17. June 2017* (Belgrade: Faculty of Economics), pp. 193-213.
- Steffen, B. (2018) The importance of project finance for renewable energy projects, *Energy Economics*, 69, pp. 280–294, <https://doi.org/10.1016/j.eneco.2017.11.006>.
- Zlatanović, M. (2009) *The usage of wind energy in Serbia – natural conditions and practical policy* [in Serbian: Korišćenje energije vetra u Srbiji – prirodni uslovi i praktična politika] (Jefferson Institute), available at: <http://envidome.com/wp-content/uploads/2015/11/Korisćenje-energije-vetra-u-Srbiji.pdf> (October 20, 2022).
- WE (2022) Financing and investment trends: The European wind industry in 2021, *Wind Europe*, available at: <https://windeurope.org/intelligence-platform/reports/> (November 15, 2022).
- WE (2022a) Wind energy in Europe: 2021 Statistics and the outlook for 2022-2026, *Wind Europe*, available at: <https://windeurope.org/intelligence-platform/reports/> (November 15, 2022).



## The Loyalty of Internet Banking Users in Serbia

ZENAIDA SABOTIC, SEMIR VEHAPI & AHMEDIN LEKPEK

**Abstract** The subject of this research is the loyalty of users of internet banking services. The aim of the research is to analyze the factors that determine the loyalty of users of internet banking services in Serbia. The research was conducted using a survey, in which a questionnaire was used with questions grouped into six groups according to the number of variables used in the research. The data collected by the survey were processed using descriptive statistical analysis, correlation analysis, and multivariate regression analysis. The research results show that the variables e-Satisfaction, Website Quality, Switching Barriers and Reputation have a statistically significant positive influence on the Loyalty of users of internet banking services, while the influence of e-Trust is not statistically significant.

**Keywords:** • loyalty • internet banking • e-loyalty • Serbia • multivariate regression analysis

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## 1 Introduction

Internet banking arose on the wave of radical changes in business systems that were stimulated by the dynamic development of information technology (Al-Agaga & Nor, 2013). Banks have effectively used the extraordinary opportunities that modern information technologies offer and, with them, have developed numerous distribution channels to expand their client base (Raza, et al., 2020). Thanks to this, bank operations have become more flexible, business costs have been significantly reduced, the range of services has been expanded, and the possibility of shaping services according to the needs of clients has increased (Zhang, Yi & Zhou, 2022). Users of internet banking services can fulfill their requirements much faster and cheaper than traditional banking (Mohammadi, 2014). As a result, internet banking has stood out as one of the most profitable electronic business platforms (Loureiro, 2013).

Clients' loyalty can be as „defined is a deeply held commitment to rebuy or repatronize a preferred product/service consistently in the future, thereby causing repetitive same-brand or same-brand set purchasing, despite the fact that situational influences and marketing efforts have the potential to cause switching behavior“ (Oliver, 1999: 34). Loyal customers are the key strength of any business entity. Loyalty is positively correlated with the frequency and volume of purchases of products and services of the brand to which loyalty is expressed (Rahi & Ghani, 2016). Keeping existing clients and strengthening their loyalty is a key task in cooperation with clients and an important factor in business success. Retaining existing customers is much easier than attracting new ones (Rahi & Ghani, 2016). Attracting new customers can be extremely expensive. Research shows that it takes some time for businesses with newly arrived clients to be profitable precisely because of the high costs of attracting them (Aldas-Manzano, et al., 2011).

Over time, e-loyalty came into focus as a specific form of loyalty of e-product users. The client's e-loyalty represents his favoring of certain providers of e-products from which he buys again and again (Srinivasan, Anderson & Ponnnavolu, 2002; Anderson & Srinivasan, 2003). Given the many benefits that electronic shopping offers, it was thought that customer relationships would be far stronger and healthier as a result (Raza, et al., 2020). However, the easy availability of e-products has, at the same time, making it possible to easily switch e-retailers from which to buy, which ultimately leads to less customer loyalty. Banks also face this challenge regarding internet banking (Aldas-Manzano, et al., 2011). This has led to the situation that the costs of attracting new clients are higher in Internet banking than in traditional banking, as a result of which business with new clients can be unprofitable even for up to three years (Yee & Faziharudean, 2010). A key factor that can make an e-client loyal is the high costs of switching banks whose e-services they use (Rahi & Ghani, 2016). Consequently, through their internet banking services, banks must provide value to clients that they cannot easily give up by choosing another bank, as this would be an unacceptably high switching cost.

The subject of this research is the loyalty of users of internet banking services. The aim of the research is to analyze the factors that determine the loyalty of users of internet banking services in Serbia. The research was conducted using a survey, in which a questionnaire was used with questions grouped into six groups, according to the number of variables used in the research. The data collected by the survey were processed using descriptive statistics, correlation analysis, and multivariate regression analysis. In the continuation of the paper, an overview of the literature is given, the research process is presented, and the results are discussed.

## **2 Literature overview**

Several studies have identified factors influencing brand loyalty in the Internet banking sector. López-Miguens and Vázquez (2017) surveyed Internet banking users in Spain to explain how user loyalty is formed in this sector. On that occasion, they established that e-satisfaction, e-trust, and switching barriers directly affect e-loyalty, with e-satisfaction having the strongest impact. Earlier research conducted in the Spanish-speaking area showed that website perceived reputation and customer satisfaction directly and significantly impact consumer loyalty to the bank's website. In addition, the results emphasized the importance of satisfaction with previous interactions with the website in building its reputation (Casaló, et al., 2008). In their study, Al-Agaga and Nor (2013) point out customer satisfaction and a sense of belonging as factors determining customer loyalty in internet banking. A better understanding of the link between e-satisfaction and e-loyalty in the context of internet banking is provided by Malhotra, et al. (2021) through research conducted in India. According to their results, structural assurance moderates the relationship between e-satisfaction and e-loyalty at the consumer level, while market share regulates the relationship at the bank level.

Ghali (2021) and Chowdhury, et al. (2017) find that e-satisfaction and e-trust play a central role in building e-loyalty in the e-banking sector. Surveying more than 2,000 users of Austrian online banks, Floh and Treiblmaier (2006) identify satisfaction and trust as important antecedents of loyalty. Esmaili et al. (2021) show that satisfaction, trust, and relative advantages significantly influence the loyalty of Iranian consumers to mobile banking. Similar results were obtained by Alonso-Dos-Santos, et al. (2020), which indicates that satisfaction, trust, and use are the variables with the most significant influence on the loyalty of mobile banking users. The significant impact of satisfaction, trust, bank reputation, and commitment on customer e-loyalty towards internet banking was also confirmed in research conducted in Nigeria (Aishatu & Lim, 2017). Moreover, Yee and Faziharudean (2010) prove that reputation has the strongest influence on customer loyalty towards Internet banking websites compared to trust or habit factors. Another factor that is considered important in building consumer satisfaction and loyalty is customer intimacy (Mulia, et al., 2020).

A survey involving only regular users of online banking services in the United Arab Emirates shows that e-quality significantly affects e-satisfaction, which positively and

directly affects e-loyalty. The findings of this study reveal that the relationships between e-quality, e-satisfaction, and e-loyalty are stronger if the online banking user is introverted than extroverted (Al-Hawari, 2014). Malnaad, et al. (2022) researched a sample of Asian users of online banking and found that overall service quality and customer satisfaction are significantly related to customer loyalty. On the sample of online banking users, Garepasha, et al. (2020) prove that online service quality, in the form of utilitarian quality and hedonic quality, has a positive direct and indirect effect on customer loyalty. Shankar and Jebarajakirthy (2019) conducted research in India analyzing the impact of e-banking service quality dimensions on consumer loyalty. The findings showed that reliability, privacy, and security, as dimensions of e-banking service quality, improve loyalty, while website design has no significant impact on loyalty to e-banking.

Raza, et al. (2020) include the following service quality dimensions in Internet banking in their research model: site organization, reliability, responsiveness, user's friendliness, personal need, and efficiency. According to their findings, all the mentioned dimensions positively and significantly affect customer satisfaction, which further significantly and positively affects customer loyalty in Pakistan. Another study was conducted in Pakistan on a larger sample of respondents, which found reliability and website design increased e-banking loyalty, especially during the COVID-19 pandemic (Ul Haq & Awan, 2020). Fragata and Moustakas (2013) tested e-banking loyalty by examining the relationship between major Portuguese banks and their corporate clients. The results of this study identified four main quality dimensions of e-banking portals: assurance, reliability, convenience, and quality monitoring. The same results show that e-banking quality strongly and indirectly affects loyalty while switching costs directly impact e-banking loyalty. Based on surveys of users of mobile banking services in China, Zhou, et al. (2021) confirm the importance of interface design, security assurance, and service quality in mobile banking loyalty intention. Amin (2016), in his research conducted in Malaysia, reveals that personal needs, site organization, user friendliness, and website efficiency are the main determinants of internet banking service quality. The same author proves a significant relationship between internet banking service quality, e-customer satisfaction, and e-customer loyalty. Another study in Malaysia revealed the significance of responsiveness, satisfaction, and reliability in building loyalty in e-banking (Suleiman, et al., 2012). The following study, also conducted in Malaysia, shows that all five dimensions of internet banking service quality (assurance-fulfillment, privacy, contact-responsiveness, website aesthetics, and guide) positively influence e-satisfaction, which further positively influences e-loyalty (Ariff, et al., 2013).

Garzaro, et al. (2021), through a survey of electronic and mobile banking users, found positive effects of interactivity and social presence on brand engagement and a positive relationship between brand engagement, brand experience, satisfaction, and loyalty. The same authors suggest that the effect of social presence on brand engagement is higher for website users than for mobile banking application users. According to Loureiro and Miranda (2011), brand loyalty can be seen as a result of internet banking brand equity, of which the perceived quality of internet banking is a good predictor. Brand loyalty in the

context of online banking was also examined by Ong, et al. (2017). Their study indicates that a clear and consistent virtual brand personality leads to consumer satisfaction and, consequently, greater brand loyalty. In doing so, it was determined that excitement, sophistication, and competence are the dimensions that make up a consumer-based virtual brand personality. Some authors have conducted cross-cultural studies to identify common determinants of e-loyalty. Sampaio, et al. (2017) surveyed a sample of bank customers who experienced service failures from three countries: Brazil, India, and the USA. This research confirmed that the use of banking applications for mobile phones increases consumer satisfaction, which is further a predictor of trust, loyalty, and positive word-of-mouth. Comparing consumer perceptions of the wireless services sector in the national markets of Barbados, Singapore, Turkey, the UK, and the US, Morgeson, et al. (2015) point out: a) the greater importance of quality compared to the value in influencing consumer satisfaction in developed markets; and b) less importance of satisfaction in influencing consumer loyalty in emerging markets.

Based on the given literature review, the following five hypotheses are proposed:

H1: Bank clients' satisfaction with internet banking services positively affects their loyalty.

H2: Clients' trust in internet banking services positively affects their loyalty.

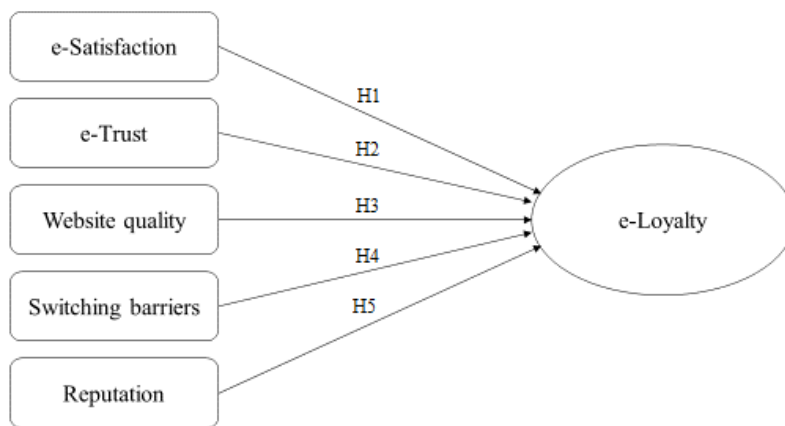
H3: The perceived quality of the bank's website has a positive effect on the loyalty of users of internet banking services.

H4: Switching barriers in the online context have a positive effect on the loyalty of users of internet banking services.

H5: The reputation of the bank's website has a positive effect on the loyalty of users of internet banking services.

The conceptual model illustrated in Figure 1 examines the above hypotheses in the context of Serbia. In developing the conceptual model for this study, we started with the integral model of e-loyalty proposed by López-Miguens and Vázquez (2017). The integral model of e-loyalty in this study is extended so that, in addition to e-satisfaction, e-trust, website quality, and switching barriers, it includes another determinant of e-loyalty, which is the reputation of the bank's website.

**Figure 1:** Conceptual model



Source: Authors.

### 3 Research

The study presented in this paper is based on findings obtained in quantitative research using the survey technique. A structured questionnaire covering two segments was used as an instrument. The first part consists of 31 statements measured on a five-point Likert scale that refer to the observed variables of loyalty of users of internet banking services. Findings from this part of the questionnaire were grouped into six variables and were taken from earlier research by relevant foreign authors (Table 1). The second part of the questionnaire includes four questions about the respondents' demographic characteristics (gender, age, education, and work status).

**Table 1:** Structure of the questionnaire: research variables and their corresponding statements

Variable	Statement	Source
e-Satisfaction	I am satisfied with the transactions processed through internet banking.	Yoon, 2010; Sikdar & Makkad, 2015
	I am satisfied with the services provided by internet banking.	
	I believe that I made the right decision to use internet banking services.	
	I am satisfied with the security aspects of internet banking.	
	The overall experience I have with online banking is satisfactory.	
e-Trust	The online banking site I use usually lives up to its obligations.	Shankar & Jebarajakirthy, 2019; Ul-Haq & Awan, 2020
	Internet banking services respect the current and future interests of users.	
	Internet banking services are equally beneficial for both service providers and service users.	

	My bank has the necessary experience to provide internet banking services.	
	My bank is equipped with the required resources to provide internet banking services.	
Website quality	My bank's website contains useful and accurate information.	<i>López-Miguens &amp; Vázquez, 2017</i>
	The information on the website of my bank is regularly updated.	
	Navigation on the website of my bank is transparent and easy to use.	
	Navigating my bank's website gives me a clear list of products and services.	
	Navigating my bank's website makes it easy for me to find what I want.	
	I find my bank's website visually appealing.	
Switching Barriers	Switching to another bank's internet banking would cause significant financial costs.	<i>López-Miguens &amp; Vázquez, 2017</i>
	I am afraid that the new financial institution will offer me worse internet banking services.	
	By switching to the internet banking of another bank, I would lose the advantages I gained with the existing bank (points, free services,...).	
	By switching to internet banking at another bank, I would lose friendships with the existing bank employees.	
	Changing my online banking would require a lot of effort and time.	
Reputation	The bank whose internet banking services I use has a good reputation.	<i>Aishatu &amp; Lim, 2017; Yee &amp; Faziharudean, 2010</i>
	The bank whose internet banking services I use has a better reputation compared to other competitors.	
	The bank whose internet banking services I use has a good reputation for offering quality services.	
	The bank whose internet banking services I use has a good reputation for good customer relations.	
e-Loyalty	I intend to recommend my bank's internet banking services to others.	<i>Bhat, et al., 2018; Chang &amp; Chen, 2008</i>
	I do not intend to switch to another bank's internet banking services.	
	I like to use the internet banking services provided by my bank.	
	I will also use the new internet banking services if my bank offers them.	
	I prefer my bank's internet banking services compared to services offered by other banks.	
	Whenever I want to do financial transactions, my bank's online banking is my first choice.	

The research was conducted on a convenient sample, and banking clients from Serbia participated in the survey. In order to enable the participation of different groups of respondents and to increase the participation rate, the questionnaire was published online (Google Survey Form) and distributed through various social networks. The entire survey took place in the period 15. 5 – 5. 6. 2021. The final sample included 194 respondents, whose demographic characteristics are shown in Table 2. The results presented in the

following part of the paper were obtained based on descriptive statistics, correlation analysis, and multivariate regression analysis.

**Table 2:** Sample structure

Characteristics of respondents		Number of respondents	% of respondents
Total		194	100
Gender	Male	77	39,7
	Female	117	60,3
Year of Birth	Between 1925-1945.	3	1.5
	Between 1945-1964.	13	6.7
	Between 1965-1978.	51	26.3
	Between 1979-1994.	49	25.3
	Between 1995-2012.	78	40.2
Education	High School	95	49.0
	Higher School (3 years)	14	7.2
	Bachelor's degree (4 years or more)	40	20.6
	Master's degree	33	17.0
	PhD degree	12	6.2
Work status	Full time job	90	46.4
	Temporarily employed	21	10.8
	Unemployed	6	3.1
	Pupil/student	69	35.6
	Pensioner	8	4.1

## 4 Discussion

As part of the research, a descriptive statistical analysis was first conducted on a sample of 122 respondents who declared that they use internet banking services. The arithmetic mean and standard deviation were used for the analysis, the values shown in Table 3. Based on the values shown, it can be established that the respondents have the most favorable attitudes and the highest degree of agreement regarding the statement „*I am satisfied with the transactions processed through internet banking*“ ( $4.43 \pm 0.65$ ). At the same time, the most unfavorable views are expressed regarding the statement that „*By switching to internet banking at another bank, I would lose friendships with the existing bank employees*“ ( $3.06 \pm 1.29$ ). The results of descriptive statistics also point to the conclusion that respondents are highly satisfied with internet banking since the average score for the e-Satisfaction dimension is  $4.3656 \pm .63177$ , as well as that they have a high level of Trust in internet banking services ( $4.2803 \pm .68691$ ), and that they consider the Website quality high ( $4.2172 \pm .73258$ ).



**Table 3:** Descriptive statistical analysis

Statement	Arithmetic mean	Standard deviation
<b>e-Satisfaction</b>		
I am satisfied with the transactions processed through internet banking.	4.4344	.65540
I am satisfied with the services provided by internet banking.	4.4180	.75886
I believe that I made the right decision to use internet banking services.	4.5082	.71865
I am satisfied with the security aspects of internet banking.	4.0984	.89452
The overall experience I have with online banking is satisfactory.	4.3689	.71813
<b>e-Trust</b>		
The online banking site I use usually lives up to its obligations.	4.2377	0.90044
Internet banking services respect the current and future interests of users.	4.1803	.85296
Internet banking services are equally beneficial for both service providers and service users.	4.2377	.76118
My bank has the necessary experience to provide internet banking services.	4.3689	.81515
My bank is equipped with the required resources to provide internet banking services.	4.3770	.82650
<b>Website quality</b>		
My bank's website contains useful and accurate information.	4.3525	.84229
The information on the website of my bank is regularly updated.	4.2623	.87010
Navigation on the website of my bank is transparent and easy to use.	4.2541	.86780
Navigating my bank's website gives me a clear list of products and services.	4.2131	.85502
Navigating my bank's website makes it easy for me to find what I want.	4.2131	.89285
I find my bank's website visually appealing.	4.0082	.88603
<b>Switching Barriers</b>		
Switching to another bank's internet banking would cause significant financial costs.	3.1885	1.21514
I am afraid that the new financial institution will offer me worse internet banking services.	3.2131	1.17290
By switching to the internet banking of another bank, I would lose the advantages I gained with the existing bank (points, free services,...).	3.1639	1.18084
By switching to internet banking at another bank, I would lose friendships with the existing bank employees.	3.0574	1.28757
Changing my online banking would require a lot of effort and time.	3.3525	1.14936
<b>Reputation</b>		
The bank whose internet banking services I use has a good reputation.	4.1639	.88477
The bank whose internet banking services I use has a better reputation compared to other competitors.	3.7295	.90029
The bank whose internet banking services I use has a good reputation for offering quality services.	4.0164	.97050

The bank whose internet banking services I use has a good reputation for good customer relations.	4.0410	.86624
<b>e-Loyalty</b>		
I intend to recommend my bank's internet banking services to others.	4.0574	.99834
I do not intend to switch to another bank's internet banking services.	3.8525	1.18999
I like to use the internet banking services provided by my bank.	4.2295	.86039
I will also use the new internet banking services if my bank offers them.	4.1967	.84930
I prefer my bank's internet banking services compared to services offered by other banks.	3.9426	.85570
Whenever I want to do financial transactions, my bank's online banking is my first choice.	4.2377	.86295

When conducting the research, care was taken to ensure that the measuring scale was reliable and that there was an internal agreement on the scale. The internal consistency of the findings used to measure the research variables was evaluated by looking at Cronbach's alpha coefficient value. The value of this coefficient ranges from 0 to 1, whereby all values above 0.70 are considered acceptable (Pallant, 2011). Cronbach's alpha coefficient values for all variables that make up the conceptual model vary from 0.841 to 0.918 (Table 4). The obtained values are above the threshold value, which indicates adequate reliability and internal consistency of the research variables.

**Table 4:** Reliability analysis

Variable	Cronbach's alpha
e-Satisfaction	0.895
e-Trust	0.883
Website quality	0.918
Switching Barriers	0.875
Reputation	0.841
e-Loyalty	0.862

Correlation analysis was conducted to determine whether there was a relationship between the variables of the baseline model and establish the relationship's direction and strength. In this case, the relationship was investigated using the Pearson coefficient, whose value from 0.1 to 0.29 indicates a correlation analysis was conducted to determine whether there was a relationship between the variables of the baseline model and establish the relationship's direction and strength. In this case, the relationship was investigated using the Pearson coefficient, whose value from 0.1 to 0.29 indicates a weak correlation, from 0.30 to 0.49 to a moderate one. In contrast, a value from 0.50 to 1.0 indicates a strong correlation (Pallant, 2011). The results of the correlation analysis shown in Table 5 prove that almost all values of the Pearson correlation coefficient are statistically significant at the 0.01 and 0.05 level (a statistically significant linear relationship was not established between the e-Satisfaction variables and Switching Barriers,  $p = 0.124$ , as and between the variables Website Quality and Switching Barriers,  $p = 0.158$ ). The highest

degree of linear correlation was established between the variables Reputation and e-Loyalty ( $r = 0.784$ , strong positive correlation), while the lowest degree of correlation is present between the variables Switching Barriers and e-Trust ( $r = 0.200$ , weak positive correlation). Between the other pairs of variables, there is a strong and moderate positive correlation because the Pearson correlation coefficient values between them are more significant than 0.3, correlation, from 0.30 to 0.49 to a moderate one. In contrast, a value from 0.50 to 1.0 indicates a strong correlation (Pallant, 2011). The results of the correlation analysis shown in Table 5 prove that almost all values of the Pearson correlation coefficient are statistically significant at the 0.01 and 0.05 level (a statistically significant linear relationship was not established between the e-Satisfaction variables and Switching Barriers,  $p = 0.124$ , as and between the variables Website Quality and Switching Barriers,  $p = 0.158$ ). The highest degree of linear correlation was established between the variables Reputation and e-Loyalty ( $r = 0.784$ , strong positive correlation), while the lowest degree of correlation is present between the variables Switching Barriers and e-Trust ( $r = 0.200$ , weak positive correlation). Between the other pairs of variables, there is a strong and moderate positive correlation because the Pearson correlation coefficient values between them are more significant than 0.3.

**Table 5:** Correlation matrix

Variable	e-Satisfaction	e-Trust	Website quality	Switching Barriers	Reputation	e-Loyalty
e-Satisfaction	1	0.708**	0.524**	0.124	0.576**	0.686**
e-Trust	0.708**	1	0.716**	0.200*	0.646**	0.693**
Website quality	0.524**	0.716**	1	0.158	0.590**	0.694**
Switching Barriers	0.124	0.200*	0.158	1	0.339**	0.367**
Reputation	0.576**	0.646**	0.590**	0.339**	1	0.784**
e-Loyalty	0.686**	0.693**	0.694**	0.367**	0.784**	1

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

Multivariate regression analysis was used to examine the influence of independent variables (e-Satisfaction, e-Trust, Website Quality, Switching Barriers, and Reputation) on the dependent variable (e-Loyalty). Table 6 and Table 7 summarize the results of the multivariate regression analysis required to test the proposed hypotheses. Multicollinearity was checked based on Tolerance values and VIF coefficient (Variance Increase Factor). The Tolerance value for each variable ranges from 0.499 to 0.877, which is not less than 0.10 as the benchmark significance value, while the VIF coefficient value ranges from 1.141 to 2.004, which is well below the cut-off point of 10. Therefore, there is no problem of multicollinearity between predictor variables. The regression model was formed using the stepwise method, whereby the final model was developed in four steps (the constant in the model is -0.457). The multiple correlation coefficient ( $R$ ) is 0.874,

indicating a strong positive correlation between e-Customer Loyalty and the retained variables (e-Satisfaction, Website Quality, Switching Barriers, and Reputation). The coefficient of determination ( $R^2$ ) is 0.763, which means that in the examined sample, 76.3% of the variance of e-Loyalty of clients is determined by the variance of the set of independent variables found in the final model.

After the multivariate regression analysis, 4 out of 5 variables were retained in the final model. It was shown that e-Satisfaction, Website Quality, Switching Barriers, and Reputation have a statistically significant positive influence on the Loyalty of users of internet banking services ( $p < 0.05$ ). The variable Reputation has the strongest influence on e-Loyalty, because this variable has the highest  $\beta$  value ( $\beta = 0.390$ ,  $p < 0.0005$ ), followed by the variable e-Satisfaction ( $\beta = 0.333$ ,  $p < 0.0005$ ), the variable Web Quality site ( $\beta = 0.280$ ,  $p < 0.0005$ ), while the variable Switching Barriers has the weakest influence ( $\beta = 0.111$ ,  $p = 0.002$ ) (Table 6). Based on the above results, it can be concluded that hypotheses H1, H3, H4, and H5 are confirmed. On the other hand, the obtained results show that the e-Trust variable is excluded from the model, which means that it does not have a statistically significant influence on the Loyalty of users of internet banking services ( $p = 0.919$ ) (Table 7), thus not confirming the hypothesis H2.

**Table 6:** Final stepwise multiple regression model

Independent variables	t	p	B	Beta	Collinearity	
					Tolerance	VIF
Reputation	6,288	0,000	0,390	0,400	0,499	2,004
e-Satisfaction	5,033	0,000	0,333	0,289	0,612	1,633
Website quality	4,864	0,000	0,280	0,282	0,600	1,666
Switching Barriers	3,133	0,002	0,111	0,150	0,877	1,141

\*Dependent variable: *e-Loyalty*.

**Table 7.** Statistics of predictor variables that were excluded from the model

Independent variables	t	p	Beta In	Collinearity	
				Tolerance	VIF
e-Trust	-0,102	0,919	-0,008	0,315	3,172

\*Dependent variable: *e-Loyalty*.

## 5 Conclusions

Internet banking has enabled users of banking services to fulfill their requests with significantly less money, time, and effort. On the other hand, clients have become aware of the possibilities available to them and the ease with which they can replace the bank with which they are currently cooperating with another bank. Accordingly, it can be concluded that the benefits banks provided to clients through internet banking did not make clients more loyal but only more demanding. The depersonalization of the

relationship between the client and the bank, which internet banking inevitably leads to, has significantly reduced the impact of the client's attachment to a specific bank. The client's decision to be loyal to the existing bank or, on the other hand, to use the internet banking services of another bank is primarily influenced by the replacement costs that he would have to bear.

The research conducted in this paper dealt with the influence of selected variables, e-Satisfaction, Website Quality, Switching Barriers, Reputation, and e-Trust, on the Loyalty of users of internet banking services in Serbia. The results of the descriptive statistical analysis show that the users of internet banking services in Serbia are satisfied with the service quality and the websites through which the mentioned services are offered, as well as that they have a high level of trust in this form of banking services. On the other hand, the correlation analysis results show a moderate and strong positive correlation between most pairs of variables. Based on the conducted multivariate regression analysis, it can be concluded that the variables e-Satisfaction, Website Quality, Switching Barriers, and Reputation have a statistically significant positive influence on the Loyalty of users of internet banking services. In contrast, the impact of e-Trust is not statistically significant.

The question of loyalty of internet banking users in Serbia has not been the focus of researchers to a significant extent. The value of this work is that it indicates the importance of this topic, both for researchers who need to take a step further in examining this important factor of the success of internet banking, as well as practitioners who can use the results of the conducted research to strengthen the loyalty of their clients. A better understanding of the relationship between the determinants mentioned above of e-loyalty will help banks maintain long-term relationships with clients and achieve a competitive advantage in their markets. The limitations of the conducted research include a relatively small and suitable sample and the non-use of moderator variables. Recommendations for future research are to expand the sample used and include moderate variables.

## References:

- Al-Hawari, M. A. A. (2014) Does customer sociability matter? Differences in e-quality, e-satisfaction, and e-loyalty between introvert and extravert online banking users, *Journal of Services Marketing*, 28(7), pp. 538-546, <https://doi.org/10.1108/JSM-02-2013-0036>.
- Aishatu, I. O. & Lim, G. C. (2017) Customer Loyalty towards Internet Banking in Nigeria, *Journal of Advances in Economics and Finance*, 2(3), pp. 149-159, <https://dx.doi.org/10.22606/jaef.2017.23001>.
- Al-Agaga, A. M. & Nor, K. M. (2013) Factors that influence e-loyalty of internet banking users, *International Journal of Electronic Commerce Studies*, 3(2), pp. 297-304, <http://dx.doi.org/10.7903/ijecs.1097>.
- Aldas-Manzano, J., Ruiz-Mafe, C., Sanz-Blas, S., & Lassala-Navarre, C. (2011) Internet banking loyalty: evaluating the role of trust, satisfaction, perceived risk and frequency of use, *The Service Industries Journal*, 31(7), pp. 1165-1190, <https://doi.org/10.1080/02642060903433997>.

- Alonso-Dos-Santos, M., Soto-Fuentes, Y. & Valderrama-Palma, V. A. (2020) Determinants of mobile banking users' loyalty, *Journal of Promotion Management*, 26(5), pp. 615-633, <https://doi.org/10.1080/10496491.2020.1729312>.
- Amin, M. (2016) Internet banking service quality and its implication on e-customer satisfaction and e-customer loyalty, *International Journal of Bank Marketing*, 34(3), pp. 280-306, <https://doi.org/10.1108/IJBM-10-2014-0139>.
- Anderson, R. E. & Srinivasan, S. S. (2003) E-satisfaction and e-loyalty: A contingency framework, *Psychology & Marketing*, 20(2), pp. 123-128, <https://doi.org/10.1002/mar.10063>.
- Ariff, M. S. M., Yun, L. O., Zakuan, N. & Ismail, K. (2013) The Impacts of Service Quality and Customer Satisfaction on Customer Loyalty in Internet Banking, *Procedia - Social and Behavioral Sciences*, 81(2013), pp. 469-473, <https://doi.org/10.1016/j.sbspro.2013.06.462>.
- Bhat, S. A., Darzi, M. A. & Parrey, S. H. (2018) Customer Loyalty in Banking Sector: A Mediation Study, *The Journal for Decision Makers*, 43(2), pp. 92-105, <https://doi.org/10.1177/0256090918774697>.
- Casaló, L. V., Flavián, C. & Guinalíu, M. (2008) Towards loyalty development in the e-banking business, *Journal of Systems and Information Technology*, 10(2), pp. 120-134, <https://doi.org/10.1108/13287260810897756>.
- Chang, H. H. & Chen, S. W. (2008) The impact of customer interface quality, satisfaction and switching costs on e-loyalty: Internet experience as a moderator, *Computers in Human Behavior*, 24(6), pp. 2927-2944, <https://doi.org/10.1016/j.chb.2008.04.014>.
- Chowdhury, I. A., Othman, A. S., Bo, Y. & Huey, L. Y. (2017) Driving force of e-loyalty in online banking sector in the context of Malaysia, *International Journal of Social Sciences*, 3(3), pp. 43-65, <https://dx.doi.org/10.20319/pijss.2017.33.4365>.
- Esmaeili, A., Haghgoo, I., Davidaviciene, V. & Meidute-Kavaliauskiene, I. (2021) Customer loyalty in mobile banking: Evaluation of perceived risk, relative advantages, and usability factors, *Inžinerine Ekonomika-Engineering Economics*, 32(1), pp. 70-81, <https://doi.org/10.5755/j01.ee.32.1.25286>.
- Floh, A. & Treiblmaier, H. (2006) What keeps the e-banking customer loyal? A multigroup analysis of the moderating role of consumer characteristics on e-loyalty in the financial service industry, *Journal of Electronic Commerce Research*, 7(2), pp. 97-110, <https://doi.org/10.2139/ssrn.2585491>.
- Fragata, A. & Moustakas, E. (2013) Investigating the Determinants of e-Banking Loyalty for Large Business Customers: Two Empirical Models, *Journal of Economics, Business and Management*, 1(2), pp. 204-208, <https://doi.org/10.7763/JOEBM.2013.V1.44>.
- Garzaro, D. M., Varotto, L. F. & Pedro, S. D. C. (2021) Internet and mobile banking: the role of engagement and experience on satisfaction and loyalty, *International Journal of Bank Marketing*, 39(1), pp. 1-23, <https://doi.org/10.1108/IJBM-08-2020-0457>.
- Garepasha, A., Aali, S., Bafandeh Zende, A. R. & Iranzadeh, S. (2020) Relationship dynamics in customer loyalty to online banking services, *Journal of Islamic Marketing*, 12(4), pp. 830-863, <https://doi.org/10.1108/JIMA-09-2019-0183>.
- Ghali, Z. (2021) Motives of customers' e-loyalty towards e-banking services: a study in Saudi Arabia, *Journal of Decision Systems*, 30(2-3), pp. 172-193, <https://doi.org/10.1080/12460125.2020.1870063>.
- López-Miguens, M. J. & Vázquez, E. G. (2017) An integral model of e-loyalty from the consumer's perspective, *Computers in Human Behavior*, 72, pp. 397-411, <https://doi.org/10.1016/j.chb.2017.02.003>.
- Loureiro, S. M. C. & Miranda, F. J. (2011). Brand Equity and Brand Loyalty in the Internet Banking Context: FIMIX-PLS Market Segmentation, *Journal of Service Science and Management*, 4(4), pp. 476-485, <https://doi.org/doi:10.4236/jssm.2011.44054>.

- Loureiro, S. M. C. (2013) The effect of perceived benefits, trust, quality, brand awareness/associations and brand loyalty on internet banking brand equity, *International Journal of Electronic Commerce Studies*, 4(2), pp. 139-158, <https://doi.org/10.7903/ijecs.1000>.
- Malhotra, N., Sahadev, S., Leeftang, P. S. H. & Purani, K. (2021) New Insights into e-Loyalty of Internet Banking Users in an Emerging Market Context: A Multilevel Analysis, *Information systems frontiers*, 23, pp. 1521-1536, <https://doi.org/10.1007/s10796-020-10046-z>.
- Malnaad, P., Rahman, A., Connie, G., Osman, Z. & Haque, R. (2022) An Examination on E-Banking Service Quality and Its Significance on E-Satisfaction and E-Loyalty: An Asian Study, *Journal of Positive School Psychology*, 6(6), pp. 10311-10326.
- Mohammadi, H. (2014) The moderating role of individual and social factors in Internet banking loyalty: an exploratory study, *Transforming Government: People, Process and Policy*, 8(3), pp. 420-446, <https://doi.org/10.1108/TG-10-2013-0042>.
- Morgeson, F. V., Sharma, P. N. & Hult, T. M. (2015) Cross-National Differences in Consumer Satisfaction: Mobile Services in Emerging and Developed Markets, *Journal of International Marketing*, 23(2), <https://doi.org/10.1509/jim.14.0127>.
- Mulia, D., Usman, H. & Parwanto, N. B. (2020) The role of customer intimacy in increasing Islamic bank customer loyalty in using e-banking and m-banking, *Journal of Islamic Marketing*, 12(6), pp. 1097-1123, <https://doi.org/10.1108/JIMA-09-2019-0190>.
- Ong, K. S., Nguyen, B. & Syed Alwi, S. F. (2017) Consumer-based virtual brand personality (CBVBP), customer satisfaction and brand loyalty in the online banking industry, *International Journal of Bank Marketing*, 35(3), pp. 370-390, <https://doi.org/10.1108/IJBM-04-2016-0054>.
- Oliver, R. (1999) Whence customer loyalty?, *Journal of Marketing*, 63(1), pp. 33-44, <https://doi.org/10.2307/1252099>.
- Pallant, J. (2011) *SPSS survival manual: A step by step guide to data analysis using the SPSS program* (Berkshire: Allen & Unwin).
- Rahi, S. & Ghani, M. (2016) Internet banking, customer perceived value and loyalty: the role of switching costs, *Journal of Accounting & Marketing*, 5(4), 188, <https://doi.org/10.4172/2168-9601.1000188>.
- Raza, S. A., Umer, A., Qureshi, M. A. & Dahri, A. S. (2020) Internet banking service quality, e-customer satisfaction and loyalty: the modified e-SERVQUAL model, *The TQM Journal*, 32(6), pp. 1443-1466, <https://doi.org/10.1108/TQM-02-2020-0019>.
- Sampaio, C. H., Ladeira, W. J. & Santini, F. D. O. (2017) Apps for mobile banking and customer satisfaction: a cross-cultural study, *International Journal of Bank Marketing*, 35(7), pp. 1133-1153, <https://doi.org/10.1108/IJBM-09-2015-0146>.
- Shankar, A. & Jebarajakirthy, C. (2019) The influence of e-banking service quality on customer loyalty: A moderated mediation approach, *International Journal of Bank Marketing*, 37(5), pp. 1119-1142, <https://doi.org/10.1108/IJBM-03-2018-0063>.
- Sikdar, P. & Makkad, M. (2015) Online banking adoption: A factor validation and satisfaction causation study in the context of Indian banking customers, *International Journal of Bank Marketing*, 33(6), pp. 760-785, <https://doi.org/10.1108/IJBM-11-2014-0161>.
- Srinivasan, S. S., Anderson, R. & Ponnnavolu, K. (2002) Customer loyalty in e-commerce: an exploration of its antecedents and consequences, *Journal of retailing*, 78(1), pp. 41-50, [https://doi.org/10.1016/S0022-4359\(01\)00065-3](https://doi.org/10.1016/S0022-4359(01)00065-3).
- Suleiman, G. P., Mat, N. K. N., Adesiyun, O. I. & Mohammed, A. S. (2012) Customer Loyalty in e-Banking: A Structural Equation Modelling (SEM) Approach, *American Journal of Economics*, 2(4), pp. 55-59, <https://doi.org/10.5923/j.economics.20120001.13>.
- Ul Haq, I. & Awan, T. M. (2020) Impact of e-banking service quality on e-loyalty in pandemic times through interplay of e-satisfaction, *Vilakshan - XIMB Journal of Management*, 17(1/2), pp. 39-55, <https://doi.org/10.1108/XJM-07-2020-0039>.

- Yee, B. Y. & Faziharudean, T. M. (2010) Factors affecting customer loyalty of using Internet banking in Malaysia, *Journal of Electronic Banking Systems*, 2010(2010), <https://doi.org/10.5171/2010.592297>.
- Yoon, C. (2010) Antecedents of customer satisfaction with online banking in China: The effects of experience, *Computers in Human Behavior*, 26(6), pp. 1296-1304, <https://doi.org/10.1016/j.chb.2010.04.001>.
- Zhang, L., Yi, Y. & Zhou, G. (2022) Cultivate customer loyalty in national culture: a meta-analysis of electronic banking customer loyalty, *Cross Cultural & Strategic Management*, 29(3), pp. 698-728, <https://doi.org/10.1108/CCSM-08-2021-0155>.
- Zhou, Q., Lim, F. J., Yu, H., Xu, G., Ren, X., Liu, D., Wang, X., Mai, X. & Xu, H. (2021) A study on factors affecting service quality and loyalty intention in mobile banking, *Journal of Retailing and Consumer Services*, 60, <https://dx.doi.org/10.1016/j.jretconser.2020.102424>.



## CEO Compensation and Firm's ESG Performance – An Analysis of Banks and Insurance Companies

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**Abstract** Chief executive officers (CEOs) of environmental, social, and governance (ESG) firms are known to take lesser pay and engage themselves in corporate social responsibility activities to achieve the dual objective of the enhancement of firm's performance as well as benefit for stakeholders in the long run. This study examines the role of ESG transparency in strengthening the impact of firm performance on total CEO pay in ESG firms. A panel of 67 firms for the period of 2014–2019 has been analyzed using the two-step system GMM model, with NSE Nifty 100 ESG Index as the data sample and ESG scores from Bloomberg database as a proxy for transparency. Findings reveal that environmental and governance disclosure scores have the potential to intensify the negative relationship between firm performance and CEO compensation, while social disclosure scores do not. In addition, various firm-specific, board-specific, and CEO-specific attributes have also been considered controls affecting remuneration. This paper contributes to the literature by exploring the effect of exhibiting ESG transparency and its nexus with CEO pay as well as firm performance.

**Keywords:** • compensation • ESG • banks • insurance

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## **1 Section 1: Introduction**

### **1.1 Background**

The 2008 financial crisis can be attributed to the unsound incentive compensation system for the management in the financial industry and CEO compensation has become a central topic in society. At the same time, environmental pollution problem is more serious in the world, and environmental protection problem has also become a major debate in society and most of firms are facing more pressure from governmental regulations and criticism of the public. For the long-term development of firms, the current CEO compensation system should be improved, as well as take environmental and social factors into account.

### **1.2 Significance and motivation**

Over the past few years, the topic of CEO compensation and firm performance has been widely discussed. Early compensation studies only focus on the perspective of the pay-to-performance relationship. Research by Coleman (2000) studied the association between CEO compensation and firm performance and concluded that the association is observable and strong. However, Sigler and Carolina (2011) suggested an opposite view in their study. During the 2008 financial crisis, people were concerned with the unfair CEO compensation system since they discovered that twenty CEOs of banks got over \$90 million in compensation, which is not consistent with firm's performance (Gomstyn, 2009).

The research of CEO compensation and firm performance has been continuously developed. For instance, research by Berrone and Gomez-Mejia (2009) points out that good environmental awareness is aligned with better firm performance, as such, firms should add environmental performance standards into the CEO compensation system. Moreover, Waldman et al. (2006) also demonstrated that CEOs have an obligation to plan for the company's strategy and they should push the development of firm's social and environmental performance.

With the promotion of the concept of environment, social and governance performance, the correlation between CEO compensation and ESG performance has been widely discussed by many researchers. For instance, work by Jian and Lee (2015) found that the association between CEO compensation and corporate social responsibility is negative in regulated industries on the basis of poor corporate governance. However, work by Fabrizi and Mallin (2014) concluded that the connection between CEO compensation and corporate's social and environmental responsibility is positive in various industries in the USA, which is different from Jian and Lee's (2015) study.

The study mentioned above are concentrated on the different industries and only focus on only one or two factors in ESG performance. However, there are limited studies

measuring the association between CEO compensation and ESG performance in the financial industry. Within these research, discussions on the relationship between CEO compensation and ESG performance have not reached a unified view. Therefore, it seems to be a motivation to study the link between the CEO compensation and ESG performance in banks and insurance companies.

### 1.3 Aim and objectives

Many previous researches have concentrate their topic mainly on the structure of the CEO compensation and firm performance. However, not many researchers connected the CEO compensation with ESG performance. The aim of the research is to examine the differences on the relationships between CEO compensation with ESG performance in banks and insurance companies. The ESG performance is consisted of three factors: environmental; social; and corporate governance, each factor will be individually linked to CEO compensation in this research.

The concept of ESG performance is a new concept to the society, and the discussion between CEO compensation and ESG performance is rare in existing articles and the findings of this research can provide some ideas about the management of company to the readers. Moreover, in order to measure the listed banks and insurance companies from the point view of environmental, social and corporate governance respectively, four different multiple liner regression models will be created in this research. Furthermore, in each model, the choice of variables is based on the following four research questions.

- Firstly, whether the degree of resource consumption and environmental pollution will affect the CEO compensation?
- Secondly, whether the level of female participation in management will affect the CEO compensation?
- Thirdly, will the diversity and independence of the board affect CEO compensation?
- Fourthly, which component of CEO compensation has the main impact on CEO compensation and which factor in ESG performance has the dominant influence on CEO compensation?

This research study the connection between each factor on ESG performance and CEO compensation and make a comparison between banks and insurance companies. Based on the findings of the research results in this study, the regulators and firm's managers can make their decision more wisely, which are beneficial to the sustainable development of firms in the future.

### 1.4 Structure

The paper is divided into six sections starting with this introduction as the first section. This section mentioned the background, significance and motivation, aim and objectives

of the research topic. In section 2, firstly, it will give some basic concepts about the structure of CEO compensation. Secondly, the measurements of firm performance will be illustrated. Thirdly, some analytical summaries of studies in ESG performance will be discussed. Fourthly, this paper will demonstrate the association between CEO compensation and ESG performance accordingly. The third section focuses on research methodology. The research philosophy and research approaches will be illustrated in the beginning. And then, the source of the data as well as the size and criteria of sample will be presented. Next, four research questions about the association between CEO compensation and ESG performance will be showed. Based on these four research questions, four corresponding hypotheses are proposed. Additionally, four multiple linear regression models are created to answer these questions and verify the hypotheses. Then the formula and the process of ANOVA test and T-test will be presented. In section 4, based on the model in section 3, the result of data analysis will be presented, followed by the test of hypothesis. In section 5, the overall findings will be demonstrated. Moreover, based on section 2 and section 4, the similarities and differences between the result of data analysis and literatures reviews will be discussed from the perspective of banks and insurance companies, followed by interpretation. Finally, the implication of findings will be illustrated. In section 6, the overview of the research results will be illustrated, then the limitation and recommendations of this research will follow.

## **2 Section 2: Literature review**

This section provides background to readers. The basic concepts about the structure of CEO compensation will be provided. Then, it will illustrate the measurements between different firm performances. Following that, ESG performance will be introduced. Lastly, the relationships between CEO compensation and ESG performance will be demonstrated.

### **2.1 CEO compensation**

Nowadays, CEO compensation plans are adopted by many companies in different industries around the world. The management of CEO compensation has become a part of the corporate governance and the board of directors decides the level of CEO compensation in firms. Trammell (2014) suggested that CEO uses their talents and ability to help the company produce and sell the products, in order to appreciate the effort and contribution of CEOs, the firms will reward CEOs in financial compensation or non-financial compensation under normal circumstances.

Managing CEO compensation is critical for company, as well as a hot topic in society. The discussion on the drawbacks of CEO compensation has spread to various industries in the next ten years (Frydman and Saks, 2007). In order to cope with this tense situation, both the Reconstruction Finance Corporation and the Federal Trade Commission asked for companies to disclose information on CEO compensation and limited the pay of CEO

(Leff, 2003). The Securities and Exchange Commission requires companies to publicly disclose executive compensation information through legislative means, and the information on CEO compensation is available to the general public since 1934 (Loss and Seligman, 1995).

Particularly, the structure of the CEO compensation in the financial industry has been the concern of the public for a long time. Eavis (2014) has suggested that the structure of CEO compensation package is changing and becoming more complicated in the past decades. Garner (2013) also demonstrated that a good CEO compensation package is consisted both of short-term incentive compensation (including salaries and bonus) and long-term incentive compensation (including stock awards and options awards). This combination will be conducive to the structure of CEO compensation and firm's long term development. In this research, the structure of CEO compensation package will focus on CEO's salaries, bonus, stocks awards, options awards, non-equity incentive awards and pension.

**Table 1:** Key literature on CEO compensation

Author(s)	Titles of the papers	Models (or theories) used	Data used and sources	Key findings
Joel Trammell	Lead From the Top: 5 Core Responsibilities of CEO	Agency theory	500 companies in the world and firm's proxy statement	Demonstrate the function and responsibilities of CEO in the firms
Frydman, C., & Saks, R	Historical trends in executive compensation	Agency theory	50 largest firms CEO data and the data is from Compustat	The problems existing in the CEO compensation are widely discussed in the society.
Proctor, R., & Murtagh, J	Incentive Compensation for Bank CEOs and CFOS before and after the Financial Crisis	Agency theory	50 largest financial institutions and the data obtained from the firm's proxy statement	The management of the structure of the CEO compensation is connected with the firm performance
Balsam, S	An introduction to executive compensation	Agency theory		Explains and illustrates the various components of the compensation package
Chen, J., Goergen, M., Leung, W. S., and Song, W. (2019)	CEO and director compensation, CEO turnover and institutional investors: Is there cronyism in the UK?	Agency theory		

### 2.1.1 The types of CEO Compensation

#### *Salary*

Salary is a fixed yearly payment paid to the CEO on the basis of their performance, which is normally paid in cash. Research by Balsam (2002) has showed that the annual salary in a large company in the United States averages 1 million dollars, making salary as a dominant form of payment in CEO compensation. According to the related filing provided by Federal, most of bank's CEOs received a huge amount of compensation in the way of salary (Stych, 2011). The CEO of U.S. Bancorp, Richard Davis, was rewarded \$19.4 million in 2014 and his salary is about 1.2 million dollars. Compared with his 2013 salary, his salary increased by about eight percent in 2014 (Johnson, 2015).

#### *Bonus*

Under normal circumstances, bonus is used to reward for the performance and it can be both short-term compensation and long-term compensation (Sirkin and Cagney, 2015). Proctor and Murtagh (2014) also demonstrated that the majority of the bonus payments are paid in cash. Sometimes, the bonus payment is not in accordance with the performance. For example, the banks in the Wall Street has reserved around \$4.7 billion to their CEOs and staffs as compensation on the basis of their poor performance during the financial crisis of 2008 (Quinn, 2009).

#### *Stock Awards*

The stocks awards are also known as equity-based compensation which typically is rewarding CEOs with the company's restricted stock shares (Proctor and Murtagh, 2014). The accounting rules were adjusted after 2004, it required all the companies to pay for the options, therefore, stock compensation has become increasingly popular (Reiner, 2006). Different researchers have different attitude towards stock awards. Fahlenbrach and Stulz (2011) analyzed the sample of U.S. banks and concluded that stock awards cannot affect the performance of the bank. However, Bhagat and Romano (2009) suggested that stock awards are the main components of the CEO compensation, and they believed that stock awards can provide a long-term benefit for the investors and is conducive to the development of firm in the future.

#### *Option Awards*

Proctor and Murtagh (2014) states that most of options awards are based on the shares of the firm's common stock. Due to the encouragement and support from the institutional investors and regulators in the 1990s, the total amount of stock options showed a significant growth in the world (Bebchuk and Fried, 2003). Moreover, stock options not only provide a way to shape the behavior of CEO and then regulate the interest between employees and CEOs, it also encourages and attracts talented young people to join the company (Barnes, n.d.).

### *Non-equity Incentive Awards*

Similar to bonus, non-equity incentive awards are typically paid out in cash to CEOs. In 2006, the concept of the non-equity incentive awards was first formally introduced by the SEC in the regulations when it enforced the requirement to disclose CEO compensation to the general public (Enderle, 2015). In addition, Ayure (2016) demonstrated that non-equity compensation provides a platform for employers to encourage the CEOs and enables them to enjoy the success of the firm under the premise of simplifying the capital structure of the company.

### *Pension and Non-Qualified Defined Pension*

Pension can be considered as a fund, where the amount of money in the employee's employment period is constantly accumulated, and during the period of employee's retirement, the compensation will be paid regularly to employees in order to support their daily lives (The Internal Revenue Service, 2015). Ippolito (1991) demonstrated that the existence of pension effectively provides stable financial help to retired employees at the same time. Furthermore, Weight (2013) suggested that the pension is not only a significant part of the CEO compensation, but also vital for regulators, firms and investors. Additionally, Collins (2011) states that among the one hundred most influential companies in the world, about eighty percent of companies have adopted non-qualified defined pension plan in the past few years in the financial industry.

## **2.2 Firms Performance Measures**

Neely et al. (2005) illustrated that the measurement of firm is a process of assessing the effectiveness and efficiency of decisions. Performance management is a process of cooperation with the business strategy and objectives for the firms in which decent performance in the firm can bring more profits to their managers and shareholders (Eccles and Serafeim, 2014). According to the criteria of classification, a firm's performance can be measured by financial performance and non-financial performance. Work by Hofmann (2001) demonstrated that financial performance measures are used to evaluate firm's total value and non-financial performance measures are used to estimate the value of performance. Research by Al-Matari (2014) also illustrated that the dominant measurement of the financial performance is accounting-based metrics, which usually includes ROA and ROE. However, Moon and Fitzgerald (1996) believed that in the increasing complexity of the global economy and growing number of competitors, accounting-based measurements is too simple and is not adequate for firms to adopt to the complex environment in the process of making strategy. In addition, Banker et al. (2000) also illustrated that non-financial measures cannot be ignored because it focuses on satisfaction of employee, product quality and customer service, which can provide better indication for firm in the long term.

**Table 2:** Key literature on firm's performance measures

Author(s)	Titles of the papers/books	Model (or theories) used	Data used and sources	Key findings
Hofmann, C.	Balancing financial and non-financial performance measures	The model is based on the LEN-model and principal/agent model	Used agent pre-decision information and non-financial performance data from company's annual report.	A firm should set a balance point between the measurement of financial and non-financial performance
Banker, R. D., Potter, G., & Srinivasan, D.	An empirical investigation of an incentive plan that includes nonfinancial performance measures	Two estimation models for non-financial performance and four estimation models for financial performance	Financial data in 18 hotels come from hotels' headquarters; non-financial data from interviews and company documents	Non-financial measures is beneficial to firm performance in the long term
Moon, P., & Fitzgerald, L.	Delivering the goods at TNT: the role of the performance measurement system	A multivariable model for financial performance and non- financial performance	The data collected form the questionnaire of CEO in the Australia and Mauritian manufacturing companies	The role of non-financial performance can not be ignored



## 2.3 ESG performance

**Table 3:** Key literature on the relation of ESG performance

Author(s)	Titles of the papers/books	Model (or theories) used	Data used and sources	Key findings
Amankwah, G., & Abonge Viyu, H.	Investigating Environmental, Social and Governance (ESG) considerations in Venture Capital & Private Equity firms: A study in US and UK venture capital industry	A multivariable model	The ESG data in 112 private companies in the UK and USA and data is collected from the firm's proxy statement	The ESG performance has been a vital part in the firm's performance measures and sustainable development
Aguilera, R. V., Williams, C. A., Conley, J. M., & Rupp, D. E	Corporate governance and social responsibility: A comparative analysis of the UK and the US	A multi-level theoretical model about corporate governance	The CSR index in the UK and US and collect from Dow Jones Sustainability Indices and the FTSE4 Good Index	The role of ESG performance is unique for the firm and it has been widely used by many companies
Global Sustainable Investment Association	Global Sustainable Investment Review	A theoretical model based on the agency theory	Financial and ESG data are provided by each national or regional Sustainable Investment Forum (SIF) and collated by GSIA	ESG performance is positively related to financial performance

### 2.3.1 The background of ESG performance

ESG is the abbreviation of the environmental, social and corporate governance criteria, which refers to a series of standards and factors in evaluating a company's sustainable and moral influence of an investment and it is belonging to non-financial performance (Amankwah and Viyu, 2011). According to the report by Goldmansachs (2015), environmental criteria are focus on environmental pollution problems and the utilization and consumption of sources; social criteria concentrates on the diversity and independence of firm's recruitment system, the level of consumer and employee protection; governance criteria looks at the structure of management, and employee satiation degree.

### 2.3.2 Agency theory and ESG performance

The purpose of the agency theory is to help people have a deeper understanding of the association between agents and principals. Both shareholders and managers have the right to pursue the maximization of their own interests. As a result, the conflicts between

shareholders and managers about the interests will bring a lot of unnecessary issues to company in financial and administrative area.

The following researches are focus on the evaluation between ESG performance and CEO compensation, and ESG performance is part of non-financial performance. Each part successively corresponds to environmental, social and corporate governance.

Firstly, Friedman (2008) demonstrated that profitability is negatively connected with environmental performance in firm on the basis of agency theory. However, Brouwers et al. (2014) challenged this view and stated that the relationship between firm performance and environmental performance is positive, because the cost in environmental performance in earlier stage is valuable and it will be returned in the future. Secondly, research by Gkiliatis (2009) suggested that based on agency theory, the function of the board of directors cannot be ignored and firm's performance can be enhanced with the help of board. In addition, work by Hillman and Dalziel (2003) illustrated that the function of board is not only to monitor the relationship between agents and managers but also protect the interests of the shareholders from the perspective of the agency theory. Thirdly, Hong et al. (2015) evaluated the link between corporate governance and CEO compensation from the view of agency cost and found that higher level of corporate governance is in line with the less agency cost, which is beneficial to shareholders. In addition, Rekker et al. (2014) states that when CEOs are acquired to shoulder corporate social responsibility, they will be rewarded with less compensation and agency problems will be reduced at the same time.

### **2.3.3 ESG performance in financial industry**

As a new indicator for measuring the long-term development of the company, ESG performance is getting more attention from people and companies. The ESG performance is popular because its unique function for companies. Maverick (2016) states that there are two main factors to promote the prevalence of ESG performance in society. The first is the increasing awareness of environmental protection in general public, taking consideration of environmental when making investment decisions; the second is ESG-based investing can produce a higher return and higher ESG rating means lower cost of capital. Moreover, Reynolds (2014) states along with disclosing CEO compensation to the public, they should also be required to include comments regarding to the connection between environmental, social and corporate governance. It is apparent that more and more companies have realized the significance of ESG performance. In 2005, ESG performance was formally incorporated into the mainstream market. The connection between ESG performance and financial performance is stronger than before, and from the perspective of investment market, the concern about corporate governance and environmental protection is becoming increasingly significant (Aguilera et al., 2006).

In addition, the correlation between ESG performance and financial performance is also widely discussed in existing literature. A number of articles demonstrated that the ESG performance need to be encouraged as it can develop financial performance. For instance, Ballou et al. (2003) illustrated that the action to strengthen the management of the company by using ESG performance did not damage the financial performance, on the contrary, this behavior guaranteed the efficiency of the enterprise and the maximum efficiency of the management of personnel. Furthermore, Edmans (2011) has also found that companies that are considering ESG performance are gain more stock returns than the other companies in the same industry in the period of 1984 to 2009, which is far beyond the expectation from the economists.

Conversely, some people hold the opposite attitude toward the relationship between ESG performance and financial performance. Work by Boettke (2003) has suggested if the ESG performance is used in firms, not only will the financial performance be negatively affected but the market will also be damaged. He concluded that in the long run, ESG performance will harm the firm's development. In addition, Hoops (2005) believed that ESG performance is harmful to portfolio performance and stock returns.

## 2.4 Relation between CEO compensation and ESG performance

**Table 4:** Key literature on the relation between CEO compensation and ESG performance

Author(s)	Titles of the papers/books	Model (or theories) used	Data used and sources	Key findings
Stanwick, P. A., & Stanwick, S. D.	CEO compensation: does it pay to be green	A multivariable model	186 firms' s CEO compensation and environmental reputation index and data is collected from Fortune	The relation between environmental performance and CEO compensation is positive
Namrita Kapur	The benefits of tying executive compensation to sustainability			The association between CEO compensation and firm's sustainable development is positive
Bertrand, M., & Hallock, K. F	The gender gap in top corporate jobs	Theory of Discrimination	Use Standard and Poor's ExecuComp data, which contain information on compensation for the top five executives for all firms in the S&P 500, S&P Midcap 400, and S&P Small Cap 600	The gender difference can be explained by some potential reasons and this article also highlighted the importance of female management
Canyon, M. J., & He, L.	Executive compensation and corporate governance in China	Agency theory	Use two compensation data sets that cover all firms listed on China's domestic stock exchanges, the Shanghai and Shenzhen Stock Exchange	On the basis of increasing the number of independent directors in board, the relationship between corporate governance and CEO compensation can be strengthened
Wade, J. B., O'Reilly III, C. A., & Pollock, T. G.	Overpaid CEOs and underpaid managers: Fairness and executive compensation	Social comparison theory	Individual-level data from 120 firms and the data are come from the a survey conducted from 1981 to 1985 by a compensation consultant company	The employee's attitude and their reaction to CEO compensation is important in the measurement of social performance

During the past few decades, the relation between ESG performance and CEO compensation is being widely discussed in society. As a new concept of ESG performance

several researchers were interested on this topic. Kapur (2013) suggested that the practice of linking CEO compensation and ESG performance not only improve the power of long-term financial profitability for company, but also encourage firms to increase the sense of social responsibility and positive cultural impact. However, Guevarra (2011) states that the link between the ESG performance and CEO compensation is not only weak, but firms will have to invest a large amount of money for the ESG performance in the early stage.

In this study, the connections between executive compensation and environmental, social, corporate governance performance will be illustrated separately in order to make its relations become easier to understand.

#### **2.4.1 CEO compensation and environmental performance**

As the global economy continues to develop, different kinds of environmental pollution problems also arise at the same time. With the increasing pollution problems in the world in the last twenty years, people's environmental awareness is also raising. The consumption of the energy as well as the related policy have been the essential elements to measure the relation between CEO compensation and environmental performance. In S & P 100, about one tenth of companies take environmental factors into consideration when making the CEO compensation plan, and the consumption of the energy as well as the related policy have been the essential elements to measure the relation between CEO compensation and environmental performance, which is in line with the goal of sustainable development (Ferracone, 2011).

Environmental issues have become the focus of society, and companies are facing more and more strict laws and regulations on environmental protection. As an important part of company management, the relationship between CEO compensation and environmental performance cannot be ignored. Some previous studies have evaluated the connection between CEO compensation and environmental performance. For instance, Stanwick and Stanwick's paper (2001) demonstrated that the connection between CEO compensation and environmental performance is positive and firm's environmental reputation is also playing a vital role in the measurement of the environmental performance. Work by Berrone and Gomez-Mejia (2009) used about 500 companies as samples to analyze the relationship between CEO compensation and environmental performance and concluded that the better environmental performance, the higher the CEO got paid. However, only a few studies hold the opposite. For example, Coombs and Gilley (2005) believed that this strong and positive relation dose not exist.

#### **2.4.2 CEO compensation and social performance**

Social performance is used to measure the level of achievement in a company's social goals and the management of social performance will influence employee, suppliers and customers. Social performance is consisted of many factors, which mainly focus on human right, employee turnover rate and level of female participation in management of company. In the past few years, researchers have been paying more attention to these topics for firm's long term development.

The association between women's participation in management and CEO compensation has been a hot topic in society and it can be traced back to the last century (NCPE, 2009). Research by Mohan and Ruggiero (2007) illustrated that lack of equal opportunity leads to a low participation rate of women in the management of firm and the gender differences may be a reason for the women's low participation rate. However, other studies have shown some reasonable explanations for this issue. Bertrand and Hallock (2001) suggested that female CEO compensation is generally lower than men's compensation about forty-five percent, but seventy-five percent of this gap can be explained by the differences in company's size and this gap would not affect the enthusiasm of women's participation in management. Khan and Vieito (2008) also found that the gap in CEO compensation pay between female and male is becoming smaller over time. Work by Dezsö and Ross (2012) also illustrated that the representation of women in management bring social diversity benefits for firms and improve firm performance.

In addition, the concept of the corporate social responsibility (CSR) and employee turnover rate are also closely associated with firm's social performance, which are becoming increasingly popular in firms. Work by D'Amato et al. (2009) suggested that the concept of CSR is positively associated with social performance, which is not only being widely used in businesses, it also ensures the sustainable development for firms. Wade et al. (2006) also illustrated that employees would measure the rationality of CEO compensation by themselves and a certain degree of employee turnover is helpful to the development of the company.

Traditionally, CEOs need to be rewarded for their hard work. However, most of the related studies hold the opposite attitude toward this opinion. For instance, work by Jian and Lee (2015) has evaluated the association between CEO compensation and social performance and suggested that the correlation is negative. Furthermore, Cai et al. (2011) has approved this statement and concluded that higher level of social performance is in accordance with lower CEO compensation.

#### **2.4.3 CEO compensation and corporate governance performance**

A company is made up of various departments with different functions. In order to maintain the power and cohesiveness of firm for the long term development, corporate

governance is essential for the company. The structure of the corporate governance is mainly concentrated on the board, shareholders and directors. The link between CEO compensation and corporate governance performance has been argued by many researchers.

Most studies indicate that the board is totally controlled by CEO and it is actually not independent. For instance, Crystal (1992) states that the board of directors will not maintain a fair attitude in the process of setting the level of CEO compensation, as most of them are hired by CEO and they have to follow the CEO's instructions. In addition, research by Conyon and He (2011) found that higher percentage of independent directors in the board, closer the association between CEO compensation and corporate governance. Research by Brogi (2008) also illustrated that there are some differences on the regulations about corporate governance between banks and insurance companies.

Moreover, there are numerous researches on the relationship between CEO compensation and corporate governance performance with different methods and data in different countries from the various aspects. For example, Ntim et al. (2015) uniquely created a set of corporate governance devices on the basis of the three stages least square method to measure the link between CEO compensation and corporate governance. Hong et al. (2015) used new CEO compensation data to analyze the connection between CEO compensation and corporate governance and found that the relationship is positive.

From the above discussions it is clear that CEO compensation, ESG performance and its relations have been widely discussed by many researchers. However, there is not a common view on the correlations between CEO compensation and environmental performance, CEO compensation and social performance as well as CEO compensation and corporate governance performance due to the various research methodologies. Moreover, most of the researches only focus on one or two relations between CEO compensation and ESG performance. It is important to find more evidences to refine the discussion of the three relationships. This gap will be bridged in this research.

### **3 Section 3: Methodology**

#### **3.1 Characteristics of Data**

The data in this research are focuses on the world's most influential banks and insurance companies. Stata is also used to analysis the four multiple liner regression models. These four models are created to measure the links between CEO compensation and ESG performance and some dummy variables are also included in order to improve the accuracy of model. In addition, ANOVA test is used to measure how well the model fits for the data and then T-test is used to test the level of correlation between independent variable and dependent variables.

### 3.2 Sample

There are 56 banks and 55 insurance companies are being chosen in this research. The list of banks and insurance companies are presented in the Appendix. We choose these 111 financial institutions according to its comprehensive strength and the rankings released by the World Bank. In addition, CEO compensation data, ESG performance data and the financial data are obtained from Bloomberg. A panel dataset is chosen in this research and all data are quantitative. Since the concept of ESG performance was proposed in 2006, the time horizon used in this research is from 2006 to 2015.

### 3.3 Research questions

Unlike other existing researches which only focuses on one or two questions when evaluating the relationships between CEO compensation and ESG performance, four questions are presented in this research.

Firstly, whether the degree of resource consumption and environmental pollution will affect the CEO compensation?

Secondly, whether the level of female participation in management will affect the CEO compensation?

Thirdly, will the diversity and independence of the board affect CEO compensation?

Lastly, which component of CEO compensation has the main impact on CEO compensation and which factor in ESG performance has the dominant influence on CEO compensation?

### 3.4 Models

In the following models, as dependent variable, CEO compensation comprises pf total salary paid, total bonus paid, stock awards granted, option awards granted, non- equity incentives granted and pension and non-qualified defined pension in a given fiscal year. In addition, *CEO compensation<sub>i</sub>* represents compensation for banks and *CEO compensation<sub>j</sub>* represents compensation for insurance companies.

#### 3.4.1 CEO compensation and environmental performance

Hypothesis 1: lower degree of resource consumption and environmental pollution is connected with the higher CEO compensation.

*CEO compensation<sub>ij</sub>*

$$= \beta_0 + \beta_1 \times EDS + \beta_2 \times TGE + \beta_3 \times TEC + \beta_4 \times TWU + \beta_5 \times TW + \beta_6 \times EEP + \beta_7 \times ESCM + \beta_8 \times GBP + \beta_9 \times WRP + \beta_{10} \times EQMP + \beta_{11} \times BP + \text{INDUSTRY} + \text{YEAR}$$



Where:

EDS=Environmental Disclosure Score

TGE=Total GHG Emissions

TEC =Total Energy Consumption

TWU =Total Water Use

TW =Total Waste

EEP =Energy Efficiency Policy

ESCM =Environmental Supply Chain Management

GBP =Green Building Policy

WRP =Waste Reduction Policy

EQMP =Environmental Quality Management Policy

CCP =Climate Change Policy

BP =Biodiversity Policy

INDUSTRY = Dummy variables to control for industry fixed with 2 digital SIC level

YEAR = Dummy variables to control for year fixed effects

CEO compensation is conducted as a dependent variable. Research by Khanna and Damon (1999) used different kinds of resource consumption data to measure the impact on CEO compensation. In this model, TGE, TEC, TWU and TW are used to calculate the amount of emissions and consumption. Moreover, work by Zhang (2008) suggested that emission of polluting gases and consumption of resource are all affected by environmental protection policies. Therefore, the rest of variables in this model are used as dummy variable to control the effect of the preceding four dependent variables. The variable of year and industry are used to control the effect of industry and time.

### 3.4.2 CEO compensation and social performance

Hypothesis 2: the higher the participation of women in the firm's management, the higher the CEO compensation.

**CEO compensation<sub>ij</sub>**

$$= \beta_0 + \beta_1 \times SDS + \beta_2 \times NOE + \beta_3 \times ET + \beta_4 \times WIW + \beta_5 \times WIM + \beta_6 \times HSP + \beta_7 \times EOP + \beta_8 \times HRP + \beta_9 \times BEP + \beta_{10} \times AEP + \beta_{11} \times UGCS + \beta_{12} \times PRI + INDUSTRY + YEAR$$

Where:

SDS=Social Disclosure Score

NOE =Number of Employees

ET =Employee Turnover %

WIW =% Women in Workforce

WIM =% Women in Management

HSP =Health and Safety Policy

EOP =Equal Opportunity Policy

HRP= Human Rights Policy

BEP =Business Ethics Policy

AEP =Anti-Bribery Ethics Policy

UGCS =UN Global Compact Signatory

PRI=PRI Signatory

INDUSTRY = Dummy variables to control for industry with 2 digital SIC level

YEAR = Dummy variables to control for year fixed effects

CEO compensation plays the role of the dependent variable. Following Medina (2012), the operating conditions of firm can be demonstrated by employee turnover rate. Furthermore, Elkinawy and Stater (2011) illustrated that degree of women's employment participation has become an important factor in firm's social performance. Hence, WIW and WIM are used as independent variables in this model. The remaining variables are used as dummy variables, which are made up of social-related policies so as to consider the rights of employees and safeguard their interests, such as health and safety policy and equal opportunity policy. Moreover, industry and year are used to control CEO compensation's industry and time effect.

### 3.4.3 CEO compensation and corporate governance performance

Hypothesis 3: higher level of diversity and independence of the board are associated with higher CEO compensation.

**CEO compensation<sub>ij</sub>**

$$\begin{aligned}
 &= \beta_0 + \beta_1 \times GDS + \beta_2 \times SB + \beta_3 \times NEDOB + \beta_4 \times ID + \beta_5 \\
 &\times DU + \beta_6 \times WOB + \beta_7 \times FCEO + \beta_8 \times FE + \beta_9 \times BAL + \beta_{10} \\
 &\times BD + \beta_{11} \times BMA + \beta_{12} \times IDAC + \beta_{13} \times NEDCC + \beta_{14} \\
 &\times NEDNC + \beta_{15} \times CSR + \beta_{16} \times ESGLCB + \beta_{17} \times PD + \beta_{18} \\
 &\times GRIC + INDUSTRY + YEAR
 \end{aligned}$$

Where:

GDS = Governance Disclosure Score

SB = Size of the Board

NEDOB = % Non-exec Director on Board

ID = % Independent Directors

DU = CEO Duality

WOB = % Women on Board

FCEO = Female Chief Executive Officer or Equivalent

FE = % Female Executives

BAL = Board Age Limit

BD = Board Duration (Years)

BMA = Board Meeting Attendance %

IDAC = % Independent Director on Audit Commitment

NEDCC = Non-executive Director on Compensation Commitment

NEDNC = Non-executive Director on Nomination Commitment

CSR = CSR/Sustainability Committee

ESGLCB = ESG Linked Compensation for Board

PD = Political Donations

GRIC = Global Reporting Initiatives Checked

INDUSTRY = Dummy variables to control for industry with 2 digital SIC level

YEAR = Dummy variables to control for year fixed effects

CEO compensation is used as a dependent variable. Following Ahmed et al. (2013) and Boyd (1994), this model uses SB, FCEO and DU to control the influence of the board structure. In order to measure the influence of dependence and diversity of the board, the following variables are used as independent variables, there are NEDOB, ID, WOB, FE and BAL. The board duration and the percentage of board meeting attendance are used to control the characteristic of the board. Moreover, in order to control the impact of other various committee of board, the number of directors in audit committee, compensation committee, nomination committee and sustainability committee are also considered. The effect of global surrounding is also measured, both the variable of political donations and global reporting initiatives checked are included as dummy variables in this model. Additionally, there are two more dummy variables used in this model to control the effect of industry and time-series, industry and years.

### 3.4.4 CEO compensation and ESG performance

Following the prior studies by Jian and Lee (2015) on the relationship between CEO compensation and corporate social responsibility as well as previous three models, the following model is used to test the connections between CEO compensation and ESG performance.

Hypothesis 4: salary is the leading element in total CEO compensation, and social performance is the dominant factor in ESG performance to influence CEO compensation.

**CEO compensation<sub>ij</sub>**

$$\begin{aligned}
 &= \beta_0 + \beta_1 \times \text{Environment} + \beta_2 \times \text{Social} + \beta_3 \\
 &\times \text{Governance} + \beta_4 \times \text{ROA} + \beta_5 \times \text{Return} + \beta_6 \times \text{VOLARET} \\
 &+ \beta_7 \times \text{MCTBV} + \beta_8 \times \text{TSP} + \beta_9 \times \text{TBP} + \beta_{10} \times \text{SAG} + \beta_{11} \\
 &\times \text{OAG} + \beta_{12} \times \text{NIP} + \beta_{13} \times \text{PNDP} + \beta_{14} \times \text{CEO Duality} \\
 &+ \text{INDUSTRY} + \text{YEAR}
 \end{aligned}$$

Where:

CEO compensation = total CEO compensation paid

Environmental = comprising environmental disclosure score, total GHG Emissions and other ten factors

Social = comprising social disclosure score, social supply chain management and other ten factors

Governance = comprising governance disclosure score, board structure and other fifteen factors

ROA = Return on assets

RETURN = Return on common equity

VOLARET = volatility in 360 days

MCTBV = Market Capitalization to Book Value

TSP = Total Salary Paid

TBP = Total Bonus Paid

SAG = Stock Awards Granted

OAG = Option Awards Granted

NIP = Non-equity Incentives Granted

PNDP = Pension and Non qualified Defined Pension

CEO Duality = CEO is also the chairman of the board

INDUSTRY = Dummy variables to control for industry with 2 digital SIC level

YEAR = Dummy variables to control for year fixed effects

CEO compensation is the dependent variable. In order to control the influence of economic determinants of CEO compensation, the following variables are being used in this model: ROA; RETURN; VALARET; and MCTBV. Following the previous three models in this research, this model focuses on finding the dominant factor in CEO compensation and ESG performance. Proctor and Murtagh (2014) demonstrated that the analysis of the leading factor on the structure of CEO compensation is an important part in firm's management. The main components of CEO compensation as independent variables are used in this model and following the research by Lee (2014) and Peni (2014), the feature of the CEO such as CEO duality is used as dummy variables. In addition, the variable of industry and years will be also used in the models.

#### **4 Section 4: Results and Analysis**

We analyzed the factor of environmental, social and corporate governance in ESG performance separately with CEO compensation. There are four research questions regarding CEO compensation and ESG performance in this study, which was mentioned in section 1: Introduction. In order to answer these questions clearly, the process of analysis is divided into two steps. First, the ANOVA test will be used to estimate how well the models used for the data analysis were and the result of deceptive statistics data will be demonstrated, followed by T-test results. Then, testing the hypothesis based on the results of ANOVA test and T-test, followed by a summary.

**Table 5:** Summary of Statistical tests

Name Test	Purpose	Model	Input (data)	Output (result)	Interpretation of the result	Use of the output
ANOVA test	To test the model how fits for the data	CEO compensation and environmental performance	CEO compensation data, environment-al performance data and financial data in banks and insurance companies	The model fits for the data	The value of <b>Prob</b> > <b>F</b> is zero	Confirm that model is suitable for the data
T-test	To determine whether the difference between two sets of data is significant	CEO compensation and environmental performance	CEO compensation data, environment-al performance data and financial data in banks and insurance companies	For banks, estimated coefficient on TGE and TWU is smaller than zero as well as TEC and TW is bigger than zero. For insurance companies, estimated coefficient on TGE, TEC, TWU and TW are all bigger than zero	For banks, TGE and TWU are showing negative impact on CEO compensation. TEC and TW are positively associated with CEO compensation. For insurance companies, TGE, TEC, TWU and TW are showing positive impact on CEO compensation	To illustrate-d the association between two data sets is positive or negative, and weather the association is significant
ANOVA test	To test the model how fits for the data	CEO compensation and social performance	CEO compensation data, social performance data and financial data in banks and insurance companies	The model fits for the data	The value of <b>Prob</b> > <b>F</b> is zero	Confirm that model is suitable for the data
T-test	To determine whether the difference between two sets of data is significant	CEO compensation and social performance	CEO compensation data, social performance data and financial data in banks and insurance companies	For banks, estimated coefficient on ET and WIM is bigger than zero as well as WIW is smaller than zero. For insurance companies,	For banks, both ET and WIM are showing positive impact on CEO compensation, and WIW is showing negative effect. For insurance companies,	To illustrate-d the association between two data sets is positive or negative, and weather the

				estimated coefficient on ET, WIW and WIM are bigger than zero	ET, WIW and WIM are positively associated with CEO compensation	association is significant
ANOVA test	To test the model how fits for the data	CEO compensation and corporate governance performance	CEO compensation data, corporate governance performance data and financial data in banks and insurance companies	The model fits for the data	The value of <b>Prob</b> > <b>F</b> is zero	Confirm that model is suitable for the data
T-test	To determine whether the difference between two sets of data is significant	CEO compensation and corporate governance performance	CEO compensation data, corporate governance performance data and financial data in banks and insurance companies	For banks, estimated coefficient on NEDOB, ID, WOB, FE and BAL are bigger than zero. For insurance companies, only the estimated coefficient on NODOB is smaller than zero, the rest of the variables are larger than zero.	For banks, NEDOB, ID, WOB, FE and BAL are positively associated with CEO compensation. For insurance companies, only NEDOB has negative impact on CEO compensation	To illustrate the association between two data sets is positive or negative, and whether the association is significant
ANOVA test	To test the model how fits for the data	CEO compensation and ESG performance	CEO compensation data, ESG performance data and financial data in banks and insurance companies	The model fits for the data	The value of <b>Prob</b> > <b>F</b> is zero	Confirm that model is suitable for the data
T-test	To determine whether the difference between two sets of data is significant	CEO compensation and ESG performance	CEO compensation data, ESG performance data and financial data in banks and insurance companies	For banks, estimated coefficient on salary and employee turnover rate are bigger than zero as well as dominant in CEO compensation and ESG performance. For insurance companies, the estimated	For banks and insurance companies, salary is the dominant element in CEO compensation as well as the social performance has the biggest impact on ESG performance	To illustrate the association between two data sets is positive or negative, and whether the association is significant

				coefficient on salary and employee turnover rate are bigger than zero as well as dominant in CEO compensation and ESG performance.		
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#### 4.1 CEO compensation and environmental performance

##### 4.1.1 CEO compensation and environmental performance in banks

##### Model fitting

**Table 6:** ANOVA test for CEO compensation and environmental performance in banks

Source	Sum of square	Degree of freedom	Mean square	<i>Prob &gt; F</i>	Number of observations
Model	9143.46517	22	415.612053	0.0000	538
Residual	23844.0285	515	46.2990845		
Total	32987.4937	537	61.4294427		

The value of Sum of square, Degree of freedom and Mean square are used to calculate the value of  $P > |F|$ . If the value of  $P > |F|$  is below 0.05, and then the model is considered to be suitable for the data. In Table 6, the value of  $P > |F|$  is obtained after the ANOVA test and it shows as zero, it means that this model fits for the data and the model can be used for the data analysis.

**Table 7:** Descriptive statistics for CEO compensation and environmental performance in banks

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
TGE	-0.0010785	0.004617	-2.34	0.020
TEC	0.0034487	0.0007736	4.46	0.000
TWU	-0.000145	0.0002357	-0.06	0.951
TW	0.0013007	0.0021241	0.61	0.541

Table 7 shows the multiple liner regression result of the relationship between CEO compensation and environmental performance in banks. The estimated coefficient on TGE (Total GHG Emissions) and TWU (Total Water Use) is negative, while TEC (Total

Energy Consumption) and TW (Total Waste) is positive. In other words, as mentioned in section 3: Research Methodology, after controlling the environmental protection policy, such as EEP (Energy Efficiency Policy) and ESCM (Environmental Supply Chain Management), it shows CEOs receive higher total compensation with higher TEC (Total Energy Consumption) and TW (Total Waste), as well as lower TGE (Total GHG Emissions) and TWU (Total Water Use). The result of T-test is also presented in Table 6, the value of  $P > |t|$  in TGE (Total GHG Emissions) and TEC (Total Energy Consumption) are smaller than 0.05, which implies that significance of these two variables is high. In particular, the significance of TEC (Total Energy Consumption) is the highest among the dependent variables.

#### 4.1.2 CEO compensation and environmental performance in insurance companies

##### Model fitting

**Table 8:** The ANOVA test for CEO compensation and environmental performance in insurance companies

Source	Sum of square	Degree of freedom	Mean square	<i>Prob &gt; F</i>	Number of observations
Model	6453.62336	22	293.346516	0.000	481
Residual	17440.8278	458	38.080499		
Total	23894.4511	480	49.7801066		

The ANOVA test shows how well the model is used for the analysis. The use of F-test can provide more details for the model. When value of  $P > |F|$  is more than 0.05, it means that the model does not fit the data. In Table 8, the significance of statistics is high as the numerical value of the  $Prob > F$  is zero, which is smaller than 0.05.

**Table 9:** Descriptive statistics for CEO compensation and environmental performance in insurance companies

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
TGE	0.0003212	0.0009206	0.35	0.727
TEC	0.113817	0.0021277	5.35	0.000
TWU	0.007176	0.000901	0.80	0.426
TW	0.007649	0.0006408	1.19	0.233



Table 9 illustrates the multiple liner regression result of the relationship between CEO compensation and environmental performance in insurance companies. The independent variables of TGE (Total GHG Emissions), TEC (Total Energy Consumption), TWU (Total Water Use) and TW (Total Waste) presents a positive impact on TCP (Total CEO Compensation). As mention in section 3: Research Methodology), after governing the environmental protection policy such as EEP (Energy Efficiency Policy) and ESCM (Environmental Supply Chain Management), CEOs receive higher total compensation with higher consumption of resource in insurance companies. Moreover, the value of t-statistics in TEC (Total Energy Consumption) is zero, which suggests that the level of significance between TEC (Total Energy Consumption) and TCP (Total CEO Compensation) is high.

#### 4.1.3 Testing the hypothesis

Hypothesis 1: lower degree of resource consumption and environmental pollution is connected with the higher CEO compensation.

The results shown in Tables 6 and 7, TGE (Total GHG Emissions) shows a negative impact on CEO compensation and their correlation is significant. However, the TEC (Total Energy Consumption) is suggesting a positive impact on CEO compensation and their correlation is also significant. Hence, hypothesis 1 is rejected in the industry of banks.

Moreover, all factors involving consumption of resource and emissions of polluting gas shows a positive correlation to CEO compensation in insurance companies. And only TEC (Total Energy Consumption) meets the condition of significant correlation. It means that higher level of consumption in total energy correlates to higher CEO compensation. Therefore, hypothesis 1 is also rejected in the insurance companies.

Generally speaking, the negative link between the degree of resource consumption and environmental pollution is not significant in banks and insurance companies.

## 4.2 CEO compensation and social performance

### 4.2.1 CEO compensation and social performance in banks

#### Model fitting

**Table 10:** ANOVA test for CEO compensation and social performance in banks

Source	Sum of square	Degree of freedom	Mean square	<i>Prob &gt; F</i>	Number of observations
Model	10593.0548	22	481.502492	0.0000	531
Residual	22092.8171	508	43.4897975		
Total	32685.872	530	61.6714565		

The ANOVA test is used to measure how well the model fits the data. The use of F-test can provide further details for the model. When value of  $P > |F|$  is more than 0.05, it means that the model does not fit the data well. Table 10 illustrates the result of ANOVA test. This table suggests that this model fits the data and the significance of the statistics is high because the value of the  $\text{Prob} > F$  is zero.

**Table 11:** Descriptive statistics for CEO compensation and social performance in banks

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
ET	0.2915286	0.073015	3.99	0.000
WIW	-0.1591135	0.376698	-4.22	0.0313
WIM	0.0811142	0.326576	2.48	0.000

Table 11 explains the outcome of multiple liner regression between CEO compensation and social performance in the banking industry. It shows ET (Employee Turnover %) and WIM (% Women in Management) have a positive impact on TCP (Total CEO Compensation), while WIW (% Women in Workforce) has a negative impact on CEO compensation. When CEO compensation increased one unit, both ET (Employee Turnover %) and WIM (% Women in Management) will increase by 0.29 and 0.08 units respectively. And WIW (% Women in Workforce) decreased by approximately 0.16 units. The result of T-test is also illustrated in Table 11, where both ET (Employee Turnover %) and WIM (% Women in Management) shows a high level of significance associated with TCP (Total CEO Compensation).

#### 4.2.2 CEO compensation and social performance in insurance companies

##### Model fitting

**Table 12:** ANOVA test for CEO compensation and social performance in insurance companies

Source	Sum of square	Degree of freedom	Mean square	$\text{Prob} > F$	Number of observations
Model	52000.30958	22	236.377708	0.0000	485
Residual	19179.0805	462	41.5131612		
Total	24379.0805	484	50.5131612		

The number of observation is 485 in the ANOVA test. The value of Sum of square, degree of freedom and mean square are used to calculate the value of  $P > |F|$ . If the value of  $P > |F|$

is below 0.05, then it shows that this model is considered to be suitable for the data. As shown in Table 12, the value of Prob > F is zero in this model, which indicates that the model is suitable for data analysis and the significance of model is in a high level.

**Table 13:** Descriptive statistics for CEO compensation and social performance in insurance companies

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
ET	0.264837	0.0083517	3.17	0.002
WIW	0.236968	0.0195188	1.12	0.225
WIM	0.1710085	0.0280381	6.10	0.000

From Table 13, descriptive statistics shows the outcome of multiple liner regression between CEO compensation and social performance in insurance companies. It suggests that the estimated coefficient on ET (Employee Turnover %), WIW (% Women in Workforce) and WIM (% Women in Management) are positive, which illustrates that TCP (Total CEO Compensation) is positively connected with these three variables. As mentioned in section 3: Research Methodology, after controlling company operation policy such as HSP (Health and Safety Policy) and EOP (Equal Opportunity Policy), the CEO can receive higher level of compensation with higher ET (Employee Turnover %), WIW (% Women in Workforce) and WIM (% Women in Management) in insurance companies. The result of T-test can be obtained from the Table 13, where ET (Employee Turnover %) and WIM (% Women in management) shows a high level of significance connected to TCP (Total CEO Compensation) as both of the value of on  $P > |t|$  is zero.

#### 4.2.3 Testing the hypothesis

Hypothesis 2: the higher the participation of women in firm's management, the higher the CEO compensation.

Firstly, it is suggested that factors such as ET (Employee Turnover %), and WIM (% Women in Management) are positively related to CEO compensation for banks as shown in the statistics outcome in Table 11. In particular, value of  $P > |t|$  on ET (Employee Turnover %) and WIM (% Women in Management) is zero, which represents that the association between these two variables and dependent variable is significant. Therefore, combining the results shown in Tables 10 and 11, it suggests hypothesis 2 is proved to be true in the banking industry.

Secondly, the estimated coefficient on ET (Employee Turnover %), WIW (% Women in Workforce) and WIM (% Women in Management) are positive in insurance companies, which shows that dependent variable is positively connected with these three independent variables. Additionally, both ET (Employee Turnover %) and WIM (% Women in

Management) shows a significant correlation. Hence, combining the results presented in Table 12 and Table 13, suggests that hypothesis 2 is true for insurance companies.

To summarize, the positive relationship between the participation of women in management and CEO compensation exists both in banks and insurance companies.

### 4.3 CEO compensation and corporate governance performance

#### 4.3.1 CEO compensation and corporate governance performance in banks

##### Model fitting

**Table 14:** ANOVA test for CEO compensation and corporate governance performance in banks

Source	Sum of square	Degree of freedom	Mean square	<i>Prob &gt; F</i>	Number of observations
Model	12331.8625	26	474.302402	0.0000	499
Residual	18996.0468	472	40.2458619		
Total	31327.9093	498	62.9074483		

The value of Sum of square, degree of freedom and mean square are used to calculate the value of  $P > |F|$ . If value of  $P > |F|$  is more than 0.05, it means that this model cannot be used for data analysis. In Table 14, number of  $P > |F|$  is obtained after ANOVA test and it shows zero, it means that the model fits the data.

**Table 9:** Descriptive statistics for CEO compensation and corporate governance performance in banks

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
NEDOB	0.0266576	0.030027	0.89	0.375
ID	0.0889572	0.0294563	3.02	0.003
WOB	0.0083163	0.035893	0.23	0.0817
FE	0.0580519	0.032174	1.80	0.072
BAL	1.118814	0.2284259	4.90	0.000

Table 15 describes the consequence of multiple liner regression on the connection between CEO compensation and corporate governance performance in banks. It reflects that after constricting the variable of DU (CEO Duality) and FCEO (Female Chief

Executive Officer or Equivalent), the following variables presents a positive impact on CEO compensation: NEDOB (% Non-Exec Director on Board); ID (% Independent Directors); WOB (% Women on Board); FE (% Female Executives); and BAL (Board Age Limit). It means that higher level of CEO compensation is associated with higher level of these variables. The outcomes of T-test are demonstrated in Table 15. According to observing the value of  $P > |t|$ , only ID (% Independent Directors) and BAL (Board Age Limit) represents a high significance among the variables.

#### 4.3.2 CEO compensation and corporate governance performance in insurance companies

##### Model fitting

**Table 10:** ANOVA test for CEO compensation and corporate governance performance in insurance companies

Source	Sum of square	Degree of freedom	Mean square	$Prob > F$	Number of observations
Model	9422.55753	26	362.406059	0.0000	424
Residual	12012.8911	397	30.2591716		
Total	21435.4487	423	50.6748195		

The value of Sum of square, Degree of freedom and Mean square are used to calculate the value of  $P > |F|$ . If the result of F-test is below 0.05, it means that this model is suitable for data analysis. As shown in Table 16, the value of  $Prob > F$  is zero, thus, the model fits for the data analysis and the significance of model is high.

**Table 11:** Descriptive statistics for CEO compensation and corporate governance performance in insurance companies

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
NEDOB	-0.0073194	0.0324603	-0.23	0.822
ID	0.0362896	0.0167569	2.17	0.031
WOB	0.0512612	0.0287276	1.78	0.075
FE	0.1238007	0.0266268	4.65	0.000
BAL	1.129651	0.1669955	6.76	0.000

The Table 17 presents the statistics result for the connection between CEO compensation and corporate governance performance in insurance companies. The estimated coefficient on ID (% Independent Directors), WOB (% Women on Board), FE (% Female Executives) and BAL (Board Age Limit) are positive, which suggests TCO (Total CEO Compensation) is positively linked with these variables. In other words, firm's CEO can get more compensation with higher level of these variables after controlling the DU (CEO

Duality) and FCEO (Female Chief Executive Officer or Equivalent). Table 16 illustrates the statistics results of T-test. It shows that value of  $P > |t|$  on ID (% Independent Directors), FE (% Female Executives) and BAL (Board Age Limit) are smaller than 0.05, which proves that the significance of these variables is high. But value of NEDOB (% Non-Exec Director on Board) is very large, around 0.82, which means that the negative association between CEO compensation and NEDOB (% Non-Exec Director on Board) is not significant.

#### 4.3.3 Testing the hypothesis

Hypothesis 3: higher level of diversity and independence of the board are associated with higher CEO compensation.

As shown in Table 15, all variables related to the diversity and independence of the board have expressed a positive influence on CEO compensation in banks. However, not all of them show the feature of significance linked to CEO compensation. Only dependent variables of ID (% Independent Directors) and BAL (Board Age Limit) hold the significant correlation with CEO compensation. In addition, the significance of the remaining variables cannot be demonstrated from the statistics result. As such, hypothesis 3 is rejected for banks.

For insurance companies, almost all variables related to the diversity and independence of the board have illustrated a positive effect associated with the CEO compensation, while NEDOB (% Non-Exec Director on Board) shows an opposite result. Moreover, the negative correlation between NEDOB (% Non Exec Director on Board) and CEO compensation is not significant as the statistics outcome is approximately 0.82. In addition, the value of  $P > |t|$  on WOB (% Women on Board) is 0.075, which is over 0.05. This means that the positive correlation between WOB (% Women on Board) and CEO compensation is not significant. Consequently, the outcome of descriptive statistics for CEO compensation and corporate governance performance is not consistent with hypothesis 3 for insurance companies.

In sum, the positive association between the diversity and independence of board and CEO compensation is not significant in banks and insurance companies.

## 4.4 CEO compensation and ESG performance

### 4.4.1 CEO compensation and ESG performance in banks

#### Model fitting

**Table 12:** ANOVA test for CEO compensation and ESG performance in banks

Source	Sum of square	Degree of freedom	Mean square	<i>Prob &gt; F</i>	Number of observations
Model	29298.9127	62	472.563107	0.0000	482
Residual	1239.32941	419	2.95782675		
Total	30538.2421	481	63.4890688		

The number of observation is 482 in this ANOVA test. The value of Sum of square, Degree of freedom and Mean square are used to compute the value of  $P > |F|$ . If the value  $P > |F|$  is below 0.05, and this model is considered to be suitable for the data analysis. It is suggested that the model is suitable for data and significance of the model is high due to the value of  $Prob > F$  is zero in Table 18.

**Table 13:** Descriptive statistics for CEO compensation and ESG performance in banks

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
TSP	1.347682	0.1301002	10.36	0.000
TBP	0.8911485	0.0446013	19.98	0.000
SAG	0.950971	0.234598	40.54	0.000
OAG	1.105412	0.0395901	27.92	0.000
NIP	0.8197482	0.663881	12.35	0.000
PNDP	1.078551	0.0670222	16.09	0.000
ET	0.0831573	0.0258221	3.22	0.0001

In Table 19, descriptive statistics shows the result of multiple liner regression between CEO compensation and ESG performance in banks. The structure of TCP (Total CEO Compensation) is consisted of following components: TSP (Total Salary Paid); TBP (Total Bonus Paid); SAG (Stock Awards Granted); OAG (Option Awards Granted); NIP (Non-Equity Incentives Granted); and PNDP (Pension and Non qualified Defined Pension). Comparing the estimated coefficient in each element of CEO compensation, it is apparent that TSP (Total Salary Paid) plays the dominant role in TCP (Total CEO

compensation), followed by OAG (Option Awards Granted) and PNDP (Pension and Non qualified Defined Pension). Considering all the statistics results on the independent variables in ESG performance, after controlling the economic determinants of CEO compensation such as ROA (Return on assets), Return (Return on assets), VOLARET (volatility in 360 days) and MCTBV (Market Capitalization to Book Value), the ET (Employee Turnover %) has become the dominant factor in ESG performance, which is a part of social performance. And ET (Employee Turnover %) also shows a positive impact on CEO compensation as the estimated coefficient is positive. The value of  $P > |t|$  in ET (Employee Turnover %) is 0.0001 and it represents that the level of significance between CEO compensation and ET (Employee Turnover %) is very high.

#### 4.4.2 CEO compensation and ESG performance in insurance companies

##### Model fitting

**Table 14:** ANOVA test for CEO compensation and ESG performance in insurance companies

Source	Sum of square	Degree of freedom	Mean square	$Prob > F$	Number of observations
Model	20164.1917	62	325.228898	0.0000	416
Residual	463.09714	353	1.31188991		
Total	20627.2888	415	49.7043105		

In this ANOVA test, the number of observation is 416. The value of Sum of square, Degree of freedom and Mean square are used to calculate the value of  $P > |F|$ . If the value of  $P > |F|$  is over 0.05, it means that this model is not suitable for the data. However, the number of  $Prob > F$  shows as zero in Table 20, which illustrates that the model fits the data well and the significance is high in this model.



**Table 21:** Descriptive statistics for CEO compensation and ESG performance in insurance companies

Independent variable	Coefficient	Standard error	t	$P >  t $
TCP				
Dependent variable				
TSP	1.151621	0.1301002	10.36	0.000
TBP	0.9800219	0.0446013	19.98	0.000
SAG	0.9826425	0.0234598	40.54	0.000
OAG	1.030728	0.0395901	27.92	0.000
NIP	1.024277	0.0663881	12.35	0.000
PNDP	0.9743386	0.0670222	16.09	0.000
HRP	1.083483	0.2923669	3.71	0.000

Table 21 demonstrates the link between CEO compensation and ESG performance in insurance companies. It suggests that the leading components is TSP (Total Salary Paid) in CEO compensation, which shows the highest estimated coefficient among the other components. After governing the economic determinants of CEO compensation such as ROA (Return on assets), Return (Return on assets), VOLARET (volatility in 360 days) and MCTBV (Market Capitalization to Book Value), it is easy to find that the HRP (Human Rights Policy) became the major factor effecting the ESG performance, which is belongs to social performance. Table 21 also shows that all components of CEO compensation have a positive impact on CEO compensation. In particular, the value of  $P > |t|$  TSP (Total Salary Paid) is zero, which suggests that the positive association between TCP (Total CEO compensation) and TSP (Total Salary Paid) is significant. Moreover, the value of  $P > |t|$  for the variable of HRP (Human Rights Policy) is zero which represents the positive link between TCP (Total CEO Compensation) and HRP (Human Rights Policy) is significant.

#### 4.4.3 Testing the hypothesis

Hypothesis 4: salary is the leading elements in total CEO compensation, and social performance is the dominant factor in ESG performance to influence CEO compensation.

It is clearly all components of CEO compensation are positively related to the CEO compensation, and their relations are both significant. In particular, the value of estimated correlation in TSP (Total Salary Paid) is the highest compared with other elements, around 1.15. It means that TSP (Total Salary Paid) plays a dominant role in CEO compensation. Based on comprehensive consideration of the correlation and significance between the independent variable and various dependent variables, it can be suggested that ET (Employee Turnover %) has become the most influential factor in ESG performance to influence CEO compensation. And this factor is belonging to the

measurement of social performance. Hence, hypothesis 4 is proven to be appropriate for banks.

Additionally, as shown in Table 21, TSP (Total Salary Paid) is the most important part of CEO compensation in insurance companies. The correlation between TSP (Total Salary Paid) and TCP (Total CEO Compensation) is positive and significant. Under the premise of fully taking account of correlation and significance between CEO compensation and several dependent variables, it is can be demonstrated that HRP (Human Rights Policy) has the greatest impact on CEO compensation and this impact is positive. Moreover, this element is a part of social performance. Consequently, hypothesis 4 is proven to be true for insurance companies.

In sum, in both banks and insurance companies, TSP (Total Salary Paid) is a key factor in CEO compensation. In addition, CEO compensation is deeply influenced by social performance.

#### **4.5 Results**

By using four multiple linear regression models, the four questions in this research and their corresponding hypotheses are answered and verified. The findings of the four models are listed below:

First, the negative association between the degree of resource consumption and environmental pollution is not significant in banks and insurance companies.

Second, the higher level of female participation in management is associated with higher CEO compensation in banks and insurance companies and its correlation is significant.

Third, the association between the diversity and independence of the board and CEO compensation is positive but not significant in banks and insurance companies.

Finally, from the perspective of banks and insurance companies, the TSP (Total Salary Paid) is the dominant factor in CEO compensation and social performance has become the most influential factor in the association between CEO compensation and ESG performance.

## **5 Section 5: Discussion of implication**

### **5.1 Overall results**

Based on the analysis and results in section 4, while it is apparent that CEO compensation is influenced by ESG performance, there are also differences exists between banks and insurance companies. In this research, the compensation data, ESG performance data and the financial data was first obtained from Bloomberg. Then, four multiple liner regression models are used to answer the four research questions for banks and insurance companies. Finally, four findings are obtained through the analysis of data.

Firstly, under the background of considering the relevant environmental protection policy, such as Environmental Quality Management Policy and Energy Efficiency Policy, the negative association between CEO compensation and environmental performance is not significant in banks and insurance companies.

Secondly, from the perspective of banks and insurance companies, the higher participation of female in management is associated with higher CEO compensation as well as their correlation are both significant.

Thirdly, after controlling the characteristic of board, it can be seen that higher level of diversity and independence of board is related to higher level of CEO compensation, but their correlation is not significant in banks and insurance companies.

Fourthly, the salary paid is the main component in CEO compensation whether in a bank or an insurance companies, and social performance has the biggest positive impact in ESG performance.

### **5.2 Finding and discussion**

The discussion will be divided into four parts in order to have a better understanding of the relationship between existing literatures and research findings.

#### **5.2.1 CEO compensation and environmental performance**

The factors such as the emissions of total greenhouse gases and use of total water, are used to measure the environmental performance in this research. From the perspective of banks, TGE (Total GHG Emissions) and TWU (Total Water Use) is negatively associated with CEO compensation, while TEC (Total Energy Consumption) and TW (Total Waste) show positive impact on CEO compensation. For insurance companies, the connections between these four factors and CEO compensation are all positive. Stanwick and Stanwick's paper (2001) demonstrated that connection between CEO compensation and environmental performance is positive and firm's environmental reputation is also a vital factor that influence this relationship. Banks and insurance companies are faced with

varying degree of environmental reputation in this research, which leads to the differences in the analysis results between them.

### **5.2.2 CEO compensation and social performance**

With regards to the association between CEO compensation and social performance, the factor of women's participation and the percentage of employee turnover are involved in this study. From the perspective of banks and insurance companies, the results of this research presents a positive relationship between CEO compensation and employee turnover rate and women's participation in firm's management. The finding of Dezső and Ross (2012) illustrated that the representation of women in management bring social diversity benefits for firms and improve firm performance. Moreover, research by Wade et al. (2006) also found that when a firm has a certain degree of employee turnover rate, the connection between CEO compensation and social performance is positively related. For banks and insurance companies, based on the diversity of management and a certain level of employee turnover rate, the association between CEO compensation and social performance is positive.

### **5.2.3 CEO compensation and corporate governance performance**

Factors such as independent directors, percentage of women on board, percentage of female executives and limitation of board age are used in corporate governance performance. For banks and insurance companies, it can be summarized from the data analysis that the association between CEO compensation and corporate governance performance is positive but not significant. Conyon and He (2011) believed that the relationship between corporate governance and CEO compensation can be strengthened by increasing the number of independent directors. Moreover, Brogi (2008) suggested that the regulations about corporate governance between banks and insurance companies are also dissimilar. For banks and insurance companies, due to the differences in the number of independent directors and regulations, the positive correlation between CEO compensation and corporate governance performance is not significant.

**Table 22:** Findings in banks and insurance companies

Hypotheses	Findings (results)		Interpretation
	Banks	Insurance companies	
Lower degree of resource consumption and environmental pollution is connected with the higher level of CEO compensation	Low GHG emission and high energy consumption is associated with high CEO compensation	Higher the level of resource consumption and environmental pollution is connected with higher level of CEO compensation	The varying level of environmental reputation between banks and insurance companies
Higher participation of woman in management in firm, the higher the CEO compensation	The participation of woman in firms' management has positive impact on CEO compensation.	The higher participation of female in management is connected to higher CEO compensation	Gender diversity and a certain level of employee turnover rate are good for firm
Higher level of diversity and independence of the board are associated with the high CEO compensation	The association between CEO compensation and corporate governance performance is positive but not significant	The association between CEO compensation and corporate governance performance is positive but not significant	The difference on the regulations between banks and insurance companies. The number of independent directors will influence the corporate governance performance.
The salary paid is the leading elements in the total CEO compensation, and the social performance will be the dominant factor in ESG performance to influence CEO compensation	Salary paid and social performance are dominant in CEO compensation and ESG performance respectively	Salary paid and social performance are dominant in CEO compensation and ESG performance respectively	Salary paid is fixed and annual. The concept of CSR is widely used in business.

### 5.2.4 CEO compensation and ESG performance

In order to control the effect of economic constraints, some economic elements such as ROA, volatility, market capitalization to book value and return on stocks are used to control the ESG performance. For banks and insurance companies, CEO compensation is divided into six parts in this research and each of element is positively associated with CEO compensation. Garner (2013) found that in order to optimize the structure of CEO compensation and ensure the long-term development of firms, a good compensation package must be composed of different types of compensation and each element is positively related to total CEO compensation. Moreover, salary accounted for the biggest portion in the structure of CEO compensation in this study, which is consistent with the findings by Balsam (2002). Balsam (2002) illustrated that the pattern of payment in salary is fixed and annual. Furthermore, the results of data analysis in this study also indicates that social performance has become the key factor in the relationship between CEO

compensation and ESG performance and its impact is positive. D'Amato et al. (2009) suggested that the concept of CSR (Corporate Social Responsibility) is associated with social performance, which is widely used in business to ensure the sustainable development of firms.

### **5.3 Implications of findings**

It is suggested that as a part of non-financial performance, ESG performance not only has become a new indicator for firms to measure the sustainable development in the long term but is also be closely related to CEO compensation on the basis of literature review in section 2 and results of data analysis in section 4. In terms of the findings, ESG performance should be considered when analyzing an investment decision in order to promote the sustainable development for firms. The investors can measure the relationship between CEO compensation and ESG performance from their own perspective, and then make a decision. Furthermore, for policy makers, they can make some adjustment in the management of CEO compensation on the basis of ESG performance.

This research examines the relation between CEO compensation and ESG performance. Overall, there are some differences and similarities exists between this research's findings and previous research findings. This situation can be explained by the differences in the choice of variables and research perspectives.

## **6 Section 6: Conclusion**

This section is organized in three s. 6.1 will provide a summary of the research. The limitation of this research will be illustrated in 6.2. Finally, the 6.3 will demonstrates the recommendation of this research.

After the financial crisis, an increasing number of people believed that the current CEO compensation system need to be improved in order for the system to be trusted in the future. At the same time, the concept of ESG performance is being formally put forward, as an important part of evaluating the company's non-financial performance.

This research studies the relationships between CEO compensation and ESG performance in banks and insurance companies, and how each factor in ESG performance are individually linked to CEO compensation. Firstly, the level of resource consumption and environmental pollution is considered to be the environmental factor in ESG performance. Secondly, from the point view of society, this study makes a connection between the level of women's participation in management and CEO compensation. Thirdly, from the perspective of corporate governance, the level of diversity and independence of board is measured against CEO compensation. Lastly, the dominant factor of CEO compensation and ESG performance is also investigated in this research.

From the literature reviews, there are some existing articles which illustrated the association between CEO compensation and ESG performance. The ESG performance is mainly consisted of three factors: environmental; social; and corporate governance. Most of the previous researches only focus on the link between one particular element in ESG performance and CEO compensation. In this research, each factor of ESG performance is respectively associated with CEO compensation and then discussed.

Most of the existing research concentrates on traditional industry and polluted industry, such as chemical industry and steel manufacturing industry. This research studies the association between CEO compensation and ESG performance in the financial industry, specifically, in banks and insurance companies. Corporate managers will be able to have a better understanding of the concept of CEO compensation and ESG performance through this study, and can use the associated knowledge in decision-making. Moreover, from the perspective of policy makers, they can take advantage of the results in this study and carry out some policies that can contribute to the long-term and stable development of society.

In order to achieve the research objectives and answer the research questions, this study follows the philosophy of positivism with the deductive approach. The secondary set of data are obtained from Bloomberg on the basis of quantitative method. Also, there are four multiple liner regression models are prepared to analyze the data with the help of Stata. The ANOVA test is required to confirm the model is suitable for the data in the beginning of the data analysis. After the models are performed, the correlation and the significant degree between variables will be displayed according to the value of estimated coefficient and t-statistics. In summary, there are some differences between CEO compensation and specific factor in ESG performance. First, the higher level of resource consumption and environmental pollution is positively associated with CEO compensation in insurance companies. Second, the CEO compensation will increase with the increase of women's participation in management. Thirdly, higher level of the diversity and independence in board of directors is linked to the higher CEO compensation. Lastly, salary is the dominant element in the structure of CEO compensation and social performance has become the determining factor in ESG performance.

## 6.1 Limitations

The first limitation in this research is the selection of the sample. The 111 financial institutions were chosen and they are classified as insurance companies and banks in this study. These financial institutions mainly come from the United States and the Europe, with only a few from Japan. As such, all financial institutions are from developed countries. Since the concept of ESG performance was officially put forward in 2006, many financial institutions in developing countries have not adopted this criterion in the

process of operation. For the further study, the financial institutions in developing countries may be considered.

The second limitation in this research is the selection of variables of each factor in ESG performance. For a factor, it may include a lot of variables. The variables in these four questions are selected on the basis of previous related literatures. Thus, they are not enough to answering the research questions entirely. For social governance, variables such as consumer protection, animal welfare and the firm's recruitment policy can also be selected into the multiple liner regression model in the further study.

The third limitation in this research is the selection of data analysis method. The panel data analysis is used instead of time series data analysis in this research. Conversely, the majority of researchers used time series data analysis in order to control time-series effect in this research area. Since there are four multiple linear regression models used in this study, the use of panel data analysis can avoid the problem of multivariate co-linearity.

## 6.2 Recommendations

Based on the limitation in this research, researchers can expand the size of the sample in further studies. If the financial institutions in developing countries are also included in the sample, the accuracy of the data analysis results can be improved to some extent. Moreover, for more in depth research, as the number of relevant variables in the model increases, the explanatory function of this model will increase.

## References:

- Aguilera, R. V., Williams, C. A., Conley, J. M. & Rupp, D. E. (2006) Corporate governance and social responsibility: A comparative analysis of the UK and the US, *Corporate Governance: An International Review*, 14(3), pp.147-158.
- Ahmed Sheikh, N., Wang, Z. & Khan, S. (2013) The impact of internal attributes of corporate governance on firm performance: evidence from Pakistan, *International Journal of Commerce and Management*, 23(1), pp.38-55.
- Al-Matari, E. M., Al-Swidi, A. K. & Fadzil, F. H. B. (2014) The measurements of firm performance's dimensions, *Asian Journal of Finance & Accounting*, 6(1), pp.24-49.
- Amankwah, G. & Abonge Viyu, H. (2011) *Investigating Environmental, Social and Governance (ESG) considerations in Venture Capital & Private Equity firms: A study in US and UK venture capital industry* [Master's thesis] (Umeå School of Business).
- Ayure, H. (2016) Non-Equity Incentive Plans, *Knowingstartups*, 11 February, available at: <http://www.knowingstartups.com/non-equity-incentive-plans/> (July 17, 2016).
- Banker, R. D., Potter, G. & Srinivasan, D. (2000) An empirical investigation of an incentive plan that includes nonfinancial performance measures, *The accounting review*, 75(1), pp.65-92.
- Balsam, S. (2002) *An introduction to executive compensation* (Cambridge: Academic Press).
- Ballou, B., Godwin, N. H. & Shortridge, R. T. (2003) Firm value and employee attitudes on workplace quality, *Accounting Horizons*, 17(4), pp.329-341.



- Barnes, R. (n.d.) The Benefits and Value of Stock Options, *Investopedia*, n.d., available at: <http://www.investopedia.com/articles/optioninvestor/07/evolvingoptions.asp?ad=dirN&qo=investopediaSiteSearch&qsrc=0&o=40186> (July 25, 2016).
- Bebchuk, L. A. & Fried, J. M. (2003) Executive compensation as an agency problem, *The Journal of Economic Perspectives*, 17(3), pp.71-92.
- Berrone, P. & Gomez-Mejia, L. R. (2009) Environmental performance and executive compensation: An integrated agency-institutional perspective, *Academy of Management Journal*, 52(1), pp.103-126.
- Bertrand, M. & Hallock, K. F. (2001) The gender gap in top corporate jobs, *Industrial & Labor Relations Review*, 55(1), pp. 3-21.
- Bhagat, S. & Romano, R. (2009) Reforming Executive Compensation: Focusing and Committing to the Long-Term, *Yale Journal on Regulation*, 26(2), pp.359-372.
- Brogi, M. (2008) Regulation, corporate governance and risk management in banks and insurance companies, *18th AFIR Colloquium: Financial Risk in a Changing World*, available at: <https://ssrn.com/abstract=1710086> (February 1, 2023).
- Boettke, P. J. (2003) Milton and Rose Friedman's 'Free to Choose and its Impact in the Global Movement Toward Free Market Policy: 1979-2003, The Legacy of Milton and Rose Friedman's "Free to Choose": Economic Liberalism at the Turn of the 21st Century (Dallas, Tex.: Federal Reserve Bank of Dallas), pp.137-52.
- Box, J. F. (1987) Guinness, Gosset, Fisher, and small samples, *Statistical Science*, 2(1), pp.45-52.
- Boyd, B. K. (1994) Board control and CEO compensation, *Strategic Management Journal*, 15(5), pp. 335-344.
- Brouwers, R., Schoubben, F., Van Hulle, C. & Van Uytbergen, S. (2014) The link between corporate environmental performance and corporate value: A literature review, *Review of Business and Economic Literature*, 58(4), pp.343-374.
- Boyd, B. K. (1994) Board control and CEO compensation, *Strategic Management Journal*, 15(5), pp. 335-344.
- Cai, Y., Jo, H. & Pan, C. (2011) Vice or virtue? The impact of corporate social responsibility on executive compensation, *Journal of Business Ethics*, 104(2), pp. 159-173.
- Conyon, M. J. & He, L. (2011) Executive compensation and corporate governance in China, *Journal of Corporate Finance*, 17(4), pp.1158-1175.
- Coleman, C. M. (2000) The pay to performance relationship: is CEO compensation linked to performance [Master thesis] (University of San Jose State).
- Collins, M. (2011) Deferred Compensation Lets Executives Avoid Caps on 401(k)s, *Bloomberg*, 29 June, available at: <http://www.bloomberg.com/news/articles/2011-06-29/deferred-compensation-lets-executives-avoid-401-k-saving-caps> (July 28, 2016).
- Crystal, G. S. (1992) *In search of excess: The overcompensation of American executives* (New York City: WW Norton & Company).
- D'Amato, A., Henderson, S., & Florence, S. (2009) *Corporate social responsibility and sustainable business: A Guide to Leadership Tasks and Functions* (Greensboro: Center for Creative Leadership, North Carolina).
- Dezső, C. L. & Ross, D. G. (2012) Does female representation in top management improve firm performance? A panel data investigation, *Strategic Management Journal*, 33(9), pp.1072-1089.
- Eccles, R. G., Ioannou, I. & Serafeim, G. (2014) The impact of corporate sustainability on organizational processes and performance, *Management Science*, 60(11), pp.2835-2857.
- Edmans, A. (2011) Does the stock market fully value intangibles? Employee satisfaction and equity prices, *Journal of Financial Economics*, 101(3), pp. 621-640.

- Elkinawy, S. & Stater, M. (2011) Gender differences in executive compensation: Variation with board gender composition and time, *Journal of Economics and Business*, 63(1), pp.23-45.
- Enderle, G. (2015) *Ethical Innovation in Business and the Economy* (Cheltenham: Edward Elgar Publishing).
- Eavis, P. (2014) Executive Pay: Invasion of the Supersalaries, *The New York Times*, 12 April, available at: <http://www.nytimes.com/2014/04/13/business/executive-pay-invasion-of-the-supersalaries.html> (July 19, 2016).
- Fahlenbrach, R. & Stulz, R. M. (2011) Bank CEO incentives and the credit crisis, *Journal of Financial Economics*, 99(1), pp.11-26.
- Fabrizi, M., Mallin, C. & Michelon, G. (2014) The role of CEO's personal incentives in driving corporate social responsibility, *Journal of Business Ethics*, 124(2), pp. 311-326.
- Ferracane, R. (2011) The Role of Environmental Sustainability in Executive Compensation, *Forbes*, 26 April, available at: <http://www.forbes.com/sites/robinferracane/2011/04/26/the-role-of-environmental-sustainability-in-executive-compensation/#5e19a14a1af6> (July 30, 2016).
- Frydman, C. & Saks, R. (2007) Historical trends in executive compensation, 1936-2003, *Journal of Economic History*, 6(2), pp. 520-521.
- Friedman, M. (2008) The social responsibility of business is to increase its profits, In: Burchell, J.(ed.) *The corporate social responsibility reader - Context & Perspectives* (London: Routledge), pp. 84-89.
- Garner, G. (2013) *The Garner Group Executive research*, available at: <http://www.thegarnergrp.com/blog/bid/94565/The-5-Most-Important-Elements-of-Executive-Compensation-Packages> (July 20, 2016).
- Gkiliatis, I. (2009) *Boards of Directors and Firm Performance: A Combination of Agency and Dependence Theory Perspectives*, [PhD thesis] (Brunel University London).
- Gomstyn, A. (2009) Wall Street Roller Coaster Means Big CEO Paydays, *ABC News*, September 2, available at: <http://abcnews.go.com/Business/ceo-compensation-soars-wall-streetgains/story?id=8462841> (July 17, 2016).
- Goldmansachs (2015) *ESG report* (New York City), available at: <http://www.goldmansachs.com/s/esgreport/index.html> (July 17, 2016).
- Guevarra, L. (2011) Is Tying Executives' Pay to ESG Performance Effective?, *GreenBiz*, 13 May, available at: <https://www.greenbiz.com/news/2011/05/13/tying-executives-pay-esg-performance-effective> (July 17, 2016).
- Hillman, A. J. & Dalziel, T. (2003) Boards of directors and firm performance: Integrating agency and resource dependence perspectives, *Academy of Management review*, 28(3), pp.383-396.
- Hofmann, C. (2001) *Balancing financial and non-financial performance measures* [Master's thesis] (University of Hannover).
- Hong, B., Li, Z. & Minor, D. (2015) Corporate Governance and executive compensation for corporate social responsibility, *Journal of Business Ethics*, 136(1), pp. 199-213.
- Hoops, T. (2015) Why it's time to believe the hype behind ESG investing?, *Investment News*, 8 April, available at: <http://www.investmentnews.com/article/20150408/BLOG09/150409926/why-its-time-to-believe-the-hype-behind-esg-investing> (July 17, 2016).
- Ippolito, R. A. (1991) Encouraging long-term tenure: wage tilt or pensions?, *Industrial & Labor Relations Review*, 44(3), pp.520-535.
- Jian, M. & Lee, K. W. (2015) CEO compensation and corporate social responsibility, *Journal of Multinational Financial Management*, 29(1), pp.46-65.

- Khanna, M. & Damon, L. A. (1999) EPA's voluntary 33/50 program: Impact on toxic releases and economic performance of firms, *Journal of environmental economics and management*, 37(1), pp. 1-25.
- Khan, W. A. & Vieito, J. P. (2008) Gender and executive compensation in S&P listed firms, *Journal of Economics and Finance*, 36(2), pp.371-399.
- Larrain, J. (1979) *The concept of ideology* (London: Hutchinson).
- Leff, M. H. (2003) *The Limits of Symbolic Reform: The New Deal and Taxation* (Cambridge: Cambridge University Press).
- Lee, K. W. (2014) Compensation Committee and Executive Compensation in Asia, *International Journal of Business*, 19(3), pp.213-236.
- Loss, L. & Seligman, J. (1995) *Fundamentals of Securities Regulation* (New York City: Little, Brown Company).
- Macionis, J. J. & Gerber, L. M. (2008) *Sociology*, 6th ed. (Canada: Pearson).
- Maverick, J. B. (2016) Will ESG Investments Become a Staple of 401(k) Plans?, *Investopedia*, 25 February, available at: <http://www.investopedia.com/articles/financial-advisors/022516/will-esg-investments-become-staples-401k-plans.asp> (July 17, 2016).
- Medina, E. (2012) *Job satisfaction and employee turnover intention: what does organizational culture have to do with it?* [Master's thesis] (Department of Quantitative Methods in the Social Sciences, Columbia University).
- Moon, P. & Fitzgerald, L. (1996) Delivering the goods at TNT: the role of the performance measurement system, *Management Accounting Research*, 7(4), pp. 431-457.
- Mohan, N. & Ruggiero, J. (2007) Influence of firm performance and gender on CEO compensation, *Applied economics*, 39(9), pp.1107-1113.
- National Committee on Pay Equity (2009) *Pay equity information*, available at: <http://www.pay-equity.org/info-history.html> (July 30, 2016).
- Namrita Kapur (2013) *The benefits of tying executive compensation to sustainability* (New York City: Environmental Defense Fund), available at: <http://business.edf.org/blog/2013/08/12/the-benefits-of-tying-executive-compensation-to-sustainability/> (July 17, 2016).
- Neely, A., Gregory, M. & Platts, K. (1995) Performance measurement system design: a literature review and research agenda, *International journal of operations & production management*, 15(4), pp.80-116.
- Ntim, C. G., Lindop, S., Osei, K. A. & Thomas, D. A. (2015) Executive compensation, corporate governance and corporate performance: a simultaneous equation approach, *Managerial and Decision Economics*, 36(2), pp.67-96.
- Peni, E. (2014) CEO and Chairperson characteristics and firm performance, *Journal of Management & Governance*, 18(1), pp. 185-205.
- Proctor, R. & Murtagh, J. (2014) Incentive Compensation for Bank CEOs and CFOS before and after the Financial Crisis, *Journal of Legal, Ethical and Regulatory Issues*, 17(2), pp. 61-75.
- Quinn, J. (2009) Bankers to receive huge bonuses despite financial crisis, *Telegraph*, 15 April, available at: <http://www.telegraph.co.uk/finance/recession/5154915/Bankers-to-receive-huge-bonuses-despite-financial-crisis.html> (July 17, 2016).
- Reiner, E. L. (2006) Ins And Outs Of Restricted Stock, *Financial Advisor*, 1 April, available at: <http://www.fa-mag.com/news/article-1361.html> (July 22, 2016).
- Reynolds, F. (2014) Executive pay should reflects' firms ESG goals, *Adviser*, 15 December, available at: <http://www.ftadviser.com/2014/12/15/investments/global/executive-pay-should-reflect-firms-esg-goals-6n5oHCvXtaV1v1B2PVP6cL/article.html> (July 28, 2016).
- Robson, C. (2002) *Real world research*, 2nd ed. (Malden: Blackwell Publishing).
- Sirkin, M. S. & Cagney, L. K. (2015) *Executive compensation* (New Jersey: Law Journal Press).

- Saunders, M. N. (2011) *Research methods for business students*, 5th ed. (London: Pearson).
- Sigler, K. J. & Carolina, N. (2011) CEO compensation and company performance, *Business and Economics Journal*, 31(1), pp. 1-8.
- Stanwick, P. A. & Stanwick, S. D. (2001) CEO compensation: does it pay to be green?, *Business Strategy and the Environment*, 10(3), pp.176-182.
- Stych, E. (2011) U.S. Bank CEO Davis' pay more than doubles to \$18.8 million, *Bizjournals*, 15 March, available at: <http://www.bizjournals.com/twincities/news/2011/03/15/us-bank-ceo-davis-pay-doubles.html> (July 21, 2016).
- The Internal Revenue Service (2015) *Pension and Annuity Income* (Washington, D.C: The Internal Revenue Service), available at: <https://www.irs.gov/pub/irs-pdf/p575.pdf> (July 17, 2016).
- Trammell, J. (2014) Lead from the Top: 5 Core Responsibilities of a CEO, *Entrepreneur*, 1 May, available at: <https://www.entrepreneur.com/article/233354> (July 21, 2016).
- Wade, J. B., O'Reilly III, C. A. & Pollock, T. G. (2006) Overpaid CEOs and underpaid managers: Fairness and executive compensation, *Organization Science*, 17(5), pp. 527-544.
- Waldman, D., de Luque, M. S., Washburn, N., House, R. J., Adetoun, B., Barrasa, A., Bobina, M., Bodur, M., Chen, Y. J., Debbarma, S., Dorfman, P., Dzuvichu, R. R., Evcimen, I., Fu, P., Grachev, M., Duarte, R. G., Gupta, V., Hartog, D. N. D., Hoogh, A. H. B., Jone, J. H. Y., Kabasakal, H., Konrad, E., Koopman, P. L., Lang, R., Lin, C. C., Liu, J., Martinez, B., Munley, A. E., Papalexandris, N., Peng, T. K., Prieto, L., Quigley, N., Rajasekar, J., Rodríguez, F. G., Steyrer, J., Tanure, P. T. V. D., Thierry, B., Thomas, H., Berg, V. M. & Wilderom, C. P. M. (2006) Cultural and leadership predictors of corporate social responsibility values of top management: A GLOBE study of 15 countries, *Journal of International Business Studies*, 37(6), pp. 823-837.
- Weight, C. (2013) *Directors' Remuneration Handbook*, 2013 ed. (London: Bloomsbury Professional).
- Zhang, Z. (2008) Asian energy and environmental policy: promoting growth while preserving the environment, *Energy Policy*, 36(10), pp. 3905-3924.

## Spreadsheet Application for Determining Activity Priority of Control and Inspection Authorities

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**Abstract** The research objective of this paper is to analyze the complaint evaluation and management process, required for inspection control carried out by state control bodies. In response to identified needs of state bodies, related to initiating the official inspection control procedure, which implies complaints consideration and justification of statements made in the petition, as well as the petition evaluation procedure, the authors of the paper propose development of corresponding spreadsheet application. The application should facilitate and improve identification and quantification of activities and subjects of control characterized by significant risk, and in which there is significant public interest, i.e., eliminate possible misuse of complaint. The paper shows the direct contribution of automation to more efficient limited resource management of state bodies in the Republic of Serbia.

**Keywords:** • inspection planning process • risk assessment • spreadsheet application • evaluation of petitions • efficient management

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## 1 Introduction

With the adoption of the systemic Law on Inspection Supervision in 2015, the reform of inspection supervision was formally initiated in the Republic of Serbia (Stefanović et al., 2017; Rapajić et al, 2021). The law defines modern inspection standards and common rules and procedures for all inspections. The law introduces novelties, and among other things the obligation to plan inspection supervision and conduct supervision in accordance with the risk assessment. One of the essential missing links in the risk-based inspection system, aimed at making the law enforcement more efficient, is the specific criteria for the risk assessment. In the process of reforming inspection supervision, i.e. implementation of the system Law on inspection supervision, several analyses of the current situation in the field of inspection supervision were conducted. It was concluded that, in order to harmonize inspection practice, it is necessary to develop and adopt models of appropriate procedures for the work of inspectors. This especially important when there are already a number of related doubts about how to act. One such procedure that was concluded that it is necessary is a procedure that would refer to the assessment of petitions (i.e., applications), which come from third parties and initiate inspection supervision. It has been suggested that for the assessment of complex petitions it is expedient to form teams, which would triage petitions and assess the risk arising from them, since more complex petitions require knowledge and experience of several persons, which should be determined by the above procedure.

This paper provides a solution to the previously described problem. In particular, the paper deals with a procedure for the assessment of petitions proposed based on the risk assessment arising from the petition. The whole process is automated and implemented into the application that replicates the risk assessment of petitions and determines priorities in the actions of the authorities.

The aim of the research was to develop a tool in a spreadsheet environment which enables the prioritization of activities and entities, carried out on the basis of the established risk degree in the procedure of assessment of petitions. This aim was set at the very beginning of the research and was successfully achieved, so the model developed by the end-user gives the possibility of objective assessment of petitions and determination of priorities in acting proportionally determined risk. The model that has been developed represents the basic version and it is possible to develop and improve it in several directions, which will be discussed in the final part of the paper.

Starting from this point, the paper is organized as follows, after the Introduction, Section 2 presents research and analysis of the situation in the field of planning inspection supervision in which the problem of non-compliance of the authorities with the legislative framework and ways in which compliance can be achieved are illuminated. Section 3 describes the objectives of the research, while following Section 4 considers shortcomings and limitations of procedures for assessing petitions that are currently in

use in one of the inspection bodies in the Republic of Serbia, which was the premise of a detailed analysis. The proposed procedures are applicable to other inspection and control state authorities (republic, provincial and local inspections, the Anti-Corruption Agency, and other control bodies). Section 5 illustrates the development of the application based on an innovative methodology for the evaluation of petitions. Concluding remarks appear in Section 6, followed by future research directions.

## 2 Background

The basic starting point for the research related to the topic of this paper is legal regulations, primarily the Law on Budget System, the Law on Inspection Supervision and the Law on State Administration and their bylaws. Legal regulations are analyzed or logically completed and presented in a pre-existing environment. In addition to legal regulations, the basic starting point for the preparation of this paper is the Risk Assessment analysis of risk management and risk notification (BCRR, 2016), Planning Methodology of Inspection Supervision (BCRR, 2018), as well as the Methodological Guide for the analysis of the required number of inspectors for performing inspection supervision and performing official advisory services (USAID, 2017), Analysis of factors and other analyses and instructions of the Ministry of Public Administration and Local Self-Government as well as expert methodological instructions published on the website of the Coordination Commission (<https://inspektor.gov.rs>).

The adoption of the law is only the beginning of improving the work of inspections. In order for the law to achieve its purpose, proper implementation, i.e. compliance with the norms prescribed by the law, is necessary. To ensure compliance with the norms introduced by the reform of inspection supervision, and primarily by the adoption of the Law on Inspection Supervision, the Ministry of Public Administration and Local Self-Government has implemented the project “Analysis in the process of implementing the Law on Inspection Supervision”, which includes, among other things, the party “Improving planning of inspection supervision (Part 2)”. Within this process, through the cooperation of USAID BEP, the Coordination Commission and republic inspections, 147 special laws were analyzed and, of them, 117 were determined to be amended and/or amended. One of the essential missing links in the risk-based inspection system, to make law enforcement better, is the specific criteria for risk assessment. The Anti-Corruption Agency in the Model of the Local Anti-Corruption Plan, as a preventive anti-corruption mechanism, also speaks about this, in the part related to inspection supervision, anticipating the need and obligation to adopt / establish special criteria for risk assessment in the field of inspection supervision. To achieve legal completeness and to achieve full effectiveness in risk assessment, regulators in specific areas should be in accordance with Article 9(10) of the Treaty on the Functioning of the European Union. In accordance with Article 10 of the Law on Inspection Supervision, special elements of risk assessment are prescribed or determined in special laws and general acts, and this also includes specific criteria, i.e. general criteria from the Law on Inspection Supervision, which are

concretized and adapted according to individual areas of inspection supervision, and possible additional special criteria, i.e. other special criteria when required by regulations, standards and recommendations of the European Union. In addition, research has shown that there is a discrepancy in the conduct of inspection bodies and that there is a need to adopt a model of appropriate procedures for the assessment of petitions. The spreadsheet application proposed in this paper provides a solution to both problems, i.e., a proposal for harmonization of the budgetary inspection procedure with the legislative framework and a proposal for the procedure for assessing petitions that is applicable to all state authorities, and could accordingly ensure uniformity of inspection practice.

### **3 Planning of inspection supervision, procedure for evaluation of claims and determination of activity priority of budget inspection**

#### **3.1 Research objectives**

The development of the application described in this paper arose in response to the expressed need of state bodies that when initiating the procedure of official / inspection control consider complaints (reports, requests, warnings of state bodies and other initiatives to initiate the procedure) and assess the justification of the reasons for initiating the procedure, state the statements made in the petition and conduct the petition evaluation procedure (Republic, provincial and local inspections, the Anti-Corruption Agency and other control bodies). Therefore, to initiate the procedure of inspection or official control, it is necessary to evaluate the allegations presented in the petition, i.e., to conduct the procedure of assessment of the petition.

The evaluation of petitions aims to identify supervised entities whose illegal actions can cause significant negative consequences for the public interest, goods and rights protected by law, i.e., it is necessary to identify users and activities that carry significant risk and include them in the work plan. The purpose of the entire procedure is to assess the justification of initiating the procedure of inspection or official control.

The analysis of the procedure of management and evaluation of petitions conducted by individual inspection bodies has identified several areas where there are certain inconsistencies and deviations from standardized procedures and identified opportunities for improvement and automation of procedures that will be the subject of this paper. The basic hypothesis (H0), on which the research is based, is that the development of spreadsheet models for the evaluation of petitions enables users to identify and quantify the activities of the subject of control that are characterized by significant risk and in which significant public interest is present. It is assumed that if the focus of control is placed on activities and entities with significant risk and which are of great importance for the public interest, it directly contributes to more efficient management of resources of state bodies.



Two auxiliary hypotheses were investigated in the paper:

H(1): The development of inspection planning in the Republic of Serbia is at a very low level, while the procedure and specific tools (programs) for the evaluation of applications, despite the expressed need for them, have not been established.

H(2): The development of a spreadsheet application for determining the priorities in the actions of state control and inspection bodies can greatly simplify, i.e. facilitate and speed up the work of employees in state bodies who evaluate applications.

### **3.2 Deficiencies and organizations of procedures for evaluation of claims currently applied**

The analysis of the procedure of management and evaluation of petitions currently applied in the Sector for Budget Inspection of The Ministry of Finance of the Republic of Serbia revealed that there are certain inconsistencies in special regulations governing the work and conduct of budget inspection in the area of risk identification and management (Law on Budget Systems and Decree on the Work, Powers and Characteristics of Budget Inspection) with the Law on Inspection Supervision. Also, the incompleteness of the system and the need to develop comprehensively defined special criteria for risk assessment were noticed, to properly implement the risk assessment methodology in the process of planning inspections from the scope of budget inspection. This identifies opportunities for improvement and automation of procedures, which will be explained in detail below.

#### **3.2.1 Dualism of legal provisions related to inspection planning**

The inspection body carry out inspections according to a previously adopted plan based on the established situation in the field of supervision and systematically prepared risk assessment, while reports (petitions) from third parties are an additional source of information relevant for risk assessment and inspection planning and when justified, are the reason for performing inspection control (Stefanović, 2017). In this way, the nature and essence of modern inspection based on risk assessment and risk management and inspection planning according to assessed risks and priorities is clearly manifested, as opposed to the approach that is characteristic of the previous period when inspections were based solely on reports (Risk-based vs. Complaint-based inspection).

The analysis of the procedure of planning inspections of the budget inspection showed that although it is formally prescribed by general and individual legal acts that inspections are based on risk assessment, in practice there is no complete deviation from the fact that inspection controls are based on the handling of complaints (reports) of third parties (BCRR, 2019). Deviation from that approach is not possible, given that the Law on Budget System, which established the budget inspection, stipulates that the work program

of the budget inspection and its changes is determined by the Minister, and it is made primarily on the basis of applications, petitions, complaints and control requests, received from bodies, organizations, legal and natural persons (Official Gazette of RS, No. 31, 2019). Therefore, in such an established legislative framework, the specificity of the budget inspection is that it must find a way to base inspections primarily on the petitions submitted, in accordance with the provisions of the Law on Budget System, while on the other hand, having in mind the requirements of modern inspection supervision, or the Law on Inspection Supervision, inspections must be based on a risk assessment and proportionate to the assessed risk.

The assessment of petitions conducted by the budget inspection is part of the activities carried out during the planning of inspection and is regulated by the Rulebook on special elements of risk assessment, frequency of inspections based on risk assessment and special elements of the inspection program (hereinafter: the Rulebook), which declaratively states the commitment to act based on risk assessment, i.e. stipulates that the selection of inspection control entities is based on risk analysis and assessment and that in order to determine priorities in the budget inspection special elements for risk assessment are applied in areas of material and financial operations and purposeful and legal use of public funds, while the essential choice of control subjects is the result of subjective assessment (Official Gazette of RS, No. 90, 2018). Namely, the mentioned Rulebook defines that the numerical value of special elements for risk assessment is the result of subjective assessment, which is contrary to the provisions of the Decree on common elements of risk assessment in inspection issued by the RS Government and stipulates that values of the severity of harmful consequences and the probability of their occurrence, i.e. the result of an objective assessment, given that quantifying risk means determining all possible values of the risk variable and the relative probability for each value.

Accordingly, the Budget Inspection recognized the need for the budget inspection to be based on risk assessment and that it is necessary to quantify the result of risk level assessment, however, the method of risk quantification regulated by this Ordinance is not adequate and requires correction, as it does not specify relative the probability for each value is already the result of the subjective assessment of the employees. The experience and integrity of employees who evaluate applications play a key role in assessing whether there is justification for initiating proceedings, while supervision is mainly based on "external impulses" - applications from citizens, workers, and competitors in a particular job. In this way, all controlled entities are placed on the same level regardless of the risk that characterizes them or the importance they have. The consequence of such a relationship is the creation of favorable conditions for budget inspection resources to be spent unnecessarily on low-risk entities, business and activities, which have the largest share in the structure of control entities and which cause consequences that are insignificant or low, while the identified irregularities, to the greatest extent, can be classified as errors of a formal nature, unintentional, negligible exceeding of the deadlines

prescribed for the submission of various reports or documentation, etc. On the other hand, often, significant subjects and activities, which cause serious harmful consequences for the public interest, property or other resources, get out of control and remain out of it, so that they become visible only after serious damage has been done.

Given the above, it can be concluded that the budget inspection has not fully harmonized with the Law on Inspection, which was adopted in order to introduce into inspection practice the principles of modern inspection based on risk assessment and risk management, as well as inspection planning according to assessed risks and priorities, i.e. to eliminate or significantly reduce arbitrariness, inequality, corruption and other possible abuses in initiating and conducting inspections, as well as to reduce objections to the frequency of inspections in some and the absence of this supervision in other economic entities. However, although due to the mentioned specificity of budget inspection it is not possible to completely deviate from the procedure based on reports, some purposeful harmonization of procedures and introduction of an adequate system of risk assessment related to petitions is not only possible but necessary given that budget inspection resources are both human and financially severely limited and insufficient to meet the needs of inspections. Namely, the Department of Budget Inspection has systematized 28 and filled only 11 jobs for inspectors. The Budget Inspection has the authority to carry out inspection control over more than 36,000 users of public funds, while annually it receives about 300 reports (representations). In the course of one year, the budget inspection carries out about 30 inspection controls. Given that the budget inspection annually controls less than 0.05% of supervised entities, while the inspection procedure is initiated on the basis of 7% of submitted applications and requests for inspection control, it is clear that in addition to the legal obligation there is a real need to prioritize inspection supervision through risk assessment and timely response when high and critical risk is assessed. Classification of controlled entities according to risk, depending on the severity and probability of potential harmful consequences, establishes planning of inspections and independence from citizens' reports, inspection resources are oriented towards entities, areas and activities in which control is most needed, causing the greatest damage to the budget and where the best results will be achieved in public risk management, protection of public goods, rights and interests. Establishing a methodology for risk assessment and prioritization of inspections enables timely undertaking of prescribed measures and actions that consequently result in compliance with the law and prevention of illegal spending and damage to public funds.

In addition, according to (BCRR, 2016), the misuse of the petition, which occurs in various forms, must first be identified in the assessment process, and later eliminated from the proceedings, i.e. it is necessary that the risk arising from the petition be assessed according to appropriate criteria. Given that the law stipulates that inspections are not carried out on the basis of risk assessed as insignificant, it is necessary to base the assessment of petitions on analysis and risk assessment based on objective assessment and resulting in quantified risk, which will ensure that inspections when it is meaningful

and purposeful, so that resources (time, resources, people) are effectively and efficiently allocated and spent on the subjects of control that are not insignificant from the aspect of the damage they can cause. In that sense, having in mind all the above, we can freely say that the assessment of allegations (existence of reasons for initiating inspection control procedures) in petitions or, conversely, possible abuse of petitions, as well as adequate selection of control subjects, which is directly dependent on petition assessment, is one of the important issues related to the initiation the budget inspection procedure, given the function delegated to it by the Law on Budget System. The current situation requires certain corrections and changes that will enable the selection of control subjects to be the result of objective and not subjective assessment, i.e. to quantify the risk and thus the budget inspection procedure harmonized with the provisions of the Law on Inspection Supervision.

### **3.2.2 Dualism of criteria defined by bylaws**

The Rulebook (Official Gazette of RS, No. 90., 2018), which is a bylaw of the Law on Inspection Supervision, and the Decree (Official Gazette of RS, No. 93., 2017), which is a bylaw of the Law on Budget System, prescribe different criteria used in the same risk assessment and analysis procedure, while omitting some of the criteria necessary for a proper and comprehensive risk assessment in applications. The Decree defines six criteria, while the Rulebook defines five other criteria. Since the assessment, as we mentioned, is subjective, and the criteria are not harmonized, employees who evaluate applications are not able to identify and quantify the activity and control subjects that are characterized by significant risk or in which there is significant public interest. In addition, differently defined criteria make it difficult for employees to identify possible abuses of the petition, because the criteria used are not adapted to that purpose. In that sense, it is necessary to determine the criteria by which the risk identification will be performed first, and then the risk quantification. Namely, risk identification implies that for each criterion, situations are identified that may cause negative consequences for public goods, rights and interests that are protected by law. Risk quantification involves the evaluation of identified risks, quantification of the impact of risk events, determining the probability of their occurrence and the range of possible values.

In the process of evaluation of petitions, the Budget Inspection applies additional analyzes that have no basis in procedures or legal regulations, but employees conduct it on the basis of arbitrary choice of method and manner in which it will be conducted, while evaluation, as the end result of analysis, is subjective and arbitrary. Given that this analysis has a good logic and foundation and it is based on a broader view of the subject of control, its significance and activities, it is necessary to systematize this analysis, establish clear criteria and quantify the results, and then include it in the official procedure of processing and evaluation of petitions. Accordingly, certain amendments and refinements of the current procedures and procedures carried out by the budget inspection are necessary. It is necessary to determine the methodology for assessing the petition

based on assessment and objective quantification of risk, in accordance with the legislative framework governing inspection supervision.

### **3.2.3 Data collection, processing, and IT tools of the inspection**

Employees of the budget inspection, who receive applications, enter data from applications in the table of applications kept in the spreadsheet program Microsoft Excel. After receiving and recording, the application is processed, which is mainly reflected in the manual assessment of the allegations in the applications on the Application Assessment Form, and in accordance with the special elements for risk assessment prescribed by the said Ordinance. These activities take a lot of time for employees, as data processing is manual and it is necessary to read the application in detail and analyze the subject of control using publicly available data and registers, using only their logic, experience, and knowledge to determine risk by subjective feeling. At the same time, if the employee as an individual is very responsible, this activity can be very stressful, having in mind the responsibility and consequences of deciding on the level of assessed risk. In such circumstances, in which the process of planning inspections and evaluation of applications is carried out without the use of handy IT tools for systematic processing, analysis and evaluation of applications, in addition to the need to supplement and refine the current application evaluation procedures, that is, establishing a purposeful and legally harmonized methodology for the assessment of petitions, which would be based on an objective and quantified risk assessment, it is necessary to automate the whole procedure of evaluation of petitions and determination of priorities in the actions of the body since it consists of a series of logical-arithmetic, mathematical and other operations necessary for decision-making. Therefore, we can conclude that average employee's evaluation of complaints takes 2-3 hours and is an activity that is marked as highly stressful and responsible.

In addition to the above reasons, the results of expert analyzes (Kovačević, 2017) point out that in order to harmonize the practice of inspection bodies and standardize actions in the same or similar situations, where necessary, it was expedient to develop and adopt models of appropriate procedures, including the procedure for the evaluation of petitions (applications) submitted by third parties and on the basis of which the inspection control is initiated.

## **4 Spreadsheet application based on innovative performance evaluation methodology**

Research and analysis of the described problems resulted in certain propositions that were offered as a possible solution to the existing dualisms and inconsistencies, and they were developed and implemented in the spreadsheet application for determining priorities in the actions of control and inspection bodies, which will be described below. The application was developed using the Microsoft Office Excel spreadsheet environment.

According to (Kostić, et al., 2014; Antić & Đorđević, 2018; Djordjevic et al., 2019), a great advantage of the spreadsheet environment is the possibility of research modeling, which through the identification of tasks leads to a better understanding of the problem and finding the best solution. Another reason why the authors opted for the spreadsheet model is primarily because of its ease of use and the ability of domain experts in the field to update and modify the model in a simple way (Đorđević Milutinović et al., 2023). Also, the spreadsheet model is easy to use, so that employees who do not have specific knowledge and skills in this area can perform objective and relevant processing and evaluation of applications. Developed model is implemented as spreadsheet application.

The model itself, as well as implementing application, must have defined input parameters, output values or results, as well as the calculation section or module, consisting of relations that show how the calculation of output values was performed on the basis of inputs (Antić & Đorđević, 2018). The basis of the calculation section of the application is an innovative methodology for the assessment of applications based on a three-level risk assessment that introduces three categories of criteria for risk assessment, presented in (Jovanović, 2020). For each individual criterion, it is necessary to define a factor of importance and issues that identify all interests, goods and rights that will be endangered in the event of risk, and which may arise from the business or actions of the supervised entity. According to the appropriate criteria, the severity of harmful consequences and the probability of their occurrence are estimated so that the estimated degree of risk is obtained. The criteria are determined at least once a year and are updated during the year if necessary. In the application presented in this paper, determining the criteria for risk assessment, determining the significance factors for each criterion and scoring the definitions of the criteria, is done manually and represents the input to the model. As an improvement of the basic version of the application, it is possible to upgrade with a module whose functionality is reflected in the automation of the following activities: determining the criteria for risk assessment, determining the significance factors for each criterion, scoring criteria definitions.

By applying the innovative methodology that is the basis of the calculation part of the application and introducing an adequate system of risk assessment related to petitions, it is possible to purposefully harmonize the conduct of the budget inspection with the provisions of the Law on Inspection Supervision, and thus ensure that inspections of the budget inspection are based primarily on the submitted petitions, while at the same time they are based on risk assessment and proportionate to the assessed risk. The spreadsheet application for determining priorities in the actions of inspection and control bodies consists of three modules, related to registration of records, or data entry, evaluation of the application and register of applications.

The first module called Application Records is used to enter application data and application records in the single Application Register. The user enters the application data in the application registration form. Each application is automatically assigned a unique

application number which is later used for evaluation, printing, and data retrieval. The user received a message about the successful registration of the application and the entry of data in the register of applications. The entry of entered data in the Register of Applications is done automatically. The Register of Applications represents database of developed spreadsheet application.

The second module, called Application Assessment, is used to determine the degree of risk borne by the application and includes risk assessment from three segments: general risk assessment, application risk assessment and risk assessment of the subject of control. The user in the application evaluation form selects the application to be evaluated and defines the criteria options for all three levels of evaluation. Based on the selected values, the model automatically evaluates the application and enters the data on the evaluation of the application in the database Register of Applications. At the end of the process, the user receives a message about the successful entry of data on the evaluation of the application in the register of applications. This module represents an innovation in relation to the previous way of assessing applications, bearing in mind the fact that the methodology for determining risk is diversified and based on objective assessment. In this manner, the biggest shortcoming of the previous way of working, which was based exclusively on the subjective assessment of the employee, was eliminated. This three-step risk assessment approach is an innovation of the author.

The third module is the Register of Applications. By pressing the button, the user activates the registry search worksheet. The search can be performed according to several criteria and several arguments at the same time. The registry search process is automated. Within the application, two forms were created and standardized: Records of reporting irregularities and Application Risk Assessment. The user has the option of printing and saving the specified forms. It is only necessary to select the unique application number to be printed from the drop-down menu by clicking on the button from the drop-down menu and clicking on the print button starts automatic printing. If the user is not connected to the printer, he should select the name and location of the document that will be saved in PDF format in the dialog box that opens.

The application, which is the intellectual property of the author of the application and may not be used, reproduced, distributed and modified without authorization, is marked version 1.B.1 and is a version adapted to the procedure of budget inspection. The first digit one (1) in the version designation says that it is an originally developed model in a spreadsheet environment with a unique graphical interface, organized data, activities and logical connections between them. The letter mark (B) in the version mark means that the model is adapted exclusively for the purposes of budget inspection. Letter B will be replaced by the number zero or other letters during further refinement of the model, creating a basic universal version and special adaptation to a particular group of users (eg 1.0.1 will be a version of the model specifically tailored to the needs of all inspection bodies, while version 1.P.1 was intended exclusively for tax inspection). The third digit

in the model designation, which also bears the designation one (1), refers to the number of changes to the basic model in relation to the number of amendments to legal regulations.

Launching the spreadsheet application, that implements the model, opens a user login dialog (Figure 1). Model users are defined by an administrator who has access to all model content, while user access is variable and depends on predefined permissions and approvals that are implemented in the Login worksheet which only the model administrator has access to (Figure 2).

**Figure 1:** User login form

A screenshot of a user login dialog box. At the top, it says "You are entitled to three login attempts" with a close button (X) on the right. The dialog has a dark blue header with the text "USER LOGIN" in white. Below the header, there are two input fields: "User name" and "Password". The "User name" field has a cursor in it. Below the input fields, there is a dark blue button labeled "OK" and a small icon of a person with a padlock, indicating a login or security function.

While working in the model, the user fills the forms or searches for data from a database that is formed on the basis of data entered by the user. Based on the data entered in the user form, the model performs calculations and enters basic or recalculated values into the database.

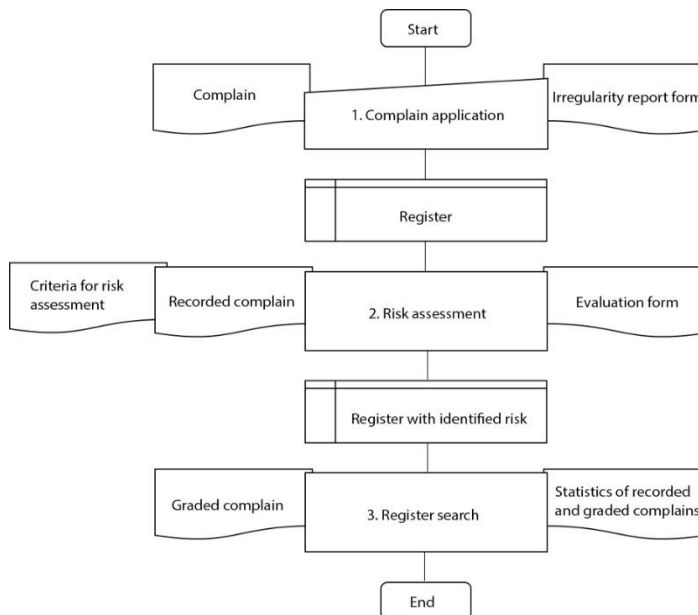


**Figure 2:** Application cover page



The control model consists of a series of logically related activities shown in the activity flow diagram in Figure 3.

**Figure 3:** Activity flow diagram



The flowchart data shows the flow and sequence of activities that the user performs through the model. The flowchart also shows the inputs and outputs of the model. From the displayed flowchart of the model, it is possible to identify the activities that the user can perform, as follows (Figure 4):

- Recording of applications (petitions);
- Evaluation of applications and determination of the degree of risk;
- Search the register of applications;
- Automatic filling and printing of forms of registered and evaluated applications.
- Insight into the statistics of registered and evaluated applications.

Testing the spreadsheet application for determining priorities in the actions of control and inspection bodies, which implements an innovative method of three-level segmentation of risk, confirmed that the application can identify and quantify the activities of the control entity, which is characterized by significant risk in that way, they eliminate possible misuse of petitions. Also, it was confirmed that the application of the model significantly simplifies, facilitates and speeds up the work of persons engaged in the tasks of evaluating petitions and determining priorities in the actions of bodies. The assessment of objections is no longer a highly stressful and responsible activity that can sometimes take more than 3 hours, but a routine operation that takes no more than 20 minutes of the employee's time (including the time needed for the analysis and search of publicly available data) and implies a relaxed and pleasant work.

**Figure 4:** Application home page (activity selection)



In addition, the spreadsheet application is an adequate response to the expressed need for procedures and specific IT tools for the evaluation of petitions, which is recognized in relevant professional circles, both at the level of budget inspection and at the national level.

Future directions of developing the spreadsheet application for determining priorities in the procedure of budget inspection will refer to more detailed development of the application and setting measures for application protection. All future changes in legislation and some other circumstances that are important for the operation of the model will be implemented in the model.

## 5 Conclusions

After the presented research results, the following conclusions are imposed:

- research presented in the paper confirmed research questions and proved the basic hypothesis, as well as two special hypotheses;
- the developed spreadsheet application is based on national legislation and provides users with compliance with it;
- the application improves and automates the process of planning inspections, related to the segment related to risk assessment in petitions and allows users to objectively assess the risk associated with petitions, ranking petitions and determining priorities in dealing with identified risk;
- the application enables the strengthening of the analytical function of the inspection and other control bodies that can use it in their work (primarily the Anti-Corruption Agency of the Republic of Serbia), since it enables the aggregation of data on reports into a database used for collecting, monitoring and analyzing the situation in the field of inspection;
- by applying the inspection control application, they are focused on activities, i.e. control subjects that are characterized by significant risk and in which there is a significant public interest, which directly contributes to more efficient management of budget inspection resources;
- spreadsheet application provides the basis for a better schedule of inspection supervision and allocation of scarce resources, in proportion to the amount of assessed risk in the subjects of control, in order to achieve more efficient and economical work.

During the development of the model and implementing application, the characteristics of the user were taken into account and special attention was paid to the interactivity of the model. The user constantly manages the process of evaluation of petitions and during the work receives information on whether an operation has been completed and whether it is necessary to take another activity and what are the consequences if the activity is taken or not taken. In this way, the passivity of the participants was overcome and the interaction between the user and the model was achieved, and the possibility of an error in the assessment was reduced.

Prerequisite for the application is the harmonization of the regulatory framework, especially amendments to bylaws by introducing an adequate risk assessment system. The model introduces a change in the procedures of the budget inspection in the part

concerning the determination of criteria and requires adjustment of the legislative framework. Inspections continue to be based primarily on the submitted petitions, while at the same time they are based on risk assessment and are proportionate to the assessed risk. The developed model or spreadsheet application, which is the subject of this paper, can be implemented in practice as an extremely efficient, effective and economical solution that would provide support to inspection bodies in their work. The developed application is a basic version and can be developed and improved in several directions, apply to other inspection bodies in the Republic of Serbia, as well as to inspection bodies in neighboring countries, which modern standards of inspection have almost developed, or they have this process at an early stage.

## References:

- Antić, S. & Đorđević, L. (2018) Control models and applications in spreadsheets, In: Benković, S. (ed.) *FINancial management, Accounting and Curricula development for capacity building of public administration - FINAC* (Belgrade: Faculty of organizational sciences), pp. 245-277.
- Balkan Center for Regulatory Reform (BCRR), Group of authors (2016) *Risk Assessment, Risk Management and Risk Reporting Analysis* (Belgrade: Balkan Center for Regulatory Reform).
- Balkan Center for Regulatory Reform (BCRR), Group of authors (2019) *Functional Analysis of Republic Inspections with Capacity Analysis* (Belgrade: National Alliance for Local Economic Development - NALED).
- Djordjevic, L., Lecic-Cvetkovic, D., Makajic-Nikolic, D., Babarogic, S. & Omerbegovic-Bijelovic, J. (2019) Spreadsheet Error Detection and Debugging Approach for Dynamic Discrete Inventory Control Models, *International Journal of Industrial Engineering: Theory, Applications and Practice*, 26(5), <https://doi.org/10.23055/ijietap.2019.26.5.4727>.
- Đorđević Milutinović, L., Raković, L. & Antić, S. (2023) Characteristics of Spreadsheet-Based Shadow IT in Serbian Companies, In: Mihić, M., Jednak, S. & Savić, G. (eds.) *Sustainable Business Management and Digital Transformation: Challenges and Opportunities in the Post-COVID Era, SymOrg 2022, Lecture Notes in Networks and Systems*, vol. 562, (Wiesbaden, Germany: Springer), pp. 148–171, [https://doi.org/10.1007/978-3-031-18645-5\\_10](https://doi.org/10.1007/978-3-031-18645-5_10).
- Jovanovic, M. (2020) *Development of a model for the assessment of petitions and determining priorities in the conduct of budget inspection* [Master thesis] (Belgrade: Faculty of Organizational Sciences).
- Kovačević, A. (2017) *Methodological Instruction for the Analysis of the Required Number of Inspectors for Performing Inspection Supervision and Performing Official Advisory Visits* (Belgrade: USAID).
- Kostić, K., Antić, S. & Đorđević, L. (2014) *Enterprise information systems in Excel* (Belgrade: Faculty of Organizational Sciences).
- Official Gazette of RS, No. 31. (2019) *Law on Budget System*.
- Official Gazette of RS, No. 90. (2018) *Rulebook on special elements of risk assessment, frequency of inspection based on risk assessment and special elements of inspection program, for control within the scope of budget inspection*.
- Official Gazette of RS, No. 93. (2017) *Decree on the work, powers, and characteristics of the budget inspection*.

- Rapajić, M., Lapčević, M. & Miladinović, V. (2021) Tax control and inspection supervision in the Republic of Serbia: Characteristics of the legal framework and the need for coordination, *Ekonomika*, 67(4), pp. 75-90.
- Stefanović, M., Radovanović, D. & Jolović, D. (2017) *Guide for the application of the Law on Inspection Supervision – amended 2017* (Belgrade: Ministry of public administration and local self-government and USAID).



## Analysis of Acid Mine Drainage Effects to the Domestic Water Resources Using GIS-Based Technique

DELIA SENORO, KEVIN LAWRENCE DE JESUS & CRIS EDWARD MONJARDIN

**Abstract** Acid mine drainage (AMD) is a serious problem to the environment, water resources and people. Calculating areas affected by AMD is helpful to create strategic programs for the protection of water resources, its remediation needs, reduction of adverse health effects, and enhancement of policy or guideline values. Accounting the extent of area contaminated by metals and metalloids (MMs), the research team collected 26 groundwater (GW), 49 tap water (TW), and 25 water samples from refilling stations (RS) in the island province that was exposed to mining disaster. The analyzed water samples coupled with geographic information system (GIS) created the spatial MMs concentration maps that were then used as environmental accounting tool to determine specific areas contaminated by As, Ni, and Pb. Records showed that 80 – 100% of the total area of the island province have water resources containing MMs concentration beyond the Philippines NSDW and WHO permissible limit.

**Keywords:** • AMD • environmental accounting • GIS • spatial analysis • water resources

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## 1 Introduction

Abandoned mines pits are major sources of acid mine drainage (AMD) that have detrimental effects to the environment, the wildlife that thrives in the surrounding area, and the people. Mining pits with low pH and elevated concentrations of metals and metalloids (MMs) alter the ecosystems and have an adverse impacts on human and natural environments (Rezaie and Anderson, 2020; Menzel et al., 2021). More than 630,000 mining sites worldwide were abandoned and have little to no rehabilitation (Tabelin et al., 2022) had been carried out. Also, there were about 50,000 of these mines were projected to release contaminated water, that could severely damaged about 6400 km of rivers, 8000–16,000 km of streams, and 72,000 hectares of lakes and reservoirs (Kiiskila et al., 2019). In the Philippines alone, there are more than 20 abandoned mining sites (Samaniego et al., 2020). Accounting of these contaminations have not been given attention. Hence, this study focused in the accounting of the extent of contamination in water resources in the island province. Accounting the areas and the extent of contamination is helpful in creating strategies and programs for the protection of water resources, determining the appropriate remediation needs, reduction of adverse human health effects, and enhancement of relevant policies and/or guidance values intended for specific area. Therefore, the outputs of the present study aimed to provide information on the extent of the effect/s of these MMs in domestic water resources by establishing the area coverages where water quality contains MMs concentrations beyond the threshold limits of the PNSDW 2017.

## 2 Literature Review

According to the Philippines Mines and Geosciences Bureau, about 9 million hectares, or 30% of the Philippines' total land area, have strong mineral deposits potential. Various mining activities, consisting of 55 metallic mines and 60 non-metallic mines, covered 2.54% of the nation's total land area as of June 2022. Copper, nickel, and gold are the primary mineral products of the country (Mines and Geosciences Bureau, 2022). The Philippines have several abandoned mine tailing areas as reported in the study of Aggangan et al. in 2019 and Samaniego et al., 2020. This includes the abandoned mine pits in the island province of Marinduque. This island province is situated at the southwestern tagalog region in the Philippines. The island province of Marinduque, known for its mineral deposits, has its mining operations commenced since 1969. Marinduque province experienced two major mine tailing disasters in the 1990s resulted to devastating environmental effects. The Mogpog town was inundated by the collapse of the Maguilaguila Tailings Storage Facility embankment in December 1993. Twenty-one barangays in Mogpog were submerged in contaminated floodwater and tailings as a result of this disaster. Another disaster event was in 1996. The concrete drainage tunnel cap of another mining spot, i.e., the Tapan pit, ruptured on March 24, 1996, causing over millions of cubic meter of hazardous mine tailings to spill into the Boac River. The Boac River is the longest river and important river system in Marinduque This was the second



disaster and one of the most catastrophic mining and environmental disasters to ever occur in the Philippines (Monjardin et al., 2022). Prior to the mining disasters in 1993 and 1996 that severely damaged the communities and environment, mining industry contributed significantly to the Marinduque's economy (Salvacion, 2021). Nearly three decades after the disaster, several studies reported elevated levels of MMs such as arsenic (As), chromium (Cr), manganese (Mn), iron (Fe), lead (Pb), cadmium (Cd), zinc (Zn), nickel (Ni), and copper (Cu) in groundwater (GW) (De Jesus et al., 2021), domestic water (DW) (Senoro et al., 2022), sediments (Senoro et al., 2019), soils (Monjardin et al., 2022), crops and agricultural yields (Senoro et al., 2020).

In the study of Nelson et al. conducted in Marinduque reported more than a third of the household respondents obtained their drinking water from public sources including pumps, shallow wells, and municipal waterworks in addition to natural sources like springs, rivers, or streams. Some of this public water source contain elevated MMs. The consumption of contaminated water resulted in adverse health consequences in the people residing in the nearby communities. Igual et al. cited that there were villagers that were incapacitated due to direct and indirect exposures to MMs. Moreover, the research of Fatalla in 2019 mentioned that MMs poisoning in the villagers resulted to chemical intoxication, gastrointestinal problems, and a suspected death of children in the area. Increasing mental health cases, and anemia in children below 5 years were reported, too. The adverse environmental impact of some mining activities is a global concern and has become prevalent in recent years.

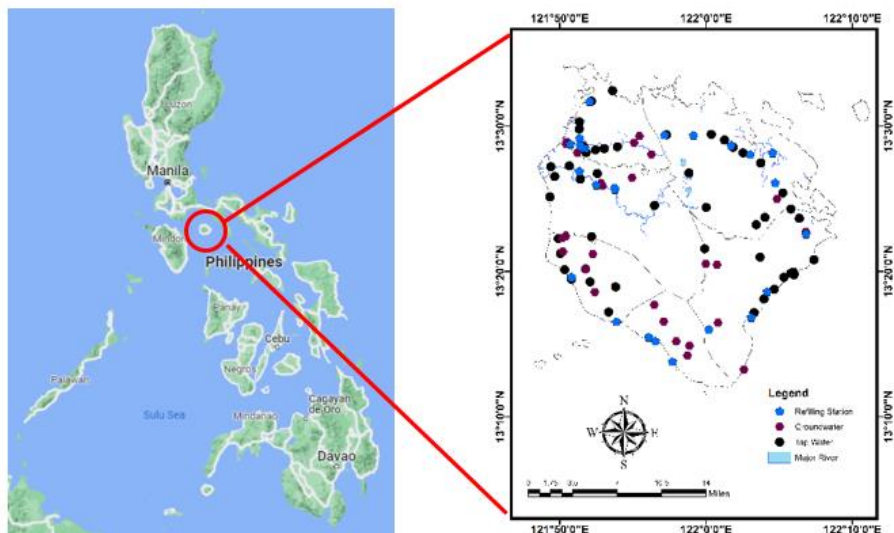
On water pollution accounting, water stress assessment and its analysis, a related study conducted at the Licum River water at Qingdao, China, showed that the industrial discharge was not the main source of pollution in the river but it was the contribution of TP and  $\text{NH}_3\text{-N}$  concentration from non-point source (Zhang et al., 2022). In the work of Wang, et al. (2021), it was elaborated on how to measure the physical water stresses to account for the water footprints which is useful in conducting the water stress assessment. Also, Robielos et al., (2020) demonstrated on how to account the disaster risks reduction indicators in order to assess the vulnerability of three geo-political levels. Further, the work of Prasetyo et. al. (2020), elaborated on how to account and analyze the interrelationship among the three dimensions of vulnerability risks utilizing the 'confirmatory factor analysis« technique. These techniques and methodologies on environmental pollution accounting, vulnerability reduction, disaster risks reduction, and among other related studies aided in making decision/s to determine the appropriate treatment strategy and program/s for the improvement of river water, environmental quality, and reduce health risks.

### 3 Materials and Methods

#### *Description of the Study Area*

The island province of Marinduque (Figure 1) located at  $13^{\circ}24' N$  latitude and  $121^{\circ}58' E$  longitude is in the Luzon island group in the Philippines. Marinduque has an estimated land area of  $952 \text{ km}^2$  with a population density of 251 inhabitants per  $\text{km}^2$ . It has 218 barangays (smallest local government unit) in 6 municipalities, i.e., Boac (the capital municipality), Buenavista, Gasan, Mogpog, Santa Cruz, and Torrijos (PhilAltas, 2022). Rice, root crops and coconuts are among the agricultural products grown in Marinduque. The precipitation in the province varies from 10mm (during March) to 331mm (during October) while its temperature is ranging from  $22.3^{\circ}\text{C}$  to  $28.8^{\circ}\text{C}$ , during January and May, respectively (Salvacion, 2017).

**Figure 1:** Sampling Locations of the Study

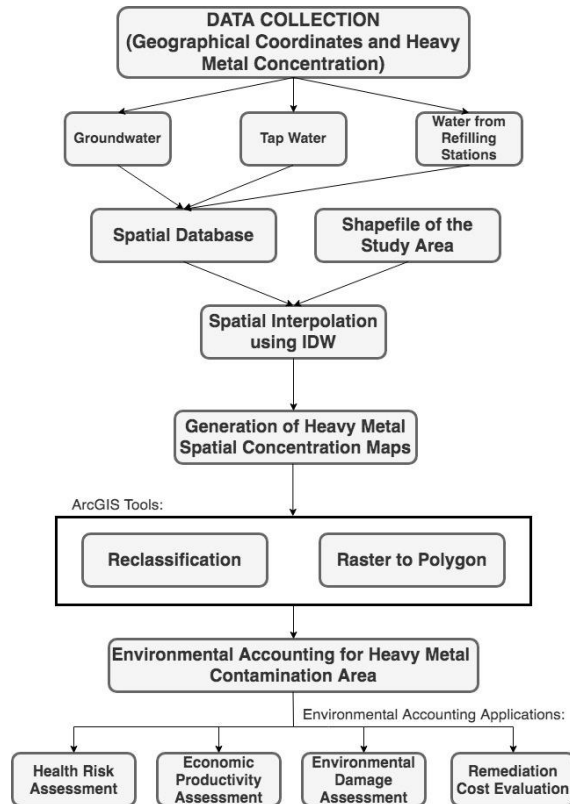


### 4 Theoretical Framework

Figure 2 demonstrates the theoretical framework of AMD for environmental assessment to account on the effects, impacts to the ecosystem by metals and metalloids using the GIS technique. Several studies utilized Geographic Information System (GIS) in the monitoring and assessment of water resources impacted by MMs in different asian countries including Bangladesh (Towfiqul Islam et al., 2017), China (Fei et al., 2017), Cambodia (Bun et al., 2021), India (Raja et al., 2021), Indonesia (Wulan et al., 2020), Iran (Eslami et al., 2022), Iraq (Amin Al Manmi et al., 2019), Malaysia (Zainol et al.,

2021), Pakistan (Bux et al., 2022), Philippines (Nelson et al., 2020; Senoro et al., 2021), Taiwan (Liang et al., 2017), and Thailand (Nilkarnjanakul et al., 2022). In an AMD-affected site, the GIS in conjunction with the Inverse Distance Weighting (IDW) method is a crucial tool for guaranteeing frequent and ongoing assessments and tracking of GW (Hamzaoui-Azaza et al., 2020) quality. When it comes to deploying and assessing geographical knowledge about water resources for spatial analysis, GIS is a potent tool to observe patterns and relationships of pollutants, a less time-consuming and cost-effective technique converts data sets into spatial representations. For human consumption, agricultural use, and the protection to serious environmental health problems, a map of the quality of the water is vital (Panneerselvam et al., 2020).

**Figure 2:** Theoretical Framework of the AMD Assessments for Environmental Accounting



### *Water Sampling and Analysis*

Sampling points (Figure 1) were selected randomly to cover major river system, watersheds, and those water refilling stations (RSs) in populated areas. The GW samples were obtained from 26 different private and public hand pump wells, and placed in polyethylene bottles. Additionally, 49 tap water (TW) samples were collected from faucets throughout the province while 25 samples obtained were water from RSs. The coordinates of the sampling locations were recorded utilizing the Garmin Montana 680 global positioning system. The HM concentration such as As, Ba, Cu, Fe, Pb, Mn, Ni, and Zn were detected in the sample analysis using the Olympus Vanta portable handheld X-ray Fluorescence Spectrometer and Accusensing metals analysis system (MAS). The Accusensing MAS was utilized for HMs concentration detection when pXRF recorded 'limits of detection (LOD)'.

### *Statistical Analysis*

A descriptive statistical analysis of the water samples were obtained from Table 1 to have an overall view of the range of each water quality parameter. The analysis was performed using the IBM SPSS software which includes the maximum, minimum, range, standard deviation, skewness, and kurtosis of the datasets for GW, TW, and water from RS. The descriptive statistics of the GW, TW, and water from RSs datasets are enumerated in Table 1. Additionally, the results was assessed and compared to the threshold values set by the WHO (2004) and PNSDW 2017.

**Table 15:** Descriptive statistics of the datasets (Senoro et al., 2022)

	Metal	Max	Min	Range	SD	Skewness	Kurtosis	WHO	PNSDW 2017
Ground-water (n = 26)	As	0.760	0.020	0.740	0.195	2.640	6.358	0.01	0.01
	Ba	0.049	0.000	0.049	0.015	-0.773	-0.607	0.70	0.70
	Cu	0.310	0.000	0.310	0.062	4.206	18.889	2.00	1.00
	Fe	15.026	0.000	15.026	2.929	4.846	24.113	0.30	1.00
	Pb	13.430	0.160	13.270	3.027	3.400	11.702	0.01	0.01
	Mn	0.028	0.000	0.028	0.006	1.279	1.935	0.40	0.40
	Ni	0.250	0.000	0.250	0.043	2.347	11.214	0.07	0.07
	Zn	0.149	0.000	0.149	0.033	1.995	4.895	3.00	5.00
Tap Water (n = 49)	As	19.030	0.020	19.010	3.845	3.919	14.454	0.01	0.01
	Ba	0.051	0.000	0.051	0.019	-0.261	-1.587	0.70	0.70
	Cu	0.540	0.000	0.540	0.088	5.126	27.248	2.00	1.00
	Fe	2.129	0.000	2.129	0.310	5.732	37.043	0.30	1.00
	Pb	4.750	0.160	4.590	0.796	4.096	18.889	0.01	0.01
	Mn	0.021	0.002	0.019	0.005	0.438	-0.617	0.40	0.40
	Ni	3.410	0.000	3.410	0.576	4.626	22.435	0.07	0.07
	Zn	0.074	0.000	0.074	0.015	0.901	1.619	3.00	5.00
Water from Refilling Stations (n = 25)	As	9.310	0.020	9.290	1.862	4.761	23.238	0.01	0.01
	Ba	0.059	0.000	0.059	0.019	-0.363	-0.963	0.70	0.70
	Cu	0.330	0.000	0.330	0.085	3.017	8.386	2.00	1.00
	Fe	1.503	0.000	1.503	0.308	3.587	15.131	0.30	1.00
	Pb	2.750	0.160	2.590	0.587	3.464	12.251	0.01	0.01
	Mn	0.017	0.002	0.016	0.004	0.067	-0.328	0.40	0.40
	Ni	0.180	0.010	0.170	0.025	1.649	12.907	0.07	0.07
	Zn	0.050	0.000	0.050	0.014	0.090	0.362	3.00	5.00

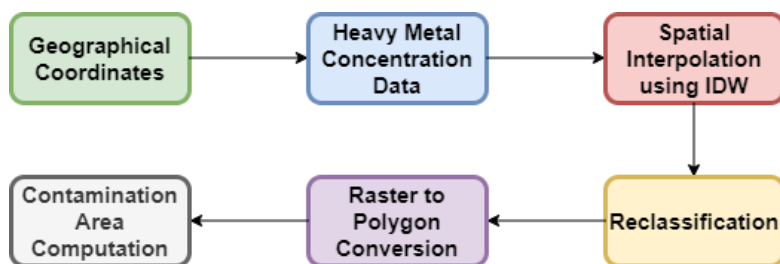
*Spatial Analysis*

The ArcGIS Desktop 10.8.1 was employed to generate the geographic variation pattern for each water quality indicator. Its feature called 'inverse distance weighing (IDW)' was used for spatial interpolation of GW quality. The weights were allocated to each site (Borrego-Alonso et al., 2022) to establish distances, numbers (calculations) were obtained based on the areas that were known to be nearest. The geographical map's delineation of the concentration of each water evaluation metric makes it simple to view by the general public and decision-makers working in the water resources sector (Pal et al., 2022). It produces geographical decision support data sets by which decision-makers may simply understand to address GW quality management and environmental issues (Kada et al., 2022).

### Contamination Area Calculation

Using the raster created for each water quality using the IDW method, the area of contamination was calculated and evaluated with respect to the domestic water resource quality threshold limits set by the PNSDW 2017. Figure 2 exhibits the schematic diagram of the flow of the procedure in the contamination area calculation for each HM detected in GW, TW, and water from RSs.

**Figure 2:** The HM contamination area calculation procedure



## 5 Results and Discussion

### Spatial Analysis

The spatial HM concentration maps of the GW samples are illustrated as Figure 3. It was observed that the 'hotspot' area for As, Ba and Mn is in Brgy. Bagacay, in the municipality of Buenavista with concentration of 0.76, 0.05 and 0.03 mg/L, respectively. The highest concentration for Fe (15.03 mg/L) and Zn (0.15 mg/L) were observed in Brgy. Bachao Ilaya in the municipality of Gasan (13.30977° N, 121.8732° E). The highest concentration of Cu was 0.31 mg/L and was recorded in Brgy. Bocboc, municipality of Mogpog (13.46756° N, 121.9377° E). The elevated concentration of Pb (13.43 mg/L) was detected in Brgy. Bicas Bicas, municipality of Buenavista (13.2369° N, 121.97878° E). Moreover, the highest Ni (0.25 mg/L) concentration was observed in Brgy. Sibuyao, municipality of Torrijos (13.34089° N, 121.01254° E).

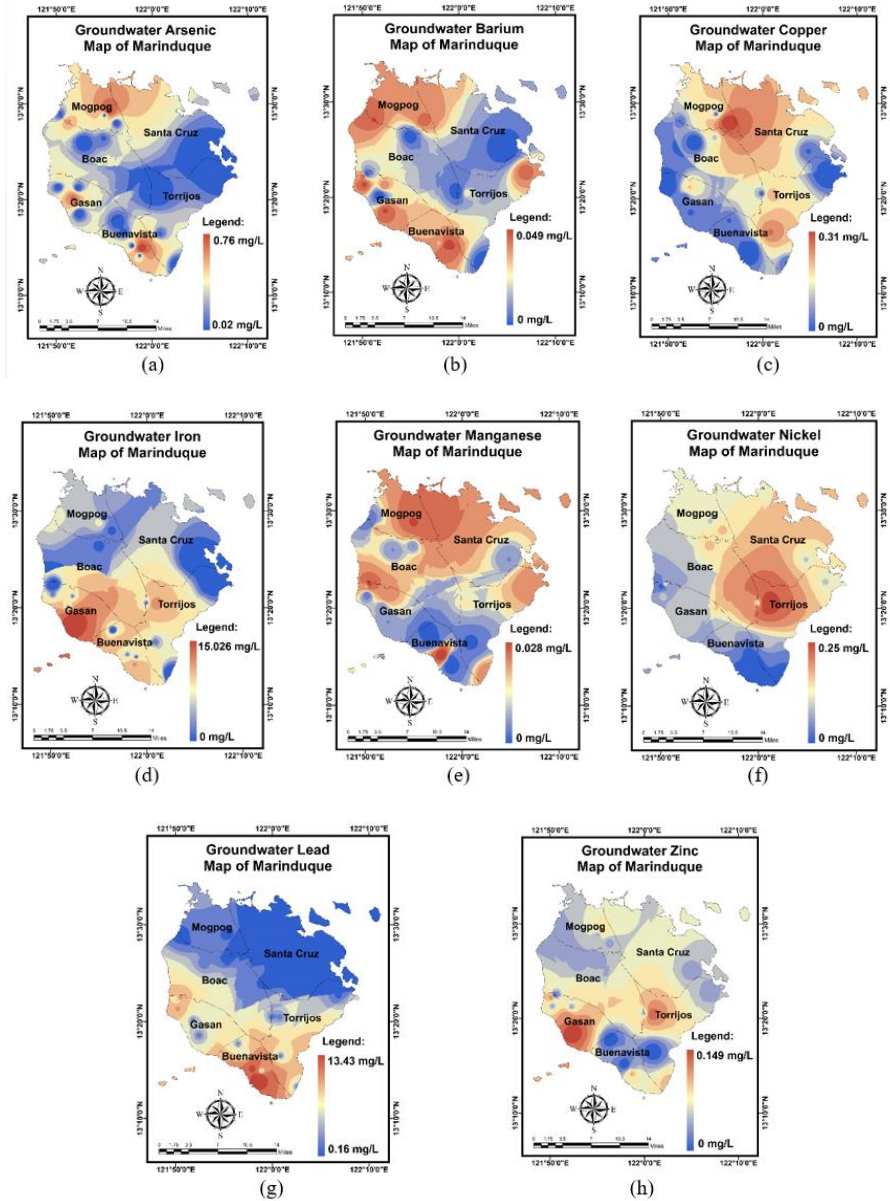
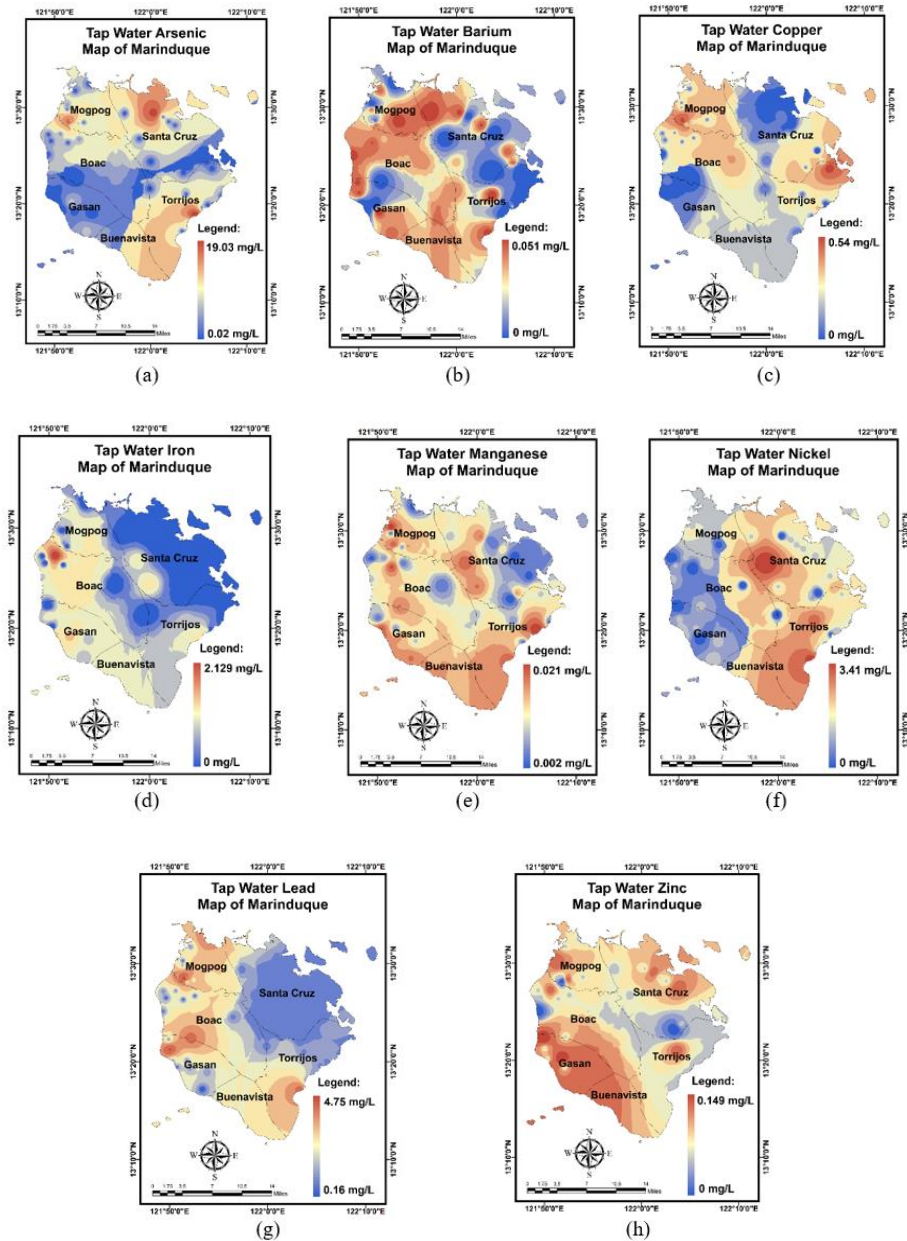
**Figure 3:** The GW spatial concentration map of Marinduque (a) As, (b) Ba, (c) Cu, (d) Fe, (e) Mn, (f) Ni, (g) Pb, (h) Zn.

Figure 4 displayed a map of the tap water samples' HM spatial concentrations. The hotspot for Cu (0.54 mg/L) and Pb (4.75 mg/L) concentrations was found in Brgy. Market Site, located in the Mogpog Municipality. The highest concentration value of As (19.03 mg/L) was found in Brgy. Buangan in the Torrijos municipality (13.31286<sup>0</sup> N, 121.07771<sup>0</sup> E). The Brgy. Malusak in the municipality of Mogpog (13.47623<sup>0</sup> N, 121.89895<sup>0</sup> E) had the highest Ba (0.05 mg/L) concentration. While, highest concentration of Fe (2.13 mg/L) was found in Brgy. Tanza, municipality of Boac (13.45433<sup>0</sup> N, 121.8441<sup>0</sup> E).

Highest Mn concentrations of 0.02 mg/L were detected in multiple locations including Brgy. Ino (13.50491<sup>0</sup> N, 121.85581<sup>0</sup> E), municipality of Mogpog and Brgy. Poctoy, municipality of Torrijos (13.32956<sup>0</sup> N, 121.10024<sup>0</sup> E). Highest Ni concentration was observed in Brgy. San Antonio, municipality of Santa Cruz (13.44613<sup>0</sup> N, 121.98041<sup>0</sup> E) with 3.41 mg/L concentration. Furthermore, highest Zn concentration which is 0.07 mg/L were detected in municipality of Gasan including Brgy. Bahi (13.371<sup>0</sup> N, 121.83178<sup>0</sup> E), and Brgy. Tiguion (13.3361<sup>0</sup> N, 121.86275<sup>0</sup> E).

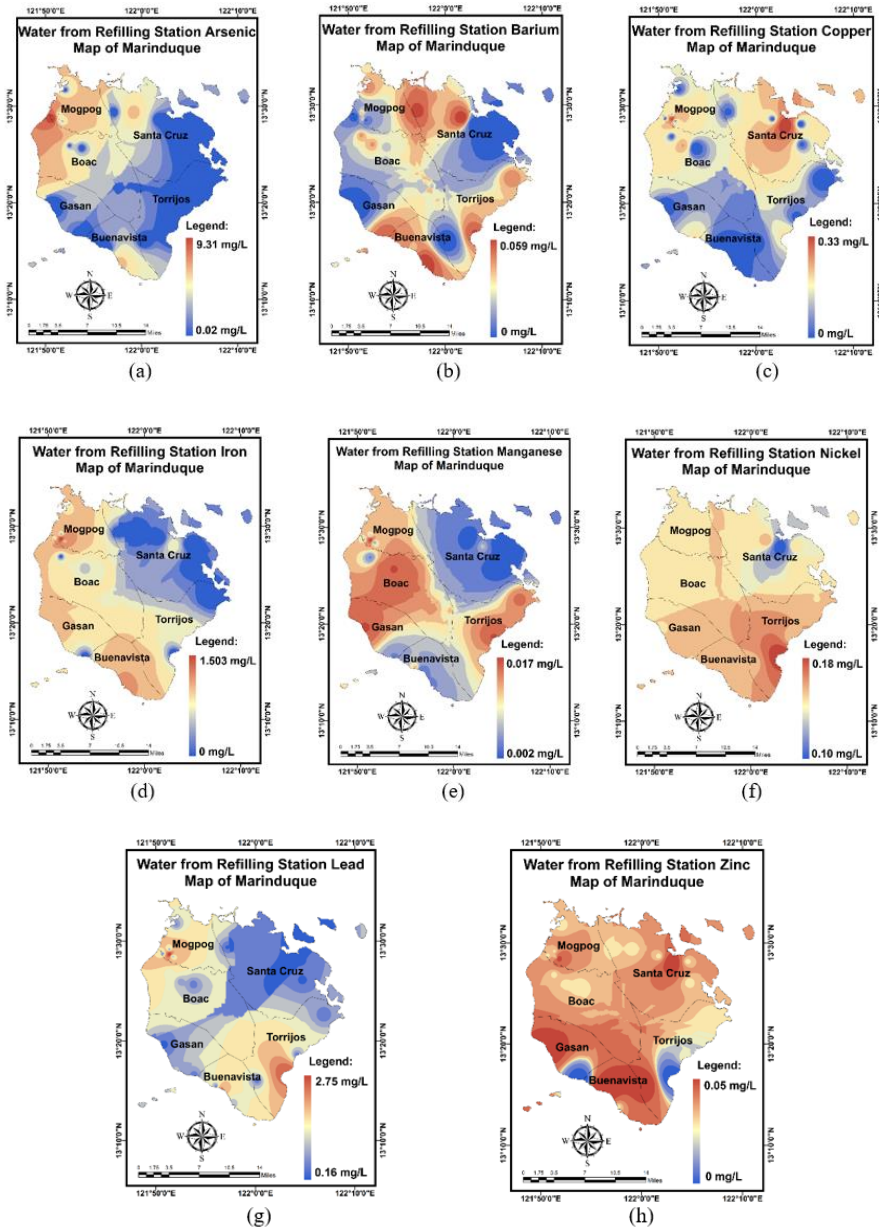


**Figure 4:** Tap water Spatial concentration map of Marinduque (a) As, (b) Ba, (c) Cu, (d) Fe, (e) Mn, (f) Ni, (g) Pb, (h) Zn



The HM spatial concentration levels water from RS were shown in Figure 5. Brgy. Janagdong in the municipality of Mogpog (13.47932<sup>0</sup> N, 121.84538<sup>0</sup> E) recorded the highest concentration of As (9.31 mg/L). Brgy. Libas in the municipality of Buenavista (13.22996<sup>0</sup> N, 121.96165<sup>0</sup> E) recorded the highest Ba concentration of 0.06 mg/L while Brgy. Buyabod in the municipality of Santa Cruz (13.46743<sup>0</sup> N, 122.05034<sup>0</sup> E) has the highest Cu and Zn concentration of 0.33 mg/L and 0.0495 mg/L, respectively. Highest Ni concentration was recorded in Brgy. Cabuyo, municipality of Torrijos (13.28071<sup>0</sup> N, 122.05138<sup>0</sup> E) with 0.18 mg/L. Highest concentration of Fe (1.50 mg/L), Pb (2.75 mg/L), and Mn (0.02 mg/L) was observed in Brgy. Nangka I, in the municipality of Mogpog (13.4779<sup>0</sup> N, 121.85673<sup>0</sup> E). Moreover, highest Zn (0.05 mg/L) concentration was reported in multiple sites including Barangay II (13.25355<sup>0</sup> N, 121.94233<sup>0</sup> E) and Brgy. Kaigangan (13.25821<sup>0</sup> N, 121.9345<sup>0</sup> E), in the municipality of Buenavista, Barangay I in municipality of Gasan (13.32708<sup>0</sup> N, 121.8467<sup>0</sup> E), Brgy. Gitnang Bayan in the municipality of Mogpog (13.4746<sup>0</sup> N, 121.8621<sup>0</sup> E), and Brgy. Malibago in municipality of Torrijos (13.26705<sup>0</sup> N, 122.00304<sup>0</sup> E).

Overall HM concentrations scenario, and considering the As and Pb concentrations in GW, TP and water from RS, it was observed that these two HMs (As and Pb) exceeded the threshold of 0.01 mg/L set by the PNSDW 2017. Moreover, the Fe and Ni maximum concentrations detected in all water types samples were more than the permissible limits of 1.00 mg/L and 0.07 mg/L, respectively.

**Figure 5:** Spatial concentration map of HM in Water from Refilling Station in the Marinduque (a) As, (b) Ba, (c) Cu, (d) Fe, (e) Mn, (f) Ni, (g) Pb, (h) Zn

Through a variety of exposure pathways, the HM contamination in domestic water sources can enhance the risks to human health. Chronic HM exposure through water ingestion has been one of the emerging health concerns around the world. Arsenic exposure can affect skin, liver, and nervous system but the most serious problem it poses is the chronic exposure leading to increased risk for developing cancer (Kumar et al., 2021). Another, exposure to Ba through drinking water can cause gastrointestinal disturbances and muscle weakness (Peana et al., 2021). Ingesting Cu may cause strictures to develop all throughout the digestive track. Direct Cu toxicity can cause tissue necrosis, which can lead to acute liver failure (Royer and Sharman, 2020). Hemorrhagic necrosis and sloughing of the stomach mucosa with extending into the submucosa have been seen in autopsies (WHO, 2004). Exposure to Pb causes gastrointestinal harm, cardiovascular and reproductive issues, renal dysfunction, hematological abnormalities, endocrine diseases, neurological and developmental disabilities. Also, Pb can also cause human cancer (Hossain and Patra, 2020). Manganese is necessary for human health, poisoning may result in "manganism," a motor illness that is somewhat distinct from idiopathic Parkinson's disease but linked with profound neurologic damage (Rehman et al., 2019). Also, lung, nose, larynx, prostate, laryngitis, asthma, chronic bronchitis, respiratory failure, birth abnormalities, allergic responses such skin rashes, and heart conditions can all result from excessive Ni absorption (Hossain and Patra, 2020). Moreover, recurrent dyspnea or airway inflammation following inhalation exposure or gastrointestinal problems with dehydration, and possibly gastrointestinal hemorrhage following ingestion, are the complications caused by Zn toxicity. Additionally, tiredness, anemia, and lightheadedness can occur (Agnew and Slesinger, 2020).

#### *Contamination Area Calculation*

Utilizing the IDW maps generated for GW, TW, and water from RSs, the classes were re-classified to determine the areas affected by AMD which were beyond the threshold values set by the PNSDW 2017. In the calculated region where there is contamination of GW samples, there was elevated As and Pb concentrations were in 100% of the area. Additionally, Ni concentrations were found to be above the allowable limit of 0.07 mg/L throughout 89.882% of the entire area, or this is equivalent to 855.7 km<sup>2</sup>. In addition, Fe concentrations were found to be over 1 mg/L PNSDW 2017 limit in 17.26% of the province's total area, or around 164.3 km<sup>2</sup>. On the contrary, Ba, Mn, Cu, and Zn concentrations were all below the threshold values as set by the PNSDW 2017.

**Table 16:** Contamination Area Calculation Results for GW

<b>Metal</b>	<b>Threshold Value (mg/L)</b>	<b>% Area Below the Threshold</b>	<b>% Area Above the Threshold</b>
As	0.01	0.000	100.000
Ba	0.70	100.000	0.000
Fe	1.00	82.738	17.262
Pb	0.01	0.000	100.000
Mn	0.40	100.000	0.000
Ni	0.07	10.118	89.882
Cu	1.00	100.000	0.000
Zn	5.00	100.000	0.000

Further, it was recorded that 100% of the area from where the TW samples were collected, was contaminated by As with concentration (19.03 mg/L) above the threshold value. Additionally, 99.956% of the total area or about 951.6 km<sup>2</sup> have Pb concentrations (4.75 mg/L) above the permissible limit of 0.01 mg/L. Moreover, concentration of Ni (3.41 mg/L) was way above the 0.07 mg/L PNSDW 2017 limit in 81.564% of the total area of the province or about 776.5 km<sup>2</sup>. On the other hand, concentrations of Fe that recorded above the permissible limit of 1 mg/L was only about 0.283% of the total area or approximately 2.69 km<sup>2</sup>. Whereas, all of the total area of the province have concentrations of Ba (0.05 mmg/L), Mn (0.02 m/L), Cu (0.54 mg/L), and Zn (0.07 mg/L) below the threshold values. Table 3 presents the contamination area calculation for TP water.

In the calculated area of contamination for water samples from RSs, As and Pb contamination and concentrations were present in 100% of the area. Additionally, Ni concentrations were found to be above the allowed limit of 0.01 mg/L throughout 95.203% of the entire area, or 906.3 km<sup>2</sup>. However, just 0.162 km<sup>2</sup> or 0.017% of the province's total area has Fe concentrations over the acceptable limit of 1 mg/L, whereas the province as a whole has concentrations of Ba, Mn, Cu, and Zn all below the threshold levels. The water from RSs contamination area calculation is shown in Table 4.

**Table 17:** Contamination Area Calculation Results for Tap water

<b>Metal</b>	<b>Threshold Value (mg/L)</b>	<b>% Area Below the Threshold</b>	<b>% Area Above the Threshold</b>
As	0.01	0.000	100.000
Ba	0.70	100.000	0.000
Fe	1.00	99.717	0.283
Pb	0.01	0.044	99.956
Mn	0.40	100.000	0.000
Ni	0.07	18.436	81.564
Cu	1.00	100.000	0.000
Zn	5.00	100.000	0.000

Accounting of contamination has not given attention, often overlooked, and unaccounted. Every contamination in the environment carries costs. These costs shall be considered by the industries, communities and the people. The subsequent costs as a result of environmental contamination are as follows (Landrigan, 2012): [1] direct medical expenses of person/s made ill due to exposure to contamination; [2] indirect health-related costs by the concerned person who became ill due to exposure such as time lost from school and/or work, cost of rehabilitation, and/or cost of special education; [3] diminished economic productivity of persons whose organs systems were damaged due to toxic exposures; [4] loss of irreversible damaged to the environmental treasures, and [5] the cost of environmental clean up, remediation. Hence, the outputs of this study such as data and tools are useful in environmental accounting and in determining its subsequent costs. Also, these are useful in making policy and its corresponding guidance values.

**Table 18:** Contamination Area Calculation Results for Water from RSs.

<b>Metal</b>	<b>Threshold Value (mg/L)</b>	<b>% Area Below the Threshold</b>	<b>% Area Above the Threshold</b>
As	0.01	0.000	100.000
Ba	0.70	100.000	0.000
Fe	1.00	99.983	0.017
Pb	0.01	0.000	100.000
Mn	0.40	100.000	0.000
Ni	0.07	4.797	95.203
Cu	1.00	100.000	0.000
Zn	5.00	100.000	0.000

*Statistical Analysis*

The skewness and kurtosis values computed were used to assess and evaluate the HMs' asymmetry and to add understanding of the data. Table 5 elaborates the statistical data analysis interpretation. All HMs, with the exception of Ba showed positive skewness for all water samples; i.e, GW, TP, and water from RSs. The data set of Ba illustrates its normal occurrence in all three types of water samples but its existence has been attributed together with other metals. The Ba is a divalent earth metal, produced naturally through weathering of rocks but toxic to human. The negative value is attributed to its normal existence with other metals. The data of Mn and Zn in water showed normal distribution. This means Mn and Zn frequently occurred in all types of water samples that were collected. Another, the As concentrations were seen to occur significantly in the GW. This is attributed to a possible massive extraction of GW in the island province. Also, it has been observed the high affinity of As and Zn. This scenario was also recorded in the study of Otte et al., 1995. Also, other metals were seen in occurrence with other target metals. Further, Cu concentration in water from RSs was recorded to occur moderately.

**Table 19:** Statistical Data Analysis Interpretation

	<b>Metal</b>	<b>Max</b>	<b>Min</b>	<b>Range</b>	<b>SD</b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>Interpretation</b>
Ground-water (n = 26)	As	0.760	0.020	0.740	0.195	2.640	6.358	Occurrence is significant
	Ba	0.049	0.000	0.049	0.015	-0.773	-0.607	Regular occurrence with other metals
	Cu	0.310	0.000	0.310	0.062	4.206	18.889	With various outliers, occurred with other metals
	Fe	15.026	0.000	15.026	2.929	4.846	24.113	With various outliers, occurred with other metals
	Pb	13.430	0.160	13.270	3.027	3.400	11.702	With various outliers, occurred with other metals
	Mn	0.028	0.000	0.028	0.006	1.279	1.935	Occurrence is substantial
	Ni	0.250	0.000	0.250	0.043	2.347	11.214	With few outliers, occurred with other metals
	Zn	0.149	0.000	0.149	0.033	1.995	4.895	Occurrence is significant
Tap Water (n = 49)	As	19.030	0.020	19.010	3.845	3.919	14.454	With various outliers, occurred with other metals
	Ba	0.051	0.000	0.051	0.019	-0.261	-1.587	Regular occurrence with other metals
	Cu	0.540	0.000	0.540	0.088	5.126	27.248	With various outliers, occurred with other metals
	Fe	2.129	0.000	2.129	0.310	5.732	37.043	With various outliers, occurred with other metals
	Pb	4.750	0.160	4.590	0.796	4.096	18.889	With various outliers, occurred with other metals
	Mn	0.021	0.002	0.019	0.005	0.438	-0.617	Data distribution is fairly symmetrical, regular occurrence
	Ni	3.410	0.000	3.410	0.576	4.626	22.435	With various outliers, occurred with other metals
	Zn	0.074	0.000	0.074	0.015	0.901	1.619	Occurrence is substantial
Water from Refilling Stations (n = 25)	As	9.310	0.020	9.290	1.862	4.761	23.238	With various outliers, occurred with other metals
	Ba	0.059	0.000	0.059	0.019	-0.363	-0.963	Normal occurrence with other metals
	Cu	0.330	0.000	0.330	0.085	3.017	8.386	Occurrence is moderate
	Fe	1.503	0.000	1.503	0.308	3.587	15.131	With various outliers, occurred with other metals
	Pb	2.750	0.160	2.590	0.587	3.464	12.251	With various outliers, occurred with other metals
	Mn	0.017	0.002	0.016	0.004	0.067	-0.328	Normally distributed, regular occurrence in all samples
	Ni	0.180	0.010	0.170	0.025	1.649	12.907	With few outliers, occurred with other metals
	Zn	0.050	0.000	0.050	0.014	0.090	0.362	Normally distributed, regular occurrence in all samples



## 6 Conclusion

A study on the water source quality for domestic supply was conducted in an island province of the Philippines that experienced two mining disasters a couple of decades ago. This was to account the areas adversely affected by the HMs contamination. The HM concentrations in the domestic water were analyzed, evaluated and compared to the threshold values set by the PNSDW 2017. The findings exhibited elevated concentrations of As, Pb, and Ni in GW, TW, and water from RS. These concentrations in multiple sites were above the permissible limits of the PNSDW 2017. Employing the IDW method of GIS, the spatial concentration maps of the detected HMs including As, Ba, Fe, Pb, Mn, Ni, Cu, and Zn were generated; hence, identifying the pollution hotspot with respect to the HMs. Moreover, utilizing the IDW-based spatial maps, the area of contamination by these HMs were calculated and the findings revealed that 80% - 100% of the total area of the island province have concentrations of As, Pb and Ni greater than the permissible limits set by PNSDW 2017. The Ba concentration was prevalent in all water types samples, and were seen to co-exist with other metals as intrinsic characteristic of Ba. The As was prevalent in GW samples, and Mn and Zn were observed to occur regularly in all types of water samples. The methodology employed, and the tools created in this study would be beneficial for environmental accounting that would influence policy makers and research direction. In addition, these environmental accounting tools are useful, for the local government units in conducting environmental monitoring, create strategic program to reduce health risks, in drafting remediation plan and its corresponding budget. Furthermore, it is recommended to include the As, Pb and Ni in the domestic water quality parameters that are regularly monitored by the local and national government agency.

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### References:

- Aggangan, N. S., Anarna, J. A. & Cadiz, N. M. (2019) Tree legume–microbial symbiosis and other soil amendments as rehabilitation strategies in mine tailings in the Philippines, *Philipp J Sci*, 148(3), pp. 481-491, available at: [https://philjournalsci.dost.gov.ph/images/pdf/pjs\\_pdf/vol148no3/tree\\_legume\\_microbial\\_symbiosis.pdf](https://philjournalsci.dost.gov.ph/images/pdf/pjs_pdf/vol148no3/tree_legume_microbial_symbiosis.pdf) (October 7, 2022).
- Agnew, U. M. & Slesinger, T. L. (2020) *Zinc toxicity*, available at: <https://europemc.org/article/NBK/nbk554548> (October 7, 2022).

- Amin Al Manmi, D. A. M., Abdullah, T. O., Al-Jaf, P. M. & Al-Ansari, N. (2019) Soil and groundwater pollution assessment and delineation of intensity risk map in Sulaymaniyah City, NE of Iraq, *Water*, 11(10), <https://doi.org/10.3390/w11102158>.
- Borrego-Alonso, D., Martínez-Graña, A. M., Quintana, B. & Lozano, J. C. (2022) From Spatial Characterisation to Prediction Maps of the Naturally Occurring Radioactivity in Groundwaters Intended for Human Consumption of Duero Basin, Castilla y León (Spain), *Agronomy*, 12(9), p. 2059, <https://doi.org/10.3390/agronomy12092059>.
- Bun, S., Sek, S., Oeurng, C., Fujii, M., Ham, P. & Painmanakul, P. (2021) A Survey of Household Water Use and Groundwater Quality Index Assessment in a Rural Community of Cambodia, *Sustainability*, 13(18), <https://doi.org/10.3390/su131810071>.
- Bux, R. K., Haider, S. I., Mallah, A., Solangi, A. R., Moradi, O. & Karimi-Maleh, H. (2022) Spatial analysis and human health risk assessment of elements in ground water of District Hyderabad, Pakistan using ArcGIS and multivariate statistical analysis, *Environmental Research*, 210, <https://doi.org/10.1016/j.envres.2022.112915>.
- De Jesus, K. L. M., Senoro, D. B., Dela Cruz, J. C. & Chan, E. B. (2021) A Hybrid Neural Network–Particle Swarm Optimization Informed Spatial Interpolation Technique for Groundwater Quality Mapping in a Small Island Province of the Philippines, *Toxics*, 9(11), pp. 273, <https://doi.org/10.3390/toxics9110273>.
- Eslami, H., Esmaili, A., Razaiean, M., Salari, M., Hosseini, A. N., Mobini, M. & Barani, A. (2022) Potentially toxic metal concentration, spatial distribution, and health risk assessment in drinking groundwater resources of southeast Iran, *Geoscience Frontiers*, 13(1), <https://doi.org/10.1016/j.gsf.2021.101276>.
- Fatalla, J. M. (2019) The 1996 Marcopper Mining Disaster in Marinduque: five decades of social injustice and neglect, *CSS Papers*, 2, pp. 11-22.
- Fei, J. C., Min, X. B., Wang, Z. X., Pang, Z. H., Liang, Y. J. & Ke, Y. (2017) Health and ecological risk assessment of heavy metals pollution in an antimony mining region: a case study from South China, *Environmental Science and Pollution Research*, 24(35), pp. 27573-27586, <https://doi.org/10.1007/s11356-017-0310-x>.
- Hamzaoui-Azaza, F., Ameer, M., Chaouch, R., Cheikha, L. B., Gueddari, M. & Carrillo-Rivera, J. J. (2020) Assessment of groundwater quality based on GIS and geochemical methods: coastal aquifer of Bouficha (North-Eastern Tunisia), *Journal of Coastal Conservation*, 24(4), pp. 1-20, <https://doi.org/10.1007/s11852-020-00762-8>.
- Hossain, M. & Patra, P. K. (2020) Contamination zoning and health risk assessment of trace elements in groundwater through geostatistical modelling, *Ecotoxicology and Environmental Safety*, 189, <https://doi.org/10.1016/j.ecoenv.2019.110038>.
- Igual, Y. M. L., Maglente, J. L., Malabana, D. A. O., Rillera, K. T. A. & Rosario, F. S. (2014) *Current Status of Biological and Social Impacts of Marcopper Mining Tragedy in Marinduque*, available at: [https://www.academia.edu/download/31434264/Current\\_Status\\_of\\_Biological\\_and\\_Social\\_Impacts\\_of.pdf](https://www.academia.edu/download/31434264/Current_Status_of_Biological_and_Social_Impacts_of.pdf) (October 6, 2022).
- Kada, H., Demdoun, A., Baali, F., Aouati, H. & Eddine, H. D. (2022) Heavy metal contamination and exposure risk assessment via drinking groundwater in Ain Azel territory, north-eastern Algeria, *Sustainable Water Resources Management*, 8(5), pp. 1-19, <https://doi.org/10.1007/s40899-022-00748-4>.
- Kiiskila, J. D., Sarkar, D., Panja, S., Sahi, S. V. & Datta, R. (2019) Remediation of acid mine drainage-impacted water by vetiver grass (*Chrysopogon zizanioides*): A multiscale long-term study, *Ecological Engineering*, 129, pp. 97-108, <https://doi.org/10.1016/j.ecoleng.2019.01.018>.

- Kumar, A., Ali, M., Kumar, R., Kumar, M., Sagar, P., Pandey, R. K., Akhouri, V., Kumar, V., Anand, G., Niraj, P. K. & Ghosh, A. K. (2021) Arsenic exposure in Indo Gangetic plains of Bihar causing increased cancer risk, *Scientific Reports*, 11(1), pp. 1-16, <https://doi.org/10.1038/s41598-021-81579-9>.
- Landrigan, P. J. (2012) The hidden costs of environmental contamination, *European Respiratory Journal*, 40(2), pp 286-288, <https://doi.org/10.1183/09031936.00006112>.
- Liang, C. P., Chien, Y. C., Jang, C. S., Chen, C. F. & Chen, J. S. (2017) Spatial analysis of human health risk due to arsenic exposure through drinking groundwater in Taiwan's Pingtung Plain, *International Journal of Environmental Research and Public Health*, 14(1), pp. 81, <https://doi.org/10.3390/ijerph14010081>.
- Menzel, K., Barros, L., García, A., Ruby-Figueroa, R. & Estay, H. (2021) Metal sulfide precipitation coupled with membrane filtration process for recovering copper from acid mine drainage, *Separation and Purification Technology*, 270, <https://doi.org/10.1016/j.seppur.2021.118721>.
- Mines and Geosciences (2022) *Minerals Industry at a Glance* (Department of Environment and Natural Resources), available at: [https://mgb.gov.ph/images/Mineral\\_Statistics/MFF\\_JULY\\_2022.pdf](https://mgb.gov.ph/images/Mineral_Statistics/MFF_JULY_2022.pdf) (October 07, 2022).
- Monjardin, C. E. F., Senoro, D. B., Magbanlac, J. J. M., de Jesus, K. L. M., Tabelin, C. B. & Natal, P. M. (2022) Geo-Accumulation Index of Manganese in Soils Due to Flooding in Boac and Mogpog Rivers, Marinduque, Philippines with Mining Disaster Exposure, *Applied Sciences*, 12(7), <https://doi.org/10.3390/app12073527>.
- Nelson, G. L. M., Abrigo, G. N. A. & Raymundo, A. K., (2020) The Acceptability of Using Bioremediation in Mogpog, Marinduque, A Mined-Out Community in the Philippines, *Journal of Nature Studies*, 19(1), pp. 81-104.
- Nilkarnjanakul, W., Watchalayann, P. & Chotpantarat, S. (2022) Spatial distribution and health risk assessment of As and Pb contamination in the groundwater of Rayong Province, Thailand, *Environmental Research*, 204, Part A, <https://doi.org/10.1016/j.envres.2021.111838>.
- Otte, M. L., Kearns, C. C. & Doyle, M. O. (1995) Accumulation of arsenic and zinc in the rhizosphere of wetland plants. *Bull. Environ. Contam. Toxicol*, 55, pp. 154-161, <https://doi.org/10.1007/BF00212403>.
- Pal, S. C., Islam, A. R. M. T., Chakraborty, R., Islam, M. S., Saha, A., & Shit, M. (2022) Application of data-mining technique and hydro-chemical data for evaluating vulnerability of groundwater in Indo-Gangetic Plain, *Journal of Environmental Management*, 318, pp. 115582, <https://doi.org/10.1016/j.jenvman.2022.115582>.
- Panneerselvam, B., Paramasivam, S. K., Karuppannan, S., Ravichandran, N. & Selvaraj, P. (2020) A GIS-based evaluation of hydrochemical characterisation of groundwater in hard rock region, South Tamil Nadu, India, *Arabian Journal of Geosciences*, 13(17), pp. 1-22, <https://doi.org/10.1007/s12517-020-05813-w>.
- Peana, M., Medici, S., Dadar, M., Zoroddu, M. A., Pelucelli, A., Chasapis, C. T. & Bjørklund, G. (2021) Environmental barium: Potential exposure and health-hazards, *Archives of toxicology*, 95(8), pp. 2605-2612, <https://doi.org/10.1007/s00204-021-03049-5>.
- PhilAtlas (2022) *Marinduque*, available at: <https://www.philatlas.com/luzon/mimaropa/marinduque> (October 08, 2022).
- Prasetyo, Y. T., Senoro, D. B., German, J. D., Robielos, R. C. & Ney, F. P. (2020) Confirmatory factor analysis of vulnerability to natural hazards: A household vulnerability assessment in Marinduque Island, *Philippines International Journal of Disaster Risks Reduction*, 50, <https://doi.org/10.1016/j.ijdr.2020.101831>

- Raja, V., Lakshmi, R. V., Sekar, C. P., Chidambaram, S. & Neelakantan, M. A. (2021) Health risk assessment of heavy metals in groundwater of industrial township Virudhunagar, Tamil Nadu, India, *Archives of environmental contamination and toxicology*, 80(1), pp. 144-163, <https://doi.org/10.1007/s00244-020-00795-y>.
- Rezaie, B. & Anderson, A. (2020) Sustainable resolutions for environmental threat of the acid mine drainage, *Science of the Total Environment*, 717, <https://doi.org/10.1016/j.scitotenv.2020.137211>.
- Royer, A. & Sharman, T. (2020) *Copper toxicity*, (Treasure Island, FL, USA: StatPearls Publishing), available at: <https://europepmc.org/article/nbk/nbk557456> (October 6, 2022).
- Salvacion, A. (2017) Exploring determinants of child malnutrition in Marinduque Island, Philippines, *Human Ecology*, 45(6), pp. 853-863, <https://doi.org/10.1007/s10745-017-9951-0>.
- Salvacion, A. R. (2021) Mapping land limitations for agricultural land use planning using fuzzy logic approach: A case study for Marinduque Island, Philippines, *GeoJournal*, 86(2), pp. 915-925, <https://doi.org/10.1007/s10708-019-10103-4>.
- Samaniego, J., Gibaga C.R., Tanciongco, A. & Rastrullo R. (2020) Total Mercury in Soils and Sediments in the Vicinity of Abandoned Mercury Mine Area in Puerto Princesa City, Philippines, *Applied Sciences*, 10(13), <https://doi.org/10.3390/app10134599>.
- Senoro, D. B., De Jesus, K. L. M., Yanuaria, C. A., Bonifacio, P. B., Manuel, M. T., Wang, B. N., Kao, C. C., Wu, T. N. Ney, F. P. & Natal, P. (2019) Rapid site assessment in a small island of the Philippines contaminated with mine tailings using ground and areal technique: The environmental quality after twenty years, *IOP Conference Series: Earth and Environmental Science*, 351(1), <https://www.doi.org/10.1088/1755-1315/351/1/012022>.
- Senoro, D. B., Bonifacio, P. B., Mascareñas, D. R., Tabelin, C. B., Ney, F. P., Lamac, M. R. L. & Tan, F. J. (2020) Spatial distribution of agricultural yields with elevated metal concentration of the island exposed to acid mine drainage, *Journal of Degraded and Mining Lands Management*, 8(2), pp. 2551-2558, <https://doi.org/10.15243/jdmlm.2021.082.2551>.
- Senoro, D. B., de Jesus, K. L. M., Mendoza, L. C., Apostol, E. M. D., Escalona, K. S. & Chan, E. B. (2021) Groundwater Quality Monitoring Using In-Situ Measurements and Hybrid Machine Learning with Empirical Bayesian Kriging Interpolation Method, *Applied Sciences*, 12(1), pp. 132, <https://doi.org/10.3390/app12010132>.
- Senoro, D. B., de Jesus, K. L. M., Nolos, R. C., Lamac, M. R. L., Deseo, K. M. & Tabelin, C. B. (2022) In Situ Measurements of Domestic Water Quality and Health Risks by Elevated Concentration of Heavy Metals and Metalloids Using Monte Carlo and MLGI Methods, *Toxics*, 10(7), pp. 342, <https://doi.org/10.3390/toxics10070342>.
- Tabelin, C. B., Uyama, A., Tomiyama, S., Villacorte-Tabelin, M., Phengsaart, T., Silwamba, M., Jeon, S., Park, I. Arima, T. & Igarashi, T. (2022) Geochemical audit of a historical tailings storage facility in Japan: Acid mine drainage formation, zinc migration and mitigation strategies, *Journal of Hazardous Materials*, 438, <https://doi.org/10.1016/j.jhazmat.2022.129453>.
- Towfiquel Islam, A. R. M., Shen, S., Bodrud-Doza, M., Atiqur Rahman, M. & Das, S. (2017) Assessment of trace elements of groundwater and their spatial distribution in Rangpur district, Bangladesh, *Arabian journal of geosciences*, 10(4), pp. 1-14, <https://doi.org/10.1007/s12517-017-2886-3>.
- ur Rehman, K., Bukhari, S. M., Andleeb, S., Mahmood, A., Erinle, K. O., Naeem, M. M. & Imran, Q. (2019) Ecological risk assessment of heavy metals in vegetables irrigated with groundwater and wastewater: the particular case of Sahiwal district in Pakistan, *Agricultural Water Management*, 226, pp. 105816, <https://doi.org/10.1016/j.agwat.2019.105816>.

- Robielos, R.A.C., Lin, C.J., Senoro, D.B. & Ney, F.P. (2020) Development of Vulnerability Assessment Framework for Disaster Reduction at Three Levels of Geopolitical Units in the Philippines, *Sustainability*, 12(21), <https://doi.org/10.3390/su12218815>.
- Wang D., Hubacek, K., Sha, Y., Gerbens-Leenes, W. & Liu, J. (2021) A Review of Water Stress and Water Footprint Accounting, *Water*, 13(2), <https://doi.org/10.3390/w13020201>.
- World Health Organization (2004) *Guidelines for drinking-water quality*, vol. 1, available at: <https://apps.who.int/iris/bitstream/handle/10665/42852/9241546387.pdf?sequence=1&isAllowed=y> (October 7, 2022).
- Wulan, D. R., Marganingrum, D. & Yoneda, M. (2020) Distribution, source identification, and assessment of heavy metal pollution in the surface and pore waters of Cipeles River, West Java, Indonesia, *Environmental Science and Pollution Research*, 27(31), pp. 39123-39134, <https://doi.org/10.1007/s11356-020-09823-9>.
- Zainol, N. F. M., Zainuddin, A. H., Looi, L. J., Aris, A. Z., Isa, N. M., Sefie, A. & Ku Yusof, K. M. K. (2021) Spatial analysis of groundwater hydrochemistry through integrated multivariate analysis: a case study in the urbanized Langat Basin, Malaysia, *International journal of environmental research and public health*, 18(11), pp. 5733, <https://doi.org/10.3390/ijerph18115733>.
- Zhang, M., Wang, L., Mu, C. & Huang Z. (2022) Water quality change and pollution source accounting of Licun River under long-term governance, *Scientific Reports*, 12, <https://doi.org/10.1038/s41598-022-06803-6>.



## Financial Management of Budgetary Revenues via Enhanced Digital Tax Literacy in Serbia

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**Abstract** The topic of this paper is the research of digital tax literacy (DTL) conducted with 385 participants in Serbia and based on a survey in the OECD. DTL can be defined as usage of digital tools for fulfilling tax obligations and evaluating the tax collection risks. The aim of this paper is to provide empirical evidence related to the potentials for DTL enhancement, which results in more efficient and transparent tax collection, lower costs, and higher productivity. The paper provides three groups of guidelines for further DTL enhancement. First, the benchmarking of the DTL level in Serbia with the OECD. Next, an overview of the DTL structure in Serbia shows a good basis for further development via three channels: acquired digital habits by taxpayers, deficient use of existing digital services and preferred electronic communication with the tax administration. Finally, the analysis provides a determination of the main impediments to DTL enhancement that must be addressed.

**Keywords:** • financial management • digital tax literacy • tax administration • Serbia

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## 1 Introduction

This research aims to analyze why digital tax literacy is important through the changes in the digital society, which, due to new technologies, affect the relationship of citizens with tax administrations and the transformation of tax administrations in general. The growth of e-commerce and the usage of digital platforms have increased substantially in the past several years and have revealed some new vulnerabilities in tax systems, such as online tax fraud. At the same time, technology provides tools for combating fraud and increasing government revenue through the effective digital transformation process (Malaszczyk and Purcell, 2016: 7). One of the preconditions for the effective digital transformation of tax administration (TA) is the digital tax literacy. Digital tax literacy can be defined as using digital tools to fulfil tax obligations and evaluate possible tax risks.

The importance of this topic is numerous. First, the concept of digital tax literacy (DTL) has yet to be recognized as a unique element in contemporary literature. Many authors still see two terms, digital and tax literacy, as separate categories, and therefore the importance could be the launch of a new idea that is a consequence of current events in the digital realm of tax administrations. The relevance of the topic is supported by the fact that countries such as Spain and Australia already use virtual assistants – chatbots, that robotic process automation is already part of tax administrations in France and Finland, that the Netherlands uses predictive analytics, while Brazil and China partly use blockchain, and most of the OECD countries are preparing and planning to go that way (OECD, 2020a).

The changes in the global economy will affect the transformation of tax administrations worldwide. However, the question arises about the significance of these transformations for the citizens themselves and how capable (digitally mature) taxpayers can absorb all the new technologies available to tax administrations. For example, one of the OECD reports indicated that despite the introduction of electronic service channels, some countries have experienced that citizens prefer the old way through personal mediation or contact centers (call centers), and that during the transformation, it is important to be guided by strategies demand management strategies (OECD, 2020a). This is exactly the importance of this research, which will answer the question of what Serbian taxpayers are looking for and whether they understand the benefits brought to them by the digital transformation of the tax administration.

Finally, the limited number of papers deal with the topic of digital transformation of the tax administration in Serbia (Pitić, Radosavljević, Babin, Erić, 2018; Atanasijević et al., 2018; Babin, Ivanov, Radosavljević, 2021), so the research in this paper will be a contribution to this field and its additional importance can be seen in this.



## 2 Literature overview

With the Fourth Industrial Revolution and the development of the knowledge economy, the need to become digitally literate and combine financial (including tax literacy as its element) and digital literacy growth. The use of new digital technologies not only transforms traditional ways of doing business but enables the creation of new business models that bring with them challenges in taxation and questions about traditional ways of taxation (Lucas-Mas and Junquera-Varela, 2021). According to Hadzhieva (2019), these characteristics "make it difficult to implement tax policy, collect taxes, and identify tax functions within companies (that is, the required people, systems, and use of financial data), especially concerning cross-border trade in services and intangibles" (Hadzhieva, 2019: 17). taxation of the digital economy will become an important policy of future governments that will create new fiscal space and the possibility to increase tax revenues (Lucas-Mas and Junquera-Varela, 2021).

Digitalization has triggered many direct challenges for tax administrations, mainly relating to how tax rights to income generated from cross-border activities in the digital age should be distributed among countries. (ICC, 2020: 4). If digitization allows companies based on new business models to conduct their business in one country without a physical presence in the same country, this presents a significant tax challenge, since in the traditional way of taxation, physical presence was the main factor used to determine the right of a country to tax a foreign company operating within its borders. This further means that if the digital income of companies in one country is taxed, and those companies do not have a representative office in that country, then the local population will bear the burden on top of the already additional burden they suffer from indirect taxes (Lucas-Mas and Junquera-Varela, 2021: xvii).

As technology has expanded in the modern world, our world has become more connected than ever. This created a global virtual world in which all technology users live, and as a result of modern technology, users had to learn how to become "digital citizens" (Spiers et al., 2018: 238). Digital identity (e-Residency) is offered to individuals who want to start a business in the country so that companies can be launched online, without the need to appoint local staff or open a local bank account as PayPal or other services can be used online payments (Pitić, Radosavljević, Babin, Erić, 2018: 132).

Most of tax administrations have moved from the analog to the digital way of functioning. The Inland Revenue Authority of Singapore (IRAS) has changed its procedures to be able to send digital notices to taxpayers based on service design and user behavior (IRAS, 2021). The Australian Taxation Office uses an SMS to inform its taxpayers promptly about their tax obligations (IOTA, 2017). It also introduced the mobile application *myTax*, an online system that makes a tax return in just 20 minutes (Parliament of the Commonwealth of Australia, 2018). The tax administration of Georgia implements a program for students who can meet and try all the services offered online by the tax

administration on the demo version of the user tax portal (IOTA, 2017). To raise awareness and consent to pay taxes, the tax administration in France created a special website where, in a practical sense, every taxpayer can see what the collected tax revenue is used for (IOTA, 2017). Several times they gathered developers, experts, companies, startups and tech-labs through multi-day hackathons to work on developing new computer solutions and creating algorithms (based on data provided by the tax administration), which led to the creation of 21 solutions which are currently under development or in initial use (Charrié and Janin, 2015).

In Norway, there is a strategy that says if we would involve taxpayers actively in process transformation, our focus must shift from our own processes to the taxpayers themselves. This means we must look from the taxpayers' point of view, not from the point of view of the tax administration (NTA, 2020, p. 14). In the Netherlands, they apply a strategy of connecting with taxpayers. The Netherlands Tax and Customs Administration has a strategy of social media presence to communicate with taxpayers, provide the necessary information, maintain good relations and build the role of the tax administration as a service to citizens. The Spanish tax authority has a chatbot that provides value-added tax information (OECD, 2019: 180). In Sweden, there is also a similar solution called Skatti, while in Australia, a chatbot called Alex is available to citizens that answers questions on the portal of the tax administration.

However, most TAs are still far from a digitally transformed tax administration (Radosavljević, Babin, Erić, 2023). The aim of the digital transformation of the tax administration is to enable efficient, constant and continuous provision of services over time, which can only be achieved if we cooperate with taxpayers, the public sector, as well as with partners from the private sector, all with the aim of building confidence in the use of data and the security of its use (OECD, 2020: 3). Interested parties in the digitalization of the tax system are individual taxpayer, who see tax filing as an unnecessary and frustrating chore while wanting a simple and understandable way to interact with the tax system; companies that have already begun to digitally transform their business; tax agents whose job is changing into tax advisors for choosing the appropriate business model in the digital economy; software producer who will receive another cash flow as a source of income through the digitization of tax administrations; government as the most complex participant that should act in the interest of all other participants (ICEAW, 2019: 5).

A larger part of the economy is moving to the digital economy, where the business environment is changed (Rosario and Chavali, 2020: 62). Transactions can be concluded in the form of real money or virtual currencies. Even when these transactions are virtual, they still have tax consequences for the participants. Taxpayers, therefore, need knowledge of both taxation and digital to be able to account for these transactions on their tax returns (Bornman and Wasserman, 2020: 2). Almost two and a half decades ago, Gilster defined digital literacy as "the ability to understand and use information in

multiple formats from a wide variety of sources when presented via a computer" (Glistler, 1997: 1). A decade and a half later, Spiers and Bartlett point out that digital literacy in the future rests on the ability to decode and construct meaning from the ever-evolving digital environment (Spiers and Bartlett, 2012: 8).

At the same time, if the efforts to improve financial ability are such that there is the creation of new taxpayers and an increase in the tax revenue base, then the lack of financial, and therefore tax literacy, would certainly represent a risk for tax revenues (Chardon, 2011: 58). Issues such as tax complexity, low tax morale, low tax liability and shadow economy can be reduced by increasing the level of financial literacy of taxpayers (Cvrlje, 2015: 157). Genest-Grégoire et al. define tax literacy as "the knowledge, skills and confidence to make responsible tax decisions" (Genest-Grégoire et al., 2017: 2). Bornman and Wasserman propose that tax literacy consists of three elements - tax awareness, which implies that the individual understands his role in the fiscal system and the social contract with the state; contextual knowledge, which refers to knowledge of procedural activities in communicating with tax institutions and having legal knowledge about why and how an individual is taxed; and finally, informed decision-making in fulfilling tax obligations arising as a consequence of the previous two elements (Bornman and Wasserman, 2018: 1). Alexander and Balavac suggest that improving tax literacy among young people is a central and important goal of tax authorities in educational programs. The intention is to improve the tax awareness and morale of young people at important stages in secondary and higher education, before the next generation enters the labor market (Alexander and Balavac, 2018: 5). Mouchkova and Vitek define "tax literacy is a specialized branch of financial literacy. Currently, there is no single methodology for measuring and assessing tax literacy" (Mouchkova and Vitek, 2018: 553). Making economic decisions without an adequate, up-to-date and accurate set of knowledge could have short-term and long-term consequences both at the individual and societal level, according to Nichita, et al. These authors define "tax literacy as the ability of taxpayers to understand their rights and obligations, to use their tax knowledge and skills to properly complete tax returns and to comply with applicable tax laws" (Nichita, et al., 2019: 398).

### 3 Research

In order to evaluate digital tax literacy in Serbia, we started with the OECD analysis, which has been conducting ISORA research (International Survey on Revenue Administration) for the last few years (ISORA, 2020; OECD, 2019). We also used other OECD research which follows the digital transformation of tax administrations (OECD, 2016; IOTA, 2017; OECD 2020a; OECD 2021). Based on that, we selected several case studies and asked taxpayers in Serbia whether they supported their application. To analyze the demand for the digital transformation of the Tax Administration, we use a comparative analysis of the digital habits that we consider generators of that demand (OECD, 2020b). We also considered the survey conducted by Alghamdi A., Rahim M. (2016) in Australia on satisfaction with implementing the e-tax system.

Finally, we benchmark a level of digital maturity and digital tax literacy in Serbia with the OECD level based on the first two pillars of Digital Transformation Maturity Index (Radosavljević, Babin, Erić, 2022: 232; OECD, 2022: 16).

Based on OECD methodology, we surveyed 385 participants divided into three groups, individuals (66.3%), entrepreneurs (17%) and companies (16.7%). In the gender structure, there were more men, 52.3%, while the share of women was 47.7%. According to the age structure, the largest number of respondents belongs to the group 36-54 (45%), followed by the 25-34 age group (32.4%), 55-64 group (11.8%), 6.7% of respondents aged 18-24 years and 4% over 65. Regarding work status, 68.6% of respondents are employed, 15% are self-employed, 9.4% are unemployed, 4.3% are retired, and the remaining 2.7% declared themselves as "other". About 45% of respondents filled out the questionnaire via social networks, while about 55% received the questionnaire by e-mail. The majority of the sample consists of individuals with completed higher education, 80%, secondary education 18.6% and only 0.8% of respondents with primary education. We started from the assumption that they are taxpayers, which should be more tax-literate and digital-literate than the others. Thus, the sample has a positive bias. Also, our goal was a greater coverage of individuals (66%), considering that greater digital tax literacy will facilitate their access to the tax administration to a greater extent since legal entities have other channels, such as accountants, tax advisors, etc. Finally, the survey was used as a model for the research of tax administrations in OECD countries where tax administrations are at a higher level of digital maturity than the Tax Administration of Serbia (Radosavljević, Babin, Erić, 2022: 236).

Research shows that a fairly high percentage of respondents use payment cards and electronic banking whenever possible. The high percentage of use of electronic banking and payment cards can be explained by the fact that these are services that banks have been offering for many years, and they work on their additional promotion every day. This is particularly pronounced in the conditions caused by the Covid-19 pandemic when the reduced use of paper money is encouraged. Furthermore, these habits represent a good basis for the development and use of online commerce, and yet the majority of respondents (64%) tend to buy online, but only sometimes.

The reasons can be found on two sides - the subjective feeling of shopping "live" and safety on the internet when shopping. While the first reason is somewhat justifiably understandable, the second reason could indicate poor digital literacy and misunderstanding of what internet payment looks like and what is behind it. In addition, almost 40% do not actively use mobile banking, so it is justified to ask why a service that exists and has the function of improving the efficiency of communication with the bank and performing daily activities is not used to the greatest possible extent, or at least to a greater extent. The answer can be twofold: users need to learn how to use mobile bank applications (they need to be digitally literate enough) or be more user-oriented. In the

latter case, there is still a gap in the need for more understanding between supply (banks) and demand (users), which points to a different level of digital knowledge and skills.

As a prerequisite for digital tax literacy, we see widespread digital services such as electronic banking, mobile banking, online trade, credit/debit cards, electronic wallet (eWallet), social networks, etc. This means that we could expect that an individual who uses more digital services has a higher level of digital literacy and a potentially better base for DTL. We assume that this digital literacy is a consequence of the experience of use. That is why, in the research, we first examined the digital habits related to digital services. Electronic wallet is not excessively used, considering that the survey showed that the vast majority of respondents do not use this product (79%). However, two things should be kept in mind when it comes to its use. First, this is a relatively new service in the Serbian market. Second, the eWallet option is offered by only a few banks and one telecommunications operator.

On the other hand, this service is used by all generations, indicating its future potential. As for social networks, the survey showed that only 6.5% of them have no social network accounts at all. Also, 70.6% of respondents have accounts on several social networks. Such a high percentage indicates that today almost all generations of users can be found on social networks, especially when it comes to Facebook, and increasingly Instagram. The results are summarized in Table 1 below.

**Table 1:** Digital habits

Use bank cards for payment	77%
Pay electronically whenever possible	74%
Has accounts on several social networks	70%
Buys online, but only sometimes	64%
Actively uses all functions of mobile banking	59%
Use the eWallet app	21%

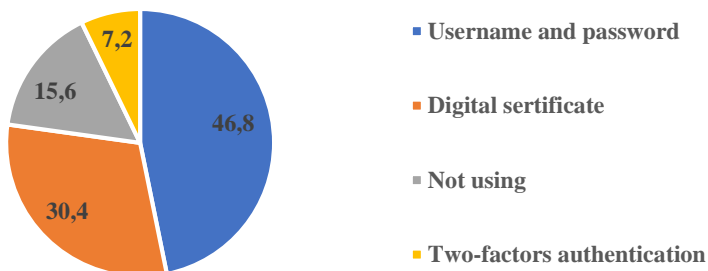
Source: Authors' calculation based on the survey.

The previous conclusions lead us to believe that the basic digital literacy caused by everyday digital habits is at a satisfactory level. This basis shows that there is a need and space for further improvement of digital services in other spheres as well.

Also, we wanted to check how respondents log in to the electronic service of public administration, *eUprava* (*eGovernment*). This is important because *eUprava* represents a big step towards the digitalization of public administration and follows modern trends in the establishment of electronic administrations around the world. A more complex method of registration should also represent a higher degree of digital literacy. In addition, it also enables users to have more services and information at their disposal. Almost half of the respondents log in with a username and password (46.8%), about one-third use an

electronic certificate (30.4%), and only 7.2% use two-factor authentication. Results are presented in Graphic 1. The low use of two-factor authentication is that it is the most complex and difficult to understand. When it comes to an electronic certificate, in addition to requiring you to understand how it works and the knowledge to start and install it, one also needs to pay for its creation (it can also be provided for free by Government). The remaining option is the easiest and represents the lowest level of digital literacy but provides the least information and services available. Among the respondents, there are 15.6% of them who do not use eGovernment services at all. These are respondents with a high degree of education, which raises doubts as to whether the reason for their non-use is ignorance that such a service exists, lack of interest in using such a service, or lack of competence to use it. However, it is surprising that respondents of this age (almost half of them are 34-56 years old) and education level as someone certain a taxpayer is not involved in using this digital service. In general, a certain digital literacy exists, but according to the choice of solutions, it is at the basic level because the largest number still choose the basic usage level.

**Graph 1:** Method of logging in to the portal *eUprava*, in %

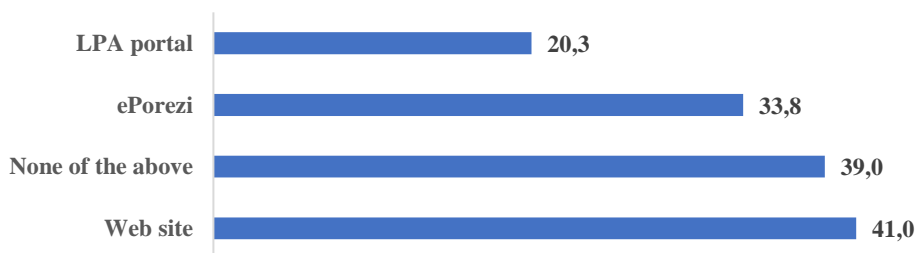


Source: Authors' calculation based on the survey.

We also analyze the usage of digital services provided by the Tax Administration of the Republic of Serbia. The results of using digital services will give us a better indication of digital tax literacy. Having in mind that taxpayers are using more than one service, we allowed multiple answers. In addition to what they use to perform their tax obligations, we will analyze digital tax literacy through the usage of a channel of communication with the Tax Administration. Our goal is to get an impression of the easiest way for the user, providing them with enough information for their competence level. Ways of communication with the Tax Administration also speak to the level of digital habits of taxpayers.

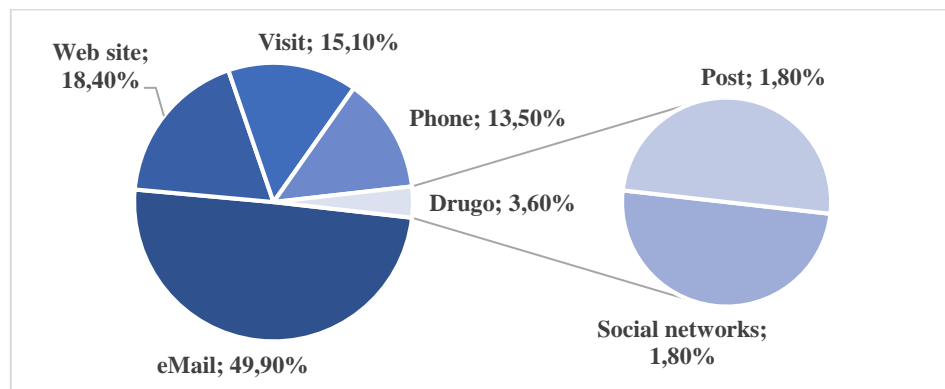
As expected, most of the respondents use the website of the Tax Administration (41%), but it is unexpected that almost 39% of them do not use any digital service offered by TA. Slightly more than one-third use the portal *ePorezi* (*eTax*), while one-fifth of the respondents use the Local Tax Administration (LPA) service (Graph 2 below). Most of the respondents who do not use any of TA's digital services are individuals (87%). Such results can be explained by the fact that individuals either need to learn that such services exist in the Tax Administration or do not need these services. However, if we look at the fact that most respondents aged 25-54 (69%), it is simply impossible that they cannot find usefulness, at least when it comes to paying property taxes under LPA. The question arises whether the problem here is that they may be digitally literate but not tax literate, so they do not use digital services because they are safer to go to the Tax Administration and have the tax officer do something for them or is the problem that they are tax literate, and they are not digitally literate, so they cannot fulfil their tax obligations digitally. Suppose 40% of respondents do not even use a basic online tool, which is a website. In that case, both are likely at issue, i.e. that in terms of digital and tax literacy, taxpayers are insufficiently competent when it comes to fulfilling their tax obligations digitally.

**Graph 2:** Use of digital services of the Tax Administration of the Republic of Serbia



Source: Authors' calculation based on the survey.

Contrary to the fact that 46% of respondents recognize that the Tax Administration informs them mostly by post, when asked for the most convenient way for them to communicate with the Tax Administration, almost half of the respondents said that it is e-mail (Graph 3 below). Sending information by post is the least convenient way for them to communicate (1.8%), as well as social networks (1.8%). When it comes to other means of communication, the remaining half of respondents more or less equally declared that the most convenient way for them to communicate with TA is the website (18.4%), followed by a visit to the tax administration (15.1%) and finally, the phone (13.5%). If we were to add up all the methods of electronic communication, we would realize that 69.3% of the respondents prefer this type of communication (e-mail, social networks and website) against the traditional methods of communication (letter, phone and going to the Tax Office).

**Graph 3:** Preferred way of communication with the Tax Administration

Source: Authors' calculation based on the survey.

Around 30% of respondents still prefer the "old" way of communication, which is small but not insignificant. To that should be added the fact that for sources of tax information, one-fifth of the respondents turn to Tax Administration officials (21.3%), while slightly fewer use social networks (19.1%) and traditional media (TV, radio or newspapers). Around 34.5% of respondents use tax advisors or accountants. The use of e-mail significantly shortens the time for obtaining information but does not testify to high digital tax literacy, just as hiring tax advisors (mostly in the case of legal entities, but also entrepreneurs) can indicate deficiencies in tax literacy.

Finally, we analyzed the potential future demand for digitalization of tax administration. Among other things, it is significant because it shows the readiness of current and future taxpayers to move to a higher level, from analog to digitally transformed tax administration. This is only possible if taxpayers are digitally and tax literate enough to follow this transition. In this context, the demand for the future digitization of tax administration indirectly reflects the digital tax literacy of taxpayers. Inspired by examples and practices from OECD countries, we asked taxpayers in Serbia if they would like some of those solutions implemented in the domestic tax administration. Questions concern the use of chatbots, demo versions, electronic tax solutions, and SMS notifications, but also the organization of hackathons and other forms of cooperation, with the use of facial recognition techniques.

Out of the total number of respondents, 71.8% stated that they would like the Tax Administration to introduce some virtual assistant or chatbot. As reasons for this request, the respondents state that they would rather consult a virtual assistant than go to the tax office for information (62%), that it would significantly shorten the time needed to obtain information (55%), and that they would significantly shorten the time necessary for the



entire tax payment process (53%). In addition, chatbots enable the improvement of tax literacy by providing feedback that is subject to storage.

A total of 67.3% of respondents would like the Tax Administration of Serbia to have demo versions of its services where they could practice using them (Table 2). Respondents believe that demo versions of user tax portals are the right way to get to know the services offered by the tax administration. They will allow users to be sure that they are doing the right thing several times before performing a certain transaction or activity on the Internet portal or mobile application, thereby contributing to the development of digital tax literacy. The demand for demo versions directly indicates the need to improve digital tax literacy, as it suggests that taxpayers need to be more confident in themselves when using the Tax Administration's existing digital services. In addition, such services contribute to the literacy of the older population of taxpayers and provide an interesting way to introduce tax obligations to future taxpayers.

**Table 2:** Digital habits

Question	Yes	No
TA should introduce face or fingerprint recognition as an option for logging into systems	54.0%	45.0%
TA should introduce some virtual assistant/chatbot	71.7%	28.3%
TA should introduce demo versions of their services where I could practice using them	67.3%	9.3%
I would like to receive the tax documents electronically instead of by post office	87.0%	13.0%
I would like to be able to see exactly for what purpose the particular tax I pay goes	95.6%	4.4%
An institution like TA should have accounts on social networks	60.5%	12.0%
I would like that TA inform me about my status via SMS messages	74.8%	25.2%
I would like that TA cooperate with taxpayers through a collaborative platform	80.3%	19.7%
I would like that TA cooperate with taxpayers through a hackathon	81.3%	18.7%
User education through social networks is appropriate	36.4%	29.4%

Source: Authors' calculation based on the survey.

Facial or fingerprint recognition is not dominantly recognized as an adequate solution. The fact that more than half of the respondents are in favor of this solution is supported by the fact that younger respondents aged 18-34 are in favor of the introduction option. Given that facial or fingerprint identification is currently present on smartphones, it is clear that these recognition techniques are much closer to younger people, while the elderly are still getting used to using smartphones in general and express distrust in new technologies. On the other hand, 87.1% of respondents would like to receive documentation from TA electronically, and 75% of respondents would like to get information about their status via SMS messages, which is already the practice in some

countries around the world. In addition to contributing to the personalization of services through unique content, SMS and electronic solutions enable more efficient execution of tax payments.

The cooperation of taxpayers and the Tax Administration to create successful user experiences and digital solutions can be a good indicator of digital tax literacy. We proposed to the respondents the Austrian solution, collaboration through a collaboration platform (OECD, 2020) and the French solution, collaboration through hackathons (OECD, 2020a) and received positive opinions. Regarding the Austrian example, 80.2% of respondents declared that this tax administration approach would be useful for them. On another side, 81.2% declared that hackathons would also be useful for them. If we analyze these results from the aspect of the status of legal entities, we can see that 52% of companies and 47% of entrepreneurs want to participate in the creation of services, while when it comes to consultations, those percentages are slightly higher - 71% of companies and 65% of entrepreneurs. The collaborative platform is supported by an equal number of legal entities and entrepreneurs (87%), while around 90% of companies and 76% of entrepreneurs, consider hackathons as appropriate. Such a great demand may indicate a higher readiness and digital tax literacy in the private sector compared to individuals. The fact that someone knows what a hackathon is or understands what collaboration through a collaboration platform means (and consequently knows how to use it) speaks of the level of digital literacy.

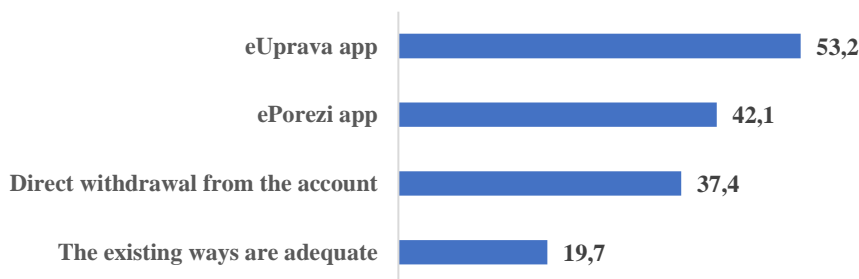
A high proportion of respondents, 95.7%, would like to see exactly for what purpose the particular tax they pay goes. When formulating this question, we were guided by the French example, which includes a platform where taxpayers can see the item in the budget where the tax they paid went. However, slightly fewer respondents, 90.1% of them, would use the option regularly if there was an option to track where their tax is going. After all, 84.2% agree with the statement that being able to track the spending of the taxes we pay is a good way digital technology can contribute to transparency. This is where the part of the definition of tax literacy comes to the fore, which says that tax knowledge also includes why it is important to pay taxes and directly points to taxpayers' knowledge to follow their country's public finances.

Speaking of taxpayer education, the answers are fairly uniform regarding whether education through social media is appropriate. About 36.4% of respondents believe that social networks are appropriate for education, while slightly fewer are against it (29.4%). However, two important points should be kept in mind here. The first is that undoubtedly the majority of respondents, namely 4 out of 5 people, believe that it is absolutely necessary to explain and educate future taxpayers about why it is important to pay taxes. If we look only at respondents in that age group (18-24), 83.7% of them agreed with this statement. This means that future generations of taxpayers are aware of education's importance and desire education in this matter. Also, with the encouragement of entrepreneurship among young generations, their education on the importance of paying

taxes must also go hand in hand. When we consider only the respondents who consider it a good way, we will see that 46.6% of them are in the age group 18-34 years, while of the total number of this age, 42% of them think that social networks are an appropriate channel for education. In addition, 59% of respondents are interested; that is, they would like to be able to contact the Tax Administration via social networks. Half of the respondents aged 18-24 voted for this option. This result is significant because it speaks to the communication preferences of future taxpayers.

At the very end, in Graphic 4, we can see the preferred ways of paying taxes. Half of the residents declared that it should be within the existing *eUprava* system (53.2%). On the other hand, we saw that a much smaller number of respondents apply for *eUprava* through an electronic certificate, so not everyone could use this service. In addition, there is a significant source of demand for two more ways - through the existing *ePorezi* application (42.1%), but also as an option of direct withdrawal from the current account with the prior approval of the taxpayer (like Netflix and similar services) (37.4%). Nevertheless, only one-fifth of respondents still think that the existing methods are adequate (19,7%).

**Graph 4:** Preferred way of paying taxes



Source: Authors' calculation based on the survey.

These ways of paying taxes should not be exclusive, but complementary, given the fact that everyone has a significant percentage of the desire to introduce it. Among other things, digital transformation should contribute to the personalization and individualization of services. Institutions must also have an omnichannel experience, i.e. provide omnichannel access to their users to choose the one or more channels they need.

## 4 Discussion

The results from the previous analysis show a fairly high level of basic digital habits in Serbia, especially regarding the use of social networks, electronic and mobile banking, payment cards and, to some extent, online shopping. That's the case for all age groups, which indicates the basis for upgrading digital tax literacy. At the same time, one-third of

respondents use every TA digital solution individually, indicating that we are at the basic level of digital tax literacy. The high demand for electronic means of communication indicates good potential, but there is a critical 30% of the population who still prefer traditional ways of communication (going personally to TA, communicating through the post office, by phone, etc.). This can be an indicator of still insufficient digital tax literacy.

The fact that there is still a certain scepticism in digital use is indicated by the fact that the majority buy online only sometimes, that 15% of respondents (mostly highly educated) do not use the governmental portal *eUprava*, that the existing TA digital services are used by barely a third of the respondents, and that even 40% declared that they do not use a single service. Also, one-fifth of the respondents believe that the existing methods of tax payment are adequate and see no reason for new, improved methods that include a digital component.

A high level of potential future demand indicates that those with a basic level of digital tax literacy today are willing to move to a higher level. Interestingly, this demand, among other things, is increased by respondents of a younger age, i.e. future taxpayers. Through research, it has been shown that this group of respondents is more digital and less tax literate, in contrast to older respondents, where the situation is more or less uniform, and in some categories, the opposite.

Finally, the digital transformation of the Serbian Tax Administration is lagging behind OECD countries (Radosavljević, Babin, Erić, 2022: 236). Based on the self-assessment received from 47 tax administrations in OECD countries Digital Transformation functions of OECD countries have "Established" maturity level (level 3/5) while in Serbia average maturity level is "Progressing" (level 2/5). Moreover, the indicator "Uses of digital identity" is a good proxy for the digital tax literacy level of taxpayers, where more mature taxpayers use a wider range and more sophisticated digital tax services. The average level of that indicator in Serbia is 2/5. Also, 37 of 47 OECD countries have recorded a higher level of that indicator than Serbia (Radosavljević, Babin, Erić, 2022: 232; OECD, 2022: 19). Therefore, we can conclude that the digital tax literacy of Serbian taxpayers is lower than the OECD average.

## 5 Conclusion

Results showed a good basis for enhancing digital tax literacy in the form of digital habits, partial use of current digital services of the Serbian Tax Administration and preferred electronic communication with the tax administration. Also, it is important to highlight that the current level of digital tax literacy in Serbia is rather basic and unevenly spread between generations. On the other side, the usage of existing TAs digital services in Serbia is low. We conclude that one of the reasons is the insufficient competence of taxpayers to perform tax obligations digitally. However, high interest in using digital services in the future is optimistic, and the sources of that demand are taxpayers who

currently possess a basic level of digital skills and future taxpayers (youth) who are advanced digitally literate but poor in tax literacy. Finally, the ultimate conclusion and recommendation are that Serbia's TA and public authorities must focus more on taxpayer education and establish effective cooperation with education and research institutions.

## References:

- Alghamdi, A. & Rahim, M. (2016) *Development of a Measurement Scale for User Satisfaction with E-tax Systems in Australia* (Germany: Springer).
- Alexander, Ph. & Balavac, M. (2018) *Improving Tax Literacy and Tax Morale of Young Adults* (London: The Chartered Institute of Taxation).
- Atanasijevic, J., Jakovetic, D., Krejic, N., Krklec-Jerinkic, N. & Markovic, D. (2019) Using big data analytics to improve efficiency of tax collection in the tax administration of the Republic of Serbia, *Ekonomika preduzeća*, 67, pp. 115-130.
- Babin, M., Ivanov, I. & Radosavljević, G. (2021) Digitalizacija godišnjeg poreza na dohodak građana i onlajn fiskalizacija, In: Ilić-Popov, G. (ed.) *Zbornik radova u čast profesora Dejana Popovića - Liber Amicorum* (Beograd: Pravni fakultet Univerziteta u Beogradu), pp. 58-73.
- Bornman, M. & Wassermann, M. (2018) Tax literacy in the digital economy, *eJournal of Tax Research*, (Sydney: The School of Accounting, Auditing and Taxation).
- Bornman, M. & Wassermann, M. (2020) Tax knowledge for the digital economy, *Journal of Economic and Financial Sciences*, 13(1), <https://doi.org/10.4102/jef.v13i1.461>.
- Chardon, T. (2011) Weathering the Storm: Tax as a Component of Financial Capability, *Australasian Accounting, Business and Finance Journal*, 5(2), pp. 53-68.
- Charrić, J. & Janin, L. (2015) Taxation and the digital economy: A survey of theoretical models, *France Stratégie*, available at: [https://ec.europa.eu/futurium/en/system/files/ged/ficalite\\_du\\_numerique\\_9\\_mars\\_13\\_h.pdf](https://ec.europa.eu/futurium/en/system/files/ged/ficalite_du_numerique_9_mars_13_h.pdf) (October 2, 2022).
- Cvrlje, D. (2015) Tax literacy as an instrument of combating and overcoming tax system complexity, low tax morale and tax non-compliance, *The Macrotheme Review*, 4(3), pp. 156-167, (Austin: Macrotheme Capital Management LLC).
- Genest-Grégoire, A., Godbout, J. H. & Guay, L. (2017) *The Knowledge Deficit about Taxes: Who It Affects and What to Do about It* (Toronto: C.D. Howe Institute Commentary).
- Gilster, P. (1997) *Digital literacy* (New York: Wiley and Computer Publishing).
- Hadzhieva, E. (2019) *Impact of Digitalisation on International Tax Matters: Challenges and Remedies*, (Brisel: European Union).
- ICAEW (2019) *Digitalisation of tax: international perspectives: 2019 EDITION* (London: Institute of Chartered Accountants in England and Wales).
- ICC (2020) *ICC BRITACOM report: Digitalization of tax administrations: A business perspective* (Paris: The International Chamber of Commerce).
- IOTA (2017) *Transforming Tax Administration and Involving Stakeholders* (Budapest: Intra-European Organisation of Tax Administrations).
- IRAS (2021) *A brief look at National Digital Identity – Singapore* (Singapore: Inland Revenue Authority of Singapore).
- ISORA (2020) *ISORA 2020 Country Level Public Data, International Survey on Revenue Administration (ISORA)*, available at: <https://data.rafit.org/?sk=57536808-1e0c-476f-bc20-afaac069aae8&Id=1631544333745> (October 7, 2022).

- Lucas-Mas, C. O. & Junquera-Varela, R. F. (2021) *Tax Theory Applied to the Digital Economy: A Proposal for a Digital Data Tax and a Global Internet Tax Agency* (Washington: World Bank Group).
- Malaszczyk, K. & Purcell, B. M. (2016) Big data analytics in tax fraud detection, *Journal of Finance and Accountancy*, 23, (Beaumont: Cabell Publishing), pp. 1-10.
- Moučková, M. & Vitek, L. (2018) Tax literacy, *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67(2), pp. 553–559.
- Nichita, A., Batrancea, L., Marcel Pop, C., Batrancea, I., Dan Mora, I., Masca, E., Roux-Cesar, A. M., Forte, D., Formigoni, H. & Aderito da Silva, A. (2019) We Learn Not for School but for Life: Empirical Evidence of the Impact of Tax Literacy on Tax Compliance, *Eastern European Economics*, 57(5), pp. 397-429 (London: Routledge).
- Norwegian Tax Administration (2020) *Consent-based loan application: Taxpayer touchpoint Example from the Norwegian Tax Administration* (Oslo: NTA).
- OECD (2016) *Technologies for Better Tax Administration: A Practical Guide for Revenue Bodies* (Paris: OECD Publishing).
- OECD (2019) *Tax Administration 2019: Comparative Information on OECD and other Advanced and Emerging Economies* (Paris: OECD Publishing).
- OECD (2020) *Addressing the Tax Challenges Arising from the Digitalisation of the Economy: HIGHLIGHTS* (Paris: Secretary-General of the OECD).
- OECD (2020a), *Tax Administration 3.0: The Digital Transformation of Tax Administration* (Paris: OECD Publishing).
- OECD (2020b) *OECD Digital Economy Outlook 2020* (Paris: OECD Publishing).
- OECD (2021) *Tax Administration 2021: Comparative Information on OECD and Other Advanced and Emerging Economies* (Paris: OECD Publishing).
- OECD (2022) *Digital Transformation Maturity Model* (Paris: OECD Publishing).
- Parliament of the Commonwealth of Australia (2018) *Taxpayer Engagement with the Tax System* (Canberra: House of Representatives Standing Committee on Tax and Revenue).
- Pitić, G., Radosavljević, G., Babin, M. & Erić, M. (2018) Digitalization of the Tax administration in Serbia, *Ekonomika preduzeća, Journal of Serbian Association of Economists and Serbian Association of Corporate Directors*, 66(1-2), pp. 131-145.
- Radosavljević, G., Babin, M. & Erić, M. (2022) The Pathway for the Effective Digital Transformation of the Tax Administration in Serbia, In: Mihić, M., Jednak, S. & Savić, G. (eds.) *Sustainable Business Management and Digital Transformation: Challenges and Opportunities in the Post COVID Era, SymOrg 2022, LNNS 562* (Switzerland: Springer Nature), pp. 228-238.
- Rosario, Sh. & Chavali, K. (2020) Digitization of Taxation in the Changing Business Environment & Base Erosion & Profit Shifting (Beps): Special Reference to India, *European Scientific Journal*, 16(1), pp. 61-74.
- Spires, H. & Bartlett, M. (2012) Digital literacies and learning: Designing a path forward, *Friday Institute White Paper Series*, (New York: NC State University), available at: <https://www.fi.ncsu.edu/wp-content/uploads/2013/05/digital-literacies-and-learning.pdf> (October 2, 2022).
- Spires, H. A., Medlock, P. C. & Kerkhoff, Sh. N. (2018) Digital Literacy for the 21st Century, In: Khosrow-Pour, M. (ed.) *Encyclopedia of Information Science and Technology*, 4<sup>th</sup> ed. (PA: IGI Global, Information Science Reference), pp. 12-21.

## Modeling and Forecasting CPI in Serbia Using the SARIMA Model

KATARINA NIKOLIĆ & DRAGANA RADOJIČIĆ

**Abstract** To develop the most appropriate economic strategies in a country, policymakers need to have a reliable forecast of the rate of inflation. This is achieved by using the appropriate model that possesses high predictive accuracy. This paper analyzes the efficacy of Seasonal Autoregressive Integrated Moving Average (SARIMA) models to anticipate the CPI rates in Serbia. The model is developed using the monthly CPI (2010=100) in Serbia in the period 1995- first half of 2022 obtained from the International Monetary Fund. The paper aims to demonstrate the importance of modeling seasonal series, the structure of the SARIMA model, and possibilities of application in the field of economics, specifically related to the analysis of CPI, but also the importance of seasonal influences in general. The qualities, as well as shortcomings of the model, serve to provide breadth in the observation of economic phenomena.

**Keywords:** • time series modeling • seasonality • CPI • forecasting • SARIMA

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## 1 Introduction

Time series arise in a wide range of areas, from marketing to oceanography, and they apply to any variable that changes over time. Time series analysis often has two goals: to understand or model the stochastic mechanism that generates an observed series and to predict or forecast the future values of a series based on the performance of that series in the past, and potentially also of other related series or factors (Springer, 2008). Analyzing such a series may raise several problems of both a theoretical and practical nature (Chatfield, 2013).

A time series is defined as a set of quantitative observations arranged in chronological order (Kirchgässner et al., 2012). In economics, there are much different time series that can be observed, including such series as share prices on successive days, export totals in executive months, average incomes in successive months, company profits in successive years, etc. (Chatfield, 2013). Thus, studying the time series allows us to better understand the variations of variables over time, so they can be better described, interpreted, predicted, and controlled by the appropriate economic policies.

According to Webster's definition of inflation from 2000, inflation is an ongoing rise in consumer price levels or an ongoing loss of money's purchasing power. The Consumer Price Index measures the overall change in consumer prices based on a representative basket of goods and services over time. As such, it is important to analyze it and draw appropriate conclusions, to implement specific economic policies in the country. As a reasonably persistent process that inflation tends to be, current and historical values should be useful in predicting future inflation (Brent and Mehmet, 2010).

This paper consists of two parts, theoretical and practical. The theoretical part discusses time series components, SARIMA models, model layout, components, and characteristics. The practical chapter of the paper will work to use the appropriate modeling and apply it to the CPI in Serbia.

## 2 Literature Review

The ARIMA and regression with ARIMA errors were introduced (Mohamed, J, 2020) to model CPI and forecast its future CPI values in Somaliland. In order to forecast Jordan's GDP and CPI for the 2020, 2021 and 2022, the Box-Jenkins model, was used (Ghazo A., 2021). After examining the consumer price index's movement between January 2010 and September 2020, inflation in the Ukraine was forecasted using ARIMA models (Shinkarenko V. et al, 2021). This approach yields an appropriate ARIMA model for forecasting Indonesia's CPI data (Ahmar A. S. et al., 2018).



### 3 Methodology

ARIMA is a Box-Jenkins method that breaks down time series data into the following categories: the Autoregressive (AR) process and Moving Average (MA) process. Denote by  $\Delta_k X_t$  the difference operator of order  $k$  of time series  $\{X_t\}_{t \in T}$ , so for  $k \in N$  we have  $\Delta_k X_t = X_t - X_{t-k}$ . Especially, within series with seasonality component is the most significant use of the seasonal difference, expressed as  $\Delta_s X_t = X_t - X_{t-s} = (1-L_s) X_t$ , where  $L$  is the delay operator (most often  $s=4$  or  $s=12$ ). The SARIMA model can be useful when time series data exhibit seasonality-periodic variations that repeat with roughly the same intensity regularly, such as quarterly (Martinez et al., 2011). Thus, the SARIMA model is suitable for research involving monthly inflation rate data and it will be used in this paper concerning inflation rates in Serbia.

#### 3.1 SARIMA models

SARIMA is an extension of the ARIMA model, enabling additional modeling of seasonal time series components. SARIMA is an easy-to-use but effective model. It makes the supposition that current behavior is dictated by historical values. Additionally, it presumes that the data is steady and devoid of anomalies and that the model's parameters and error terms are constant. Though SARIMA does not account for the stresses in market data, economic and political conditions, or correlations of all risk factors to forecast inflation rates, the process can help predict inflation movements under normal circumstances where past behavior dictates present values (Shumway, 2000).

Multiple movements can be recognized in time series, which can be categorized into trends, seasonal variations, cyclical fluctuations, calendar variations, and irregular movements. Since data observations are collected periodically, the time variable is discrete in this case (Kirchgässner et al., 2012).

The trend represents the long-term trajectory of the time series, i.e. the general tendency of growth or decline. It is usually observed utilizing a graphical representation of a time series against the flow of time (Chatfield, 1995: 10). Calendar influence occurs due to calendar changes from year to year. The main reasons for this are the change in the number of working days and weekends in a month/quarter, the change in the number of each specific day in a month/quarter (trading days), leap years and "moving holidays", where certain holidays can fall on a different day every year.

Irregular movements represent factors that affect the movement of the time series, and cannot be predicted or controlled, such as strikes or the current covid-19 virus pandemic. It can occur in several forms:

- Structural break that occurs only in one period that can easily be observed on the chart,
- Lasting for several periods and then returning to the original trend,

- Completely changing the level of the series,
- Taking more values only in certain months/years and the like.

In the absence of structural breaks, the irregular component will be white noise, a set of normally distributed random variables with a constant variance that is uncorrelated.

Seasonal and cyclical variations belong to short-term movements. Cyclical, as opposed to seasonal, occurs over a period of more than a year, usually several years. They are also called business cycles. It represents dips and rises in movement, which are usually associated with phases in the economy (prosperity, recession, depression, recovery) and occur every few years. It is usually viewed in conjunction with the time series trend and together forms the trend-cyclical component.

The seasonal component represents regular and periodic movements of the time series within one calendar year. This means that every previous and following year we can observe a certain type of similarity in movement, usually over quarters or months. Additionally, the term "moving seasonality" marks the gradual seasonal changes over time.<sup>2</sup> In certain activities, the effect of seasonal fluctuations is much more pronounced than in others. The causes differ from social, religious, climatic, and such. For instance, the sale of certain kinds of products in our region increases during Easter and Christmas, in the winter months the electricity bills are higher, etc. The season period is denoted by  $s$  - the number of periods that pass until the cycle is repeated, which is 4 for the quarterly time series, while for the monthly time series it is 12.

The role of the SARIMA model is to describe the data movement of one variable in the most precise measure, to explain its movement in the past, as well as to successfully forecast the future. In practice, the largest number of time series is non-stationary, therefore the use of the mentioned model is extremely important.

The SARIMA model can be labeled  $ARIMA(p, d, q) + (P, D, Q)_s$  or  $ARIMA(p, d, q) \times (P, D, Q)_s$ , which represents an additive and a multiplicative model respectively. They are used when there is stochastic seasonal variation. If it is about the deterministic nature of the season, it will be modeled simply by adding seasonal artificial variables. Therefore, if the movement of the season cannot be predicted, it will be considered stochastic and SARIMA models will be used. Even intuitively, it can be concluded that with the additive model, seasonal variations are added to the existing ones, while with the multiplicative model, the interactivity of variations and the inclusion of the product of standard and seasonal components are implied (Mladenović et al., 2012: 205). The multiplicative form of the SARIMA model can be represented as follows:

$$\phi_p(L)\Phi_P(L^S)\Delta^d\Delta D_s X_t = \theta_q(L)\Theta_Q(L^S)e_t$$

where applicable,

$$\begin{aligned}\phi_p(L) &= 1 - \phi_1 L - \phi_2 L^2 - \phi_3 L^3 - \dots - \phi_p L^p \\ \Phi P(L^S) &= 1 - \Phi_1 L^S - \Phi_2 L^{2S} - \Phi_3 L^{3S} \dots - \Phi_P L^{PS} \\ \theta_Q(L^S) &= 1 - \theta_1 L^S - \theta_2 L^{2S} - \theta_3 L^{3S} - \dots - \theta_Q L^{QS} \\ \theta_q(L) &= 1 - \theta_1 L - \theta_2 L^2 - \theta_3 L^3 - \dots - \theta_q L^q \\ \Delta^d \Delta D^S X_t &= (1 - L)^d (1 - L^S)^D X_t\end{aligned}$$

where  $X_t$  is the time series,

$S$  period of the season,

$\Phi_1, \Phi_2, \dots, \Phi_P$  parameters of the seasonal autoregression components of the series of order  $P$ ,

$\phi_1, \phi_2, \dots, \phi_p$  autoregression parameters of the series of order  $p$ ,

$\theta_1, \theta_2, \dots, \theta_q$  parameters of the component of moving average of order  $q$ ,

$\theta_1, \theta_2, \dots, \theta_Q$  parameters of the seasonal component of moving averages of order  $Q$ ,

$d$  the level of integration of the series,

$D$  the level of seasonal integration of the series.

### 3.2 Box-Jenkins modeling strategy

The Box-Jenkins approach consists of three steps:

1. model identification,
2. model parameter estimation, and
3. model adequacy verification.

Model identification involves the determination of several pieces of information. First, through the graphic representation of the series, it is observed whether there is a need to stabilize the variance of the time series.

Further, the degree of integration ( $d$ ) and seasonal integration ( $D$ ) of the series is determined, which can be done in several ways: analysis of the variance score, unit root tests, and analysis of the ordinary autocorrelation function score. Variance score analysis involves observing time series  $X_t$ ,  $(1-L)X_t$ ,  $(1-L^S)X_t$  and  $(1-L)(1-L^S)X_t$ . It is necessary to check which of the series has the minimum variance score and give an adequate conclusion. For  $X_t$  the conclusion is  $D=d=0$ , for  $(1-L)X_t$  the conclusion is  $D=0$  and  $d=1$ , for  $(1-L^S)X_t$  the conclusion is  $D=1$  and  $d=0$ , for  $(1-L)(1-L^S)X_t$  conclusion is  $D=d=1$ . The results obtained by this method should be taken with a grain of salt and used only as a preliminary analysis, as it is unreliable.

Unit root tests include the Dickey-Fuller test, the KPSS test (Kwiatkowski–Phillips–Schmidt–Shin), and seasonal unit root tests. The Dickey-Fuller (DF) test asserts the existence of a unit root in the null hypothesis, while the alternative hypothesis asserts the stationarity of the time series. If the null hypothesis is not rejected, it is necessary to test the existence of two unit roots by testing the stationarity of the first difference (Bachurewicz, 2017). The process needs to be repeated until the null hypothesis is

rejected and stationarity is established. Critical values obtained by certain formulas are used for rejection and hypothesis. In case the DF statistic is greater than the critical one, the null hypothesis is not rejected, otherwise, it is rejected. The DF test can differ depending on whether there is a deterministic component and autocorrelation in the model. In the case of the existence of a linear deterministic trend, the dependence of the time series is evaluated as a function of the constant, the linear trend, and the value of the variable with a delay of the first order. Otherwise, the variable is evaluated depending on the constant and the value of the variable with the delay of the first order. It is necessary to pay attention to the statistical significance of the mean value of the first difference of the series, which is checked by the Stock-Watson test (SW) which tests the null hypothesis of its insignificance. The SW test is intended to help determine the appropriate form of the Dickey-Fuller test (with or without a trend component). The presence of autocorrelation must be observed for at least a 2s delay (Mladenović et al., 2012: 216). If the existence of autocorrelation is determined in the model, it is necessary to add corrective factors that will be able to include dynamic relationships. They are defined as the values of the dependent variable on arrears. In that case, the Augmented Dickey-Fuller statistic (ADF) is in question. When choosing the number of corrective factors, the strategy from "specific to general", "general to specific" and the strategy based on information criteria are used. Information criteria include Schwarz-SC, Akaikeov-AIC, Hana-Kvinov-HQC (Mladenović et al., 2012: 17).

The KPSS test is fundamentally different from the DF test and its null hypothesis speaks of the stationarity of the time series, based on the observation of the variance of the random component of the series ( $\nu t$ ). If by testing it is determined to be greater than zero, the null hypothesis is rejected and the alternative hypothesis about the existence of a unit root is accepted. If the KPSS statistic is greater than its critical value, the null hypothesis is rejected. To test the existence of a seasonal unit root, the following can be used: DHF test (Dickey, Hasza, Fuller), HEGY test (Hylleberg, Engle, Granger, Yoo), CH test (Canova, Hansen) (Rodrigues et al., 2006). If the existence of two unit roots is established, we will observe the case  $D=1$  and  $d=1$ , or  $d=2$  and  $D=0$ , in the case of one unit root it will be  $D=1$  and  $d=0$ , or  $d=1$  and  $D=0$ .

The third way of determining the existence of a unit root involves observing the ordinary and partially autocorrelated function of the initial time series. If a gradual decrease from a value close to unity can be observed, the existence of a unit root is to be suspected. It follows that the time series is dominated by the long-term stochastic component. By eliminating the unit root, we can further determine whether there is also a seasonal unit root. If the values on the correlogram decrease slowly at lags  $s$ ,  $2s$ ,  $3s$ , etc., where the value of the delay  $s$  is close to unity, it can be said that there is also seasonal non-stationarity ( $D=1$  and  $d=1$ ). If this is not the case, the time series has only one unit root ( $d=1$ ). When the coefficients of the autocorrelation function do not gradually decrease from a value close to one, there is probably no common unit root. In that case, it is necessary to pay attention to the values of coefficients according to seasonal delays  $s$ ,  $2s$ ,

3s, etc. If there is a decrease from a value close to unity, it can be concluded that there is seasonal non-stationarity in the series ( $D=1$  and  $d=0$ ). Otherwise, it is a stationary series ( $D=d=0$ ) (Mladenović et al., 2012: 214).

After determining the degree of integration of the series, it is necessary to determine the values of the rows of autoregressive (p), seasonal autoregressive (P), components of moving averages (q), and seasonal components of moving averages (Q). It is necessary to observe the ordinary and partial function of the series which has been transformed according to the number of unit roots. When observing the correlogram, it should be kept in mind that the first q coefficients are determined by the parameters of the AR and MA components, while for the later ones greater than q, the coefficients behave as in the case of the AR model. While in the case of a partial correlogram, the first p coefficients are determined by the effect of the AR and MA components, while the lags greater than p follows a movement similar to MA models (Mladenović et al., 2012: 190). The P component can be said to exist if there is a noticeable decline in the autocorrelation coefficients gradually by seasonal lags, from a value that is not close to unity. The Q component exists if there is a significant autocorrelation coefficient only on the seasonal lag s. When statistical significance is observed on seasonal arrears and arrears around it, it is a multiplicative model.

In the model specification, it will rarely happen that D is greater than one, especially for monthly series, and the rows P and Q will also not so often need to be greater than one. Especially if the database is not large enough to justify having P and Q greater than one (Box et al., 1994: 378).

The second step of the Box-Jenkins strategy is to estimate the parameters of the ARIMA model. The Nonlinear Least Squares (NLS) method is used, while the Ordinary Least Squares (OLS) model is available only for the AR model. The last stage is checking the adequacy of the model, which includes checking the agreement of the model and checking the optimality of the selection of model components.

If the unexplained part of the movement of the time series approximated by the SARIMA model is a completely random component, the model agrees with the data. The residuals should be normally distributed and not autocorrelated, to meet the agreement condition. Normality testing is performed using the Jarque-Bera test-JB, while autocorrelation is checked using the Box-Pierce-BP statistic, Box-Ljung-Q Statistic, and Box-Leung-Q2. The optimality of the choice of model components represents the choice of the simplest ARIMA model and takes into account economy, which implies that the minimum required parameters for evaluation will be included. Information criteria can be used to check the relationship between precision and economy.

Additional methods used to check model adequacy are a subsequent extension of the ARIMA model to check its stability, a comparison of different models based on prediction

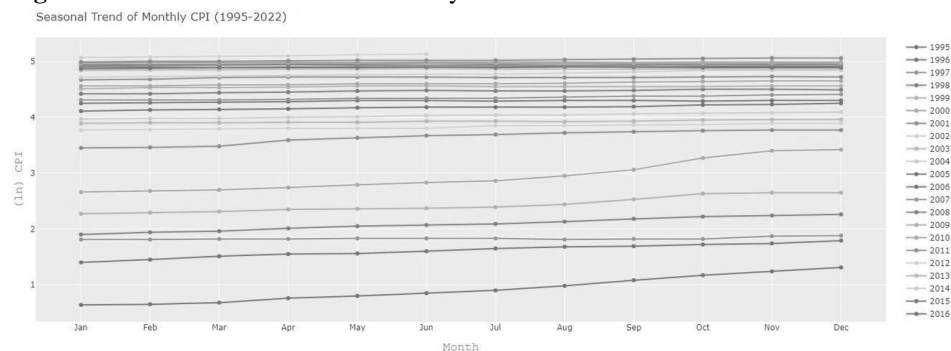
accuracy, and a comparison of model forecast accuracy. When comparing models, the one with the smaller forecast error variance will be selected. The accuracy of the forecast is observed by comparing the root mean square error of the forecast, the mean absolute error of the forecast, and the mean absolute percentage error of the forecast. A model with a lower value of the mentioned parameters is considered more accurate for the given time series (Mladenović et al., 2012: 195).

#### 4 Results and observations

The chapter is devoted to the practical application of the SARIMA model. Model creation, as well as obtaining all attached images, will be done in the Python programming language. This research is based on the dataset (open data, downloaded from: <https://data.imf.org/regular.aspx?key=61545849>) that represents the monthly Consumer Price Index (hereinafter CPI), where the base year is 2010 (2010= 100). The period observed is from 1995 to the last available data in 2022 (June). The data was transformed with the  $\ln$  function before the analysis itself (which is a standard procedure for this type of data).

Firstly, it is necessary to see if there is a characteristic seasonality for the time series. The graph (Figure 1) shows the individual monthly movement of the CPI yearly, for the period 1995-2022.

**Figure 1:** Seasonal trend of the monthly CPI



Source: Python programming language (project-ml.ipynb in annex).

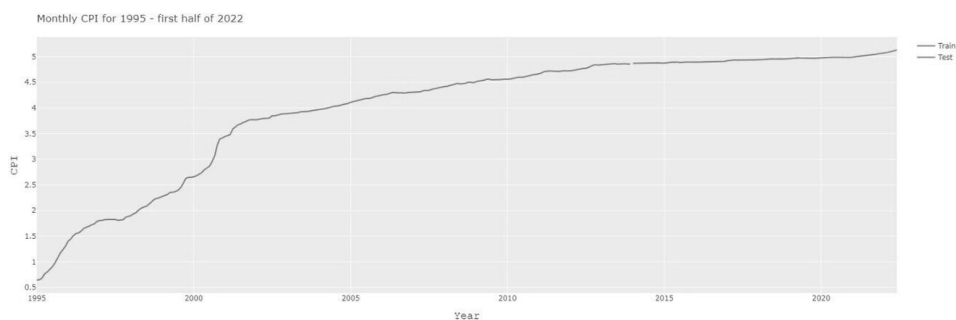
It is noticeable that there is no strong pronounced seasonality, however, there is a possibility that it is present. In further analysis, it will be determined whether the ARIMA or SARIMA model should be used.

From now on the data will be divided into 2 types: Train and Test

The model will be "trained" on past data using the Training data set, and then predict CPI, which we will subsequently compare with the actual Test data set. The usual split ratio of training and test data is 70%:30%. In our case, the data will be divided as follows: the period 1995-2013 is included in the training data, and the period 2014-2022 is included in the test data. Graph 2 shows the movement of the entire series. Training data are marked in blue and the test data in red.

Graph 2 –

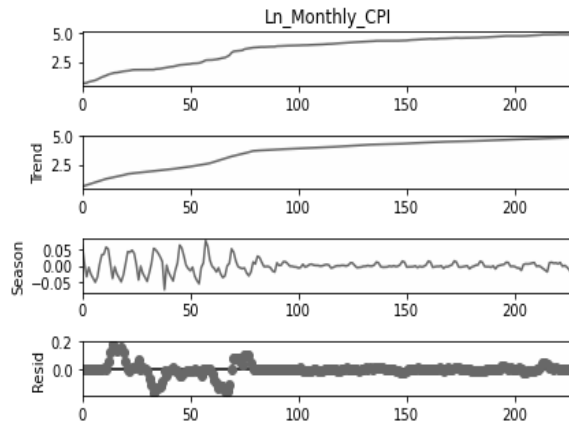
**Figure 2:** Display of test and train data (1995-2022)



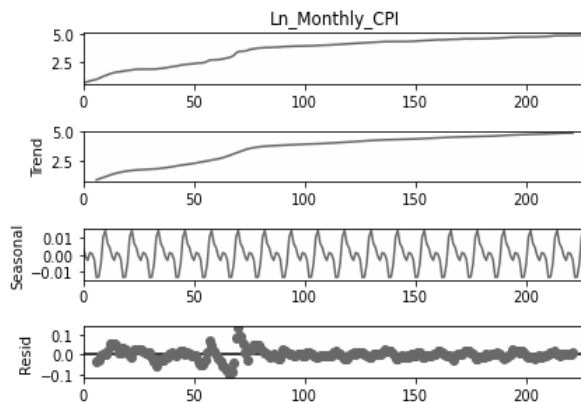
Source: Python programming language.

What we can observe is that the CPI series in Serbia (graph 2) has an increasing trend at the beginning of the period (which is confirmed with the Mann-Kendall trend test) and seems to be stochastic, followed by stagnation with a slight growth tendency. Eliminating the stochastic trend is achieved by using the first difference operator.

Graph 3 shows the components of the series obtained by STL decomposition, which is often used in economic analyses. Graph 4 presents classic decomposition. A noticeable difference between these two methods can be seen in the seasonal component. STL allows the season to change over time, while in the classic season this is not the case. Additionally, there is a difference in the residuals. This is the result of the robustness of the STL method towards outliers (it will be more noticeable in the continuation of the study), which eliminates their influence on the seasonal and trend components, but leaves an impact on the remainder component (Hyndman et al., 2018).

**Figure 3:** STL decomposition on Train data

Source: Python programming language.

**Figure 4:** Classical decomposition on Train data

Source: Python programming language.

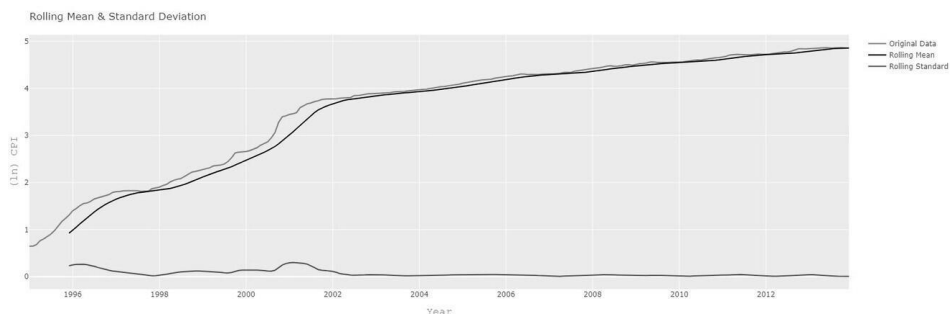
Apart from the above-mentioned differences, through both methods we can see that the series 'Observed', 'Trend', and 'Residual' are fluctuating randomly and that there is no specific systematic pattern that they follow. The "Seasonal" series, to a lesser or greater extent, shows that there are probably cyclical movements that indicate the existence of seasonality in the data set. For this reason, it is necessary to remove this seasonality to obtain the most optimal final model.



Stationarity can be checked in several ways:

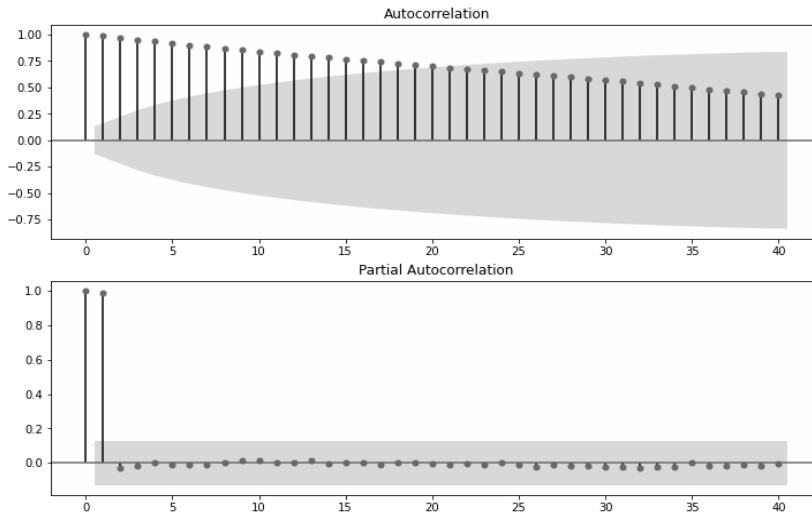
- 1) Plotting data along with Rolling Average and Rolling Standard Deviation (time series is stationary if it remains steady with time)
- 2) Augmented Dickey-Fuller Test (time series is considered stationary if the p-value is low ( $<0.05$ ) and the Test Statistic is lower than the critical values at a 5% level of significance)
- 3) By observing the correlogram of the series (if the values fall gradually from a value close to unity, there is a high probability that there is a unit root in the series)
- 4) KPSS test (time series is considered stationary if the p-value is high ( $>0.05$ ) and the Test Statistic is lower than the critical values at a 5% level of significance)
- 5) Analysis of standard deviation (looking for the smallest standard deviation of the following series  $X_t$ ,  $(1-L)X_t$ ,  $(1-L^2)X_t$ ,  $(1-L^S)X_t$ ,  $(1-L)(1-L^S)X_t$ ; the most imprecise method and is used only as a means of preliminary analysis).

**Figure 5:** Rolling Mean and Standard Deviation for Train data set



Source: Python programming language.

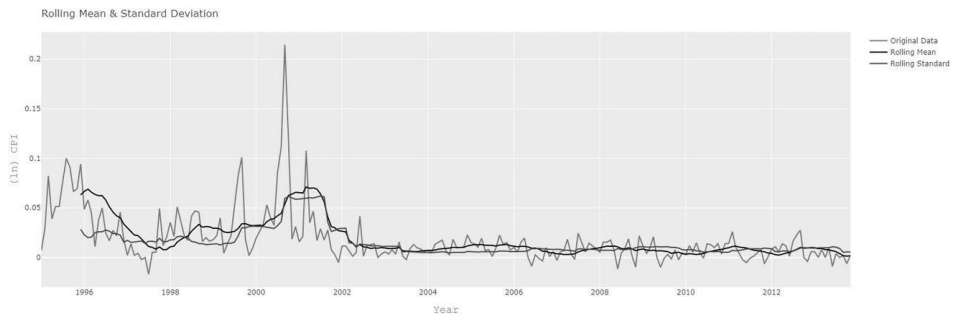
Observing graph 5, we can see that the rolling mean largely deviates from the steady movement, which is the first indicator that differentiation of the series is necessary. The KPSS test resulted in the rejection of the null hypothesis and the conclusion that the  $X_t$  series has one unit root. Analyzing the standard deviations of the series, it is observed that the smallest values, in order, have the 2nd-order difference series, the 1st-order difference series, and the ordinary and seasonally differentiated series. This means that the series potentially has one, two, or one common and one seasonal unit root. The ADF test leads to failure to reject the null hypothesis, which asserts that there is at least one unit root in the series. The last check before concluding that the series is non-stationary is to observe the correlogram of the series. Graph 6 shows a characteristic gradual decline of the autocorrelation function, which is statistically significant (outside of the blue zone), and indicates the existence of a unit root.

**Figure 6:** Correlogram for Train data set

Source: Python programming language.

After several analyses and tests, differentiation of the first order is applied, in an attempt to obtain a stationary series. Also, with this transformation, the gained series represents the inflation rate in Serbia for the same period (graph 7). It is noticeable that there has been an improvement in the appearance of the rolling mean because it is now steadier than in the original series, but there could still be room for improvement. There are a lot of outliers (one-time structural breaks), at the beginning of the observed period, which we can say that they have a hyperinflationary character. This can affect the further course of testing the series and forming the model. Therefore, further modeling should be approached with caution.

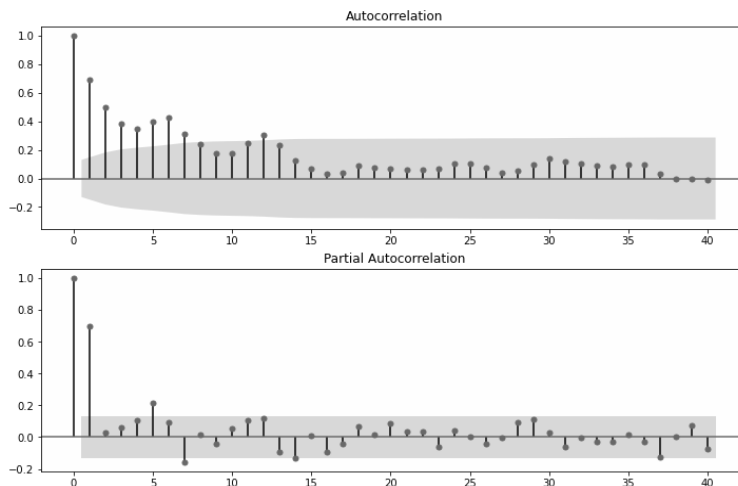
**Figure 7:** Rolling Mean and Standard Deviation for First difference of Train dataset



Source: Python programming language.

By examining the ADF test, it can be concluded that the null hypothesis should be rejected, that it is a stationary series. While the KPSS test claims the opposite, that this series also has a unit root. It should be remembered that the presence of one-time structural breaks affects both the tests and the appearance of the correlogram. It has the possibility of making the ADF test unreliable, that is, it is biased in the direction of rejecting the hypothesis of the presence of a unit root. It can also lead to an underestimation of the order of the AR and MA components (Mladenović et al., 2012: 224).

**Figure 8:** Correlogram for First difference of Train dataset

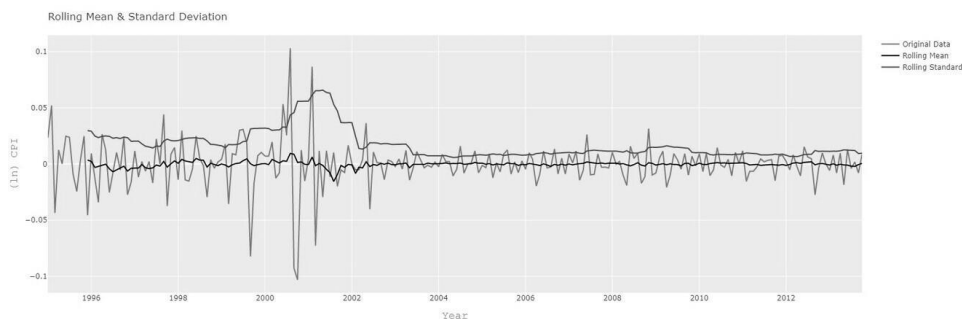


Source: Python programming language.

Looking at graph 8, where the correlogram is shown, it can be noted that there are statistically significant coefficients on seasonal delays, which indicates that there is probably a seasonal component in the series. Based on the previously mentioned arguments, we can choose whether or not to apply another differentiation to the series, or create a model based on the first differentiation of the series.

In this stage of research, there will always be a degree of subjectivity in selecting which differences to apply. A researcher has the option of choosing a different path, based on his experience (Hyndman et al., 2018).

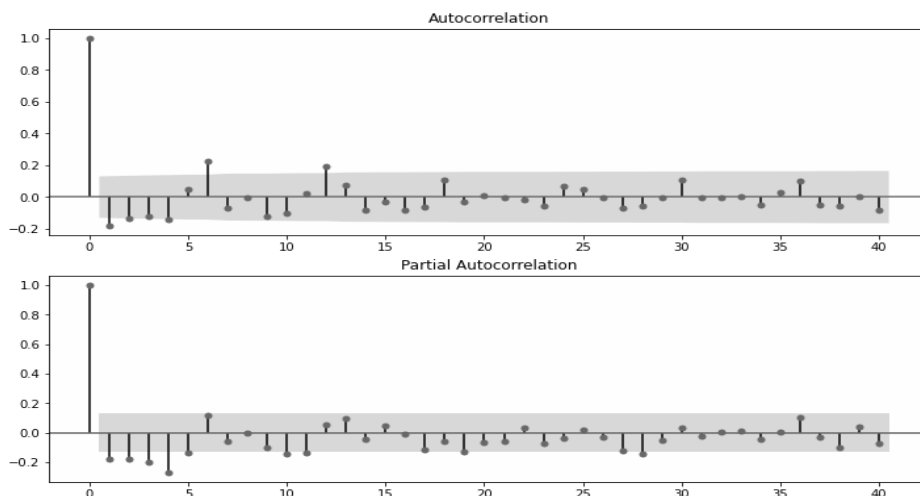
**Figure 9:** Rolling Mean and Standard Deviation for Second difference of Train dataset



Source: Python programming language.

After applying the second-order difference, there was an improvement in the rolling mean, which at this point stably and weakly oscillates around 0. The KPSS and the ADF test bring us to the same conclusion, that it is now a stationary series. The correlogram on graph 10 does not show the characteristics of a non-stationary series. Therefore, a proper foundation is built for further model-making.

**Figure 10:** Correlogram for Second difference of Train dataset



Source: Python programming language.

### Model construction

To determine the elements of the SARIMA model, it is necessary to determine the values of the following arguments:  $p$ ,  $d$ ,  $q$ ,  $P$ ,  $D$ ,  $Q$ ,  $s$ . The observation of the autocorrelation function, as well as the partial autocorrelation function, shown in the previous graphs, can help with this. During the modeling, a dummy variable was included, which takes the value 1 for the periods of one-time structural breaks that were observed on the graph of the first difference of the series, and the value 0 for the other periods.

In the following, two models will be presented, which may be adequate for predicting the monthly CPI in Serbia.

The first model:

SARIMA (1, 2, 1)x(1, 0, 0)<sub>12</sub>

**Table 1:** Estimation of the second difference equation of the monthly CPI in Serbia

Variable	Estimate	z score
V	-0.0118	-5.269
AR(1)	0.5577	9.588
MA(1)	-0.9355	-30.776
AR(12)	0.1613	2.596
Q=0.01 (0.93) JB=1431.4 (0.00) H=0.09 (0.00) AIC=-1101.648 alpha 3=1.16 alpha4=15.49		

Source: Python programming language.

Root mean squared error of the predicted CPI in the Test data set = 0.43

The standard deviation of the CPI in the Test data set = 0.0607

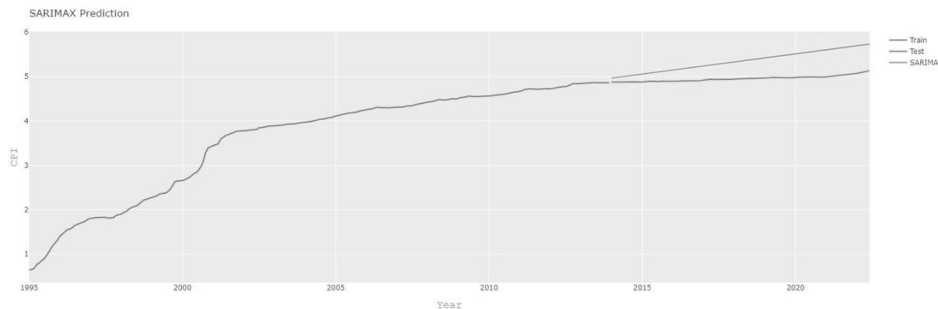
Error in model's prediction = 0.3693%

Dummy variable V takes values:

V=

$\{1, t = 1999M09, 1, t = 2000M08, 1, t = 2000M09, 1, t = 2000M11, 1, t = 2001M02, 1, t = 2001M03, 0, \text{otherwise}\}$

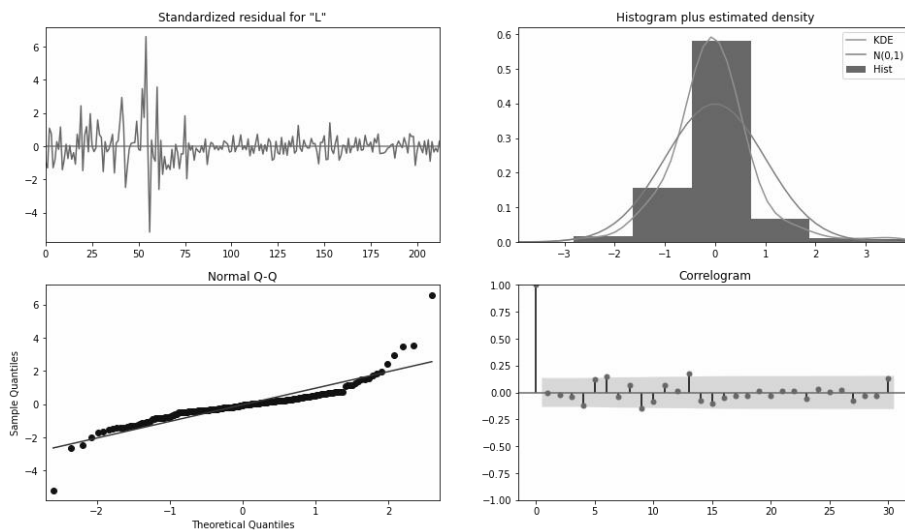
Graph 11 shows the prediction that the model makes on the test data. It can be noted that it is an overestimated movement of the series which has an upward trend, while the real test data has almost no rising trend and is stagnating.

**Figure 11:** Prediction of model for Test data (SARIMA (1, 2, 1)x(1, 0, 0)12)

Source: Python programming language.

A model that was obtained violates certain assumptions that it should fulfill for the sake of greater credibility. Box-Ljung's statistic Q is not statistically significant, which means that the null hypothesis claiming that there is an autocorrelation between the residuals is rejected. Thus, the assumption that there is no autocorrelation between the residuals is satisfied. In graph 12 (lower right sub-graph), the correlogram shows the autocorrelation of the residuals, where the area marked in blue is the zone of statistically significant coefficients.

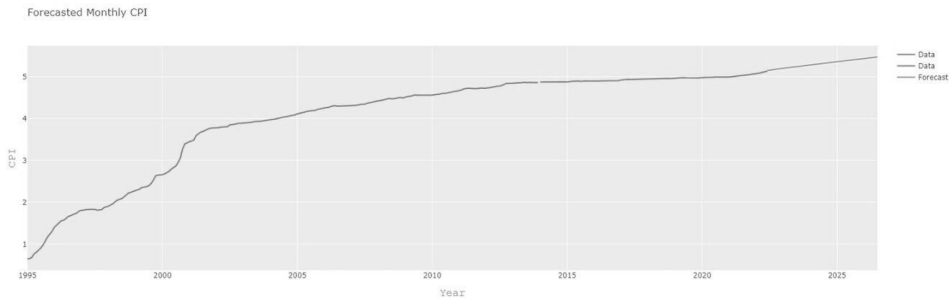
**Figure 12:** Plots for residuals (SARIMA (1, 2, 1)x(1, 0, 0)<sub>12</sub>)



Source: Python programming language.

The JB statistic in the model shows that the normality of the residuals does not apply because the null hypothesis is rejected. The same can be noticed in graph 12, on the lower left sub-graph. There is a "Normal Q-Q plot" which shows whether the residuals are normally distributed. The blue dots should not deviate much from the red line if there is normality. In the case of this model, there are "heavy tails", which means it is more likely to see extreme values than to be expected if the data was truly normally distributed. Additionally, on "Histogram plus estimated density" you can see KDE (kernel density estimation), which shows that the distribution has heavy tails (which are caused by the extreme values in the series that we have already stated) and therefore deviates from normal.

Heteroskedasticity is also present in the model. It occurs more frequently in datasets with a broad spread between the highest and lowest reported values. In a time-series model, heteroscedasticity can happen when the dependent variable drastically changes from the start to the end of the series.

**Figure 13:** Forecasted monthly CPI (SARIMA (1, 2, 1)x(1, 0, 0)<sub>12</sub>)

Source: Python programming language.

Graph 13 shows the forecast for the future produced by the SARIMA (1, 2, 1)x(1, 0, 0)<sub>12</sub> model, and it predicts an upward trend of the series.

Second model:

SARIMA (1, 1, 0)x(1, 0, 0)<sub>12</sub>

**Table 2:** Estimation of the first difference equation of the monthly CPI in Serbia

Variable	Estimate	z score
V	-0.0105	-5.026
AR(1)	0.6934	24.638
AR(12)	0.2412	3.720
Q=2.16 (0.14) JB=1363.24 (0.00) H=0.09 (0.00) AIC=-1103.007 alpha3=1.44 alpha4=15.02		

Source: Python programming language.

Root mean squared error of the predicted CPI in the Test data set = 0.4257

The standard deviation of the CPI in the Test data set = 0.0607

Error in model's prediction = 0.365%

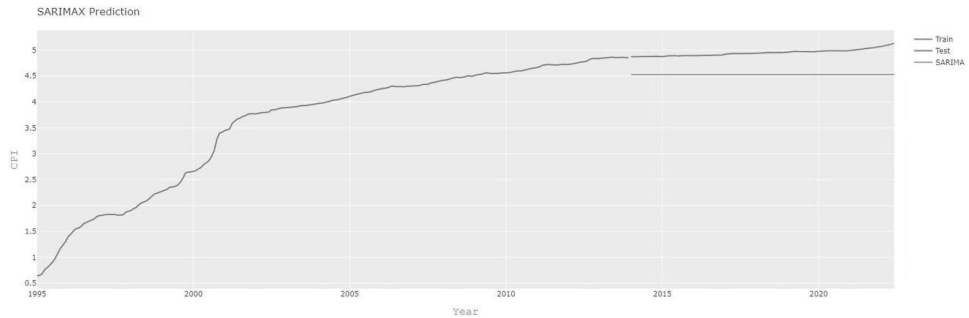
Dummy variable V takes the same values as in the first model.

It is noticed that both models have very similar parameters and statistics, with minimal differences in their values, so the conclusions and shortcomings will be the same as in the first model.

Graph 14 shows the predicted values for the test period, and they are underestimated compared to the original series.

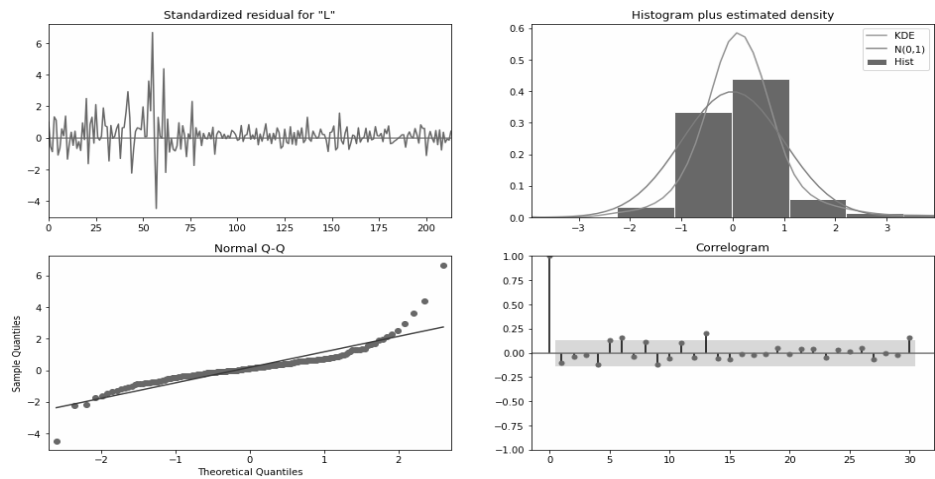


**Figure 14:** Prediction of model for Test data (SARIMA (1, 1, 0)x(1, 0, 0)<sub>12</sub>)



Source: Python programming language.

**Figure 15:** Plots for residuals (SARIMA (1, 1, 0)x(1, 0, 0)<sub>12</sub>)



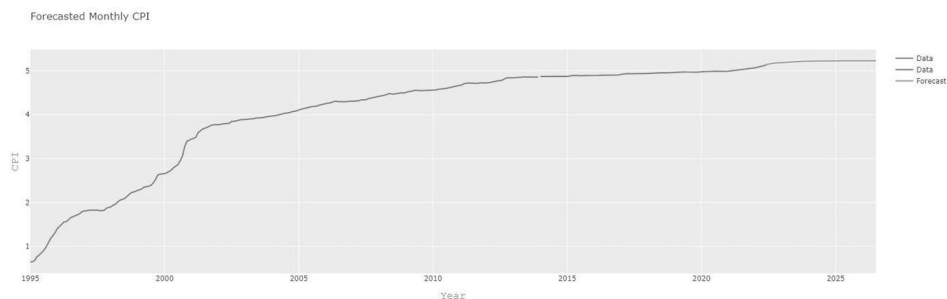
Source: Python programming language.

The main differences between models are in the graphs of prediction on test data and forecast for the future (graphs 11, 13, 14, 16). The second model may seem more appropriate for use in the forecast of the future (graph 16) because it does not have a weak upward trend like the first model. Therefore it may be concluded that only one differencing of the series would be enough for proper model building.

However, there are many obstacles due to which we cannot claim that this model predicts the movement of the series to the best extent. Since many of the assumptions that

condition the model are violated, the results should be taken with precaution and consider this model a robust one.

**Figure 16:** Forecasted monthly CPI (SARIMA  $(1, 1, 0) \times (1, 0, 0)_{12}$ )



Source: Python programming language.

## 5 Discussion and conclusion

In this paper, an appropriate SARIMA model was used to model the CPI of Serbia. The model has not been proven to be the best fitting for forecasting the inflation rate in Serbia according to assumptions of the model that are violated.

The methodology of the SARIMA model as well as its background has been investigated. We have implemented the said model in the practical portion of the paper and noted the difference in the conclusions concerning CPI that were to be drawn from the modeling phases.

Through analyzing and modeling the series, we encountered several obstacles. The original series tend to be of greater difficulty to interpret, and often the tendency of the data is not seen. Seasonality was revealed in the series, which was treated in the right way. Also, it was established that it is a non-stationary series that needs to be transformed. The biggest problem that affects the series, and the making of the model itself, is the existence of a large number of structural breaks. In this sense, the results of the study are very limited because they need to be carefully interpreted and modified. The work can be improved by more detailed analysis and treatment of extreme values that are problematic. Further research can be conducted in the direction of applying additional types of machine learning models, such as neural networks, which go beyond the scope of the study. Even though SARIMA does not account for the stresses in market data, economic and political conditions, or correlations of all risk factors to forecast inflation rates, the procedure illustrated above can be helpful for roughly predicting inflation movements under normal circumstances where past behavior dictates present values.

As for the choice of the appropriate model, it will depend on the needs of the analysis and should be left to the researcher. In the future, the field of time series modeling is certain to progress. Software programs that help faster and more accurate analyses are in rapid development and will help eliminate a large dose of subjectivism, as well as improve the precision of the drawn conclusions.

## References:

- Ahmar, A. S., Daengs, A., Listyorini, T., Sugianto, C. A., Yuniningsih, Y., Rahim, R. & Kurniasih, N. (2018) Implementation of the ARIMA(p,d,q) method to forecasting CPI Data using forecast package in R Software, *IOP Conf. Series: Journal of Physics: Conf. Series*, 1028 (2018) 012189, <https://doi.org/10.1088/1742-6596/1028/1/012189>.
- Bachurewicz, G. (2017) *The Post Keynesian Endogenous Money Supply Hypothesis: Evidence from Poland*, <https://doi.org/10.13140/RG.2.2.26920.21761>.
- Bobeica, E. & Hartwig, B. (2021) The COVID-19 shock and challenges for time series models, *ECB Working Paper Series*, No. 2558, available at: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2558~22b223a7c6.en.pdf> (October 1, 2022).
- Bryan, M. F. & Cecchetti, S. G. (1993) *The Consumer Price Index as a Measure of Inflation* (Cambridge: National Bureau of Economic Research).
- Chatfield, C. (1995) *The Analysis of Time Series - an Introduction*, 5<sup>th</sup> ed. (New York: Reader in Statistics, The University of Bath).
- Chatfield, C. (2013) *The Analysis of Time Series: Theory and Practice* (New York: Springer-Science, Business Media, B. V.).
- Cleveland, R., B., Cleveland, W., S., McRae, J., E. & Terpenning, I. (1990) STL: A Seasonal Trend Decomposition Procedure Based on Loess, *Journal of Official Statistics*, 6(1), pp. 3-73.
- Davidescu, A. A., Popovici, O.C. & Strat, V.A. (2021) An empirical analysis using panel data gravity models and scenario forecast simulations for the Romanian exports in the context of COVID-19, *Economic research*, 35(1), pp. 480-510, <https://doi.org/10.1080/1331677X.2021.1907205>.
- Eurostat (2015) *ESS Guidelines on Seasonal Adjustment* (Luxembourg: Publications office of the European Union).
- Eurostat (2020) *Guidance on time series treatment in the context of the Covid-19 crisis, Directorate b unit b1 — methodology; Innovation in official statistics*, available at: [https://ec.europa.eu/eurostat/documents/10186/10693286/Time\\_series\\_treatment\\_guidance.pdf](https://ec.europa.eu/eurostat/documents/10186/10693286/Time_series_treatment_guidance.pdf) (October 3, 2022).
- Ghazo, A. (2021) Applying the ARIMA Model to the Process of Forecasting GDP and CPI in the Jordanian Economy, *International Journal of Financial Research*, Special Issue, 12(3), <https://doi.org/10.5430/ijfr.v12n3p70>.
- Gikungu, S. W., Waititu, A. G. & Kihoro, J. M. (2015) Forecasting Inflation Rate in Kenya Using SARIMA Model, *American Journal of Theoretical and Applied Statistics*, 4(1), pp. 15-18. <https://doi.org/10.11648/j.ajtas.20150401.13>.
- Hadwan M., Al-Maqaleh B. M., Al-Badani F. N., Khan R. U. & Al-Hagery M. A. (2022) A Hybrid Neural Network and Box-Jenkins Models for Time Series Forecasting, *Computers, Materials and Continua*, 70(3), pp. 4829-4845, <https://doi.org/10.32604/cmc.2022.017824>.
- Hungarian Central Statistical Office (2007) *Seasonal adjustment methods and practices* (Budapest), available at: <https://ec.europa.eu/eurostat/documents/64157/4374310/29-SEASONAL->

- ADJUSTMENT-METHODS-PRACTICES-2007.pdf/6628a64e-2160-4e6f-a34a-499d0f5cdcf (September 25, 2022).
- Hyndman, R.J. & Athanasopoulos, G. (2018) *Forecasting: principles and practice*, 2nd edition (Melbourne, Australia: OTexts).
- International Monetary Fund-Statistics Department (2017) *Quarterly national accounts manual*, available at: <https://www.imf.org/external/pubs/ft/qna/pdf/2017/QNAManual2017text.pdf> (October 4, 2022).
- Kirchgässner, G. & Wolters, J. (2012) *Introduction to Modern Time Series Analysis* (Heidelberg: Springer Berlin).
- Mladenović, Z. & Nojković, A. (2012) *Primenjena analiza vremenskih serija* (Beograd: Ekonomski fakultet).
- Mohamed, J. (2020) Time series modeling and forecasting of Somaliland consumer price index: a comparison of ARIMA and regression with ARIMA errors, *American Journal of Theoretical and Applied Statistics*, 9(4), pp. 143-53.
- Rodrigues, P. M. M. & Taylor, A. M. R. (2006) Efficient Tests of the Seasonal Unit Root Hypothesis, *Conference on seasonality, seasonal adjustment and their implications for short-term analysis and forecasting*, *Journal of Econometrics*, Elsevier, 141(2), pp. 548-573.
- Shinkarenko, V., Hostryk, A., Shynkarenko, L. & Dolinskyi, L. (2021) A forecasting the consumer price index using time series model, *SHS Web Conf.*, vol. 107, 2021 9th International Conference on Monitoring, Modeling & Management of Emergent Economy (M3E2 2021), available at: [https://www.shs-conferences.org/articles/shsconf/pdf/2021/18/shsconf\\_m3e22021\\_10002.pdf](https://www.shs-conferences.org/articles/shsconf/pdf/2021/18/shsconf_m3e22021_10002.pdf) (September 26, 2022).
- Springer Texts in Statistics (2008) Introduction, In: Cryer, D. J. & Chan, K. (eds.) *Time Series Analysis* (New York, NY: Springer), pp. 1-10, [https://doi.org/10.1007/978-0-387-75959-3\\_1](https://doi.org/10.1007/978-0-387-75959-3_1).
- Shumway, H.R. (2000) *Time series analysis and its applications* (New York: Springer).
- United Nations Conference on Trade and Development (2021) *Key Statistics and trends in International Trade 2020* (New York: UN Publications).
- Wei, W. W. S. (2013) Time Series Analysis, In: Little, T. D. (ed.) *The Oxford Handbook of Quantitative Methods in Psychology*, vol. 2, *Statistical Analysis* (New York: Oxford Library of Psychology), pp. 458-486, <https://doi.org/10.1093/oxfordhb/9780199934898.013.0022>.
- Wynne, M. A. & Sigalla, F. D. (1994) The consumer price index, *Federal Reserve Bank of Dallas Economic Review*, 2, pp. 1-22.
- Zellner, A. (1978) *Seasonal Analysis of Economic Time Series* (Washington, D.C.: NBER).

#### Internet sources:

- International Monetary Fund, open data portal, available at: <https://www.imf.org/en/Data> (September 1, 2022).
- Swati, S. & Shruti, G. (2020) *Inflation forecasting*, available at: <https://medium.com/inflation-forecasting-using-sarimax-and-nkpc/plotting-monthly-inflation-over-the-selected-time-period-to-check-if-the-time-series-has-any-35e3b1fac761> (September 1, 2022).
- Kumari, K. (2022) *Time Series Forecasting Using Python*, available at: <https://www.analyticsvidhya.com/blog/2022/06/time-series-forecasting-using-python/> (September 1, 2022).
- Medium portal, available at: <https://medium.com/@designbynattapong/time-series-forecasting-with-python-part-3-c5f26922bf1f> (September 10, 2022).
- Manani, K. (2022) *Multi-Seasonal Time Series Decomposition Using MSTL in Python*, available at: <https://towardsdatascience.com/multi-seasonal-time-series-decomposition-using-mstl-in-python-136630e67530> (September 2, 2022).

- Skipper, S. & Perktold, J. (2010) *Statsmodels: Econometrics and statistical modeling with Python, Proceedings of the 9th Python in Science Conference*, available at: <https://www.statsmodels.org/dev/examples/notebooks/generated/autoregressions.html#Forecasting> (September 3, 2022).
- Statsmodels*, available at: [https://www.statsmodels.org/stable/examples/notebooks/generated/statespace\\_sarimax\\_stata.html](https://www.statsmodels.org/stable/examples/notebooks/generated/statespace_sarimax_stata.html) (September 3, 2022).
- Prabhakaran, S. (2019) *Time Series Analysis in Python - A Comprehensive Guide with Examples*, available at: <https://www.machinelearningplus.com/time-series/time-series-analysis-python/> (September 1, 2022).
- Medium portal*, available at: <https://towardsdatascience.com/time-series-in-python-part-2-dealing-with-seasonal-data-397a65b7051> (September 4, 2022).
- Alvarez, R. (2019), available at: [https://robert-alvarez.github.io/2018-06-04-diagnostic\\_plots/](https://robert-alvarez.github.io/2018-06-04-diagnostic_plots/) (September 5, 2022).
- Frost, J. (2017) *Heteroscedacity in Regression Analysis*, available at: <https://statisticsbyjim.com/regression/heteroscedasticity-regression/> (September 6, 2022).



## Tail Risk Transmission in the Foreign Exchange Market: A Quantile LASSO Regression Approach

TAN T. M. LE, FRANK MARTIN & DUC KHUONG NGUYEN

**Abstract** We use quantile LASSO regression to investigate tail risk spillovers among the most globally traded currencies, conditional on a set of economic and financial variables. Over the study period, the tail risk of each currency was mainly driven by extreme risk spillovers from others, which became strongest in the bearish market. From the network perspective, currencies with geographical proximity tend to flock together and stronger currencies tend to be the main spreaders of extreme risk. The resulting tail-risk networks also confirm previous findings that network connectedness is asymmetric in between the extremely bullish and bearish market conditions.

**Keywords:** • tail risk • exchange rates • spillovers • quantile LASSO

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## 1 Introduction

Fluctuations of currency values play a crucial role in managing and determining the performance of cross-border activities, especially international trade and investment. In an increasingly inter-connected world, changes in value of one currency normally result in or from changes of others or both. This inter-dependence, from time to time, sparks contagion risk which can cause both micro and macro disorders. Therefore, understanding the mechanism of risk transmission among exchange rates is very important to gain the insights of many issues of international economics and finance.

Studies on risk spillovers between foreign exchange markets date back to Engle et al. (1990) who investigated the question whether intra-day volatility of exchange rate in one market is affected by volatility from other markets (meteor showers hypothesis) or only affected by country specific news (heat waves hypothesis). They found evidence to support the meteor hypothesis that volatility spillovers are popular. In a subsequent research, the study carried out by McMillan & Speight (2010) confirms the existence volatility spillover and shows the dominance of USD over CHF and JPY vis-a-vis EUR.

Starting from McMillan & Speight, studies on risk spillovers among currencies often utilize network model analyzing market connectedness. Bubák et al. (2011) used the dynamic version of the Diebold–Yilmaz (DY) spillover index (Diebold & Yilmaz, 2009) among EUR/USD and Central European currencies and reported significant increase in the degree of volatility spillovers during periods of market uncertainty, especially the subprime mortgage crisis. Diebold & Yilmaz (2015) analyzing the exchange rates of nine major currencies against the U.S. dollar from January 1999 to June 2013, also provided evidence that magnitude of volatility spillover index increased in both Global Financial Crisis (GFC) and Sovereign Debt crisis (SDC). Greenwood-Nimmo et al. (2016) generalized the framework of Diebold & Yilmaz (2012) to include spillover between blocs and applied on nine most liquid currencies vis-a-vis the USD. They found similar result as Bubák et al. (2011) and Diebold & Yilmaz (2015) with respect to the behavior of spillover index during chaotic times.

We can see from the literature that risk transmission among currencies is a popular phenomenon and that spillover is time-varying, often increase substantially in distressed markets. Nevertheless, most authors focus on the spillover of returns and variance under GARCH-type and Vector Auto Regression models while spillover of extreme risk is largely ignored. The question of whether a currency exhibits extreme loss given others are in distress is still not adequately answered. To our knowledge, there are only two researches that address this issue. Hong et al. (2009) are perhaps the first to measure tail risk spillovers in the currency market under their own theoretical framework for Granger causality in tail distribution at a particular level. In an application on intra-day exchange rates from July to September 2000, they found that large depreciation of Euro/Dollar could significantly predict large price falls of Yen/Dollar. Shahzad et al. (2018) employed



the cross-quantilogram technique to identify main risk receivers and transmitters among 25 currencies from January 2000 to April 2016, focusing on the relationship between currencies of developed economies with those of emerging and Middle East and Africa. Their findings indicate that both strength and density of connections among currencies are time-dependent and vary along with different market scenarios including bearish, normal and bullish. Furthermore, currencies from developed economies are main tail risk spreaders fortified by the underlying economic links with emerging economies.

One shared limitation of these two studies is that the directional spillover between two currencies is calculated without considering the effects from the rest as well as other fundamental factors. Clearly the interactions between two variables do not occur in vacuum. The presence of these variables may alter the directions, enhance or drive down the magnitude of effects. Furthermore, like most of others, these authors focus on the lead-lag but not contemporaneous spillovers. The study in this chapter fills this literature gap by employing Least Absolute Shrinkage and Selection Operator (LASSO) quantile regression in our analysis. Thanks to its ability to shrink less relevant variables, the Lasso regression helps us to overcome the multicollinearity problem when dealing with high dimensional data (Li & Zhu, 2008). Specifically, we are able to estimate the spillovers between two currencies conditional on other currencies and a group of financial and macroeconomic variables such as interest rate difference, difference in inflation rate, state of current account and money supply growth.

Apart from that, the quantile regression technique helps us to investigate the risk spillovers in both lower and upper tail of return distributions. By this, we can explore the directional connectedness in good times or bad times of the foreign exchange markets and address questions such as: Is the spillover magnitude higher in bad times than in good and normal times? After taking account of network effects, which currency is the main tail risk transmitters (receivers) in bullish (bearish) market? Are the main transmitters of the two market conditions the same? Information on these are very useful for investors in diversifying and hedging their portfolios and regulators in monitoring currency markets (Shahzad et al., 2018)

In addition, we can rely on this framework to build a directed and weighted tail network of currencies, which is arguably more comprehensive as compared to Wang & Xie (2016) and Shahzad et al. (2018). Wang & Xie (2016) adopt the symmetrized Joe-Clayton copula to establish and examine non-directional upper- and lower-tail networks of 52 currencies. Shahzad et al. (2018) provides a directed network but on a sample of currencies which are less representative than ours. It is noteworthy that Lasso technique has been employed in establishing networks in finance like financial institutions network (Härdle et al., 2016; Hautsch et al., 2015), global banking network (Demirer et al., 2018) or credit default swaps network (Bostanci & Yilmaz, 2020). However, so far, we can find no such application in currency market. Through network analysis, we can then identify the most influential currency in risk transmission after taking into account network effects. By this

we can extend Shahzad et al. (2018) who used only direct connectedness to rank currencies in terms of risk transmission.

The rest of the study is organized as follows. Section 2 presents our empirical framework. Section 3 describes relevant data while Section 4 reports the empirical results and discussion. We conclude our study in Section 5 with a short discussion and suggestions for future research.

## 2 Empirical framework

### 2.1 Lasso quantile regression model

Since invented by Tibshirani (1996) LASSO regression has been widely used and expanded recently. Suppose we want to estimate a linear relationship between  $Y$  and  $X$  where  $Y = (Y_1, Y_2, \dots, Y_n)^T$  is a vector of response and  $X$  is an  $(n \times p)$  matrix of predictors. The objective function in the spirit of Tibshirani (1996) is then:

$$\min_{\beta, \beta_0} \left\{ \sum_{i=1}^n (Y_i - \beta_0 - X_i^T \beta)^2 + \lambda \sum_{j=1}^p |\beta_j| \right\} \quad (1)$$

with the turning or penalization parameter  $\lambda \geq 0$ . According to Tibshirani (1996) and Li and Zhu (2008) L1-penalization solves this type of ordinary least square problem by shrinking some of the coefficients to exactly zero. This helps to deal effectively with the multicollinearity problem in case of high-dimensional data and increases the interpretability of the fitted model. Combining LASSO with quantile regression introduced by (Koenker & Bassett, 1978), a more comprehensive approach than classical regression with respect to statistical analysis of response models, Li and Zhu (2008) proposed the L1-norm quantile regression by considering the following regularized model fitting:

$$\min_{\beta, \beta_0} \left\{ \sum_{i=1}^n \rho_\tau(Y_i - \beta_0 - X_i^T \beta) + \lambda \sum_{j=1}^p |\beta_j| \right\} \quad (2)$$

where  $\tau \in (0, 1)$  and  $\rho_\tau$  is the check function (Koenker & Bassett, 1978)

$$\rho_\tau(Y - f(X)) = \begin{cases} \tau \cdot (Y - f(X)) & \text{if } Y - f(X) > 0 \\ -(1 - \tau) \cdot (Y - f(X)) & \text{otherwise,} \end{cases}$$

The choice of regularization parameter  $\lambda$  in equation (1) plays a very crucial role. Li & Zhu (2008) mention two options to select  $\lambda$ : Schwarz information criterion (SIC) (Schwarz, 1978) and the Generalized Approximate Cross-Validation criterion (GACV) (Yuan, 2006).

$$SIC(\lambda) = \ln \left( \frac{1}{n} \sum_{i=1}^n \rho_{\tau}(Y_i - f(X_i)) \right) + \frac{\ln(n)}{2n} df, \quad (4)$$

$$GACV(\lambda) = \frac{\sum_{i=1}^n \rho_{\tau}(Y_i - f(X_i))}{n - df} \quad (5)$$

in which  $df$  is a measure of the effective dimensionality of the fitted model.

Yuan (2006) provides solid evidence that GACV performs similarly to SIC in real data analysis while it outperforms SIC in simulation studies. We therefore choose GACV for our empirical analysis.

## 2.2 Currency tail risk determinants

Our study focuses on the tail connections so we will use  $\tau = 0.05$  and  $\tau = 0.95$  respectively for the extremely bearish and extremely bullish market. For the purpose of comparison, we also utilize the quantile  $\tau = 0.5$ . One of the problems is to select the determinants of tail risk (as well as median returns). Let's denote  $W_t$  the set of possible determinants at time  $t$ . First of all, as in our case, we want to estimate the risk spillovers between two exchange rates conditional on the joint effects of other exchange rates so the first set of determinants of a particular exchange rate is the tail returns of the rest  $E_{-i,t}$ . As in Hautsch et al. (2015), in case  $\tau = 0.05$ , we call  $E_{-i,t}$  the extreme loss exceedances of exchange rate other than exchange rate  $i$  and defined as  $E_{-i,t} = X_{-i,t} 1(X_{-i,t} \leq \hat{Q}_{-i,0.1})$ , where  $\hat{Q}_{-i,0.1}$  is the unconditional 10% sample quantile. Similarly, in case  $\tau = 0.95$ , we call  $E_{-i,t}$  the gain exceedances and defined as  $E_{-i,t} = X_{-i,t} 1(X_{-i,t} \geq \hat{Q}_{-i,0.9})$ , where  $\hat{Q}_{-i,0.9}$  is the unconditional 10% sample quantile. For the normal market case,  $\tau = 0.5$ , for simplicity, we define normal market exceedances of  $i$  as  $E_{-i,t} = X_{-i,t} 1(\hat{Q}_{-i,0.1} < X_{-i,t} < \hat{Q}_{-i,0.9})$ .

The second set of variables should include the risk factors that reflect risk, uncertainty of the US economy. Following Adrian & Brunnermeier (2016) and Hautsch et al. (2015) we select Ted spread, the Chicago Board Option Exchange volatility index (VIX) and the Default spread index. Because the USA is the leading economy in the world, these indexes should also reflect universal risk. Hence, we name these the  $U_t$  factor, whereby  $U$  stands for the *US* or '*Universal*'. This set also encompasses oil returns because many among the currencies in our study belong to oil-exporting countries and because oil price fluctuations have significant impacts on the world economy (Hamilton, 1983). Last but not least are those variables in the set  $S_t$  which, theoretically, affect the value of specific

currencies with respect to the US dollar. These specific factors should include but not limit to total reserve condition, current account state, money supply growth, the sensitivity to carry trade, interest rates and inflation. It is noted here that we also include the US's current account and total reserve in set  $U$  to balance with information in the set  $S$ .

As a result, we can rewrite Equation (2) for each exchange rate returns  $X_i$  within the time series context as follows:

$$\min_{\beta_i, \beta_{0,i}} \left\{ \sum_{t=1}^n \rho_{\tau} (X_{i,t} - \beta_0 - W_{i,t}^T \beta_i) + \lambda_i \sum_{i=1}^m |\beta_i| \right\}, \quad (6)$$

where  $W_{i,t} \stackrel{\text{def}}{=} \{E_{-i,t}, U_{t-1}, S_{t-q}\}$ ,  $m = u + s + e - 1$ ,  $u$  equals the number of universal variables,  $s$  is the size of the set  $S$ ,  $e$  is the number of exchange rates under study, and  $q$  represents the lag number. In this study,  $q = 1$  for all variables in  $S$  except for *Beta with respect to AUDJPY*, which measures the sensitivity of a certain currency to carry trade returns, where  $q = 26$  (De Bock & de Carvalho Filho, 2015). Our empirical framework is thus innovated from both Härdle et al. (2016) and Hautsch et al. (2015) in the choice of independent variables and the type of financial markets to focus on.

### 2.3 Risk spillovers and tail-risk network

Equation (6) allows us to obtain relevant  $\beta$ . Define the estimated parameter  $\beta$  as:  $\hat{\beta}_i \stackrel{\text{def}}{=} \{\hat{\beta}_{i|-i}, \hat{\beta}_{i|U}, \hat{\beta}_{i|S}\}$ . In this set of estimated betas,  $\hat{\beta}_{i|-i}$  indicates the marginal effect of extreme loss (gain) exceedances of other exchange rates on the estimated lower-(upper-) tail returns. The magnitude of estimated betas represents the strength of spillovers in each market condition. To enable comparison and calculation of spillovers, all variables in Equation (6) are normalized to take values in the range  $[0,1]$  with the following equation:

$$x_{i,t}^{\text{norm}} = \frac{x_{i,t} - \min(x_i)}{\max(x_i) - \min(x_i)}$$

From the estimated beta matrix as in Table 1, we can set up the tail network following Hautsch et al. (2015). Accordingly, if the absolute value of  $\beta$  is bigger than or equal to 0.001, we have a directional link from exchange rate  $E_i$  to exchange rate  $E_j$  and  $|\beta_{ij}|$  becomes the weight of this link. We then use network visualization and network effects to pinpoint main spillovers.

**Table 1:** Spillover Matrix

	$E_1$	$E_2$	...	$E_i$	...	$E_j$	...	$E_n$
$E_1$	0	$\beta_{12}$		$\beta_{1i}$		$\beta_{1j}$		$\beta_{1n}$
$E_2$	$\beta_{21}$	0		$\beta_{2i}$		$\beta_{2j}$		$\beta_{2n}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$E_i$	$\beta_{i1}$	$\beta_{i2}$		0		$\beta_{ij}$		$\beta_{in}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$E_j$	$\beta_{j1}$	$\beta_{j2}$		$\beta_{ji}$		0		$\beta_{jn}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$E_n$	$\beta_{n1}$	$\beta_{n2}$		$\beta_{ni}$		$\beta_{nj}$		0

**Table 2:** Basic descriptive statistics of exchange rate returns

	<b>N</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>Median</b>	<b>Stdev</b>	<b>Skewness</b>	<b>Kurtosis</b>
AUD	650	-18.53	7.03	0.01	0.12	1.89	-1.70	15.74
CAD	650	-8.01	5.25	-0.01	0.06	1.34	-0.70	4.36
CHF	650	-11.44	16.67	0.04	-0.01	1.61	1.36	20.57
CLP	650	-11.62	5.86	-0.01	0.08	1.62	-1.15	7.06
CNY	650	-2.89	2.04	0.04	0.02	0.32	-0.95	15.11
COP	650	-12.74	8.80	-0.04	0.02	1.84	-0.57	5.08
CZK	650	-7.57	7.05	0.03	0.13	1.73	-0.26	1.27
DKK	650	-6.01	5.03	0.00	0.05	1.36	-0.29	1.49
EUR	650	-6.05	4.99	0.00	0.01	1.37	-0.30	1.47
GBP	650	-8.35	5.20	-0.04	-0.02	1.36	-0.66	3.59
HKD	650	-0.40	0.41	0.00	0.00	0.07	0.33	6.43
HUF	650	-8.76	8.16	-0.04	0.00	2.14	-0.35	1.84
IDR	650	-7.82	8.43	-0.05	-0.05	1.19	-0.20	10.27
ILS	650	-4.87	4.98	0.04	0.09	1.26	-0.18	1.55
INR	650	-4.50	4.77	-0.06	0.00	1.02	-0.23	2.35
JPY	650	-4.59	7.58	0.00	-0.05	1.47	0.34	1.37
KRW	650	-9.36	7.32	0.00	0.05	1.43	-0.63	6.96
MXN	650	-15.12	5.65	-0.10	-0.01	1.62	-1.41	12.73
MYR	650	-4.26	5.93	-0.01	0.04	1.04	-0.02	3.76
NOK	650	-6.42	6.73	-0.03	0.00	1.66	-0.32	0.98
NZD	650	-10.69	6.20	0.01	0.16	1.93	-0.70	2.87
PEN	650	-3.05	3.17	0.00	0.02	0.70	0.01	4.58
PHP	650	-3.28	2.94	0.02	0.04	0.80	-0.04	1.31
PLN	650	-13.04	8.45	0.00	0.13	2.04	-0.74	3.95
RON	650	-11.20	4.57	-0.04	0.07	1.66	-0.86	4.04
RUB	650	-9.96	9.75	-0.11	0.03	1.89	-0.69	5.49
SAR	650	-1.01	0.48	0.00	0.00	0.06	-4.79	110.19
SEK	650	-6.73	6.50	-0.01	0.05	1.68	-0.09	1.09
SGD	650	-4.49	2.60	0.04	0.03	0.76	-0.32	2.42
THB	650	-6.81	5.44	0.04	0.03	0.92	-0.65	10.35
TRY	650	-12.07	9.08	-0.16	-0.04	1.90	-0.51	4.25
TWD	650	-2.76	2.63	0.01	-0.01	0.64	0.11	2.21
ZAR	650	-11.28	13.62	-0.10	0.04	2.36	-0.29	3.28

**Table 3:** Determinants of lower-tail returns of selected exchange rate ( $\tau = 0.05$ )

Currency	Determinants	
AUD	HUF, MYR, NOK, NZD, ZAR	
BRL	CLP, INR, KRW, NOK, RUB, TRY, ZAR,	Inflation
CAD	BRL, CZK, GBP, KRW, NOK, NZD, ZAR	
CHF	DKK, EUR, HUF, INR, JPY, NOK	
CNY	GBP, MYR, PHP, SEK, SGD, TWD,	Current Account US, Money Supply, Interest Rate
COP	HUF, MYR, NOK, NZD, PEN, PHP, RUB, TRY,	
EUR	CZK, DKK, HUF, NOK	
GBP	CAD, CZK, HUF, KRW, NOK, NZD, PLN, TWD	Total reserve
HUF	CZK, DKK, NOK, PLN, SEK	
INR	IDR, KRW, NOK, NZD, PHP, SGD,	Interest rate
JPY	CNY, CZK, IDR, INR, MYR, NOK, SEK	TED spread, Default spread, Current Account US
KRW	BRL, CAD, GBP, INR, MYR, NZD, PHP, SEK, TWD	
MXN	BRL, CAD, INR, MYR, RUB, SEK, ZAR	
MYR	NOK, PHP, RUB, SGD, TWD, ZAR	
NOK	CZK, HUF, MYR, SEK	
PLN	CZK, HUF, SEK,	
RON	CZK, DKK, HUF, NOK, SEK	
RUB	MYR, NOK	Current Account, Inflation, Interest Rate
SEK	CZK, EUR, HUF, INR, NOK	
SGD	DKK, EUR, MYR, NOK, SEK, TWD	
THB	IDR, INR, NOK, PHP, TRY, TWD, ZAR	Current Account US, Money Growth
TRY	BRL, HUF, KRW, NZD, ZAR	Total Reserve
ZAR	HUF, MYR, NOK, TRY, TWD	

### 3 Empirical data

This study uses weekly exchange rates of top 34 globally traded currencies against the USD. According to BIS (2016), annual trading between these currencies against the USD accounts for around 80% of all pairs. In order to limit missing values, we choose the sample period from 17 July 2005 to 31 December 2017, making a total of 650 observations. This sample period witnessed several important events which preceded changes in foreign exchange markets. For example, the date 21 July 2005 witnessed the change in exchange rate policy of both China and Malaysia from fixed to managed floating regime. Other major events include the Global Financial Crisis, Sovereign Debt Crisis, the Brexit referendum as well as the rising of protectionism powered by president Donald Trump in 2017. Augmented Dickey - Fuller tests reveal that exchange rates have unit root in level; thus, weekly log returns are utilized for the analysis. To facilitate interpretation, we assign the USD to be the counter currency in every exchange rate. Thus, an increase in log return is translated into an appreciation of relevant currency vis-a-vis the USD while a decrease demonstrates the otherwise.

Data on VIX index, Ted spread, default spread, stock market indexes, interest rates and oil prices are obtained with weekly frequency. For the regression, differences in stock log returns and differences in three-month interest rates between countries in our sample and the United States are employed. To ensure the comparability, we use MSCI stock indexes for all countries except Romania because of data inadequacy. Since Augmented Dickey - Fuller (ADF) tests cannot reject the null that the above-mentioned risk series have unit roots, we use the first difference for TED and default spread and log difference for VIX index in our analysis. Data with quarterly or monthly frequency including current account to GDP, GDP index, total reserve, CPI index, money stock are converted to weekly frequency using cubic interpolation following Hautsch et al. (2015) and Härdle et al. (2016). We use broad money M3 as a proxy for money supply in all cases except for Romania, Taiwan and Romania where M2 is used instead. Our last variable is Beta with regard to AUDJPY for each currency, which measures the sensitivity of relevant currencies to carry trade returns in the. AUDJPY beta of each exchange rate is obtained by regressing changes in that exchange rate on the changes of AUDJPY over a sample 52 weeks to week  $t$ , as suggested by De Bock & de Carvalho Filho (2015). *All data is sourced from Bloomberg terminal.* Basic descriptive statistics of exchange rate returns from 2005 to 2017 can be seen from Table 2; that of other variables will be provided upon request.

### 4 Results and discussion

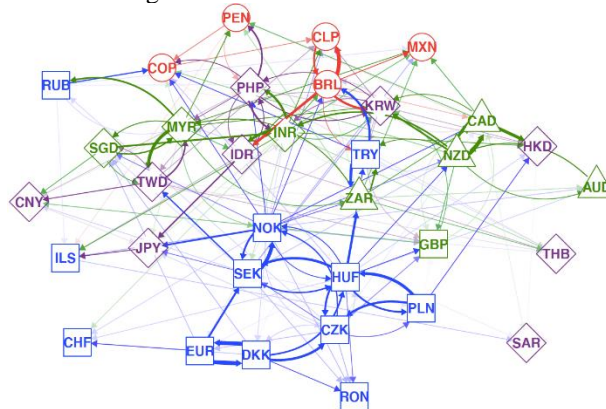
Table 3 provides the list of determinants of lower-tail returns for thirty-four currencies under study. It can be seen that tail returns are driven by variables in all three sets mentioned in Section 2, among which extreme loss exceedances from other currencies are the main drivers. In fact, in bearish markets, universal and specific variables only affect fourteen out of thirty-four currencies while loss exceedances appear in every case.



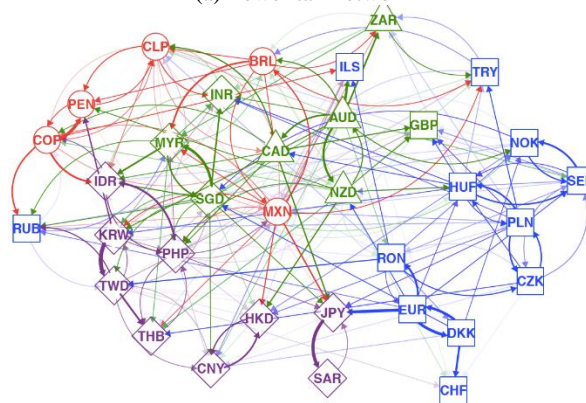
This finding partly agrees with Hautsch et al. (2015) who find that loss exceedances are the only determinants of tail risk of fifty seven major US financial institutions from 2000 to 2008. Similar results are obtained from extremely good market condition. Furthermore, in normal markets variables other than exceedances seem to almost have no role in determining the value of exchange rates (evidence will be provided upon request). We can thus come to conclusion that market states strongly impact the relationship between currencies as well as between currencies and fundamentals. Extreme loss/gain exceedances are dominant tail risk drivers while the effect of other variables is somewhat limited.

From the results of quantile lasso regression, two tail networks can be visualized as in Figure 1, whereby the upper and lower part presents extremely bearish and bullish directional connections relatively.

**Figure 1:** Tail network of global currencies



(a) Lower tail network



(b) Upper tail network

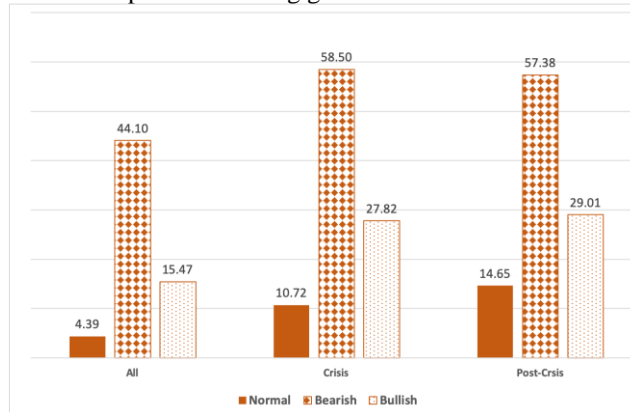
We use colors and shape to indicate different currency groups. The red circle indicates Latin America, the blue or square is for Europe, the purple or diamond for Asia, the triangle or green represents commonwealth countries. Each arrow indicates the direction of spillovers while its width reflects spillover strength. Mathematically, for example, the higher the absolute value of  $\hat{\beta}_{EUR|JPY}$  in Table 1, the higher the tail risk spillover from USDEUR to JPYEUR, which turns into the thicker arrow from EUR to JPY. It is obvious from Figure 1 that currencies from countries/territories with geographical proximity (e.g. in the same continent) are generally more connected to each other and tend to have mutual relationships. Currencies of Norway and Sweden (NOK & SEK), Chile and Brazil (CLP & BRL), Hungary and Poland (HUF & PLN), Indonesia and the Philippines (IDR & PHP), Australia and New Zealand (AUD & NZD), Taiwan and Singapore (TWD & SGD) prove such examples. This is easily understood as countries located close to each other often have strong international trades, investments and other international relationships. Some currencies that do not share physical borders but belong to countries within a particular bloc also show strong connectedness. For example, the Canadian dollar, New Zealand dollar, Australian dollar and British Pound all belong to commonwealth group. It is noted, however, that the spillover relationship between currencies, even in the same group, changes in between different market states. For instant, there exist mutual spillovers between MXN and BRL in the extremely bullish market but not in the opposite market condition. Similar phenomenon is seen between CNY and HKD, EURO and RON, KRW and TWD. This highlights the importance of quantile analysis on risk spillovers in the foreign exchange market.

The general spillover statistics are summarized on Figure 2. Here the crisis period ranges from July 2, 2007 to September 15, 2012, covering both the global financial crisis and the European Sovereign debt crisis. Post crisis period lies in between September 16, 2012 to the end of 2017. We do not include the pre-crisis period to avoid spurious results since some exchange rate returns and their relevant gain/loss exceedances are not stationary. The lower part of this figure provides information about the number of significant spillovers while the upper part presents total weight or strength of spillovers corresponding to three market scenarios: normal, extremely bearish and extremely bullish. Total weight is obtained by taking the sum of outgoing weights of the thirty-four currencies.

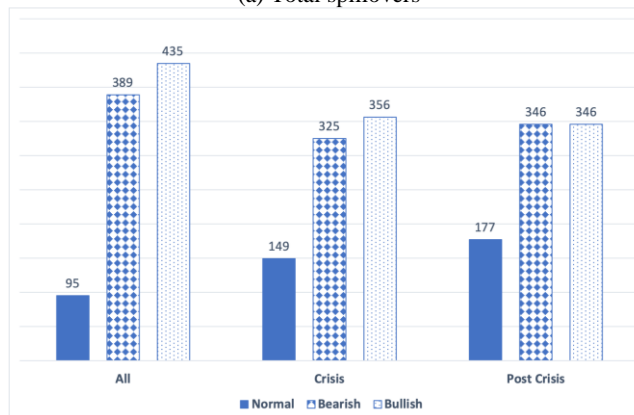
It is obvious that spillovers vary along with the time frame, general states of economy and especially different states in the foreign exchange markets. The strongest spillover is found in the crisis period corresponding to the bearish market ( $\sum W_t = 58.50$ ). In every period, spillover strength is always at peak when the foreign exchange market is in distress. It can also be seen that both links and in weights in normal market are about two times less than that in the other two extremes. This means currencies are more connected in extremely good or extremely bad times compared to normal times and that stronger connection is found in distressed times compared to vigorous market conditions.

The normal market is characterized by the struggle between up and down swing or, put it differently, there is no clear-cut direction. The 'wait-and-see' strategy therefore becomes popular in the market. As a result, spillover among currency is lower than in the two other market states. The fact that lower-tail spillover is greater than upper-tail spillover can possibly be explained by the loss spiral and the margin/haircut spiral in Brunnermeier et al. (2008): big losses cause funding problems for investors and hence they have to reduce their positions by selling the relevant currencies for USD which in turn cause further losses on the current positions and ignite higher margin requirements and so on. Losses on one currency may spread to others through rebalancing or through indiscriminate selling or herd behavior under information asymmetry (Dornbusch et al., 2000; Scott, 2016). These findings partly agree with previous studies by Shahzad et al. (2018), Wang and Xie (2016), Greenwood-Nimmo et al. (2016) and Leung et al. (2017).

**Figure 2:** Overall risk spillovers among global currencies



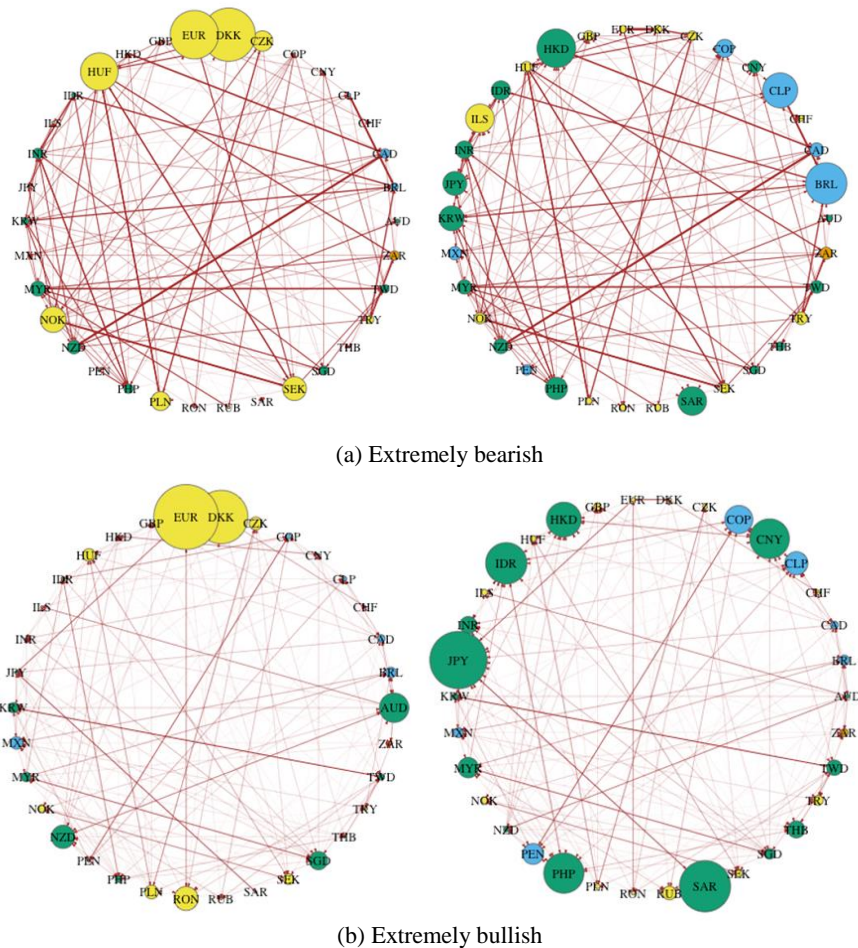
(a) Total spillovers



(b) Total links

Surprisingly, while the spillover strength in bearish market doubles that in bullish market, the total number of directional links relating to the latter tend to exceed that in the former. As an example, the total links in these two market conditions are relatively 435 compared to 389 for the entire period. Perhaps bearish markets often go hand in hand with contagion, thus, governments around the world are more likely to apply capital control measures in order to prevent the spread of risk to their domestic markets. This potentially explains why there are fewer links in extremely bad market condition as compared to extremely good one.

**Figure 3:** Main transmitters (left) and receivers (right)



To answer the question which are the main extreme risk transmitters and receivers and whether their positions change in accordance with the two extreme states, we employ the Page Rank centrality (Csardi & Nepusz, 2005) to take into account both direct and indirect effects. As shown in Figure 3, the EUR and the DKK are the two top risk spreaders in both market states. The EUR tops the ranking in bullish market but switches position for the DKK in the bearish market. This is not surprising since the DKK is pegged to the EUR, it become more volatile when the general economic state worsen, thus, have more impacts on others than the EUR. Figure 3 also shows that the Asian currencies are more likely to benefit in extremely good times while currencies from Latin America seem to be the most.

## 5 Conclusion and future research

Over the period from July 2005 to 2017, the tail risk of each currency was mainly driven by spillovers from others with risk spillovers varying across different states of foreign exchange market and of the global economy. Market states create asymmetric risk spillovers among currencies. They change the number of links, overall strength, the relationship between each pair of currencies as well as their positions as main risk receivers or spreaders. Stronger spillovers are observed in bearish market and in global distressed economic conditions. The resulting tail networks confirm a well documented phenomena in literature that currencies with geographical proximity tend to be more connected to each other.

The paper can be extended by spanning over the Covid-19 period, the Russia-Ukraine conflict period and by including rolling-window regression to see dynamic tail-risk spillovers over time.

### Acknowledgement:

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### References:

- Adrian, T. & Brunnermeier, M. K. (2016) CoVaR, *American Economic Review*, 106(7), pp. 1705–1741.
- BIS (2016) *Triennial Central Bank Survey of foreign exchange and OTC derivatives markets in 2016* available at: <https://www.bis.org/publ/rpfx16.htm> (October 10, 2022).
- Bostanci, G. & Yilmaz, K. (2020) How connected is the global sovereign credit risk network?, *Journal of Banking & Finance*, 113, <https://doi.org/10.1016/j.jbankfin.2020.105761>.
- Brunnermeier, M. K., Nagel, S. & Pedersen, L. H. (2008) Carry Trades and Currency Crashes, *NBER Macroeconomics Annual*, 23, pp. 313–348 (The University of Chicago Press).

- Bubák, V., Kočenda, E. & Žikeš, F. (2011) Volatility transmission in emerging European foreign exchange markets, *Journal of Banking & Finance*, 35(11), pp. 2829–2841.
- Csardi, G. & Nepusz, T. (2005) The Igraph Software Package for Complex Network Research, *InterJournal, Complex Systems*, available at: <https://igraph.org/r/> (July 25, 2022).
- De Bock, R. & de Carvalho Filho, I. (2015) The behavior of currencies during risk-off episodes, *Journal of International Money and Finance*, 53(C), pp. 218–234.
- Demirer, M., Diebold, F. X., Liu, L. & Yilmaz, K. (2018) Estimating global bank network connectedness, *Journal of Applied Econometrics*, 33(1), pp. 1–15.
- Diebold, F. X. & Yilmaz, K. (2009) Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets, *The Economic Journal*, 119(534), pp. 158–171.
- Diebold, F. X. & Yilmaz, K. (2012) Better to give than to receive: Predictive directional measurement of volatility spillovers, *International Journal of Forecasting, Special Section 1: The Predictability of Financial Markets*, 28(1), pp. 57–66.
- Diebold, F. X. & Yilmaz, K. (2015) *Financial and macroeconomic connectedness: A network approach to measurement and monitoring* (USA: Oxford University Press).
- Dornbusch, R., Park, Y. C. & Claessens, S. (2000) Contagion: How it spreads and how it can be stopped, *World Bank Research Observer*, 15(2), pp. 177–197.
- Engle, R. F., Ito, T. & Wen-Ling L. (1990) Meteor Showers or Heat Waves? Heteroskedastic Intra-Daily Volatility in the Foreign Exchange, *Econometrica*, 58(3), p. 525.
- Greenwood-Nimmo, M., Nguyen, V. H. & Rafferty, B. (2016) Risk and return spillovers among the G10 currencies, *Journal of Financial Markets*, 31(C), pp. 43–62.
- Hamilton, J. D. (1983) Oil and the Macroeconomy since World War II, *Journal of Political Economy*, 91(2), pp. 228–248 (The University of Chicago Press).
- Härdle, W. K., Wang, W. & Yu, L. (2016) TENET: Tail-Event driven NETWORK risk, *Journal of Econometrics*, 192(2), pp. 499–513.
- Hautsch, N., Schaumburg, J. & Schienle, M. (2015) Financial Network Systemic Risk Contributions, *Review of Finance*, 19(2), pp. 685–738.
- Hong, Y., Liu, Y. & Wang, S. (2009) Granger causality in risk and detection of extreme risk spillover between financial markets, *Journal of Econometrics, Recent Development in Financial Econometrics*, 150(2), pp. 271–287.
- Koenker, R. & Bassett, G. (1978) Regression Quantiles, *Econometrica*, 46(1), pp. 33–50.
- Leung, H., Schiereck, D. & Schroeder, F. (2017) Volatility spillovers and determinants of contagion: Exchange rate and equity markets during crises, *Economic Modelling*, 61(C), pp. 169–180.
- Li, Y. & Zhu, J. (2008) L1-Norm Quantile Regression, *Journal of Computational and Graphical Statistics*, 17(1), pp. 163–185 (Taylor & Francis).
- McMillan, D. G. & Speight, A. E. H. (2010) Return and volatility spillovers in three euro exchange rates, *Journal of Economics and Business*, 62(2), pp. 79–93.
- Schwarz, G. (1978) Estimating the Dimension of a Model, *The Annals of Statistics*, 6(2), pp. 461–464 (Institute of Mathematical Statistics).
- Scott, H. S. (2016) *Connectedness and Contagion: Protecting the Financial System from Panics* (The United States: MIT Press).
- Shahzad, S. J. H., Arreola-Hernandez, J., Bekiros, S. & Rehman, M. U. (2018) Risk transmitters and receivers in global currency markets, *Finance Research Letters*, 25(C), pp. 1–9.
- Tibshirani, R. (1996) Regression Shrinkage and Selection Via the Lasso, *Journal of the Royal Statistical Society: Series B (Methodological)*, 58(1), pp. 267–288.
- Wang, G.-J. & Xie, C. (2016) Tail dependence structure of the foreign exchange market: A network view, *Expert Systems with Applications*, 46, pp. 164–179.

T. T. M. Le, F. Martin & D. K. Nguyen: Tail Risk Transmission in the Foreign  
Exchange Market: A Quantile LASSO Regression Approach

Yuan, M. (2006) GACV for quantile smoothing splines, *Computational Statistics & Data Analysis*,  
50(3), pp. 813–829.





## Are There Price Effects of Adding or Deleting Stock From the Stock Index?

DRAGANA DRAGANAC & MIROSLAV TODOROVIĆ

**Abstract** In this paper, we investigate the effects of stock indexing on its market price. The event study methodology is used to explore what happens with share price when stocks are added to or deleted from the market index S&P 500. The aim of the research is to investigate if there are abnormal returns, can they be anticipated by traders, what is their duration, and if the effects could be explained from the perspectives of neoclassical and behavioral finance. Several explanations of price dynamics after stock price (de)indexing are provided in the paper. Our results show that index effects declined a lot in recent years, both for the case of stock inclusions and exclusion.

**Keywords:** • stock price indexing • efficient market hypothesis • behavioral finance • event study

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## 1 Introduction

The traditional (neoclassical) financial theory first considered that events such as stock inclusion or exclusion from a stock market index cannot have an impact on its price, since such events do not affect fundamental indicators of the company (e.g. expected dividends, expected cash flows, growth rates of dividends and cash flows), nor do they affect the risk of cash flow realization (see, for example, Ross et al., 2015; Fama, 1970). Later, this conclusion of traditional finance theorists was corrected: although future cash flows would not be affected by stock indexing, investors' perception of risk could be changed since the stock inclusion in the index is considered as a form of recognition of the company's quality (Dhillon and Johnson, 1991; Jain, 1987). After indexing, the company is perceived as less risky by rational investors, which will result in a decrease in the required rates of return and an increase in share price (see, for example, Merton, 1987; Hegde and McDermott, 2003; Chordia, 2008). The reverse also applies in the case of stock being excluded from the index: required rates of return will go up, while share price will go down. According to efficient market hypothesis – EMH (Fama, 1970), which is one of the pillars of traditional (neoclassical) finance theory, in efficient markets all relevant information about firms is instantly incorporated into the stock price. Therefore, the stock price fully reflects all available information and there is no space for abnormal returns to appear. If inclusion (exclusion) does not convey new information, there will be no price changes. If new information about the firm is conveyed through the inclusion (exclusion) of its stock to the stock market index, there will be instant changes in share price, without the possibility to earn money.

Within the behavioral finance, where investor rationality and market efficiency are questioned or denied, price changes after indexing/deindexing are considered to be the result of numerous investor psychological biases. Behavioral finance theorists name these price changes as a phenomenon of tyranny of the index funds, while some of the biases and psychological explanations behind it are herd behavior, information cascades, cognitive dissonance, aversion to regret, and availability and representativeness bias. Herd behavior and information cascades (Avery and Zemsky, 1998; Bikhchandani, and Sharma, 2001) mean that investor, seeing that other investors started to buy stock added to the index, follow the crowd and do the same in order to avoid aversion to regret that will occur if they missed some profitable investment opportunity. Availability bias (Kahneman and Tversky, 1974) may lead to wrong decisions based only on recent information that remained in our minds as salient. For example, investors can only remember good outcomes from buying stocks that are added to stock index, while bad outcomes from passive investments from remote past are forgotten. Representativeness biases (Kahneman and Tversky, 1974) may result in wrong estimates of probabilities that some trading strategy, such as passive tracking of the stock index, will be successful.

Regarding empirical results, earlier studies confirmed that a stock's inclusion in an index is associated with significant positive abnormal returns, while exclusions from the index

result in significant negative abnormal returns. Several explanations for the abnormal returns are offered. However, in recent years, empirical evidence suggests that abnormal returns declined over time and even disappeared.

The objectives of this paper are to investigate what happened to the index effect in the last three years, to identify and explain the reasons of observed results, and to test the weak form of EMH. To this end, we applied event study methodology and Wald–Wolfowitz runs test of randomness of returns to the sample of 54 companies, with 32 additions and 22 deletions from S&P 500 stock market index that occurred in the period from 2020 to 2022.

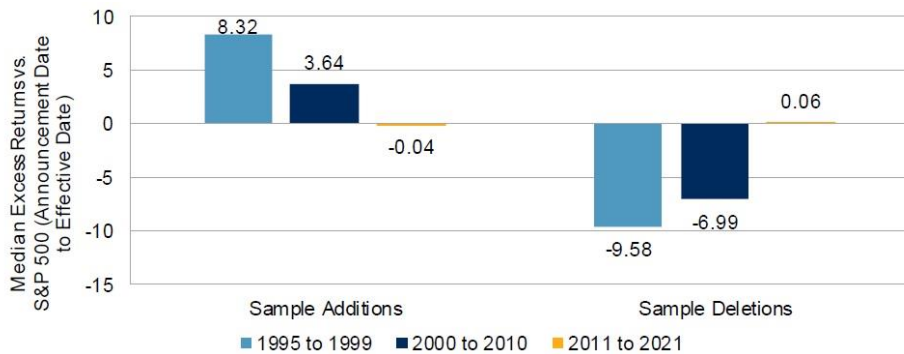
The remainder of the paper is organized as follows. Section 2 contains literature review. In section 3, we describe the applied methodology, data set and present the results. After that, in section 4 we analyse and discuss the results. Last section contains concluding remarks and future research directions.

## 2 Literature overview

First studies about the price effects of indexing appeared in 1980s. Most papers investigate the price effects for S&P 500 market index, but there are also studies about price effects on the examples of other indices and other geographical areas. The earlier empirical studies find that, in the case of stock inclusion, there is significant positive abnormal return between 3% and 8% for different event windows (Shleifer, 1986; Harris and Gurel, 1986; Jain, 1987; Beneish and Whaley, 1996; Lynch and Mendenhall, 1997; Howard and Chan, 2002; Hacibedel and van Bommel, 2006). In some studies, (e.g. Masse et al., 2000) abnormal returns were detected even before any announcement of inclusion, which is the clear evidence of information leakage. The evidence of the duration of indexing effects are mixed: some studies find that price changes are temporary (Kasch and Sarkar, 2011; Zitman, 2006), while the others, such as Shleifer (1986) and Jain (1987), find that the price changes are permanent. On the other hand, Brealey (2000) does not find any significant effects of price inclusions.

There is no unique conclusion regarding the price effects of stock deletion from the market index. Brealey (2000) finds that there is significant negative cumulative abnormal return as of -4.5% and -2.0% for FTSE All-Share index and the FTSE 100 index, respectively. Jain (1987) notices the negative abnormal return of -1.16% for exclusion from S&P 500 index. Zitman (2006) observes temporary but significant negative abnormal return for AEX deletions.

The Index Effect has weakened significantly since 2011 (Renshaw, 2020). It can be observed from Figure 1 for S&P 500 additions and deletions.

**Figure 1:** The S&P 500 index effect declined over time

Source: Preston and Soe (2021).

The illustration shows that, during the period 1995-2001, median excess returns in the window between the announcement date and effective date faded away for additions (from 8.32% to only -0.04%). At the same time, negative abnormal returns associated with stock deletions disappeared, -9.58% to 0.06%. One possible explanation for the attenuation of the inclusion effect is that exchange-traded funds (ETF) market makers trade on price disparities as soon as they occur, eliminating any sustained positive or negative price deviations (Renshaw, 2020). If this is true, it also proves that ETF trading adds liquidity to the market.

There is no consensus in the literature about the reasons of observed abnormal returns during history. In addition to abnormal returns, studies have found other effects such as an increase in trading volume following the announcement of a stock inclusion in the index. The tracking of stock indexes has grown steadily in the meantime. The estimation from the end of 2021 is that USD 15.6 trillion is indexed or benchmarked to the index. Therefore, the recent findings of decline in the index effect are intriguing.

Price Pressure Hypothesis (Harris and Gurel, 1986; Blouin et. al, 2000) explains abnormal returns through the increased demand for the included stocks by hedge funds and other institutional investors whose stock portfolios are structured to track indices. However, these abnormal returns are temporary and the reversal will occur as soon as the index funds rebalance their portfolios. Ben Rephael et al. (2011) identify temporary price pressure on the example of mutual fund flows in Izrael, where 50% of the price changes is reversed in next 10 trading days. Lin (2018) finds the evidence of temporary positive/negative abnormal returns for additions/deletions from DJIA and increase in trading volumes in both cases. Downward Sloping Demand Curve Hypothesis introduced by Shleifer (1986) points out that, since index funds reallocate their portfolios to replicate the index, the increase in share price is permanent, which causes the demand curve for shares to be downward-sloping. Downward Sloping Demand Curve Hypothesis

represents a departure from the traditional view that the demand curves are perfectly elastic and that stock trading can be done in large blocks at the prevailing stock price. Imperfect Substitute Hypothesis considers that, since it is difficult or even impossible to find perfect substitute for a given stock, demand curve is downward-sloping. Information Signaling Hypothesis (Jain, 1987) states that the inclusion (exclusion) of a stock in an index brings new valuable information about the quality of the company that was previously unknown to the market. The new information conveyed by the announcement of the inclusion is a kind of certification of the quality of the company, which results in a decrease in the perceived risk and required rates of investors. A more extreme interpretation of the Information Signaling Hypothesis refers to higher expected future cash flows; it can be expected that, as a result of the inclusion, the monitoring of the company's management is strengthened and analyst and media coverage increases, which induces managers to carry out more profitable investment projects with higher future FCFF than those that were realized before the inclusion (Denis et al., 2003). There is the asymmetry in media coverage between additions and deletions: additions are covered more intensively, so their recognition remains sometimes even after the stock is excluded from the index. Liquidity Hypothesis, introduced by Amihud and Mendelson in 1986, explain that a decrease in the perceived risk and required rates by investors could also be the result of a reduced premium for the risk of illiquidity of shares due to the possible higher liquidity of a given share after its inclusion in the index. However, in reality, these effects are negligible since most shares were already highly liquid even before inclusion in the stock market, since the firms were already listed at stock exchanges. The companies that became part of the stock market index may attract capital faster and grow at a higher rate. Greenwood and Sammon (2022) acknowledge disappearing index effects and provide several explanations: changing in compositions of additions and deletions, increase in average liquidity, which makes the market more able to absorb demand shocks, index migration, when stock was already the member of smaller/larger index before addition/deletion, increase in predictability of index change, and event-specific liquidity. In recent years, with the huge implementation of artificial intelligence (AI) prediction techniques, predictability of index change increased a lot. Lu and Ahmad (2019) find out contradictory results of decrease in stock price and trading volume, but increase in returns volatility after the announcement that the stock will be added to the Malaysian stock index. The opposite was the case when stock was deleted from the index. They offered explanation from behavioral finance point of view about higher investors' opinion divergence for added than for deleted stocks. Qin and Signal (2015) state that indexing negatively affects market efficiency and causes more intense post-earnings-announcement drift and larger deviations of stock prices from the random walk.

### 3 Research

The event study methodology is used in the paper. This methodology is introduced by Ball and Brown (1968), while MacKinlay (1997) explains how it can be applied on financial market data to investigate the effects of different events, such as dividend announcement, financial result announcement, mergers and acquisitions (M&A), spin offs and other company restructuring techniques, stock splits, the addition or deletion of stocks from the index, on the firm value. Since then, event study methodology is widely used to analyze the impact of various events on stock price and firm value, to investigate if market participants could anticipate the event, what is the duration of the event and how quickly new information is integrated into stock price. Stock prices often react to the announcement of the event even if the event is not realized. Therefore, the announcement of the event is the event per se. Two important days for studying effects of the event are announcement day (AD) and effective day (ED). Even before announcement day, market participants can anticipate the event and abnormal returns can occur. Event window is often taken as a period between announcement day and effective day, or between announcement day and several days after the effective day. In order to calculate “normal” returns, we need the estimation window, which is a period before the announcement day or even before any anticipation of the event. The estimation window should not contain any relevant event that could affect share price. The length of the estimation window differs from study to study, but most often it is between 120 and 250 trading days. When “normal” returns are calculated using market model, it is important to use long enough estimation window to obtain the plausible estimations of the beta coefficient, as a measure of systematic risk.

In previous studies about the index effects, there is no consensus about the length of the event window. Namely, event windows span from (AD – 1, ED) to (AD – 10, ED + 60). From the S&P 500 methodology, it is not completely clear when the announcement of stock inclusion or exclusion occurs. Announcement occurs from two to 10 trading days before the effective date of inclusion (exclusion), where the number of days are shorter for exclusions from the index. Therefore, apart from the fact that the studies mentioned in literature review covered different historical periods, different samples of companies and different methodological nuances, most of the differences in the results can be explained by the different event windows used. Finally, due to the aforementioned differences in the number of days from the announcement to the effective inclusion or exclusion day, it is possible that the studies do not always consistently capture daily abnormal returns, which results in the event not being captured in the same way for all the stocks in the sample.

In this paper, we opted for the event window (ED - 10, ED + 10), but were also analyzing shorter event windows: (ED - 10, ED - 1), (ED - 5, ED - 1), (ED + 1, ED + 5), (ED + 1, ED + 10). We used trading, not calendar days. Additionally, abnormal return on the

effective day is calculated and analyzed. In order to calculate abnormal returns, we used market model, given in equation (1):

$$AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \quad (1)$$

where  $AR_{it}$  is the abnormal stock return of the company  $i$  at day  $t$ ,  $R_{it}$  is the realized stock return of the company  $i$  at day  $t$ , the expression  $\hat{\alpha}_i + \hat{\beta}_i R_{mt}$  is the “normal” rate of return according to the CAPM model, where  $\hat{\beta}_i$  is the estimation of the beta coefficient, while  $R_{mt}$  is the rate of return on S&P 500 market index.

Average abnormal returns (AAR), cumulative abnormal return (CAR) and cumulative average abnormal return (CAAR) are calculated using the formulas (2), (3) and (4), respectively:

$$AAR = \overline{AR}_t = \frac{1}{N} \sum_{i=1}^N AR_{it} \quad (2)$$

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \quad (3)$$

$$CAAR(t_1, t_2) = \overline{CAR}(t_1, t_2) = \sum_{t=t_1}^{t_2} \overline{AR}_t \quad (4)$$

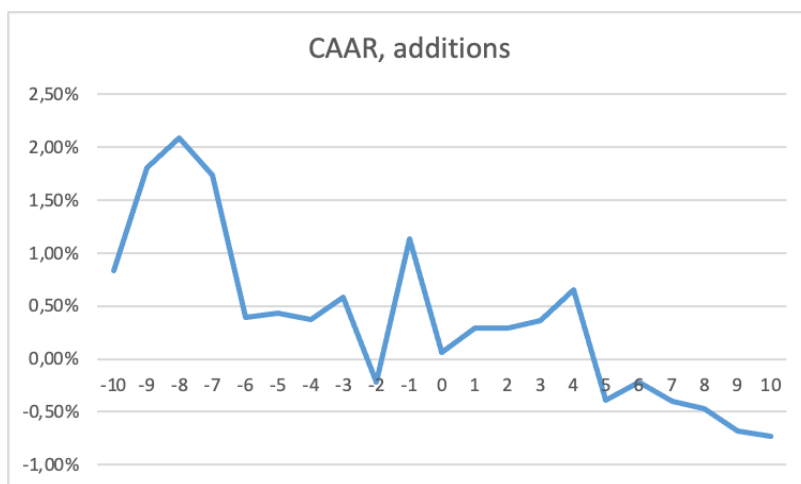
We use Wald–Wolfowitz runs test to test for the weak form of the efficient market hypothesis. This test checks whether stock returns follow the random walk, i.e. whether future stock returns are independent from the past ones. If this is the case, the weak form of EMH holds, and vice versa. In this paper, we modify Wald–Wolfowitz runs test by checking the randomness of abnormal returns in the event window (ED - 10, ED + 10).

Our sample includes 54 companies that were recently included or excluded from S&P 500: all analyzed inclusions and exclusions occurred in the period between April 2020 and November 2022. The reason for analyzing last 2.5 years is to check if the trend of disappearing of stock index effect continues. Data were obtained from Yahoo Finance web site. We analyzed 32 additions and 22 deletions from the S&P 500. Analyzed companies belong to different industries. All 22 companies from our sample of deleted stocks are the companies that are excluded from S&P 500 due to the market capitalization change. The obvious reason why we do not analyze the companies that are excluded from

S&P 500 as a result of acquisitions or bankruptcies is there are no market data after the effective day due to the delisting from stock exchanges.

Figure 2 presents the graph of the levels of CAAR for the event window (ED - 10, ED + 10).

**Figure 2:** Cumulative average abnormal return for stocks added to S&P 500, event window (ED - 10, ED + 10)



Source: Authors' calculation.

The results about the mean values of cumulative abnormal returns and their statistical significance for stocks added to the S&P 500 index for different event windows are presented in the Table 1.

**Table 1:** (Cumulative) abnormal returns for S&P 500 additions

Event window	Mean	t statistics	Significance
(ED - 10 , ED - 1)	1.13%	0.99	
(ED - 5 , ED - 1)	0.74%	0.67	
ED	-1.07%	-2.21	***
(ED + 1 , ED + 5)	-0.45%	-0.50	
(ED + 1, ED + 10)	-0.79%	-0.64	
(ED - 10, ED + 10)	-0.73%	-0.43	

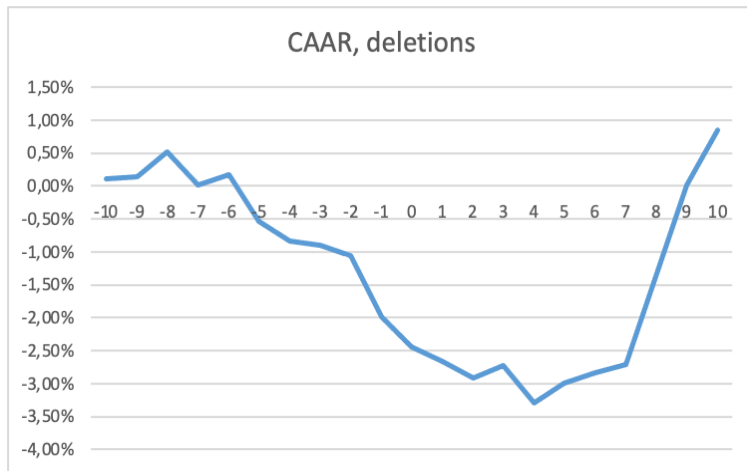
Notes: Two-tailed t-test test statistics is reported. The asterisks \*\*\* and \*\* indicate 1% and 5% significance level, respectively.

Source: Authors' calculations.



Figure 3 shows the movement of CAAR in the event window (ED - 10, ED + 10) for the companies that are excluded from S&P 500 stock market index.

**Figure 3:** Cumulative average abnormal return for stocks deleted from S&P 500, event window (ED - 10, ED + 10)



Source: Authors' calculations.

Table 2 presents the results about the mean values of cumulative abnormal returns and their statistical significance for stocks deleted from the S&P 500 stock market index for different event windows.

**Table 2:** (Cumulative) abnormal returns for S&P 500 deletions

Event window	Mean	t statistics	Significance
(ED - 10 , ED - 1)	-1.99%	-0.92	
(ED - 5 , ED - 1)	-2.15%	-1.94	
ED	-0.45%	-0.66	
(ED + 1 , ED + 5)	-0.55%	-0.54	
(ED + 1 , ED + 10)	3.29%	1.33	
(ED - 10 , ED + 10)	0.86%	0.24	

Notes: Two-tailed t-test test statistics is reported. The asterisks \*\*\* and \*\* indicate 1% and 5% significance level, respectively.

Source: Authors' calculations.

By performing Wald–Wolfowitz runs test, we obtained the results presented in Table 3 and 4.

**Table 3:** Wald–Wolfowitz runs test of abnormal returns randomness, additions

number of runs		number of days	
positive	6	positive	10
negative	7	negative	11
total	13	total	21
number of expected runs			11.476
stdev			2.227
z-statistics			0.684
p-value			0.247

Notes: Z-statistics shows Wald–Wolfowitz runs test statistics.

Source: Authors' calculations.

**Table 4:** Wald–Wolfowitz runs test of abnormal returns randomness, deletions

number of runs		number of days	
positive	3	positive	11
negative	3	negative	10
total	6	total	21
number of expected runs			11.476
stdev			2.228
z-statistics			-2.458
p-value			0.993

Notes: Z-statistics shows Wald–Wolfowitz runs test statistics.

Source: Authors' calculations.

It is important to emphasize that Wald–Wolfowitz runs test can be used for testing only the weak form of EMH.

#### 4 Discussion

The results related to the sample of stocks added to S&P 500 are as follows. Cumulative abnormal return between announcement day and the day before the effective day, i.e. in the event window (ED - 10, ED - 1), has a positive value of 1.13%, but is not significantly different from 0. The same conclusion applies for the shorter event window (ED - 5, ED - 1), when cumulative abnormal return has even lower value of 0.74% and is not statistically significant. These results are in line with newer findings that price index effects faded away, such as Greenwood and Sammon, 2022, Preston and Soe, 2021, Renshaw, 2020, and Brealey, 2000. On the other hand, the significant abnormal return occurs on the effective day. This result may seem counterintuitive since it is expected that, due to the increased demand of the investors who waited the effective index inclusion day to buy the stock, positive abnormal return be realized. By more detailed looking into data, it can be observed that there is significant positive average abnormal return of 1.35% on the day before the effective day. This suggests that there are market agents who perform the rebalancing of the portfolios just before the effective stock inclusion day, to avoid regret aversion, whose activities significantly affect market prices and result in abnormal returns. Steady increase in CAAR in period (ED - 10, ED - 8) indicate that there are investors who anticipate index inclusion and start to buy early after whom other investors start to show herd behavior. All this results about significant positive (cumulative) abnormal returns are in line with old findings (such as Harris and Gurel, 1986; Blouin et. al, 2000) that there are stock index effects, which are temporary and reversals occur after approximately 15 trading days. In both windows after the effective date, abnormal returns are negative, but insignificant. Negative abnormal returns can be interpreted as mild correction of a weak overreaction that happened before the effective date. Explanations offered by Greenwood and Sammon (2022) that could be applicable to our results are increase in average liquidity of stock markets, which makes the market more able to absorb demand shocks, and increase in predictability of index change due to wide use of AI prediction models.

The results presented in Table 2 show that there are no price effects of deleting stocks from S&P 500 index. The abnormal returns in the event windows (ED - 10, ED - 1), (ED - 5, ED - 1) and at the effective day are insignificantly negative. In the window (ED + 1, ED + 5), i.e. after the deletion of the stock from the S&P 500 index, cumulative abnormal return is still negative, though insignificant. In the longer event window (ED + 1, ED + 10), cumulative abnormal return becomes positive, but insignificant. It is worth noting that, in the event window (ED - 10, ED + 4), cumulative average abnormal return has a very high negative value of -3.29%, which is statistically significant. These results could be interpreted in the following manner. Investors are selling stocks that are announced to be excluded from the index. Afterwards, when the price dropped enough, there are investors who start buying them. However, these trading activities do not have significant impact on abnormal returns.

As we already noted, all companies in our sample of stocks excluded from S&P 500 are those that are excluded due to market capitalization change. However, if we include in the sample the companies that went bankrupt or were acquired, using the data till the effective day, i.e. the day of delisting, our results and conclusions might be different.

Runs test indicate that stock abnormal returns are random both for the sample of stocks added to the S&P 500 index and for the sample of stocks deleted from the index. This is the evidence that only the weak form of the EMH holds and that future abnormal returns do not depend on past abnormal returns. However, it must be noted that since abnormal returns are not significantly different from 0, further test of semi-strong form of EMH need to be conducted.

## 5 Conclusions

In this paper, we analysed if there are price effects of the stock addition and deletion from the S&P 500 stock market index and if there is a possibility for traders to earn abnormal returns. Additionally, our goal was to test the weak form of the efficient market hypothesis. We used a sample of 54 companies that were added or deleted from S&P 500 index in last 2.5 years. The conclusion is that index effects disappeared both for inclusions and exclusions from the index, when considering the largest analyzed event window of (ED - 10, ED + 10). However, it is clear that investors perform rebalancing of their portfolios before the effective day, which results in significant abnormal returns in shorter event windows, both for addititon and deletions. Although abnormal returns in our sample are lower than abnormal returns noticed in early studies on this topic, they have not disappeared completely, as some of the recent studies suggest. Therefore, there is still room for investors to earn abnormal returns by careful analyzing and trading with stocks that are going to be added or deleted from S&P 500 index, which is important message for portfolio managers. Wald–Wolfowitz runs test indicated that abnormal returns follow the random walk, which means that technical analysis is not useful: abnormal returns cannot be predicted on the basis of historical abnormal returns. The limitation of the research is that sample of deleted stocks do not include companies that are deleted because of bankruptcy or M&A activities, but only those whose market capitalization changed. The direction for further research is severalfold. The detailed analysis of the reasons for the stock inclusion in the S&P 500 can be performed. It can be taken into consideration whether the stock that is excluded from S&P 500 became a member of some other stock market index as well as whether the stock included in S&P 500 previously was the member of some smaller capitalization stock market index. The analysis of the indexing effect can be conducted on the examples of other stock market indices, such as the family of Russell indices and indices of less developed stock markets.

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**References:**

- Amihud, Y. & Mendelson, H. (1986) Asset pricing and the bid-ask spread, *Journal of financial Economics*, 17(2), pp. 223–249.
- Avery, C. & Zemsky, P. (1998) Multidimensional Uncertainty and Herd Behavior in Financial Markets, *American Economic Review*, 88(4), pp. 724–748.
- Ball, R. & Brown, P. (1968) An Empirical Evaluation of Accounting Income Numbers, *Journal of Accounting Research*, 6, pp. 159–178.
- Beneish, M. & Whaley, R. (1996) An anatomy of the S&P game: the effects of changing the game, *Journal of Finance*, 51(5), pp. 1909–1930.
- Ben-Rephael, A., Kandel, S. & Wohl, A. (2010) The Price Pressure of Aggregate Mutual Fund Flows, *Journal of Financial Quantitative Analysis*, 46(2), pp. 585–603.
- Bikhchandani, S. & Sharma, S. (2001) Herd Behavior in Financial Markets: A Review, *IMF working paper*, available at: <https://www.elibrary.imf.org/view/journals/001/2000/048/001.2000.issue-048-en.xml> (December 16, 2022).
- Blouin, J., Raedy, J. & Shackelford, D. (2000) The impact of capital stock price reactions to S&P 500 inclusion, *NBER working paper*, no 8011.
- Brealey, R. (2000) Stock prices, stock indexes and index funds, *Bank of England Quarterly Bulletin*, 40, pp. 61–69.
- Chan, H. W. H. & Howard, P. F. (2002) Additions to and Deletions from an Open-Ended Market Index: Evidence from the Australian All Ordinaries, *Australian Journal of Management*, 27(1), pp. 45–74.
- Chen, H., Gregory N. & Singal, V. (2004) The Price Response to S&P 500 Index Additions and Deletions: Evidence of Asymmetry and a New Explanation, *Journal of Finance*, 59(4), pp. 1901–1930.
- Chordia, T. (2008) Liquidity and Returns: The Impact of Inclusion into the S&P 500 Index, In: Lhabitant, F.S. & Gregoriou, G. N. (ed.) *Stock market liquidity: Implications for market microstructure and asset pricing* (Hoboken, New Jersey: John Wiley and Sons, Inc.), pp. 359–386.
- Denis, D., McConnell, J., Ovtchinnikov, A. & Yu, Y. (2003) S&P 500 index additions and earnings expectations, *Journal of Finance*, 58(5), pp. 1821–1840.
- Dhillon, U. & Johnson, H. (1991) Changes in the Standard and Poor's 500 list, *Journal of Business*, 64(1), pp. 75–86.
- Fama, E. F. (1970) Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, 25(2), pp. 383–417.
- Greenwood, R. & Sammon, M. C. (2022) The disappearing index effects, *NBER working paper*, no. 30748, available at: <https://www.nber.org/papers/w30748> (December 15, 2022).
- Hacibedel, B. & van Bommel, J. (2006) Do emerging markets benefit from index inclusion?, *Money Macro and Finance (MMF) Research Group Conference*.
- Harris, L. & Gurel, E. (1986) Price and volume effects associated with changes in the S&P500 list: new evidence for the existence of price pressures, *Journal of Finance*, 41(4), pp. 815–829.

- Hegde, S. & McDermott, J. (2003) The liquidity effects of revisions to the S&P 500 index: An empirical analysis, *Journal of Financial Markets*, 6(3), pp. 413-459.
- Yahoo Finance web site, available at: <https://finance.yahoo.com/> (November 18, 2022).
- Jain, P. (1987) The effect on stock price of inclusion or exclusion from the S&P 500, *Financial Analysts Journal*, 43(1), pp. 58-65.
- Kahneman, D. & Tversky, A. (1974) Judgment under Uncertainty: Heuristics and Biases, *Science*, 185(4157), pp. 1124-1131.
- Kasch, M. & Sarkar, A. (2011) *Is There an S&P 500 Index Effect?* (New York: Federal Reserve Bank of New York Staff Reports).
- Lin, E. C. (2018) The effect of dow jones industrial average index component changes on stock returns and trading volumes, *The International Journal of Business and Finance Research*, 12(1), pp. 81-92.
- Lu, M. P. & Ahmad, Z. (2019) Impact of additions and deletions from stock index in malaysia: the role of opinion divergence theory, *International Journal of Business and Society*, 20 (2), pp. 709-729.
- Lynch, A. & Mendenhall, R. (1997) New evidence on stock price effects associated with changes in the S&P 500 indeks, *Journal of Business*, 70(3), pp. 351-383.
- Masse I., Hanrahan, R., Kushner, J. & Martinello, F. (2000) The effect of additions to or deletions from the TSE 300 index on Canadian share prices, *Canadian Journal of Economics*, 33(2), pp. 341-359.
- MacKinlay, A. C. (1997) Event Studies in Economics and Finance, *Journal of Economic Literature*, 35(1), pp. 13-39.
- Merton, R. C. (1987) Presidential address: A simple model of capital market equilibrium with incomplete information, *Journal of Finance*, 42(3), pp. 483-510.
- Preston, H. & Soe, A. M. (2021) *What Happened to the Index Effect? A Look at Three Decades of S&P 500 Adds and Drops*, available at: <https://www.spglobal.com/spdji/en/research/article/what-happened-to-the-index-effect-a-look-at-three-decades-of-sp-500-adds-and-drops/> (November 16, 2022).
- Qin, N. & Signal, V. (2015) Indexing and Stock Price Efficiency, *Financial Management*, 44(4), pp. 857-904.
- Renshaw, A. (2020) The Weakening Index Effect, *The Journal of Index Investing*, 11(1), pp. 17-31.
- Ross, S., Westerfield, R. & Jordan, B. (2015) *Fundamentals of Corporate Finance* (New York: McGraw Hill).
- Shleifer, A. (1986) Do demand curves for stocks slope down?, *Journal of Finance*, 41(3), pp. 579-590.
- Zitman, A. (2006) *The price and volume effects around changes in the composition of the AEX-index*, (Amsterdam: Universiteit van Amsterdam).





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