

# Economic Horizons



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## EDITORIAL

After conducting the double-blind peer review process, Issue 2 Volume 28 Year 2026 of the scientific journal *Economic Horizons* contains six original scientific papers and the Acknowledgement to the reviewers of the manuscripts submitted to the Editorial Board of the Journal in the year 2025.

The thematic variety of the papers published in this issue of the Journal confirms that modern economic research studies are increasingly surpassing the boundaries of individual disciplines, linking macroeconomic, financial, institutional, and organizational perspectives with the intention to provide answers to complex development challenges. The authors of the contributions analyze the issues of special significance for economic policymakers, financial institutions, business organizations and the academic community, simultaneously relying on contemporary methodological approaches and relevant empirical evidence.

The paper by the author *Saša Obradović* considers the relationship between military expenditure and economic growth in the Western Balkan countries. Starting from the fact that these countries have been endeavoring to simultaneously preserve their political stability and accelerate their economic development during the last decades, the author applies the panel ARDL-PMG model and the fully modified ordinary least squares method to show the existence of a positive long-term impact of military expenditure on economic growth. The obtained results offer a new empirical basis for considering the role of investing in the defense sector in the context of the development policies of the Western Balkan countries.

The authors *Olha Mulka, Iryna Leshchukh, Mariana Bil* and *Ihor Baranyak* conduct research in the socioeconomic resilience of the Ukrainian regions to multiple crisis shocks, including the 2014 sociopolitical crisis, the COVID-19 pandemic, and the consequences of the Russian invasion. By applying a comprehensive methodological framework based on a combination of temporal and spatial composite indicators, the authors assess of regional losses, recovery capacities, and adaptive potentials, pointing at the expressed differences between the regions. The results confirm that long-term resilience does not depend only on the ability to overcome direct consequences of a crisis but also on strengthening of institutional, demographic and development capacities, which represents an important contribution to understanding the postwar economic recovery process.

In the paper written by *Velimir Lukić* and *Svetlana Popović*, the transmission of a monetary policy to deposit interest rates in the conditions of a high degree of the Euroization of the financial system of the Republic of Serbia is considered. The authors demonstrate that there are significant differences between transmission to dinar and foreign-currency deposit interest rates, and the results simultaneously indicate a stronger relationship between interest rates on foreign-currency (euro) deposits and the trends in the Eurozone. The findings of the research study contribute to a better understanding of the specificity of monetary transmission in small open economies with pronounced Euroization.

The authors *Nikolaos Kalantzopoulos, Athanasios Mandilas, Stavros Valsamidis* and *Dimitrios Kourtidis* analyze the determinants of non-performing loans in the Greek banking sector during and after the financial crisis. Using a voluminous set of macroeconomic and bank indicators, the authors

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confirm a strong relationship between the quality of a loan portfolio and the macroeconomic environment. The research study indicates that a sustainable recovery of a banking system simultaneously requires an improvement of macroeconomic performance and solving structural causes of the occurrence of non-performing loans, with the conclusions simultaneously going beyond the national framework and opening room for broader research at the Eurozone level.

The authors *Jadranka Đurović Todorović, Marina Đorđević, Milica Ristić Cakić* and *Branimir Kalaš* deal with one of the current issues in contemporary tax policy – the differences between the statutory and effective tax rate on the profit made by businesses operating in the OECD countries. The analysis carried out in this paper shows that tax incentives have a decisive role in shaping an effective tax burden, thus confirming the existence of statistically significant differences between the two rates in the period under observation. The findings of the research provide useful guidelines for improving the transparency of tax systems and a more efficient shaping of the tax policy.

Starting from the fact that trust is the foundation of successful leadership, the authors *Radmila Bjekić, Maja Strugar Jelača, Slobodan Marić* and *Marko Aleksić* examine not only the direct relationship between trust in a leader and the outcome of leadership but also the mediating role of the psychological empowerment of employees in that relationship. Using the PLS-SEM method, they confirm that trust in a leader positively influences leadership outcomes, and that psychological empowerment is a significant mechanism through which this influence is further strengthened. The paper contributes to understanding the role of trust and psychological empowerment in modern leadership, simultaneously indicating their

significance for the improvement of organizational performance and the development of more effective leadership practices, especially in the business environment of developing countries.

Perceived together as a whole, the papers published in this issue of the *Journal* indicate a broad spectrum of challenges which contemporary economies are being faced with – from security, resilience and sustainable development issues, via the issues related to monetary and tax policies, to the issues of the stability of a financial system and the improvement of organizational performance. Their common characteristic implies reliance on rigorous empirical analyses and contemporary research methodologies, which allows them to make a valuable contribution to the development of economic science and give useful implications for economic policymakers and business practice.

Issue 2 Volume 28 Year 2026 also contains the Acknowledgement to the reviewers of the manuscripts submitted to the Editorial Board of the *Journal* in the year 2025, of which the papers that had been positively rated in the double-blind peer review process were published in the *Journal* as original scientific and review papers. On behalf of the Editorial Board of the *Journal*, and on my own behalf, I express my gratitude to the authors of the contributions published in Issue 2 of the *Journal*. At the same time, our special gratitude goes to the reviewers, whose constructive and critical comments and suggestions to the authors of the submitted manuscripts have contributed to the quality level of the published papers.

The publishing of the *Economic Horizons Journal* is financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, Decision No.: 451-03-488/2026-03/2 as of April 16<sup>th</sup>, 2026.

Vladimir Mihajlović  
Editor-in-Chief

*Vladimir Mihajlović* is an associate professor at the Faculty of Economics of the University of Kragujevac, where he earned his PhD degree in the scientific field of General Economics and Economic Development. His main fields of scientific research pertain to the development of economic thought, macroeconomic analysis and modeling, and the labor market.

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# MILITARY EXPENDITURE, POLITICAL STABILITY AND ECONOMIC GROWTH IN THE WESTERN BALKAN COUNTRIES

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The Western Balkan countries have invested considerable resources in order to achieve peace, establish political stability and sustain economic growth. This study aims to empirically assess the impact of military expenditure on economic growth in a panel of five Western Balkan countries from 2001 to 2022. The research uses a panel autoregressive distributed lag (ARDL-PMG) model to estimate the short-run and long-run relationships between the variables of interest. In addition, the fully modified least squares method is applied to ensure the reliability of the findings. A positive relationship was identified between military spending, and economic growth. The results strongly indicate that military expenditure is beneficial for economic growth. The empirical findings of the study provide support for the view that policymakers should increase investment in the military defense sector so as to contribute to economic growth.

**Keywords:** military expenditure, economic growth, panel, Western Balkans, ARDL-PMG

JEL Classification: C50, H56, 011

## INTRODUCTION

The study of the economic and social impacts of military expenditure and political risks remains a fascinating and important field of research in defense economics. One of the basic issues every country is faced with regardless of its development is how to preserve its security and perform the optimal allocation of resources for military purposes. It attracts considerable attention from politicians,

economists, military and security structures, as well as researchers in the field of defense and security economics. According to traditional reasoning, military and security expenditures represent a financial burden and, first of all, a burden for underdeveloped economies. There is always a possibility of resource allocation imbalances, with a greater emphasis on increasing combat readiness and defense investments over investments in education, health, or research and development activities. These sectors, which include investments in human capital, are crucial for long-term economic growth and create the basis for socio-economic development.

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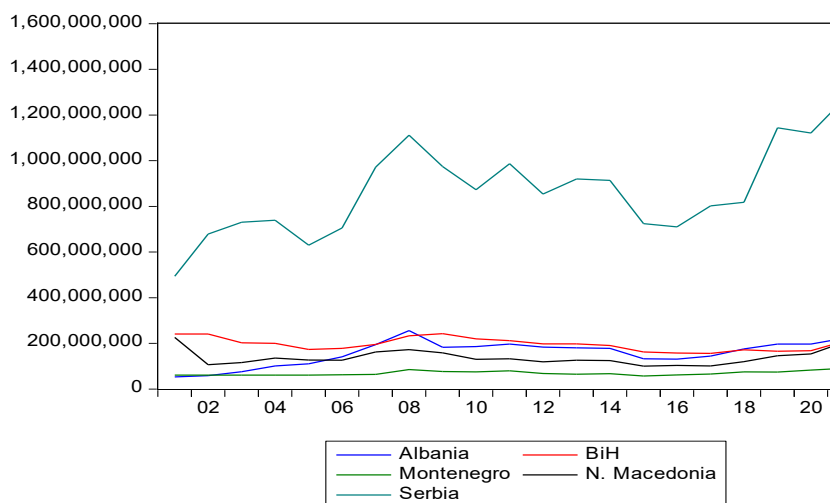
It is broadly accepted that, in an unstable region, including the Western Balkans, some countries deliberately allocate increased parts of their limited economic resources for non-productive purposes in the form of investments in the military and security. In the absence of international cooperation to alleviate political pressure, military expenditure may escalate within the Balkans as each country tends to outdo its neighbors in order to protect its security, which results in an overall increase in regional defense spending with a diversified impact on overall security. There are various mechanisms through which increased military expenditure can have an impact on economic growth performance. Any initial increase in defense and security spending potentially reduces current resources, which are allocated to other uses in the domestic economy. The primary economic goals of both underdeveloped and developed countries are to achieve long-term sustainable economic growth and prosperity.

There is a significant body of research in the economic implications of military expenditures. However, there is no consensus on whether military spending is beneficial or detrimental to economic growth. One of the starting points in the literature is the Keynesian perspective, according to which military expenditure

is justifiably treated as a component of government spending. Government expenditures are a part of the aggregate demand that the government can stimulate with its measures in the short-term determination of income (Obradović & Lojanica, 2019). Some relatively recent studies have consistently found the evidence consistent with the Keynesian perspective on the positive impact of military expenditure on a country's total output (Khalid & Noor, 2018; Raju & Ahmed, 2019).

Figure 1 shows the analysis of the trend of military expenditure in the Western Balkan countries. Military expenditure is stated in the current value of US dollars. The trend analysis indicates a significant increase in the expenditures and significantly higher expenditures for defense from 2001 to 2022 in the case of Serbia. There is also a consistently sustainable share of defense allocations for all the other countries, which has been in a slight increase during the beginning of this decade.

This study primarily aims to conduct an objective analysis and objectively quantify the effects of military expenditure on economic growth in a panel of Western Balkan countries. All the sample countries were assumed to have comparable attributes. This study contributes to the growing body of research in



**Figure 1** The trends in the military expenditure for the period from 2001 to 2022 in the Western Balkan countries

Source: Author

the impact of defense spending on economic growth in several ways. The research examines the impact of military expenditure and political (in)stability in relation to economic performance for a group of 5 non-EU countries, where there was a significant increase in the military expenditure during the investigated period. None of the current studies address this group of non-EU countries in this line of inquiry.

In the study, the panel ARDL-PMG technique was used as the key, and the methodology of unit root tests was implemented in order to ensure the reliability and accuracy of the results. In addition, the modified least-squares method is used to identify the relationships between the variables. Additionally, this model is used to prevent any potential errors in specifying the equations of significance. Finally, this study represents an attempt to thoroughly understand the complex situation in the Balkans from another angle. Therefore, the lack of information through such research is overcome, which increases the body of the knowledge about the impact of military expenditure on economic growth. The subject matter of this research study is the primary examination of the impact of military expenditure on economic growth in the Western Balkan countries, with a special focus on the identification of the long-term and short-term effects in the period from 2001 to 2022.

The hypotheses tested in the paper are as follows:

The basic hypothesis H1: Military expenditure has a positive and statistically significant impact on economic growth in the Western Balkan countries, especially in the long run.

Auxiliary H1: There is a long-term equilibrium (cointegration) relationship between military expenditure and economic growth.

Auxiliary H2: The impact of military expenditure on economic growth differs in the short run and in the long run.

Auxiliary H3: Political stability has a positive and statistically significant effect on economic growth.

The rest of the paper is structured as follows: After the literature review, the third part focuses on the

practical approach and data analysis techniques, including the findings obtained through the empirical research and a subsequent analysis and interpretation. The last section is the conclusion of the research procedure.

## LITERATURE REVIEW

Multiple studies have been conducted so far to empirically confirm the relationship between the variables of interest applying different models, estimation methodologies, country samples and data periods. Different types of government spending have different effects on economic growth. Public infrastructure, research and development activities, as well as education, are usually considered the public goods that contribute positively to economic growth, which is basically consistent with endogenous growth theories (Aschauer, 1989; Barro, 1990; Morrison & Schwartz, 1996). Conversely, there is also a hypothesis that some government spending increases, especially in non-productive areas, leading to a decrease in the output growth. S. Devarajan, V. Swaroop and H. F. Zou (1996) conducted a study to model the relationship between different components of government expenditure, taking into account their initial share. They found a positive correlation between the current government spending and economic growth. However, they also found that the physical capital components of government spending had a negative impact. Although the theory emphasizes the importance of productive government investment in achieving a better stable growth rate of the economy, some evidence does not support this relationship. This hypothesis is supported by the observations of G. Glomm and B. Ravikumar (1997). According to S. Deger and S. Sen (1995), if the burden in the form of military expenditure is a small share of the total economy, it is possible to have benefits that exceed the costs and result in a positive impact on the growth rate.

Military spending has a significant impact on economic growth through a variety of possible pathways. A study by O. R. Lobont, O. R. Glont,

L. Badea and S. Vatavu (2019) found that military expenditure had several beneficial effects on capital, labor, economic growth, and an efficient use of the existing resources in the overall economy. H. S. Atesoglu (2002) found a strong and positive correlation between the military spending and the total economic output in the United States between 1947 and 2000. C. Borch and M. Wallace (2010) found that the states with higher levels of military spending were better equipped to mitigate the negative effects of economic downturns compared to the states with lower levels of military spending in 49 US states from 1977 to 2004. When there is a decrease in aggregate demand compared to expected supply, an increase in military expenditure generally leads to higher capacity utilization, increased profitability, and subsequently to improved investment and the overall output (Faini, Annez & Taylor, 1984). In their study, M. A. Khalid and Z. M. Noor (2018) found a direct positive relationship between military spending and economic growth in 67 developing countries from 2002 to 2010. J. Malizard (2010) discovered a reciprocal causal relationship between military expenditure and economic growth in France from 1960 to 2008. M. R. Farzanegan (2014) found the evidence that military expenditure had a beneficial effect on economic growth in Iran from 1959 to 2007. In their empirical study, P. K. Narayan and B. Singh (2007) confirmed a Granger causal relationship between defense spending and exports, and between exports and national income (GDP), which suggests that defense spending indirectly affects national income in the short run. An empirical analysis conducted by J. Yildirim, S. Sezgin and N. Öcal (2005) finds that military expenditure has a positive impact on the national GDP of the Middle Eastern countries and Turkey during the period between 1989 and 1999.

On the other hand, increased military spending may tend to reduce economic productivity as it diverts more revenue to cover military-related costs. Contrary to the basic hypothesis, a part of the literature starts from the assumption that military expenditure can harm economic growth due to the crowding-out effect, which represents an alternative theoretical framework. R. Faini *et al* (1984) found that the countries with higher military burdens experienced slower economic growth between 1952 and 1970. Specifically,

a 10% increase in military spending resulted in a 0.13% loss in annual economic growth. This forces the government to raise taxes or borrow money from the capital market so as to keep the budget under control. This alternative is harmful to economic development as it leads to an increase in interest rates, a fall in investment and consumer demand, and inhibits economic growth (Borch & Wallace, 2010). In their study, C. Shaaba Saba and N. Ngepah (2019) found a causal relationship between military spending and economic growth in 35 African countries from 1990 to 2015. The researchers found the following patterns: (i) there was no causal relationship between the seven nations; (ii) in two countries, there was unidirectional causality from military expenditure to economic growth; (iii) in 14 countries, there was a unidirectional relationship from economic growth to defense spending, and (iv) in 12 countries, there was a two-way relationship between defense investment and economic growth. In short, the GMM method indicated that military expenditure had a significant negative impact on economic growth in Africa.

C. C. Lee and S. T. Chen (2007) analyzed the long-term causality of the links between defense expenditures and the national GDP using the panel data for 62 non-OECD countries from 1988 to 2003. These countries established bidirectional causality between the observed variables. Similarly, research by J. P. Dunne (2000) shows that military spending does not positively affect economic growth. In fact, it is more likely to have a negative effect. In their study, G. D'Agostino, J. P. Dunne and L. Pieroni (2017) found a significant negative relationship between military expenditure and economic growth in a large panel of countries between 1970 and 2014. T. Klein's (2004) empirical research shows that military expenditure had a detrimental effect on the growth rate in Peru from 1970 to 1996. S. Abu-Bader and A. S. Abu-Qarn (2003) found that military spending hindered economic growth, while civilian spending had a beneficial effect on growth in Egypt, Israel, and Syria during the periods from 1975 to 1998, from 1967 to 1998, and from 1973 to 1998. H. C. Chang, B. N. Huang and C. W. Yang (2011) found that military expenditure had a detrimental effect on economic growth in low-income countries. H. C. Chang *et al* (2011) observed

this effect in a sample of 90 countries from 1992 to 2006. In a study conducted by S. Deger (1986), military expenditure was found to have had a negative impact on economic growth and development in a group of 50 developing countries between 1965 and 1973, which suggests that disarmament undoubtedly represents an opportunity to increase economic performance. Therefore, there is no completely clear evidence that would indicate that defense investments or expenditures of this type contribute to economic growth.

## METHODOLOGY AND ESTIMATION STRATEGY

In this research study, the growth equation proposed by R. M. Solow (1956) is used as the basis. The equation includes material capital and labor as inputs for formatting the aggregate production function. The Solow model includes three inputs, namely: capital (K), labor (L), and the total factor productivity (A), where the output is Y. Military expenditure is included in the growth equation of the empirical model, as in the previous study by J. P. Dunne and N. Tian (2013). The economy creates production using certain amounts of labor, capital, and the element of the total factor productivity, within which different elements can be approximated, e.g. from technical progress to the institutional quality of the system. The model can be expressed in its basic form as follows:

$$Y = F(MiEx, Empl, PoSt) \quad (1)$$

This study uses a multivariate model to empirically

determine the impact of military expenditure in the current dollar terms (MiEx), along with the other control variables (employment relative to the total population (Empl), the index of political stability (PoSt)) on economic growth in terms of the GDP per capita (GDP) for the Western Balkan countries (Serbia, Montenegro, Bosnia and Herzegovina, North Macedonia, and Albania). The data were taken from the World Bank's website for the period from 2001 to 2022 (World Bank, 2024). The description and origin of the variables are given in Table 1.

Previous research projects, such as those conducted by J. P. Dunne and E. Nikolaidou (2012), O. R. Lobont *et al* (2019) and R. K. Mohanty, S. Panda and B. Bhuyan (2020), and, also used similar growth models that include military expenditure as a proxy for defense investment or military power. The multivariate regression equation used in this study can be represented symbolically as follows:

$$\ln GDP_{i,t} = \alpha_0 + \alpha_{mi} \ln MiEx_{i,t} + \alpha_{st} \ln PoSt_{i,t} + \alpha_{qt} \ln Empl_{i,t} + \varepsilon_{i,t} \quad (2)$$

In the equation with the dependent and independent variables,  $\alpha$  symbolizes the coefficients,  $\ln$  is the logarithmic value,  $\varepsilon_{i,t}$  is the error expression, while  $i$  and  $t$  take values from 1 to 5, i.e. from 1 to 22. The two basic methodological procedures of analysis are applied in the paper: the autoregressive distributed lag technique and the least squares technique.

M. H. Pesaran, Y. Shin and R. P. Smith (1999) introduced the error-corrected pooled mean autoregressive distributed lag (ARDL) analytical model as a new cointegration test. M. H. Pesaran *et al* (1999) found that the panel ARDL method can be

**Table 1** The description of the variables

| Abbreviation | Variable             | Detail                                                    | Sources (2024)                              |
|--------------|----------------------|-----------------------------------------------------------|---------------------------------------------|
| GDP          | Economic growth      | GDP per capita (the current US\$)                         | WDI (World Development Indicators, 2024)    |
| Empl         | Employment           | Employment to the population ratio, 15+, total (%)        |                                             |
| MiEx         | Military expenditure | Military expenditure (the current US\$)                   | WGI (Worldwide Governance Indicators, 2024) |
| PoSt         | Political stability  | Political stability and the absence of violence/terrorism |                                             |

Source: Author

used for variables with different levels of integration, whether integrated in order I(0) or in order I(1). A model structured in this way produces reliable coefficients even in the presence of endogeneity. This is because it includes the lagged values of the dependent and independent variables.

$$\begin{aligned} \ln GDP_{i,t} = & \alpha_0 + \sum_{j=1}^p \alpha_{pi} \ln GDP_{i,t-j} + \sum_{j=1}^q \alpha_{qi} \ln EMPL_{i,t-j} + \\ & + \sum_{j=1}^m \alpha_{mi} \ln MiEx_{i,t-j} + \sum_{j=1}^s \alpha_{si} \ln PoSt_{i,t-j} + \varepsilon_{i,t} \quad (3) \end{aligned}$$

This study uses the panel ARDL approach in order to investigate the long-term relationship between the variables of interest. Furthermore, the model estimates the impact of military expenditure on economic growth. The error correction model offers an insight into the equilibrium adjustment mechanism in the behavior of the model parameters. This strategy offers the advantage of using a compact Equation (3), as opposed to alternative cointegration approaches. ARDL is particularly helpful for representing both the current and long-term changes inside a unified framework. It enables the analysis of how the variables react to sudden changes in the short run, simultaneously capturing the longer-term equilibrium between them. The ARDL model can be described by a log-linear form, where  $\Delta$  and  $\varepsilon$  are the first difference operators and the error terms for white noise, respectively. The coefficient of ECM ( $\beta$ ) tells us how quickly the variables come together to form an equilibrium. For a long-term relationship to exist, this coefficient must be statistically significant. The equation can be specified as follows:

$$\begin{aligned} \Delta \ln GDP_{i,t} = & \alpha_0 + \sum_{j=1}^p \alpha_{pi} \Delta \ln GDP_{i,t-j} + \\ & + \sum_{j=1}^q \alpha_{qi} \Delta \ln EMPL_{i,t-j} + \\ & + \sum_{j=1}^m \alpha_{mi} \Delta \ln MiEx_{i,t-j} + \\ & + \sum_{j=1}^s \alpha_{si} \Delta \ln PoSt_{i,t-j} + \beta ec_{t-1} + \varepsilon_{i,t} \quad (4) \end{aligned}$$

As an additional econometric verification, Fully Modified Ordinary Least Squares (FMOLS) was used, which provides numerous benefits in comparison to alternative econometric methodologies, particularly when used for time series analysis and the estimation of long-term relationships. The FMOLS method was initially created by P. C. Phillips and B. E. Hansen (1990), and only to be refined later by P. Pedroni (1999) for the method to be applicable to panel data. It is a robust strategy for dealing with linked variables since it considers the endogeneity of regressors and produces consistent estimates of long-term coefficients. Not only does this technique provide efficient and reliable estimates but it also ensures that the results are unaffected by simultaneity biases that may occur throughout the cointegration process. This methodology enables an accurate and streamlined estimation of the cointegration vector. It is crucial to consider this aspect in order to accurately capture the patterns and prevent any distortion in estimations due to possible autocorrelation in the data. This method is recognized for its relatively high efficiency, particularly when dealing with small sample sizes.

## DISCUSSION

Table 2 presents the summary, descriptive statistics of the panel data. In addition, the lower part of the table presents the pairwise series correlation results. The results show that all the variables follow a normal distribution, while the mean value of the error term is within the tolerance limits and the finite variance, as is shown by the Jacques-Berra statistic. The correlation analysis reveals that there is a negative relationship between military expenditure and political stability. In contrast, there is a positive relationship between the employment rates and the economic growth, as well as between military expenditure and the basic elements of the production function. The correlation analysis indicates that there is no indication of multicollinearity between the series.

Before applying the basic methodological procedures of panel data analysis, it is essential to determine and understand the integration properties of the observed

variables. Đ. Kotarac and Z. Popović (2025) believe that panel stationarity check tests are necessary to obtain robust results.

First-generation panel unit root tests were employed in this research, specifically those by G. S. Maddala and S. Wu (1999), A. Levin, C.-F. Lin and C.-S. James Chu (2002) and K. S. Im, M. H. Pesaran and Y. Shin (2003). The stationarity-related results obtained in this analysis are shown in Table 3, where one variable

is stationary at the level, whereas the others are stationary after the first difference.

For further analysis, T. Breusch and A. Pagan's (1980) and M. H. Pesaran's (2004, 2007) techniques were applied in order to assess the presence of cross-sectional dependence in the panel data. To mitigate the issue of reliance on cross-sectional studies, it is important to consider that it may result in incomplete outcomes. Table 4 presents the findings of the cross-

**Table 2** The descriptive statistics and the correlation matrix of the variables

| Variables     | lnGDP  | lnEmpl | lnMiEx | lnPoSt |
|---------------|--------|--------|--------|--------|
| Mean          | 8.434  | 3.703  | 19.098 | 3.605  |
| Median        | 8.517  | 3.737  | 18.970 | 3.610  |
| Max.          | 9.199  | 3.970  | 21.078 | 4.304  |
| Min.          | 7.155  | 3.367  | 17.790 | 1.945  |
| Std. dev.     | 0.465  | 0.154  | 0.867  | 0.366  |
| Jarque - Bera | 13.108 | 6.077  | 10.263 | 46.900 |
| Probability   | 0.001  | 0.047  | 0.005  | 0.000  |
| lnGDP         | 1.000  |        |        |        |
| lnEmpl        | 0.257  | 1.000  |        |        |
| lnMiEx        | 0.129  | 0.136  | 1.000  |        |
| lnPoSt        | 0.523  | 0.356  | -0.180 | 1.000  |

Source: Author

**Table 3** The unit root tests

| Test                        | Variables | Level     |       | First difference |       |
|-----------------------------|-----------|-----------|-------|------------------|-------|
|                             |           | Stat.     | Prob. | Stat.            | Prob. |
| Levin, Lin and Chu t*       | lnGDP     | -5.742*** | 0.000 | .                | .     |
|                             | lnEmpl    | 1.171     | 0.879 | -4.246***        | 0.000 |
|                             | lnMiEx    | 0.711     | 0.761 | -2.686***        | 0.003 |
|                             | lnPoSt    | 0.835     | 0.798 | -2.123**         | 0.016 |
| Im, Pesaran and Shin W-stat | lnGDP     | -3.302*** | 0.000 | .                | .     |
|                             | lnEmpl    | 1.721     | 0.957 | -3.738***        | 0.000 |
|                             | lnMiEx    | 0.250     | 0.598 | -3.130***        | 0.000 |
|                             | lnPoSt    | 0.068     | 0.527 | -5.116***        | 0.000 |
| ADF – Fisher Chi-square     | lnGDP     | 28.399*** | 0.001 | .                | .     |
|                             | lnEmpl    | 4.929     | 0.895 | 32.521***        | 0.000 |
|                             | lnMiEx    | 7.472     | 0.680 | 27.218***        | 0.002 |
|                             | lnPoSt    | 6.959     | 0.729 | 43.373***        | 0.000 |
| PP – Fisher Chi-square      | lnGDP     | 64.534*** | 0.000 | .                | .     |
|                             | lnEmpl    | 3.024     | 0.980 | 47.185***        | 0.000 |
|                             | lnMiEx    | 14.673    | 0.144 | 59.386***        | 0.000 |
|                             | lnPoSt    | 23.262    | 0.009 | 143.349***       | 0.000 |

Notes: (\*\*\*) designates significance at the 1% significance level. (\*\*) designates significance at the 5% significance level.

Source: Author

sectional dependence test. The results provide strong evidence to reject the null hypothesis of no cross-sectional dependence, as is indicated by statistically significant p-values. The findings support the presence of cross-sectional interdependence for the variables (military expenditure, employment relative to the total population, the political stability index, and the GDP per capita).

The CADF test was formulated to overcome ambiguity in the presence of cross-sectional dependence (Pesaran, 2007). The results of the panel unit root test in the data modeling of this study are given in Table 5. The results are the basis for testing cointegration within the panel set. The final outcomes of the first difference unambiguously indicate stationarity.

**Table 4** The cross-sectional dependence tests

| Variable | Breusch-Pagan LM | Pesaran scaled LM | Pesaran CD |
|----------|------------------|-------------------|------------|
| lnGDP    | 216.076***       | 46.080***         | 14.699***  |
| lnEMPL   | 93.633***        | 18.701***         | 18.582***  |
| lnMiEx   | 67.859***        | 12.937***         | 6.991***   |
| lnPoSt   | 43.840***        | 7.566***          | 1.328      |

Note: (\*\*\*) designates significance at the 1% significance level.

Source: Author

**Table 5** The stationarity test

| Variable        | CADF Statistika |
|-----------------|-----------------|
| lnMiEx          | -2.221          |
| lnGDP           | -1.804          |
| lnEmpl          | -1.973          |
| lnPoSt          | -3.092***       |
| $\Delta$ lnMiEx | -3.525***       |
| $\Delta$ lnGDP  | -2.993***       |
| $\Delta$ lnEmpl | -3.174***       |
| $\Delta$ lnPoSt | -3.517***       |

Note: (\*\*\*) indicates significance at the 1% level.

Source: Author

This research study examines the cointegration relationship among all the variables by employing Kao's residual cointegration tests and Pedroni's panel cointegration tests. The empirical findings in the Western Balkan countries provide the evidence that all the variables are cointegrated, therefore supporting the hypothesis of cointegration. Hence, the empirical findings validate the presence of a stable, long-term equilibrium involving military expenditure, employment relative to the total population, the political stability index, and the GDP per capita (Tables 6 and 7).

All the variables used in the research study are combined in terms of the order of integration, i.e. in the outcome, they are I(1) in the panel. There are no I(2) variables in the model. The approach of the ARDL-PMG technique is useful in such cases for the purpose of empirical evaluation. In order to provide verified and reliable results, this study additionally used the fully modified least squares technique. The technique of autoregressive distributed lag based on the pooled mean group investigates the long-term balance and the short-term parameters between the variables. The data presented in Table 8 clearly show that certain empirically examined explanatory variables have a significant impact on the economic growth of the Western Balkan economies. The results of the ARDL analysis show that most regressors are statistically significant, which confirms and indicates that the estimated model is both theoretically and statistically acceptable. All the regressors show likely signs of their coefficients.

The findings presented in Table 8 show that there is a positive relationship between military expenditure and economic growth over a long period of time. The empirical evidence supports the likely positive impact of military expenditure on economic growth. The military expenditure variable has a statistically significant estimated coefficient of 0.385 in the long run, with the significance level of 1%. In other words, the empirical findings show that a 1% increase in military spending will increase economic growth by 0.385%. The findings are consistent with the results of P. K. Narayan and B. Singh (2007), M. R. Farzanegan (2014) and O. R. Lobont *et al* (2019), whose studies

**Table 6** Pedroni's cointegration test

| Tests               | statistic | p - value | Weighted statistic | p - value |
|---------------------|-----------|-----------|--------------------|-----------|
| Panel v-statistic   | -0.718    | 0.763     | -0.422             | 0.664     |
| Panel rho-statistic | 0.359     | 0.640     | 0.261              | 0.603     |
| Panel PP-statistic  | -1.542*   | 0.061     | -1.918**           | 0.027     |
| Panel ADF-statistic | -1.831**  | 0.033     | -2.416***          | 0.007     |
| Group rho-statistic | 1.180     | 0.881     |                    |           |
| Group PP-statistic  | -2.293**  | 0.010     |                    |           |
| Group ADF-statistic | -2.842*** | 0.002     |                    |           |

Notes: The null hypothesis: no cointegration. The trend assumption: the deterministic intercept and the trend. Lag selection: automatic SIC with the max lag of three. The Newey–West bandwidth selection with the Bartlett kernel is used. The use of the asterisks: (\*\*\*) denotes the statistical rejection level of the null hypothesis, which states that there is no cointegration, at the significance level of 1%; (\*\*) designates the significance level at 5%, and (\*) represents the significance level of 10%.

Source: Author

**Table 7** Kao's cointegration test

|                   | t-statistic | p - value |
|-------------------|-------------|-----------|
| ADF               | -4.076***   | 0.000     |
| Residual variance | 0.010       |           |
| HAC variance      | 0.018       |           |

Notes: The null hypothesis: no cointegration. The trend assumption: no deterministic trend. The automatic lag selection based on SIC with the max lag of three. The Newey–West automatic bandwidth selection and the Bartlett kernel. The use of the asterisks: (\*\*\*) designates significance at the 1% significance level.

Source: Author

showed a positive relationship between military spending and economic growth, which is consistent with the principles of the Keynesian approach. The Western Balkan countries, which allocate significant funds for their military expenditures, also engage in the export of weapons to other countries, thus strengthening their foreign exchange reserves and hence the positive connection in terms of economic growth. However, the findings of this study contradict the research conducted by G. D'Agostino *et al* (2017) and C. Shaaba Saba and N. Ngepah (2019).

The Western Balkan countries face numerous obstacles and must prioritize the promotion of

economic development and political stability, which in turn improves their social well-being. When these countries achieve the desired level of political stability and economic growth, their respective governments can also allocate increased funds for military purposes. Table 8 clearly shows that political stability has no effect on economic growth, and with statistical significance. Therefore, in the long run, the obtained estimated coefficient, which indicates that an increase in political stability, i.e., a decrease in political risk, results in no statistically significant influence on economic growth. On the other hand, the employment ratio is an approximation of labor as a factor input in the production function, which is one of the key components of the production process. The results of the ARDL-PMG analysis indicate that this ratio has a positive effect on long-term economic growth. The computed coefficient is 1.002, which is statistically significant at the 1% level in the long run. The empirical research demonstrates that a one-unit increase in this variable results in a 1% rise in economic growth.

The findings accounted for in Table 9 validate the relative reliability and neutrality of the obtained results as various econometric methods do not produce completely identical outcomes. The results of the fully modified least squares estimators confirm that military expenditure has a positive impact on the

**Table 8** The ARDL-PMG results; the selected model: ARDL(1,1,1,1)

| Variable               | Coefficient | Std. error | p-values |
|------------------------|-------------|------------|----------|
| Long run equation      |             |            |          |
| LEMPL                  | 1.002***    | 0.227      | 0.000    |
| LMIEX                  | 0.385***    | 0.101      | 0.000    |
| LPOST                  | -0.027      | 0.094      | 0.770    |
| Short run equation     |             |            |          |
| ECM t-1                | -0.294***   | 0.092      | 0.002    |
| $\Delta(\text{LEMPL})$ | 0.512***    | 0.138      | 0.000    |
| $\Delta(\text{LMIEX})$ | 0.332***    | 0.049      | 0.000    |
| $\Delta(\text{LPOST})$ | 0.001       | 0.033      | 0.953    |
| C                      | -0.611***   | 0.137      | 0.000    |

Note: (\*\*\*) designates significance at the 1% significance level.

Source: Author

economic growth of the Western Balkan countries. There is no evidence suggesting any detrimental effect of military expenditure on economic growth. All the calculated coefficients exhibit strong statistical significance and provide robust support for the empirical findings of the ARDL-PMG technique.

## CONCLUSION

Extensive studies are conducted so as to analyze the relationship between military expenditure and economic growth. However, they suggest that no final decision can be reached based on the findings. The objective of this research is to experimentally assess the influence of military expenditures, along with the other control variables, on economic growth. The analysis was performed on a sample consisting of five nations outside the European Union, covering the period from 2001 to 2022. The panel data were analyzed using unit root tests to determine the integration order for each variable. The results provide a synthesis of the findings regarding the integration order, particularly the orders  $I(0)$  and  $I(1)$ . Consequently, the panel ARDL-PMG technique was employed. Subsequently, the modified least squares method approach was used so as to validate the

obtained findings. It is a useful analytical approach for a more complete parameter estimation and the validation of results.

The results of the long-term equation indicate the existence of a positive and statistically significant impact of military expenditure on economic growth, which confirms the basic research hypothesis. The coefficient of the military expenditure variable is positive and statistically significant at the 1% level, which suggests that an increase in military expenditure contributes to the growth of the economic activity in the long run. Furthermore, the statistically significant and negative coefficient of the error correction mechanism (ECM) confirms the existence of a long-term equilibrium between the observed variables, i.e. the cointegration relationship between military expenditure and economic growth. In this way, the auxiliary hypothesis that there is a long-term relationship between the variables is confirmed. In the short run, military expenditure also shows a positive and statistically significant impact on economic growth, but with a lower intensity compared to the long-term effect, which indicates differentiated effects over time and confirms the hypothesis of different short-term and long-term impacts. Unlike military expenditures, the political stability variable does not show a statistically significant impact either in the

**Table 9** The results of the alternative econometric technique

| FMOLS              |             |            |         |
|--------------------|-------------|------------|---------|
| Variables          | Coefficient | Std. error | p-value |
| LEMPL              | 1.599***    | 0.332      | 0.000   |
| LMIEX              | 0.648***    | 0.123      | 0.000   |
| LPOST              | 0.422***    | 0.117      | 0.000   |
| Statistics         |             |            |         |
| R <sup>2</sup>     | 0.755       |            |         |
| Adj.R <sup>2</sup> | 0.736       |            |         |

Note: (\*\*\*) designates significance at the 1% significance level.

Source: Author

short term or in the long term, which implies that its role in explaining economic growth in the observed sample cannot be fully empirically confirmed by the primary econometric technique, i.e. the auxiliary hypothesis that there is a positive impact of political stability is not confirmed by applying the panel ARDL-PMG methodology.

Overall, the empirical findings indicate the existence of a stable and positive relationship between military expenditure and economic growth, with this effect being more pronounced in the long run. These results are consistent with the Keynesian approach, according to which government spending, including military spending, can stimulate aggregate demand and economic growth. These data indicate that military expenditure has a promising and consistently favorable effect on economic growth. This phenomenon is especially noticeable in some nations within the observed sample. As these economies grow, their respective governments may contemplate augmenting military expenditure in order to enhance their military powers and capabilities. Policymakers must not restrict military investment exclusively to security reasons. Governments should emphasize allocating their resources in a way that maximizes possibilities for exporting military defense

products. Furthermore, it is imperative to implement incremental actions in order to embrace a strategic and prudent approach that fosters expansion. An increase in military expenditure is expected to significantly bolster an economy. Hence, it is crucial to refrain from diminishing military expenditure while simultaneously upholding investments in other domains of development, such as healthcare and education.

Future research ought to encompass the European Union member nations situated in the Balkan region. Performing a regression analysis for these countries would enable a comparison of the empirical findings. A forthcoming comparative analysis would unquestionably offer decision-makers invaluable insights. From this, it can be inferred that there is a crucial threshold at which military expenditure has a substantial influence on economic growth. Furthermore, it is important to employ other sophisticated econometric methods so as to carry out a relevant analysis to confirm these findings.

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## UKRAINE'S SOCIO-ECONOMIC RESILIENCE IN THE FACE OF SHOCKS: SPATIAL AND TEMPORAL MODELING

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This paper aims to assess the socio-economic resilience of Ukraine's regions in the face of shocks, including the Russian Federation's invasion of Ukraine, territorial annexation, the 2014 socio-political crisis, and the 2020-2021 COVID-19 pandemic. The comprehensive methodological approach applied in this paper combines the construction of temporal and spatial composite indicators of the labor market, and social, demographic, and economic development, with the identification of shock-related losses, the recovery capacity, and the dynamics of vulnerability and recovery. The framework distinguishes between immediate losses and the long-term adaptive capacity. The empirical results show that the two major shocks (the 2014 crisis and the 2020-2021 COVID-19 pandemic) caused significant regional losses, with the deepest labor market decline in Donetsk Oblast and Luhansk Oblast and higher resilience in the western and central regions. Vulnerability lasted for two to three years, while recovery exceeded four years. Overall, resilience depends not only on overcoming immediate shocks but also on strengthening demographic stability, the institutional capacity, and adaptive mechanisms to ensure sustainable postwar recovery.

**Keywords:** resilience, Ukraine, shocks, labor market, demographic situation, recovery

JEL Classification: O15, O20, R33

### INTRODUCTION

The socio-economic resilience of regions is an existential determinant of their development, reflecting the ability of systems to respond effectively to external challenges, adapt to environmental changes, and restore stability after the impact of adverse factors. This capacity requires the creation of

mechanisms for rapid adaptation, the mobilization of resources, and their effective use to mitigate potential risks and threats, including migration. An important feature of Ukraine's socio-economic resilience in wartime conditions is the integration of economic development with the elements of migration security, which involves not only preventing the negative consequences of migration processes but also creating conditions for their effective management. Such integration ensures a more balanced response to shocks and enhances regional adaptability to new realities.

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The synergy between resilience and adaptability strengthens the effectiveness of regional economic policies, which allows for not only the preservation of stability but also the creation of conditions for sustainable growth, improvements in living standards, and the development of social institutions. As a result, resilient regions are capable of maintaining long-term stability and competitiveness in the context of global change. However, the current challenges of Ukraine's socio-economic development (the post-2014 military aggression, migration, pandemics, and systemic destabilization) significantly complicate the implementation of the policies aimed at building resilience. These critical periods demand the rethinking of approaches to managing socio-economic processes, introducing the modern principles and tools that would ensure resilience as a key factor of sustainable progress. In this sense, resilience is not only a condition for recovery but also a new paradigm of economic growth, oriented towards a fair distribution of benefits, the financial self-sufficiency of regions, and the accumulation of a "safety margin" for future shocks.

The subject matter of this study is the socio-economic resilience of Ukrainian regions, defined as a systemic characteristic that determines their ability to withstand, adapt to, and recover from external shocks. Resilience is examined through the interrelation of the labor market dynamics, social and demographic factors, migration processes, and the efficiency of economic development. Particular attention is paid to the response of the regional systems to military aggression, forced migration, pandemics, and macroeconomic crises.

The purpose of the article is to substantiate the conceptual and methodological foundations for assessing socio-economic resilience, measure vulnerability and recovery dynamics under the influence of shocks and identify the key determinants that form the basis for sustainable regional development in Ukraine.

The research is based on the following hypotheses:

H1: Socio-economic resilience is determined both by the degree of economic losses during a shock and by the adaptability and recovery capacities in the post-shock period.

H2: Endogenous and exogenous environmental factors can act as both catalysts and regressors of resilience and economic development, shaping the projection of shock consequences.

The study applies the conceptual framework of resilience theory, integrating the economic, social, and demographic dimensions. Methodologically, resilience is assessed through the spatiotemporal composite indicators of the labor market development, social and demographic stability, and the efficiency of economic development. The calculations consider the depth, duration, and speed of vulnerability; the depth, duration, and speed of recovery; the safety margin; and the degrees of resistance, recovery from and adaptation to shocks. This approach distinguishes between the shock vector (economic losses and immediate vulnerability) and the shock consequence vector (the long-term recovery and adaptation capacity). The empirical basis consists of the regional statistical data for the period from 2010 to 2021, supplemented with projections for the wartime and postwar periods.

## LITERATURE REVIEW

The concept of resilience has become one of the key categories in modern interdisciplinary research. Originally rooted in mechanics, physics, ecology, and psychology, the term later penetrated into the discourse of disaster studies, regional economics, and social sciences. The Latin root *resiliere* ("to jump back") highlights the essence of this category, which is not limited to notions of stability or resistance but emphasizes elasticity, flexibility, and the capacity for renewal after external shocks (Haustova & Reshetnyak, 2023). This understanding has allowed resilience to evolve into a cross-cutting concept that bridges natural and social sciences.

The concept of resilience has undergone a profound evolution from its origins in the natural sciences to its present role as a central category in socio-economic analysis. Initially, resilience was understood within mechanics and physics as the property of a material

to regain its original form after deformation. Later, in ecology, it came to denote the ability of ecosystems to withstand external shocks and maintain stability. In psychology, resilience was linked to the adaptive capacity of individuals in coping with stress and trauma, while in disaster studies it became a critical concept in understanding community responses to natural hazards and extreme events. This interdisciplinary foundation paved the way for transferring the category into the field of economics and social sciences, where resilience began to describe the ability of economic and social systems to adapt to shocks, crises, and long-term structural transformations (Jakopin, 2020). The growing frequency and intensity of crises (financial downturns, pandemics, military conflicts, migration surges (Semiv, Berezivskiy, Baranyak, Mulska & Ivaniuk, 2021), and climate change) stimulated the expansion of the concept, making it a key analytical tool for explaining both the vulnerabilities of socio-economic systems and their adaptive strengths.

In the context of regional economics, resilience reflects the capacity of territories to anticipate, withstand, and recover from shocks without compromising long-term development prospects. This implies not only the “bounce-back” to pre-crisis trajectories but also the potential for positive transformation, the diversification of structures, the upgrading of institutions, and the acceleration of innovation. The transition of resilience from a natural science to a socio-economic category has therefore enriched it with multidimensional content, making it simultaneously a theoretical framework, a practical policy tool, and a methodological challenge.

The UN Office for Disaster Risk Reduction defines it as the ability of systems, communities, and societies exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from their impacts (United Nations Office for Disaster Risk Reduction, 2017). This broad formulation reflects resilience not only as survival but also as transformation in the face of risks. Similarly, A. Mitchell (2013) highlights resilience as the capacity of households, communities, and nations to absorb shocks while positively adapting and reorganizing livelihoods

under long-term pressures. From an economic perspective, resilience is increasingly understood not only as recovery but as anticipation, preparation, and the ability to sustain development even under persistent disruptions. K. A. Foster (2007) stresses this anticipatory dimension, defining regional resilience as the ability to anticipate, prepare for, respond to, and recover from disturbances.

Scholars have further refined these interpretations. J. Fiksel (2006) describes resilience as the ability of a system to survive, adapt, and evolve in the face of uncertainty. O. Novikova and Y. Ostafychuk (2023) stress its practical importance: by embedding resilience mechanisms, institutions and societies can remain viable and effective in complex crisis environments, reducing long-term losses.

This conceptual evolution has laid the foundation for applying resilience to socio-economic systems. Fundamental studies (Simmie & Martin, 2010; Martin, 2012; Carriere, 2016; Levytska, Mulska, Shushkova, Ivaniuk, Vasylytsiv, Krupin & Ivanova, 2022; Melnyk, Ivaniuk, Leshchukh & Halkiv, 2023) focus on the theoretical underpinnings of socio-economic resilience, analyzing its drivers, mechanisms, and institutional frameworks. Empirical studies test these theories under specific shocks: financial and economic crises (Doran & Fingleton, 2016; Voznyak, Mulska, Bil, Patytska & Lysiak, 2022), the COVID-19 pandemic (Eshel, Kimhi & Marciano, 2020; Haldane, De Foo, Abdalla, Jung, Tan, Wu, Chua, Verma, Shrestha, Singh, Perez, Tan, Bartos, Mabuchi, Bonk, McNab, Werner, Panjabi, Nordström & Legido-Quigley, 2021; Melnyk, Leshchukh & Baranova, 2021), and wars or conflicts (Heyets, 2022; Vasylytsiv, Melnyk, Leshchukh, Fleychuk & Ilyash, 2024). Many thematic works also study resilience at the level of spatial or social systems, highlighting sectoral differences and vulnerabilities (Walker, Holling, Carpenter & Kinzig, 2004; Boorman, Fajgenbaum, Ferhani, Bhaskaran, Arnold & Kohli, 2013; Rizzi, Graziano & Dallara, 2018; Voznyak, Patytska, Mulska, Zherybylo & Sorokovyi, 2024).

Against this backdrop, methodological debates have emerged around how best to measure resilience. The

technical approach, most prominently represented by M. Friedman's *plucking model* (Friedman, 1993), interprets resilience as the ability of economies to return to potential growth trajectories after downturns (Shpak, Kulyniak, Novakivskyi & Oleksiv, 2023; Zhu, Ying & Xiang, 2025). This perspective equates resilience with recoverability: actual growth is assumed to converge with potential growth over time. Its limitation is a narrow, mechanical interpretation that overlooks adaptive or transformative capacities.

The ecological approach (Burlutska, 2016; Afolabi, Olanrewaju & Adekunle, 2022; Boiko, Lyzak, Vasylytsiv, Lupak & Ohinok, 2024) shifts the focus towards thresholds and phase transitions. Resilience is measured by the scale of shocks a system can absorb before shifting to a new state. This approach is valuable for highlighting structural transformation, but it tends to underplay recovery dynamics (Vasylytsiv, Mulska, Hrabynska, Ivaniuk & Shopska, 2023). A system that stabilizes after a decade-long recovery period may technically be defined as resilient, but in practice such a system exhibits low adaptability.

The expert approach, relying on composite indices constructed through subjective weighting, offers another perspective. M. Abdul-Rahman, W. Alade and S. Anwer (2023), for example, analyzed campus resilience in Nigeria using AI-based social media analysis and Delphi surveys. Although innovative, such methods are context-dependent, fragmented, and difficult to replicate. In addition to these dominant schools, other authors have attempted to broaden the measurement of resilience. E. Hill, H. Wial and H. Wolman (2008) distinguish between resilient, shock-resistant, and non-resilient systems, but offer no clear operational thresholds. M. Kahsai J. Yu, M. Middleton, P. V. Schaeffer and R. Jackson (2015) propose a territorial resilience index based on the six dimensions: industrial diversity, entrepreneurship, human and social capital (Halkiv, Karyy, Kulyniak, Kis & Adamovsky, 2022), infrastructure, and income diversity. J. Bruneckiene, I. Pekarskiene, O. Palekiene and Z. Simanaviciene (2019) introduce a more comprehensive approach, demonstrating that regional resilience in Lithuania depends on the ability to manage unplanned shocks at the national

and international levels. Recent studies (Carriere, 2016; Mulska, Storonyanska, Patytska, Ivaniuk & Voznyak, 2023; D'Ambrosio & Migheli, 2025) integrate risk theory, spatiotemporal approaches, and labor market analysis, pointing towards the necessity of multidimensional resilience assessment.

This recognition has led to calls for more comprehensive methodologies. Scholars argue that resilience assessment must consider not only the fact of recovery but also the depth, duration, and speed of both vulnerability and recovery, the role of safety margins, and the balance between resistance, adaptability, and transformation. It is within this framework that the present study develops its authorial methodology. By distinguishing between the shock vector (immediate economic losses and vulnerability dynamics) and the shock consequence vector (the recovery capacity, the safety margin, and adaptation), the proposed approach integrates spatiotemporal indicators and provides a more balanced, policy-relevant tool for analyzing socio-economic resilience. This methodology addresses the weaknesses of the technical, ecological, and expert approaches, offering a framework capable of explaining both the short-term elasticity and long-term adaptive capacity of the Ukrainian regions under conditions of war, migration crises, pandemics, and global turbulence.

## METHODOLOGY

To construct a series of empirical indicators of the socio-economic development of the Ukrainian regions within the spatiotemporal approach, the catalysts and regressors are normalized using Equation 1. Unlike classical normalization methods, this approach incorporates the threshold values specific to each indicator, region, and period. The key principle is not to maximize or minimize the observed values relative to the sample extremes, but rather to identify the deviation of each indicator from the predefined threshold.

$$z_{it}^n = \begin{cases} \frac{x_{it}^n}{a_{iL}}, & a_{iL} \geq x_{max} \\ \frac{a_{iL}}{x_{it}^n}, & a_{iL} \leq x_{min} \end{cases}, \quad (1)$$

where  $z_{it}^n$  is the normalized value of the  $i$  component of the  $n$  region in the  $t$  period;  $x_{it}^n$  is the initial value of the  $i$  component of the  $n$  region in the  $t$  period;  $a_{iL}$  is the threshold value of the  $i$  indicator in the  $t$  period.

Therefore, Equation 1 applies threshold-based normalization, where the comparison is made against an economically meaningful benchmark ( $a_{iL}$ ) instead of the minimum or maximum observed values. Such thresholds may represent policy targets, minimum acceptable standards, or maximum permissible constraints. The normalized value ( $z_{it}^n$ ) reflects the extent to which the actual indicator deviates from this benchmark. The thresholds were established using a combined approach, drawing on statistical references (national averages, deviations) as well as the strategic policy documents in the areas of employment, social development, and economic resilience. This ensures the consistency of normalization across regions and time, while also capturing the dual character of the indicators: catalysts, for which exceeding the threshold reflects progress, and regressors, where exceeding the threshold signals increased vulnerability.

Equation 2 is used to construct the series of the empirical indicators of the socio-economic development of the regions in the component projection.

$$SED_{tn}^k = Mz_{it}^n \quad (2)$$

where  $SED_{tn}^k$  is the empirical value of the  $k$  component of the socio-economic development of the  $n$  region in the  $t$  period;  $M$  is the average value of the indicators in the component.

The composite indicator of the socio-economic development of the regions is calculated by the method of the geometric mean (Equation 3).

$$SED_t^n = \sqrt[j]{SED_{tn}^k}, \quad (3)$$

where  $SED_t^n$  is the empirical value of the composite

indicator of the socio-economic development of the  $n$  region in the  $t$  period;  $j$  is the number of the components.

Given the multidimensional nature of resilience, an indicator of the socio-economic resilience of regions can be built by identifying the extent of economic losses as a result of a shock, the ability to recover, and dynamic estimates (period) of recovery and vulnerability. The level of resilience is the degree of change in the development indicator before, during, and after a shock.

A system of indicators is developed to assess socio-economic resilience (Equation 4):

$$sR_t^n = \left\{ \begin{matrix} VD_t^n \\ DD_t^n \\ SV_t^n \\ RD_t^n \\ RDu_t^n \\ SR_t^n \end{matrix} \right\} RSDT_t^n \quad (4)$$

where  $sR_t^n$  is the systemic indicator of the socio-economic resilience of the  $n$  region in the  $t$  period;  $VD_t^n$  is the depth of the vulnerability of the socio-economic system of the  $n$  region in the  $t$  period;  $DD_t^n$  is the period of the vulnerability of the socio-economic system of the  $n$  region in the  $t$  period;  $SV_t^n$  is the rate of the vulnerability of the socio-economic system of the  $n$  region in the  $t$  period;  $RD_t^n$  is the depth of the socio-economic recovery of the  $n$  region in the  $t$  period;  $RDu_t^n$  is the period of the socio-economic recovery of the  $n$  region in the  $t$  period;  $SR_t^n$  is the speed of the socio-economic recovery of the  $n$  region in the  $t$  period;  $RSDT_t^n$  is the rate of the socio-economic resilience of the  $n$  region in the  $t$  period.

In this study, regional resilience is not considered as a one-dimensional value reduced to an integrated index, but rather as a multidimensional characteristic formed through a system of interrelated indicators. This approach makes it possible to capture the different aspects of resilience (for example, economic, social, and demographic) while avoiding the oversimplification of complex processes into a single aggregated measure. It also enables the identification of not only the overall level of resilience but also

of structural imbalances, “bottlenecks,” or hidden development reserves that would remain invisible if only an integral index were used.

The depth of vulnerability ( $VD_t^n$ ) is the degree or scale of the vulnerability of the socio-economic system, which reflects its losses under the influence of a shock (e.g. a decrease in productivity, efficiency, GRP, the percentage of the development index, etc.); it is estimated by Equation 5:

$$VD_t^n = \min_{t+l} SED_t^n - SED_t^n \quad (5)$$

where  $SED_t^n$  is the empirical indicator of the socio-economic development of the  $n$  region in the  $l$  period (shock period);  $\min_{t+l} SED_t^n$  is the empirical indicator of the socio-economic development of the  $n$  region in the  $t + l$  period (the vulnerability period).

The period of vulnerability ( $DD_t^n$ ) is the period during which the socio-economic system incurs losses, is vulnerable to external influences or shocks, and is in a downward trend.

The speed of vulnerability ( $SV_t^n$ ) is the rate or intensity at which a socio-economic system becomes vulnerable in response to external influences or shocks. It characterizes the degree of the loss of economic resilience and the pace of transition to a state of vulnerability as a result of threats:

$$SV_t^n = VD_t^n / DD_t^n \quad (6)$$

The depth of recovery ( $RD_t^n$ ) is the level or degree of the return of the pace of socio-economic development to the pre-shock trends. It shows how close the state of the socio-economic system in the  $t+n$  period is to the state in the  $t-n$  period:

$$RD_t^n = VD_t^n \sim VD_{t+l}^n \quad (7)$$

where  $VD_{t+l}^n$  is the depth of vulnerability in the  $t+l$  period (the post-shock condition).

The period of recovery ( $RD_{u_t}^n$ ) is the period of time during which the socio-economic system is transformed into the pre-shock state. It is in an upward trend.

The speed of recovery ( $SR_t^n$ ) is the pace or intensity at which the system restores its state of functioning and the dynamics of stable development. It characterizes the extent to which the socio-economic system returns to its previous state and how quickly it transitions to the state of resilience (Equation 8).

$$SR_t^n = RD_t^n / RD_{u_t}^n \quad (8)$$

The rate of resilience ( $RD_{u_t}^n$ ) is the ability of the system to remain less vulnerable and/or recover from an economic shock. It is calculated as the sum of vulnerability (ABC area) and recovery (CDE area):

$$RSDT_t^n = VI_t^n + R_t^n \quad (9)$$

where  $VI_t^n$  is the vulnerability of the  $n$  socio-economic system in the  $t$  period;  $R_t^n$  is the recovery of the  $n$  socio-economic system in the  $t$  period.

## RESULTS AND DISCUSSION

The socio-economic resilience of the regions is calculated by identifying the scale of the economic losses caused by shocks, the recovery capacity, and the duration of vulnerability and recovery. In the period from 2010 to 2014, the labor market development indicators at the national level declined by 6.4 pp. During this period, all regions experienced a decrease in the labor market performance, except Vinnytska (+2 pp), Volynska (+1.5 pp), Zhytomyrska (+2.2 pp), and Chernihivska (+3.5 pp) oblasts. In 2014, the lowest labor market development indicators were recorded in Luhanska (0.696) and Donetska (0.710) oblasts, reflecting the impact of military operations and the large-scale forced migration, including the formation of a new socially vulnerable group (IDPs). The downward trend in the regional labor markets persisted until the year 2016, with additional losses of 3-4 pp.

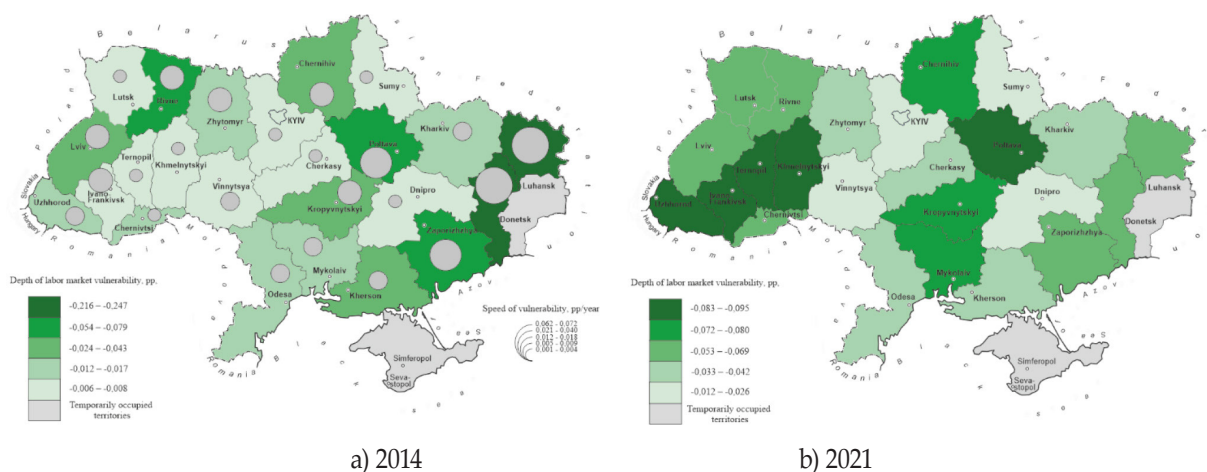
The empirical analysis of the regional labor market development in Ukraine during the period from 2010 to 2021 provides an analytical basis for assessing resilience through the indicators of vulnerability and recovery. The calculation results (Annex A) show

that the most severe labor market losses in the period between 2014 and 2015 were concentrated in Donetsk and Luhanska oblasts (0.2 pp each), correlating with the intensity of hostilities, the economic collapse, and large IDP inflows. These factors not only reduced employment but also generated structural labor market distortions and new vulnerable worker groups. In contrast, Zaporizka (0.06 pp), Poltavka (0.08 pp), Khersonska (0.04 pp), and Lvivska (0.03 pp) oblasts experienced moderate losses due to more diversified economic structures and alternative employment opportunities.

During the COVID-19 pandemic, the labor market losses (0.05-0.1 pp) were observed across all oblasts, confirming the universal nature of this shock. Unlike the military conflict, the pandemic simultaneously affected all the regions, disrupting labor relations, reducing the labor potential, and constraining employment in both the industrial sector and the service sector. The crisis led to rising unemployment and declining labor force participation. Although unemployment decreased in the second quarter of 2021 amid economic recovery, it remained elevated due to structural mismatches, limited retraining incentives, and low labor mobility (Figure 1). Alongside official unemployment, hidden unemployment declined, which reflected in fewer part-time workers and

inactive job seekers, while restrictions on external migration significantly influenced unemployment dynamics.

The identified asymmetry in the speed of the recovery of Ukraine's regional labor markets reflects a complex interaction between the depth of the shock, the sectoral structure of the economy, and the level of institutional adaptability. The regions that experienced minimal economic losses in 2014 (Mykolayivska, Khmelnytska, Cherkaska, Chernihivska, and Kharkivska oblasts) demonstrated shorter recovery periods due to the relatively small amplitude of the employment decline and the greater resilience of the local economic systems. The industrial regions proved to be more flexible, as they were able to restore the production processes and reallocate the resources more quickly, whereas service-dominated economies were more vulnerable due to their dependence on the population mobility and consumer demand. The COVID-19 pandemic highlighted the additional factors as follows: only a few oblasts (Dnipropetrovska, Zaporizka, Sumska, and Cherkaska) managed to adapt within one year, thanks to the relatively high levels of digitalization, the prevalence of remote work, and the available resources to sustain employment. At the same time, even in the most affected regions (Donetska and Luhanska oblasts), relatively high



**Figure 1** The vulnerability of the regional labor markets: The spatial and dynamic approach, 2014, 2021

Source: Authors

recovery rates (0.05-0.06 pp per year) were recorded, which is partly explained by the mobilization capacity of the local economies and state support. However, the nationwide recovery rates remained low (0.01-0.02 pp per year), indicating structural constraints on the labor market adaptability.

The full-scale war of 2022 significantly increased the vulnerability of the labor markets, especially in Central and Eastern Ukraine, drastically reducing the pace of recovery. The large-scale forced migration, the infrastructure destruction, and the loss of the labor potential critically weakened the adaptive capacity. Thus, the speed and duration of the recovery of the regional labor markets are determined by the combination of the depth and nature of the shock, the sectoral structure of the regional economy, and the institutional capacity, which leads to the uneven formation of resilience in the spatial dimension.

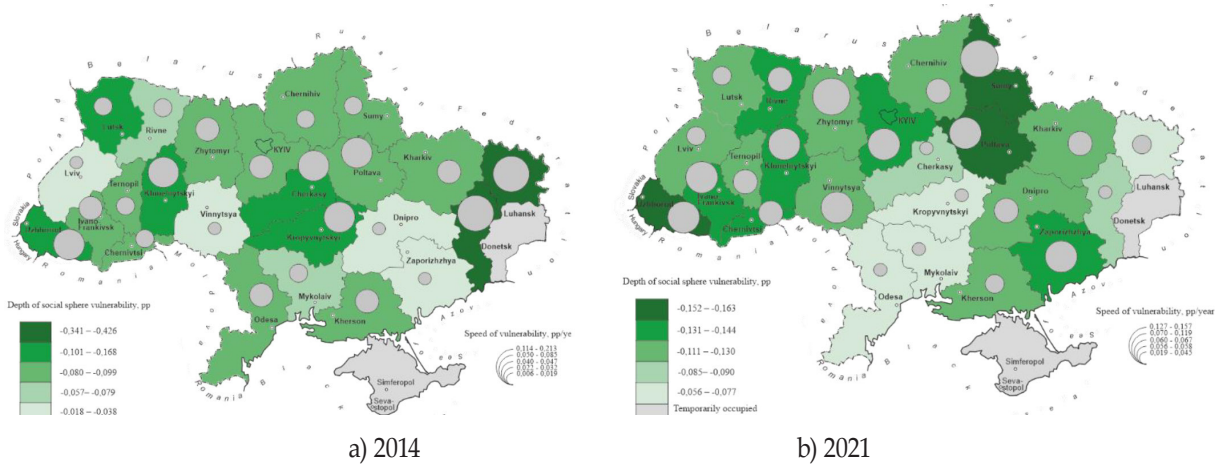
The social sphere is among the most vulnerable to systemic crises, as confirmed by the empirical evidence. The 2014 macroeconomic shock caused significantly higher losses in the social sphere than in the other components of socio-economic vulnerability, despite the social development indicators being relatively higher than those of the labor market, the demographic sphere, and the economic system. For instance, the average annual social development index in the period from 2010-2013 ranged from 0.895 to 0.912, compared to 0.654-0.689 for the labor market. In 2014, the national average loss in social development reached 0.3 pp, with the highest losses seen in Donetsk (0.3 pp) and Luhansk (0.4 pp) oblasts, and the lowest in Dnipropetrovsk (0.06 pp), Zaporizhka (0.018 pp), and Lviv (0.038 pp). In the period from 2020 to 2021, social sphere losses averaged 0.05 pp, which is 0.25 pp lower than in 2014. However, the losses across all the regions in 2021 were 0.05-0.07 pp higher than in the period from 2014 to 2015, indicating declining regional adaptability and elasticity to repeated shocks.

The period of vulnerability of the social system reflects the limited capacity of the regions to sustain development while minimizing losses. The empirical evidence reveals strong territorial differentiation:

the longest vulnerability periods were observed in Lvivska Oblast (5 years) and Vinnytska and Volynska oblasts (4 years), indicating prolonged exposure to shocks and slower institutional adaptation. In contrast, Poltavska Oblast showed the shortest vulnerability period (1 year), thus suggesting a higher capacity of the social infrastructure to absorb shocks. However, shorter vulnerability periods did not necessarily correspond to the lower losses. For example, the vulnerability rate of the social sector in Poltavska Oblast was four times higher than in Zaporizhka Oblast despite the latter having a longer three-year vulnerability period, highlighting the nonlinearity between the duration and intensity of losses.

In 2021, Vinnytska, Zhytomyrska, and Sumsk oblasts formally exhibited the shortest vulnerability periods (1 year); yet they recorded some of the highest vulnerability speeds (0.129, 0.130, and 0.160 pp/year), indicating rapid destabilization followed by a relatively fast recovery. Conversely, Lvivska, Mykolayivska, Zaporizhka, Volynska, and Dnipropetrovsk oblasts became leaders in the average vulnerability speed due to the combined effects of the 2014 and 2020 shocks, confirming the complex nature of social resilience. In the period from 2014 to 2015, Donetsk and Luhansk oblasts experienced the highest vulnerability rates (0.511 and 0.426), driven by military actions, the forced migration, and the degradation of the social infrastructure, while Zaporizhka (0.027) and Poltavska (0.042) showed the lowest vulnerability. In the period from 2020 to 2021, higher vulnerability shifted to Poltavska (0.163), Ternopilsk (0.130), and Zakarpatska (0.152) oblasts, reflecting the differentiated impact of the COVID-19 pandemic. The average recovery period across the regions remained about four years, with the recovery speeds ranging from 0.020 to 0.088 pp/year. At the national level, the average recovery speed of 0.09 pp/year indicates the formation of a safety margin and the strengthening of overall social resilience.

Zhytomyrska and Lvivska oblasts were characterized by relatively high recovery speeds (above 0.04 pp/year), indicating more flexible and adaptive social structures. In contrast, Donetsk, Luhansk, and



**Figure 2** The vulnerability of the social sphere in the Ukrainian regions:  
The spatial and dynamic approach, 2014, 2021

Source: Authors

Odeska oblasts demonstrated the recovery speeds below 0.02 pp/year, reflecting prolonged social stress and systemic weaknesses. This asymmetry confirms the uneven nature of regional resilience: while some territories compensate for the losses rapidly, others remain trapped in extended recovery cycles, increasing long-term vulnerability.

Since the 2000s, Ukraine has experienced large-scale socio-economic transformations that have profoundly reshaped its demographic structures. Demographic processes act both as a consequence of economic change and as an active factor influencing development trajectories and resilience. The current trends (the natural population decline and the intensive migration) have weakened demographic resilience across the regions. As a key institutional condition for economic growth, demographic resilience implies stable age, gender, and occupational structures capable of sustaining socio-economic systems under shocks. Therefore, analyzing its link with economic growth is of both theoretical and practical importance, particularly for postwar recovery.

Even before the shocks, several oblasts (Chernihivska, Harkivska, Luhanska, and Donetsk) had had low demographic security due to depopulation

and population aging (Figure 3). The 2014–2015 crisis accelerated these trends, with Donetsk and Luhanska losing 0.3 pp each, while Ternopilska lost 0.2 pp and several other regions lost 0.1 pp, indicating the nationwide spread of demographic risks. The COVID-19 pandemic further destabilized demographic resilience, with the largest losses in Zaporizka (0.13 pp), Lvivska (0.11 pp), and Kirovohradska (0.1 pp). Overall, demographic resilience in Ukraine remains fragile, shaped by the long-term structural decline and repeated shocks, and its weakening directly undermines the labor market stability, the social protection systems, and the regional economic recovery capacity.

In the period from 2020 to 2021, several regions demonstrated positive or stable dynamics in the demographic security indicator, including Vinnytska (0.01 pp), Ivano-Frankivska (+0.02 pp), and Dnipropetrovska (0.01 pp) oblasts. The smallest average demographic losses in the period from 2010 to 2021 were observed in Zakarpatska (0.02 pp) and Odeska (-0.01 pp) oblasts, indicating relatively stable demographic development. Demographic vulnerability is a dynamic indicator shaped by long-term trends and shocks. Since 2014, the rate of vulnerability change has gradually declined,

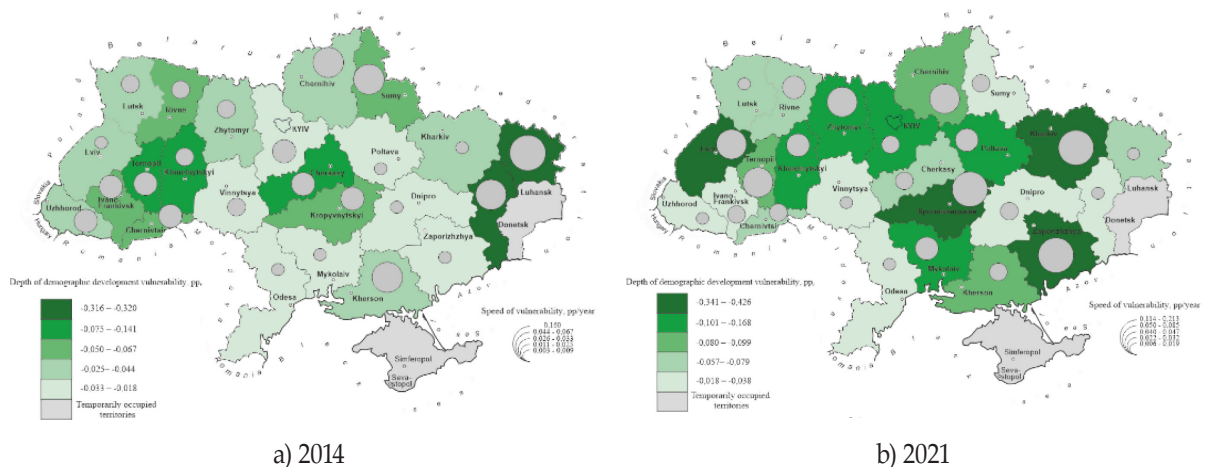
reflecting the increased adaptive capacity of the regional demographic systems. The vulnerability values ranged from 0.009 to 0.799, with the maximum recorded at the five-year lag after 2014, indicating the concentration of demographic risks in certain regions (Annex C). The lowest vulnerability levels (around 0.01) were typical for short-term periods of 1-2 years.

The analysis for the period between 2010 and 2021 reveals pronounced spatial and temporal asymmetries. The average vulnerability rates varied from 0.002 to 0.160 pp/year, with the highest values observed at the 2.5-year lag after the 2014 shock, highlighting delayed but severe effects of the military conflict and mass displacement. The short-term lags showed lower vulnerability, whereas the medium-term effects accumulated more sharply. During the COVID-19 period, demographic vulnerability fluctuated less, possibly due to the short-term nature of the shock and the temporary restrictions on external migration.

The longer vulnerability periods were associated with the higher cumulative losses: the five-year lag generated the total vulnerability of 0.799 pp, whereas the one-year lags produced much lower values. However, the vulnerability speed did not increase

linearly with the duration: the highest rate (0.160 pp/year) occurred at a 2.5-year lag, while the longer periods showed slower growth, indicating a shift from acute shocks to a gradual structural decline. Donetsk, Lvivska, and Ternopilska oblasts had the longest vulnerability periods in 2014, while in the period from 2020 to 2021, the prolonged exposure shifted to Kyivska and Hersonska oblasts. The fastest vulnerability growth in the period from 2014 to 2015 occurred in Luhanska and Donetsk oblasts, whereas during the pandemic period, the most affected regions were Zaporizka, Kirovohradska, Harkivska, and Ternopilska. This shift confirms that demographic instability has expanded beyond the conflict zones and increasingly reflects nationwide economic and pandemic-related pressures.

Ukraine's economic development depends on effective economic processes, competitive industrial structures, and balanced regional restructuring, supported by a strong social foundation that enhances the quality of life and reduces regional vulnerability to shocks. The period of the economic vulnerability of the Ukrainian regions ranged from one to six years. The maximum vulnerability period was observed in those regions that experienced prolonged shocks, such as military operations (Donetska and Luhanska



**Figure 3** The vulnerability of the demographic development of the Ukrainian regions: The spatial and dynamic approach, 2014, 2021

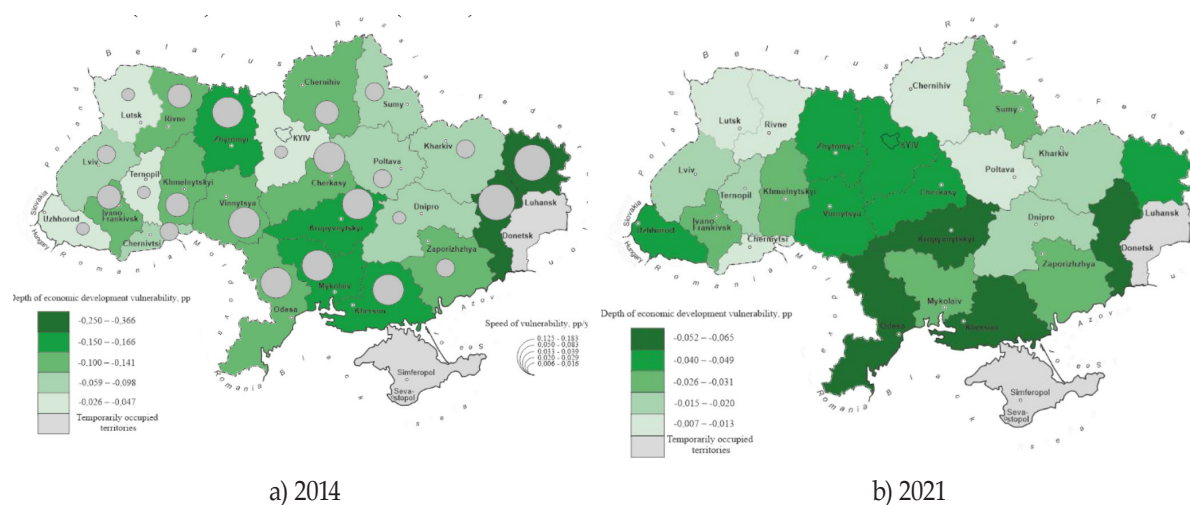
Source: Authors

oblasts, the vulnerability period was six years). On the other hand, the regions with a short (one to two years) vulnerability period (Volynska and Zakarpatska oblasts) demonstrated high resilience to macroeconomic shocks. As an indicator that reflects the pace of regional adaptation to shocks, the speed of vulnerability shows a significant differentiation between the regions in terms of economic resilience in the period from 2014 to 2015 and from 2020 to 2021 (Annex D). The highest speed of vulnerability was observed in Luhanska Oblast (0.160 pp/year), which is related to the critical impact of military operations, and the lowest values of the vulnerability speed were typical for the regions with a low level of risk, for example, Volynska Oblast (0.004 pp/year). For most regions, the speed of vulnerability ranged between 0.01 and 0.05 pp/year.

The level of the economic vulnerability of the regions was the highest during the crisis periods (2014–2015) due to the security factors and the significant weakening of the economic and resource potential of the territories. In the period from 2020 to 2021, the impact of COVID-19 on the economic development was less evident compared to the previous crises, with the exception of a few oblasts (Figure 4). In particular,

the lowest level of average vulnerability was recorded in Volynska (0.009) and Zakarpatska (0.014) oblasts, which indicates a high rate of the socio-economic resilience of the regions. The highest level of average vulnerability was observed in Donetsk (0.175) and Luhanska (0.349) oblasts.

For most regions, the recovery period after the 2014 shock averaged four to five years, but by 2021, it had shortened to one to two years. This compression reflects both growing adaptation to the recurrent crises and the declining capacity for a full recovery under prolonged shocks. Volynska Oblast was an exception with the longest recovery period (3.5 years), indicating structural rigidity. Despite the impacts of severe conflicts, Donetsk Oblast showed the highest post-2014 recovery speed (0.050 pp/year), reaching the recovery indicator of 0.624, while most other regions lagged. In 2021, the recovery indicators fell to the minimum levels (0.005–0.02) nationwide, simultaneously signaling deepening systemic vulnerability. Zakarpatska Oblast consistently demonstrated a low recovery speed and only a moderate recovery, reflecting a limited adaptive potential.



**Figure 4** The vulnerability of the economic development of Ukraine's regions:  
The spatial and dynamic approach, 2014, 2021

Source: Authors

The resilience structure in 2014 reveals further contrasts. Despite direct exposure to military shocks, Luhanska and Donetska oblasts showed relatively high resilience, with the safety margin of 0.549 in Luhanska and the resistance level of 32.97% in Donetska, reflecting the buffering role of the pre-shock economic potential. In contrast, Vinnytska, Rivnenska, Ivano-Frankivska, and Cherkaska oblasts exhibited moderate resistance (10-20%) but a high recovery capacity (close to 1.0), indicating greater flexibility. Regional trajectories in the period from 2014 to 2021 diverged further. Kyivska, Kirovohradska, and Harkivska oblasts experienced a gradual decline in the safety margins and the recovery coefficients, pointing to the erosion of long-term resilience. Conversely, despite its low resistance in 2014 (5.16%), Zakarpatska Oblast maintained high recovery rates in both 2014 (1.02) and 2021 (0.99), demonstrating adaptive recovery despite weak structural resistance.

Overall, the regions with high initial safety margins tended to show stronger resistance, whereas those with the highest recovery rates displayed only moderate resilience. This duality confirms the multidimensional nature of resilience in Ukraine and highlights the need to assess it through a system of the interrelated indicators capturing resistance, recovery, and adaptability rather than a single composite measure.

## CONCLUSION

The findings confirm that socio-economic resilience is a systemic characteristic defining the ability of Ukraine's regions to withstand shocks, reduce vulnerability, and recover in the post-shock period. The use of the composite spatiotemporal indicators, rather than a single integrated index, enabled a more nuanced assessment of the multidimensional nature of resilience and the identification of territorial asymmetries and structural bottlenecks. This approach captured the key consequences of the 2014-2015 shocks and the COVID-19 pandemic of 2020-2021, which led to declining labor market performance, increased demographic vulnerability, and deepening economic instability.

Testing the proposed methodology for the period from 2010 to 2021 revealed two major shocks that significantly weakened regional resilience. The labor market indicators declined by 6.4 percentage points in the period from 2010 to 2014, with regression observed in most regions, except Vinnytska, Volynska, Zhytomyrska, and Chernihivska oblasts. On average, Ukraine's labor market resilience indicator fell from 0.526 in 2014 to 0.025 in 2021. Demographic vulnerability proved highly dynamic, varying between 0.009 and 0.799, while economic vulnerability peaked in 2014-2015 due to the security factors and resource exhaustion; the pandemic-related effects in the period from 2020 to 2021 were comparatively less severe, except in several oblasts.

The results confirm the research hypotheses: resilience depends not only on the scale of losses but also on regional adaptive and recovery capacities, shaped by both internal structures and external shocks. The analysis is limited to the pre-war period (2010-2021) and thus reflects the baseline level of resilience that can serve as a benchmark for assessing the post-2022 challenges. The research is subject to certain methodological limitations. Since the analysis covers only the period from 2010 to 2021, it does not account for the unprecedented impact of the full-scale war, which has critically minimized the recovery capacity of the regional systems since 2022. Therefore, the findings should be regarded as reflecting the baseline (pre-war) level of resilience that can serve as a benchmark for subsequent comparisons and for assessing the scale of new challenges.

Further studies should focus on integrating the consequences of the full-scale war into resilience assessment models, as well as on adapting and testing the best international practices for building regional resilience in post-war conditions. Equally important is the need to combine short-term vulnerability management with the development of long-term adaptability and design a system of threshold values of resilience at the national and regional levels within the framework of Ukraine's European integration processes.

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## ANNEXES

## ANNEX A

The indicators of the resilience of the regional labor market: **Vulnerability** to macroeconomic shocks, 2010-2021

| Regions          | Vulnerability indicators |           |         |                |           |         |                 |       |         |
|------------------|--------------------------|-----------|---------|----------------|-----------|---------|-----------------|-------|---------|
|                  | Losses (pp)              |           |         | Period (years) |           |         | Speed (pp/year) |       |         |
|                  | 2014-2015                | 2020-2021 | average | 2014           | 2020-2021 | average | 2014            | 2021  | average |
| Ukraine          | -0.064                   | -0.100    | -0.082  | 3              | 1         | 2       | 0.021           | 0.100 | 0.061   |
| Vinnyska         | -0.005                   | -0.017    | -0.011  | 1              | 1         | 1       | 0.005           | 0.017 | 0.011   |
| Volynska         | -0.008                   | -0.063    | -0.036  | 2              | 1         | 1.50    | 0.004           | 0.063 | 0.034   |
| Dnipropetrovska  | -0.004                   | -0.012    | -0.008  | 1              | 1         | 1       | 0.004           | 0.012 | 0.008   |
| Donetska         | -0.216                   | -0.065    | -0.141  | 3              | 1         | 2       | 0.072           | 0.065 | 0.069   |
| Zhytomyrska      | -0.013                   | -0.038    | -0.026  | 1              | 1         | 1       | 0.013           | 0.038 | 0.026   |
| Zakarpatska      | -0.014                   | -0.090    | -0.052  | 3              | 1         | 2       | 0.005           | 0.090 | 0.047   |
| Zaporizka        | -0.058                   | -0.069    | -0.064  | 2              | 1         | 1.5     | 0.029           | 0.069 | 0.049   |
| Ivano-Frankivska | -0.004                   | -0.095    | -0.050  | 3              | 1         | 2       | 0.001           | 0.095 | 0.048   |
| Kyivska          | -0.007                   | -0.025    | -0.016  | 5              | 1         | 3       | 0.001           | 0.025 | 0.013   |
| Kirovohradska    | -0.024                   | -0.072    | -0.048  | 2              | 1         | 1.5     | 0.012           | 0.072 | 0.042   |
| Luhanska         | -0.247                   | -0.068    | -0.158  | 4              | 2         | 3       | 0.062           | 0.034 | 0.048   |
| Lvivska          | -0.030                   | -0.053    | -0.042  | 2              | 1         | 1.50    | 0.015           | 0.053 | 0.034   |
| Mykolayivska     | -0.015                   | -0.080    | -0.048  | 3              | 1         | 2       | 0.005           | 0.080 | 0.043   |
| Odeska           | -0.015                   | -0.034    | -0.025  | 2              | 1         | 1.5     | 0.008           | 0.034 | 0.021   |
| Poltavska        | -0.079                   | -0.083    | -0.081  | 2              | 1         | 1.5     | 0.040           | 0.083 | 0.061   |
| Rivnenska        | -0.054                   | -0.067    | -0.060  | 3              | 1         | 2       | 0.018           | 0.067 | 0.043   |
| Sumska           | -0.008                   | -0.026    | -0.017  | 3              | 1         | 2       | 0.003           | 0.026 | 0.014   |
| Ternopil'ska     | 0.004                    | -0.086    | -0.041  | 1              | 1         | 1       | 0.004           | 0.086 | 0.045   |
| Harkivska        | -0.017                   | -0.042    | -0.030  | 2              | 1         | 1.5     | 0.009           | 0.042 | 0.025   |
| Herson'ska       | -0.043                   | -0.037    | -0.040  | 5              | 1         | 3       | 0.009           | 0.037 | 0.023   |
| Hmelnytska       | 0.006                    | -0.084    | -0.039  | 2              | 1         | 1.5     | 0.003           | 0.084 | 0.044   |
| Cherkaska        | -0.004                   | -0.033    | -0.019  | 2              | 1         | 1.5     | 0.002           | 0.033 | 0.018   |
| Chernivetska     | -0.012                   | -0.068    | -0.040  | 3              | 2         | 2.5     | 0.004           | 0.034 | 0.019   |
| Chernihiv'ska    | -0.033                   | -0.074    | -0.054  | 2              | 1         | 1.5     | 0.017           | 0.074 | 0.045   |

Source: Authors

**ANNEX B**

The indicators of the resilience of the regional social system: **Vulnerability** to macroeconomic shocks, 2010-2021

| Regions          | Vulnerability indicators |           |         |                 |       |         |               |           |         |       |
|------------------|--------------------------|-----------|---------|-----------------|-------|---------|---------------|-----------|---------|-------|
|                  | Period (years)           |           |         | Speed (pp/year) |       |         | Vulnerability |           |         |       |
|                  | 2014                     | 2020-2021 | average | after 2014      | 2021  | average | 2014-2015     | 2020-2021 | average | Total |
| Ukraine          | 1                        | 1         | 1       | 0.263           | 0.050 | 0.156   | 0.132         | 0.025     | 0.078   | 0.156 |
| Vynnytska        | 4                        | 1         | 2.5     | 0.017           | 0.119 | 0.068   | 0.138         | 0.060     | 0.099   | 0.198 |
| Volynska         | 4                        | 2         | 3       | 0.026           | 0.058 | 0.042   | 0.209         | 0.116     | 0.162   | 0.325 |
| Dnipropetrovska  | 3                        | 2         | 2.5     | 0.019           | 0.065 | 0.042   | 0.085         | 0.129     | 0.107   | 0.214 |
| Donetska         | 3                        | 2         | 2.5     | 0.114           | 0.045 | 0.079   | 0.511         | 0.090     | 0.300   | 0.601 |
| Zhytomyrska      | 2                        | 1         | 1.5     | 0.050           | 0.127 | 0.088   | 0.099         | 0.063     | 0.081   | 0.163 |
| Zakarpatska      | 2                        | 2         | 2       | 0.084           | 0.076 | 0.080   | 0.168         | 0.152     | 0.160   | 0.319 |
| Zaporizka        | 3                        | 2         | 2.5     | 0.006           | 0.070 | 0.038   | 0.027         | 0.141     | 0.084   | 0.168 |
| Ivano-Frankivska | 2                        | 2         | 2       | 0.040           | 0.070 | 0.055   | 0.081         | 0.140     | 0.110   | 0.221 |
| Kyivska          | 2                        | 2         | 2       | 0.044           | 0.072 | 0.058   | 0.088         | 0.144     | 0.116   | 0.232 |
| Kirovohradska    | 2                        | 2         | 2       | 0.060           | 0.038 | 0.049   | 0.119         | 0.077     | 0.098   | 0.196 |
| Luhanska         | 2                        | 1         | 1.5     | 0.213           | 0.057 | 0.135   | 0.426         | 0.028     | 0.227   | 0.455 |
| Lvivska          | 5                        | 2         | 3.5     | 0.008           | 0.056 | 0.032   | 0.096         | 0.111     | 0.104   | 0.208 |
| Mykolayivska     | 3                        | 3         | 3       | 0.026           | 0.019 | 0.022   | 0.118         | 0.085     | 0.101   | 0.202 |
| Odeska           | 2                        | 2         | 2       | 0.047           | 0.033 | 0.040   | 0.093         | 0.066     | 0.080   | 0.160 |
| Poltavska        | 1                        | 2         | 1.5     | 0.085           | 0.082 | 0.083   | 0.042         | 0.163     | 0.103   | 0.206 |
| Rivnenska        | 3                        | 2         | 2.5     | 0.022           | 0.065 | 0.044   | 0.099         | 0.131     | 0.115   | 0.230 |
| Sumska           | 3                        | 1         | 2       | 0.027           | 0.157 | 0.092   | 0.120         | 0.078     | 0.099   | 0.198 |
| Ternopil'ska     | 3                        | 2         | 2.5     | 0.031           | 0.065 | 0.048   | 0.141         | 0.130     | 0.136   | 0.271 |
| Harkiv'ska       | 2                        | 2         | 2       | 0.046           | 0.060 | 0.053   | 0.093         | 0.120     | 0.107   | 0.213 |
| Herson'ska       | 2                        | 2         | 2       | 0.041           | 0.057 | 0.049   | 0.082         | 0.115     | 0.098   | 0.197 |
| Hmelnytska       | 2                        | 2         | 2       | 0.050           | 0.071 | 0.061   | 0.101         | 0.142     | 0.121   | 0.242 |
| Cherkaska        | 2                        | 2         | 2       | 0.062           | 0.042 | 0.052   | 0.123         | 0.085     | 0.104   | 0.208 |
| Chernivetska     | 3                        | 2         | 2.5     | 0.031           | 0.067 | 0.049   | 0.140         | 0.134     | 0.137   | 0.274 |
| Chernihiv'ska    | 3                        | 2         | 2.5     | 0.032           | 0.063 | 0.048   | 0.143         | 0.127     | 0.135   | 0.270 |

Source: Authors

## ANNEX C

The indicators of the resilience of the regional demographic system: **Vulnerability** to macroeconomic shocks, 2010-2021

| Regions          | Vulnerability indicators |           |         |                 |       |         |               |           |         |       |
|------------------|--------------------------|-----------|---------|-----------------|-------|---------|---------------|-----------|---------|-------|
|                  | Period (years)           |           |         | Speed (pp/year) |       |         | Vulnerability |           |         |       |
|                  | 2014                     | 2020-2021 | average | after 2014      | 2021  | average | 2014-2015     | 2020-2021 | average | total |
| Ukraine          | 2                        | 3         | 2.5     | 0.006           | 0.019 | 0.012   | 0.013         | 0.084     | 0.048   | 0.097 |
| Vinnyska         | 1                        | 2         | 1.5     | 0.011           | 0.005 | 0.008   | 0.005         | 0.010     | 0.008   | 0.015 |
| Volynska         | 2                        | 3         | 2.5     | 0.012           | 0.008 | 0.010   | 0.025         | 0.034     | 0.030   | 0.059 |
| Dnipropetrovska  | 1                        | 1         | 1.0     | 0.004           | 0.014 | 0.009   | 0.002         | 0.007     | 0.005   | 0.009 |
| Donetska         | 5                        | 3         | 4.0     | 0.063           | 0.002 | 0.033   | 0.790         | 0.009     | 0.400   | 0.799 |
| Zhytomyrska      | 2                        | 1         | 1.5     | 0.016           | 0.096 | 0.056   | 0.031         | 0.048     | 0.040   | 0.080 |
| Zakarpatska      | 1                        | 2         | 1.5     | 0.031           | 0.004 | 0.017   | 0.015         | 0.008     | 0.011   | 0.023 |
| Zaporizka        | 2                        | 1         | 1.5     | 0.009           | 0.125 | 0.067   | 0.018         | 0.062     | 0.040   | 0.081 |
| Ivano-Frankivska | 2                        | 1         | 1.5     | 0.027           | 0.019 | 0.023   | 0.054         | 0.010     | 0.032   | 0.064 |
| Kyivska          | 1                        | 6         | 3.5     | 0.033           | 0.013 | 0.023   | 0.017         | 0.243     | 0.130   | 0.259 |
| Kirovohradska    | 2                        | 1         | 1.5     | 0.032           | 0.100 | 0.066   | 0.063         | 0.050     | 0.057   | 0.113 |
| Luhanska         | 2                        | 3         | 2.5     | 0.160           | 0.007 | 0.083   | 0.320         | 0.029     | 0.175   | 0.349 |
| Lvivska          | 5                        | 2         | 3.5     | 0.008           | 0.056 | 0.032   | 0.096         | 0.111     | 0.104   | 0.208 |
| Mykolayivska     | 2                        | 2         | 2.0     | 0.003           | 0.038 | 0.020   | 0.005         | 0.076     | 0.041   | 0.081 |
| Odeska           | 1                        | 2         | 1.5     | 0.005           | 0.009 | 0.007   | 0.002         | 0.018     | 0.010   | 0.020 |
| Poltavska        | 2                        | 2         | 2.0     | 0.003           | 0.038 | 0.020   | 0.005         | 0.076     | 0.041   | 0.081 |
| Rivnenska        | 2                        | 1         | 1.5     | 0.025           | 0.033 | 0.029   | 0.050         | 0.016     | 0.033   | 0.067 |
| Sumska           | 1                        | 1         | 1.0     | 0.067           | 0.015 | 0.041   | 0.034         | 0.007     | 0.021   | 0.041 |
| Ternopil'ska     | 5                        | 1         | 3.0     | 0.028           | 0.060 | 0.044   | 0.352         | 0.030     | 0.191   | 0.382 |
| Harkivska        | 3                        | 1         | 2.0     | 0.008           | 0.103 | 0.056   | 0.038         | 0.051     | 0.045   | 0.089 |
| Herson'ska       | 1                        | 4         | 2.5     | 0.044           | 0.014 | 0.029   | 0.022         | 0.116     | 0.069   | 0.137 |
| Hmelnytska       | 3                        | 3         | 3.0     | 0.025           | 0.031 | 0.028   | 0.112         | 0.140     | 0.126   | 0.252 |
| Cherkaska        | 3                        | 2         | 2.5     | 0.026           | 0.013 | 0.019   | 0.117         | 0.025     | 0.071   | 0.142 |
| Chernivetska     | 2                        | 2         | 2.0     | 0.033           | 0.017 | 0.025   | 0.066         | 0.034     | 0.050   | 0.100 |
| Chernihiv'ska    | 1                        | 1         | 1.0     | 0.044           | 0.071 | 0.058   | 0.022         | 0.036     | 0.029   | 0.058 |

Source: Authors

## ANNEX D

The indicators of the resilience of the regional economic system: **Vulnerability** to macroeconomic shocks, 2010-2021

| Regions          | Vulnerability indicators |           |         |                 |       |         |               |           |         |       |
|------------------|--------------------------|-----------|---------|-----------------|-------|---------|---------------|-----------|---------|-------|
|                  | Period (years)           |           |         | Speed (pp/year) |       |         | Vulnerability |           |         |       |
|                  | 2014                     | 2020-2021 | average | after 2014      | 2021  | average | 2014-2015     | 2020-2021 | average | total |
| Ukraine          | 3                        | 1         | 2.0     | 0.057           | 0.011 | 0.034   | 0.259         | 0.005     | 0.132   | 0.264 |
| Vinnyska         | 2                        | 1         | 1.5     | 0.058           | 0.049 | 0.054   | 0.117         | 0.025     | 0.071   | 0.141 |
| Volynska         | 3                        | 1         | 2.0     | 0.011           | 0.010 | 0.010   | 0.048         | 0.005     | 0.027   | 0.053 |
| Dnipropetrovska  | 5                        | 2         | 3.5     | 0.016           | 0.008 | 0.012   | 0.202         | 0.015     | 0.109   | 0.217 |
| Donetska         | 2                        | 2         | 2.0     | 0.125           | 0.026 | 0.075   | 0.250         | 0.052     | 0.151   | 0.301 |
| Zhytomyrska      | 2                        | 1         | 1.5     | 0.083           | 0.043 | 0.063   | 0.166         | 0.022     | 0.094   | 0.188 |
| Zakarpatska      | 4                        | 2         | 3.0     | 0.006           | 0.022 | 0.014   | 0.052         | 0.045     | 0.048   | 0.096 |
| Zaporizka        | 5                        | 1         | 3.0     | 0.022           | 0.027 | 0.025   | 0.273         | 0.014     | 0.144   | 0.287 |
| Ivano-Frankivska | 3                        | 1         | 2.0     | 0.033           | 0.026 | 0.030   | 0.150         | 0.013     | 0.082   | 0.163 |
| Kyivska          | 4                        | 3         | 3.5     | 0.012           | 0.016 | 0.014   | 0.095         | 0.070     | 0.083   | 0.165 |
| Kirovohradska    | 2                        | 1         | 1.5     | 0.075           | 0.057 | 0.066   | 0.151         | 0.028     | 0.089   | 0.179 |
| Luhanska         | 2                        | 3         | 2.5     | 0.183           | 0.014 | 0.098   | 0.366         | 0.061     | 0.214   | 0.428 |
| Lvivska          | 2                        | 1         | 1.5     | 0.029           | 0.020 | 0.025   | 0.059         | 0.010     | 0.034   | 0.069 |
| Mykolayivska     | 2                        | 1         | 1.5     | 0.075           | 0.031 | 0.053   | 0.150         | 0.015     | 0.083   | 0.166 |
| Odeska           | 2                        | 1         | 1.5     | 0.050           | 0.053 | 0.052   | 0.100         | 0.027     | 0.063   | 0.127 |
| Poltavska        | 4                        |           | 4.0     | 0.023           |       | 0.023   | 0.182         | 0.000     | 0.091   | 0.182 |
| Rivnenska        | 3                        | 1         | 2.0     | 0.039           | 0.012 | 0.026   | 0.176         | 0.006     | 0.091   | 0.183 |
| Sumska           | 3                        | 1         | 2.0     | 0.028           | 0.029 | 0.028   | 0.125         | 0.014     | 0.070   | 0.140 |
| Ternopil'ska     | 4                        | 2         | 3.0     | 0.010           | 0.009 | 0.010   | 0.081         | 0.018     | 0.050   | 0.099 |
| Harkivska        | 4                        | 1         | 2.5     | 0.024           | 0.017 | 0.021   | 0.194         | 0.008     | 0.101   | 0.202 |
| Herson'ska       | 2                        | 1         | 1.5     | 0.077           | 0.065 | 0.071   | 0.154         | 0.033     | 0.094   | 0.187 |
| Hmelnytska       | 3                        | 2         | 2.5     | 0.036           | 0.015 | 0.025   | 0.160         | 0.030     | 0.095   | 0.190 |
| Cherkaska        | 2                        | 1         | 1.5     | 0.071           | 0.040 | 0.055   | 0.141         | 0.020     | 0.081   | 0.161 |
| Chernivetska     | 5                        | 1         | 3.0     | 0.020           | 0.013 | 0.016   | 0.245         | 0.006     | 0.126   | 0.252 |
| Chernihiv'ska    | 3                        | 1         | 2.0     | 0.039           | 0.007 | 0.023   | 0.176         | 0.003     | 0.090   | 0.179 |

Source: Authors



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# INTEREST RATE PASS-THROUGH TO DEPOSIT INTEREST RATES IN A DUAL-CURRENCY MONETARY SYSTEM: THE CASE OF SERBIA

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Since the financial system in Serbia is characterized by a high level of euroization, there are two distinct deposit interest rate pass-through processes at work: the domestic interest rate pass-through and the imported (cross-border) interest rate pass-through. The findings for the domestic interest rate pass-through imply that the long-term pass-through varies within a range below unity, so the pass-through from the interbank (money) market rate to deposit rates is incomplete; the evidence on the short-term pass-through is weak, and the speed of adjustment to the long-term equilibrium is relatively high. The imported interest rate pass-through shows the stronger evidence of cointegrating relationships across interest rates in comparison to the domestic interest rate pass-through, and very closely mimics the interest rate pass-through in the euro area in all relevant criteria. In effect, the findings show that the monetary policy in the euro area is integrated well with the domestic monetary policy in Serbia in terms of the cost adjustment of the deposit portion of banks' liabilities. Overall, the findings show that the monetary policy in the euro area is integrated well with the domestic monetary policy in Serbia in terms of the cost adjustment of the deposit side of banks' balance sheets stemming from the monetary policy decisions.

**Keywords:** interest rate pass-through, monetary policy transmission, deposits, autoregressive distributed lag model

JEL Classification: E43, E52, G21

## INTRODUCTION

The easing and tightening of monetary policy are constituent parts of steering the economy to overall stability and economic welfare. The monetary policy stance is communicated to the public through changes

in key policy rates. Low inflation, weak economic growth or the stagnation of economic activity with low investment may prompt the central bank to lower interest rates, which should spur economic activity in conjunction with the other economic policy instruments. If interest rate steering is insufficient to provide the revival of economic activity, the traditional monetary policy may be accompanied by unconventional monetary policy measures, such

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as quantitative easing. Through massive purchases of medium- and longer-term financial assets, novel unconventional measures, such as the asset purchase program or the pandemic emergency purchase program strongly influence the flattening of the yield curve, i.e. the lowering of the longer-term market interest rates that are difficult to accomplish through managing the short-term interest rates that are within the scope of the traditional monetary policy (Lukić, 2012). This failure of interest rate steering holds even though certain central banks pushed some of their key policy rates into the negative zone, which was effectively true for the interest rate on the deposit facility of the European Central Bank.

The interest rate channel appears to be inefficient in specific circumstances. Unconventional monetary policy measures complement conventional monetary policy measures in order to produce a full-blown monetary effect on the financial system and the economy in a low inflation environment (Darracq Pariès, Moccero, Krylova & Marchini, 2014; Hristov, Hülsewig & Wollmershäuser, 2014; van Borstel, Eickmeier & Krippner, 2014). R. Horvath, J. Kotlebova and M. Siranova (2018) highlight that unconventional measures helped to strengthen the pass-through of the conventional monetary policy in the euro area that has been impaired by the sovereign debt crisis.

This paper focuses on the cost adjustment of the deposit side of banks' balance sheets stemming from the monetary policy decisions. It contributes to discerning the specifics of the monetary policy transmission mechanism in Serbia, as an example of the country in which economic agents have rather strong preferences for deposits in both the domestic currency and the foreign currency. The high presence and reliance on the non-domestic currency in the monetary system adds to labeling it as a dual-currency monetary system.

The paper focuses on the interest rate pass-through in the realm of deposit interest rates. Since the Serbian financial system is characterized by a high level of euroization, there are two distinctive deposit interest rate pass-through processes at work. Interest rates on the dinar deposit portfolio are aligned with the key policy rate of the National Bank of Serbia, whereas

interest rates on the euro-denominated deposit portfolio should be aligned with the key policy rate of the ECB. The former process may be referred to as the domestic interest rate pass-through, and the latter as the imported (cross-border) interest rate pass-through.

This paper has two main research objectives. First, it explores if the monetary policy in the euro area influences the cost of euro deposits for the banks operating outside the euro area. While it is likely that the domestic key policy rate should have an impact on the interest rates of the domestic currency deposits, it does not straightforwardly indicate that the same is applicable to foreign-currency deposits, since depositors in a country outside the euro area do not have an easy option to transfer deposit balances to the banks operating in the euro area, where (as a standard) interest rates should be linked to the euro-area key policy rate. Second, in a quantitative sense, the paper compares the smoothness and magnitude of the domestic interest rate pass-through and the imported (cross-border) interest rate pass-through.

## LITERATURE REVIEW

Yet undoubtedly, in the high-inflation environment, the traditional interest rate channel of the monetary policy is of primary importance. It is essential for central banks to have a good knowledge of how fast and to what extent change in their key policy rates is transmitted to the range of market and bank retail interest rates (Borio & Fritz, 1995; Mojon, 2000; de Bondt, 2005; European Central Bank, 2010; Aziakpono & Wilson, 2013). This is the first step in the transmission mechanism of the monetary policy aimed at initiating the adaptations of and propagating changes in the overall economy, changes in the supply of and demand for goods and services, which will lead to preserving price stability. Retail interest rates are likely to influence aggregate demand (Kwapil & Scharler, 2010).

The interest rate pass-through is the cornerstone for an effective operation of the other main channels of the monetary policy that are dependent upon the

smooth functioning of the interest rate channel (Egert, Crespo-Cuaresma & Reininger, 2007). If change in the key policy rate is not properly transmitted to market and bank interest rates, then the credit channel, the exchange rate channel, or the asset price channel is expected to be ineffective.

Deposits represent the largest portion of banks' liabilities. As such, they are the main source of funds for banks. A stable deposit base contributes to bank soundness (Živković, Stankić, Marinković & Lukić, 2023). The stability of deposits makes them particularly well suited for funding risky and illiquid assets (Drechsler, Savov & Schnabl, 2017).

One part of deposits is commonly non-interest bearing, namely transaction and sight deposits, whereas savings and term deposits, which are interest-bearing, account for a significant part of total deposit liabilities. A rise in the key policy rate may, to differing degrees, be transmitted to various financial asset classes, and inside the subclasses of the general financial asset classes as well. As a general financial asset class, deposits are among them, and the subject matter of the analysis carried out in this paper is the development and response of their interest rates.

Deposit interest rates are most often declared as fixed rates, because of which the formal repricing procedure and the decision made by the management of each bank are needed for new interest rates to come into effect. Lending interest rates are frequently declared as variable, which makes them automatically repriced and aligned with the reference market interest rates predominantly determined by changes in the key policy rate. Accordingly, loan interest rates have an inherent adjustment mechanism, which boosts the interest rate pass-through, although no similar mechanism has yet been incorporated in changes in deposit interest rates in any way.

So far, research has often neglected the field of the interest rate pass-through, for which reason J. Gregor, A. Melecký and M. Melecký (2019) conducted a meta-analysis of the literature including 52 papers on the interest rate pass-through, not dealing with deposit interest rates at all. Instead, attention was predominantly paid to the pass-through to

loan interest rates. G. Petrevski and J. Bogoev (2012) explored the interest rate pass-through in Southeastern Europe in North Macedonia, Croatia, and Bulgaria, the countries that have adopted rigid exchange-rate regimes and pegged in some way their currencies to the euro but did not investigate the deposit rate pass-through. They concluded that the long-term pass-through on lending rates was complete only in North Macedonia. Due to that which and the sluggishness of short-term adjustment altogether, the interest rate channel was not assessed as effective in the examined countries.

As a rule, banks set their interest rates in line with the prevailing market interest rates that serve as a benchmark. When setting interest rates on various loan products, banks add a varying mark-up on the defined benchmark. In the same fashion, deposit rates are determined by subtracting a markdown from the same benchmark (Rousseas, 1985; De Graeve, De Jonghe & Vander Venet 2007; Andries & Billon, 2016). Thereby, banks' costs of funding and costs of deposits are closely connected with the prevailing level of market interest rates.

If the key policy rate rises, banks are expected to raise deposit rates, but the previous markdown on deposits does not need to remain the same. If the markdown increases, banks execute a low pass-through with positive effects on their earnings. Based on the US data, I. Drechsler *et al* (2017) show that the deposit spread (the difference between the Fed fund rate and the deposit rate) extends when the Fed funds rate increases, which consequently induces a deposit outflow from the banking system. Provided that economic subjects have access to developed financial markets and can resort to bonds, deposit contraction occurs, which induces lending contraction by the banking sector, whereby the transmission of the monetary policy is triggered.

The fewer the financial and investment alternatives of savers, the greater the market power of banks. Banks are more prone to seize the opportunity that accompanies an increase in key policy rates. The average saver in emerging markets, whose financial system is usually bank-centric, does not have many

available options for channeling short- and medium-term savings towards other financial institutions or financial markets, while long-term savings remain low. Money market funds and investment in government bills and notes are not a popular investment vehicle in emerging market economies, so banks have relatively more market power in emerging market countries than in the developed. If the elasticity of demand for deposits is lower than unity, the pass-through may become disproportionate at the expense of savers (Egert *et al*, 2007).

T. Messer and F. Niepmann (2023) observe that deposit rates are sticky and only move slowly when there is change in the key policy rate. F. De Graeve *et al* (2007) argue that interest rates on demand and savings deposits are very rigid, whereas with respect to time deposits, it is far less the case. Based on their meta study on the literature, N. Andries and S. Billon (2016) find that the size of the long-term pass-through is much larger for loan rates compared to deposit rates. The interest rate on deposits is negatively influenced by real gross domestic product and inflation, and small banks have to pay a premium on deposit rates to attract an amount of the needed deposit funds (Gambacorta, 2008). The literature mostly emphasizes that the pass-through to deposit rates seems to be less complete but increases for deposits of longer maturities (de Bondt, 2002). H. Sander and S. Kleimeier (2004) find out that the average long-term pass-through coefficient for different types of deposits is below 0.5, simultaneously arguing that more competition enhances the pass-through to deposit interest rates.

A. Ferrer, G. Ganics, A. Molina Iserre and J. M. Serena (2023) argue that the pass-through of the Euribor to deposit rates is weaker in the banking systems with higher excess liquidity and a more concentrated deposit market, and that a recent surge in Euribor has, to a lesser extent, had an influence on deposit rates in comparison to historical experiences. When banks have abundant excess reserves, they do not have a strong incentive to mobilize deposits since they do not fall short of funds; hence, deposit rates behave even more sluggishly. S. Kho (2025) explored the downward and upward stickiness of deposit rates and found out that the pass-through to deposit rates

was slower (faster) when interest rates rose (declined) in the national banking sectors with a higher degree of market concentration. T. Messer and F. Niepmann (2023) claim that a low pass-through to deposit rates is likely if ample liquidity is combined with limited banks' capacity to expand lending. I. Moder (2023) investigated the monetary policy spill-over from the ECB's monetary policy to retail rates on euro-denominated loans and deposits in the Central, Eastern and Southeastern European countries with national currencies. The paper compared the features of the pass-through from the key policy rate of the ECB and the key policy rate of the domestic central banks to deposits and loans in the euro currency but did not explore the pass-through from the domestic key policy rate to deposits in the domestic currency.

## AIM OF THE PAPER

This paper focuses on the cost adjustment of the deposit side of bank's balance sheet stemming from a monetary policy decisions. It contributes to discerning specifics of monetary policy transmission mechanism in Serbia, as an example of country in which economic agents have rather strong preferences for deposits in both domestic and foreign currency. A high presence and reliance on non-domestic currency in the monetary system adds to labeling it as a dual currency monetary system.

The paper centers on interest rate pass-through in the realm of deposit interest rates. Since the financial system in Serbia is highly euroized there are two distinctive deposit interest rate pass-through processes in action. The interest rates on the dinar deposit portfolio are being aligned with key policy rate of National bank of Serbia, and the interest rates on euro denominated deposit portfolio should be aligned with the key policy rate of the ECB. The former process may be referred to as domestic interest rate pass-through, and the later process as imported (cross-border) interest rate pass-through.

The research interest of the paper is twofold. First, it explores does monetary policy in the euro area influence the cost of euro deposits for banks operating

outside the euro area. While it is likely that domestic key policy rate should impact on the interest rates of domestic currency deposits, it is not straightforward that the same holds for foreign currency deposits, since depositors in out of euro area country do not have an easy option to transfer deposit balances into banks operating in euro area where, by default, interest rates should be linked to euro area key policy rate. Second, it compares, in a quantitative sense, smoothness and magnitude of domestic interest rate pass-through and of imported (cross-border) interest rate pass-through.

## METHODOLOGY

The choice of the applied methodology is driven by the features of the time-series variables. The non-stationarity of economic time-series variables is a common problem with them. If not adequately addressed, non-stationarity may lead to the detrimental econometric consequences that materialize in spurious regression and misinterpretations of the results. A concept of cointegration is developed to circumvent this problem in estimating regression models (Mladenović & Nojković, 2012). In the case where two variables, the dependent variable and the explanatory variable, are non-stationary of order one  $I(1)$ , a special case may arise, where a linear combination of them turns out to be a stationary process  $I(0)$ . On the one hand, the series might not be cointegrated, which means that their linear combination is of the same order one  $I(1)$  as well, while on the other hand, if a linear combination has a constant mean and variance over time, and the covariance between two values of the series depends only on the length of time between the values, it is referred to as stationary, or of order zero  $I(0)$ . The stationarity of a linear combination stems from the fact that two time-series variables do not diverge from each other in the course of time due to sharing similar stochastic trends (Engle & Granger, 1987).

A typical bivariate (the dependent variable and one regressor) ARDL model takes the following form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \beta_0 x_t + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \dots + \beta_q x_{t-q} + \varepsilon_t \quad (1)$$

The ARDL model has three distinctive variants. The above-mentioned variant specifies all the variables in levels. The second variant deals with long-term and short-term estimates, whereas the third is described by the error-correction model.

Given that the simplest bivariate ARDL model is ARDL (1,1), two last variants can be demonstrated using it as an example. The baseline expression of the model in levels is:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \quad (2)$$

Rearranging expression so as to subtract  $y_{t-1}$  from both sides, and add  $\beta_0 x_{t-1} - \beta_0 x_{t-1}$  to the right-hand side yields:

$$y_t - y_{t-1} = \alpha_0 + (\alpha_1 - 1)y_{t-1} + \beta_0(x_t - x_{t-1}) + (\beta_0 + \beta_1)x_{t-1} + \varepsilon_t \quad (3)$$

This expression is further simplified:

$$\Delta y_t = \alpha_0 + (\alpha_1 - 1)y_{t-1} + \beta_0 \Delta x_t + (\beta_0 + \beta_1)x_{t-1} + \varepsilon_t \quad (4)$$

The long-term component relates to the coefficients attached to  $y_{t-1}$  and  $x_{t-1}$ , while the short-term component in the expression is captured by the  $\Delta x_t$  term (the first difference of the regressor).

The third variant absorbs the long-term component of the model into the error correction term in order to assess convergence to the long-term equilibrium. The question arises as to how deterministic components, such as the constant, should be included in the third variant. The one possibility implies the exclusion of the constant  $\alpha_0$  from the error correction term that captures the long-term equilibrium. Namely:

$$\Delta y_t = \alpha_0 + (\alpha_1 - 1) \left[ y_{t-1} + \frac{\beta_0 + \beta_1}{\alpha_1 - 1} x_{t-1} \right] + \beta_0 \Delta x_t + \varepsilon_t \quad (5)$$

This is referred to as the ARDL model with the unrestricted constant. The long-term part in the brackets relates to the simple regression model of the type:  $y_t = \alpha + \beta x_t + \varepsilon_t$ , which, expressed in the error term, is:  $\varepsilon_t = y_t - \alpha - \beta x_t$ . When the constant is excluded from the long-term regression equation, which is the unrestricted constant case, then:  $\varepsilon_t = y_t - \beta x_t$ . In order for the error correction term to be represented in a proper manner,  $ECT_{t-1} = \left[ y_{t-1} - \frac{\beta_0 + \beta_1}{\alpha_1 - 1} x_{t-1} \right]$ , needs to be replaced by  $\alpha_1 - 1$  sa  $-(1 - \alpha_1)$ .

So, the final expression of the ARDL model with the unrestricted constant reads as follows:

$$\Delta y_t = \alpha_0 + (-)(1 - \alpha_1) \left[ y_{t-1} - \frac{\beta_0 + \beta_1}{1 - \alpha_1} x_{t-1} \right] + \beta_0 \Delta x_t + \varepsilon_t \quad (6)$$

The term  $(1 - \alpha_1)$  is important and is called the adjustment factor. It serves as the parameter that describes the speed of adjustment to the long-term equilibrium, provided that a one-off shock has occurred. In this paper, that shock takes the form of change in the monetary policy rate. This shock is of exogenous nature, since the decision is made by the independent central bank which is primarily responsible for price stability.

In the ARDL model with the restricted constant, the constant is included in the error correction term, so the expression looks slightly different from the expression of the model with the unrestricted constant:

$$\Delta y_t = (-)(1 - \alpha_1) \left[ y_{t-1} - \frac{\alpha_0}{1 - \alpha_1} - \frac{\beta_0 + \beta_1}{1 - \alpha_1} x_{t-1} \right] + \beta_0 \Delta x_t + \varepsilon_t \quad (7)$$

In the model with the restricted constant, the constant is attached to the long-term part (the error correction term), whereas in the model with the unrestricted constant, it is matched with short-term dynamics (the first-differenced terms). The constant in the restricted model represents the fixed spread between the dependent variable and the regressor and has a specific economic meaning.

An important advantage of using the ARDL is that both the long-term coefficient and the short-term

coefficient can be obtained directly from the same equation.

The analysis of the pass-through from market rates to retail interest rates carried out in this paper relies on the general ARDL (p,q) model inaugurated in M. Pesaran and Y. Shin (1999), and refined by M. Pesaran, Y. Shin and R. J. Smith (2001):

$$r_t^B = \alpha + \sum_{i=1}^p \beta_i r_{t-i}^B + \sum_{j=0}^q \gamma_j r_{t-j}^M + \varepsilon_t \quad (8)$$

where  $r_t^B$  denotes the bank retail interest rate,  $r_t^M$  represents the benchmark market interest rate,  $p$  and  $q$  denote the maximum lag of the dependent variable and the explanatory variable, respectively.

After reformulating the general model in first differences, the following is obtained:

$$\Delta r_t^B = \alpha + \sum_{i=1}^{p-1} \beta_i \Delta r_{t-i}^B + \sum_{j=0}^{q-1} \gamma_j \Delta r_{t-j}^M + \theta_1 r_{t-1}^B + \theta_2 r_{t-1}^M + \varepsilon_t \quad (9)$$

which the error correction form of the ARDL is derived as follows:

$$\Delta r_t^B = \alpha + \sum_{i=1}^{p-1} \beta_i \Delta r_{t-i}^B + \sum_{j=0}^{q-1} \gamma_j \Delta r_{t-j}^M + \theta_1 r_{t-1}^B + \theta_2 r_{t-1}^M + \varepsilon_t \quad (10)$$

where

$$\theta_1 = -(1 - \sum_{i=1}^p \beta_i), \text{ and } \theta_2 = \sum_{j=0}^q \gamma_j \quad (11)$$

The coefficients  $\beta_i$  and  $\gamma_j$  show the dynamics of the short-term alignment towards the long-term equilibrium, where  $\gamma_0$  is the immediate pass-through coefficient.  $\theta_1$  accounts for the speed of adjustment to the long-term equilibrium, and the ratio  $\frac{\theta_2}{\theta_1}$  represents the long-term pass-through. This approach adopts the methodology proposed by G. J. de Bondt (2005) and I. Moder (2023), who employed the single-equation error correction model in order to empirically analyze the interest rate pass-through. According to the equation, the model with the restricted constant is chosen.

The relevant lag length ( $p$  and  $q$ ) is chosen based on minimizing the Akaike Information Criterion (AIC) out of all the lags up to the lag 8. If the number of the lags needed to address the issue of the autocorrelation of the residuals of the model exceeds

10, it is not worthwhile estimating the model further. However, such an issue did not arise in the empirical examination.

After estimating the particular specification of ARDL, the long-term equilibrium relationship between bank retail interest rates and the market interest rate is assessed on the ground of the bounds testing approach (Pesaran et al, 2001). The F-Bounds test uses the F-test for the parameters  $\theta_1$  and  $\theta_2$ :

$$H_0 = \theta_1 = \theta_2 = 0 \quad (12)$$

The distribution of the test statistic is non-standard. Thereby, M. Pesaran *et al* (2001) provide special bounds to be used. The two limits associated with critical values are defined. The first limit is the upper-bound critical value, provided that all the variables are I(1), and the second limit is the lower-bound critical value under the assumption that all the variables are I(0). If the computed F-statistic is below the lower bound, no cointegration is possible since the variables are stationary. If the F-statistic is above the upper bound, the null of no cointegration is rejected. If the F-statistic falls in between the two bounds, then the test is inconclusive. If the bounds test is not passed, the ARDL specification is yet useful, because short-term coefficients may be interpreted in an economically meaningful way.

Of course, all estimations reported are tested for the presence of serial correlation and heteroscedasticity. The problem of serial correlation is solved by adding the lagged first differences of the variables in the model, so residuals are eventually free from

autocorrelation. Newey-West standard errors are used in estimations where needed so as to operate with heteroscedasticity and the autocorrelation consistent standard errors that correct the value of the test statistic.

## DESCRIPTIVE STATISTICS

The reaction of the deposit interest rates to the change in the market interest rates, which serve as a proxy for the change in the key policy rate, is assessed for the period from 2013 to 2024 period. The sample of the deposit interest rates under consideration covers the monthly data from January 2013 to December 2024 (a total of 144 observations). All bank interest rates reflect new business, which is important for insulating the effects of the change in the key policy rates only on new term deposits as opposed to all outstanding term deposits with terms and conditions agreed in the previous periods. All the time series are retrieved from the interest rate statistics of the National Bank of Serbia (NBS).

Table 1 summarizes the interest rates used in the analysis of the domestic and cross-border interest rate pass-throughs of the monetary policy in Serbia.

The choice of the maturity of the term deposits was guided by the available statistical records of the NBS. Thereby, three deposits' maturity buckets are taken into consideration: the maturity of the deposits of up to one year, the maturity of the deposits between one and two years, and the maturity of the deposits

**Table 1** The variables used in the analysis

| Household interest rates                                        | Non-financial corporation interest rates                        |
|-----------------------------------------------------------------|-----------------------------------------------------------------|
| Deposits with a maturity of up to one year in RSD               | Deposits with a maturity of up to one year in RSD               |
| Deposits with a maturity of over one and up to two years in RSD | Deposits with a maturity of over one and up to two years in RSD |
| Deposits with a maturity of over two years in RSD               | Deposits with a maturity of over two years in RSD               |
| Deposits with a maturity of up to one year in EUR               | Deposits with a maturity of up to one year in EUR               |
| Deposits with a maturity of over one and up to two years in EUR | Deposits with a maturity of over one and up to two years in EUR |
| Deposits with a maturity of over two years in EUR               | Deposits with a maturity of over two years in EUR               |

Source: Authors

exceeding two years. Since current accounts are not remunerated in Serbia, and sight deposits are not recognized as a distinctive category in the official interest rate statistics, it was impossible to check the interest rate pass-through for overnight deposits. I. Moder (2023) remarks that official interest rate statistics in Serbia lack granularity in deposits' maturity buckets in comparison to the other European countries that are not part of the euro area.

In practice, term deposits are denominated in the local currency (dinar) and the euro. The term deposit timeseries denominated in the euro comprise the deposits explicitly denominated in the euro and the euro-indexed deposits. The cash flows related to the euro-indexed deposits, encompassing money depositing and withdrawal, are performed in the local currency, but the amount of cash flows is determined by the current exchange rate between the dinar and the euro. In effect, there is no difference between euro-denominated and euro-indexed deposits. The existence of both categories of deposits lays the

ground for examining the imported (cross-border) interest rate pass-through of the ECB's monetary policy.

Finally, two types of depositors are individually treated and appraised in order to reveal whether there are differences in the reaction and evolution of the deposit interest rates stemming from the type of banks' counterparty – households (augmented by non-profit institutions serving households) and non-financial corporations. It may be the case that the deposits of a counterparty are more valuable to banks, for instance due to their stability or size, which may have an impact on the evolution of the respective interest rates.

Figure 1 graphically displays the evolution of the Euribor rates and euro deposit interest rates for households and non-financial corporations with the maturity of less than one year. The timeframe covers two distinctive periods with respect to the positive and negative key policy rates in place. Prior to the

**Table 2** The descriptive statistics of the interest rates' time series

| Household deposit interest rates                                | Mean | Max   | Min   | St. deviation |
|-----------------------------------------------------------------|------|-------|-------|---------------|
| Deposits with a maturity of up to one year in RSD               | 4.15 | 9.94  | 1.52  | 2.19          |
| Deposits with a maturity of over one and up to two years in RSD | 4.86 | 12.49 | 1.67  | 2.51          |
| Deposits with a maturity of over two years in RSD               | 5.63 | 14.7  | 1.87  | 2.89          |
| Deposits with a maturity of up to one year in EUR               | 1.44 | 3.67  | 0.37  | 1.01          |
| Deposits with a maturity of over one and up to two years in EUR | 1.77 | 4.48  | 0.49  | 1.06          |
| Deposits with a maturity of over two years in EUR               | 1.8  | 4.63  | 0.66  | 0.99          |
| Non-financial corporation deposit interest rates                |      |       |       |               |
| Deposits with a maturity of up to one year in RSD               | 4.1  | 10.95 | 1.22  | 2.38          |
| Deposits with a maturity of over one and up to two years in RSD | 3.71 | 19.53 | 0.00  | 3.83          |
| Deposits with a maturity of over two years in RSD               | 2.74 | 34.16 | 0.00  | 5.52          |
| Deposits with a maturity of up to one year in EUR               | 1.27 | 3.4   | 0.28  | 0.9           |
| Deposits with a maturity of over one and up to two years in EUR | 1.11 | 4.58  | 0.00  | 1.16          |
| Deposits with a maturity of over two years in EUR               | 0.48 | 2.43  | 0.00  | 0.54          |
| Market interest rates                                           |      |       |       |               |
| 3M BELIBOR                                                      | 4.35 | 11.51 | 0.87  | 2.79          |
| 6M BELIBOR                                                      | 4.53 | 11.89 | 1.07  | 2.81          |
| 3M EURIBOR                                                      | 0.46 | 3.97  | -0.58 | 1.43          |
| 6M EURIBOR                                                      | 0.56 | 4.12  | -0.54 | 1.45          |
| 12M EURIBOR                                                     | 0.67 | 4.16  | -0.5  | 1.43          |

Source: Authors

ECB's policy of negative interest rates (the negative deposit facility rate), the spread between euro deposit interest rates and Euribor rates was rapidly narrowing. The spread then stabilized with entering the period of negative interest rates, with euro deposit interest rates strictly exceeding Euribor rates. The second period of the positive and rising key policy rate brought about a turnaround in the sign of the spread, converting the sign from positive to negative, i.e. Euribor rates overrunning euro deposit interest rates in terms of their size.

## DEPOSIT PORTFOLIO AND FINANCIAL EUROIZATION

Deposits approximately account for  $\frac{3}{4}$  of the total banking sector's liabilities in Serbia (National Bank of Serbia, 2023). Local deposits add to the stability of banks' operations because they represent a stable domestically raised source of funding, which mitigates the risk of parent banks' financing and dependence on the factors of the international environment. However, short-term deposits prevail over long-term deposits (deposits whose maturity exceeds one year), meaning that the maturity structure of deposits might be improved. Over 90% of all deposits are made up of

sight deposits and deposits maturing within one year. Figure 2 displays the combination of the currency and maturity composition of the deposit liabilities.

The NBS is actively engaged in promoting and propagating the use of dinar-denominated deposits and loans that lay the ground for strengthening the domestic leg of the monetary policy transmission mechanism. The share of the total dinar deposits in the banking sector went up from 19.3% in 2012 to 44.2% in 2024. The dinar household savings increased their share from 1.9% in 2012 to 9% in 2024. The rise in the deposit dinarization is by far the most significant achievement in the dinarization strategy.

Apart from Serbia, a non-negligible number of countries keep exceptionally close economic and trading ties with the countries that have adopted the euro and vastly tolerate the use of the euro in the financial system. It is not deemed beneficial for Serbia to replace its national currency with the euro by means of unilaterally introducing the euro to its monetary system (Marković & Furtula, 2009), although N. Stanišić (2012) highlights the benefits of monetary integration reflected in macroeconomic stabilization.

It is conducive to have a snapshot of the general

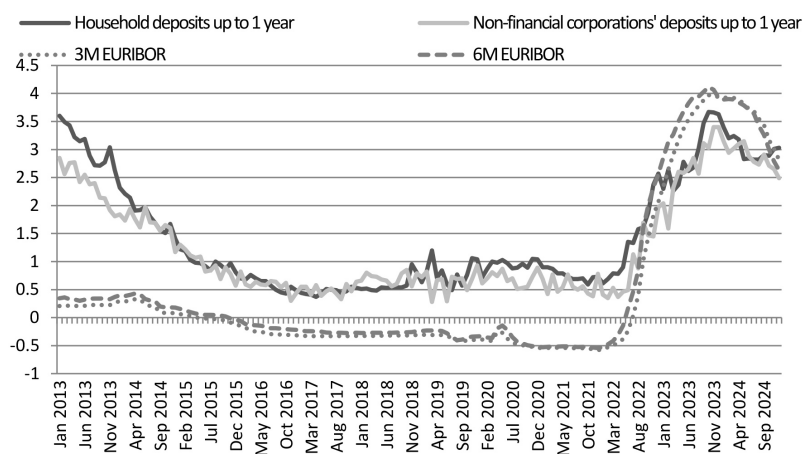
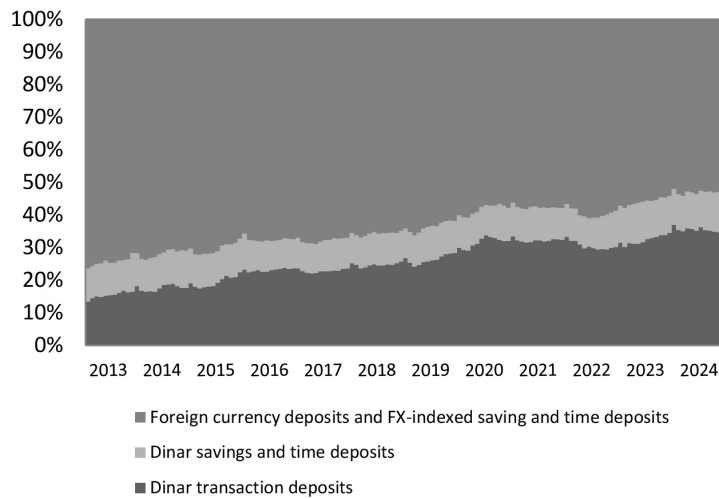


Figure 1 The evolution of the Euribor and euro deposit interest rates



**Figure 2** The deposit portfolio composition of the banking sector

Source: National bank of Serbia (2023). Annual Financial Stability Report. Belgrade, RS: NBS

euroization trends across countries so as to appraise the relative standing of and achievements made by Serbia. Table 3 depicts deposit euroization in the European Union countries that have preserved their national currencies and the EU candidate countries. It is evident that Serbia has made the greatest progress in the deposit de-euroization process (a process

identical to the de-dollarization process) in the last decade but still has the largest degree of euroization in the financial system across countries.

The importance of deposit financing for banks may be put in the context of comparison with the first next viable financing alternative in emerging

**Table 3** The outstanding euro-denominated bank deposits as a percentage of the total deposits

|                        | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022   |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Bulgaria               | 35.7% | 35.2% | 32.7% | 31.9% | 30.4% | 29.5% | 28.0% | 30.1% | 28.3% | 28.6%  |
| Croatia                | 62.2% | 60.6% | 59.4% | 56.7% | 54.2% | 51.0% | 49.2% | 47.4% | -     | -      |
| Czech Republic         | 6.8%  | 7.4%  | 7.8%  | 7.2%  | 5.8%  | 6.3%  | 6.7%  | 7.0%  | 7.8%  | 8.5%   |
| Hungary                | 15.6% | 15.1% | 15.0% | 18.3% | 16.1% | 16.1% | 16.2% | 17.9% | 19.3% | 23.7%  |
| Poland                 | 6.1%  | 6.1%  | 6.3%  | 7.1%  | 8.0%  | 7.7%  | 7.9%  | 7.5%  | 8.5%  | 10.5%  |
| Romania                | 29.5% | 28.8% | 27.5% | 26.5% | 26.9% | 28.6% | 29.8% | 30.3% | 30.6% | 29.2%  |
| Albania                | 40.5% | 40.9% | 40.1% | 40.1% | 43.6% | 44.3% | 44.9% | 43.5% | 45.5% | 47.9%  |
| Bosnia and Herzegovina | 41.4% | 39.5% | 38.4% | 36.4% | 35.3% | 33.2% | 40.0% | 39.1% | 36.9% | 34.5%  |
| North Macedonia        | 50.1% | 48.7% | 36.2% | 36.6% | 36.6% | 35.8% | 35.0% | 36.7% | 36.9% | 132.4% |
| Serbia                 | 71.6% | 70.1% | 66.3% | 64.2% | 62.9% | 61.1% | 59.5% | 54.9% | 54.2% | 53.7%  |
| Turkey                 | 16.1% | 15.2% | 15.3% | 15.9% | 16.1% | 18.3% | 19.2% | 17.9% | 21.1% | 14.7%  |

Source: European Central Bank. (2023). The international role of euro. European Central Bank, DE: Frankfurt. <https://www.ecb.europa.eu/pub/ire/html/index.en.html>

European countries, i.e. cross-border interbank financing. Launched in 2009, the Vienna Initiative spurred Western European parent banks with subsidiaries in the Central, Eastern and Southeastern European countries so as to reduce their exposure to subsidiaries in the aftermath of the global financial crisis. After a period of excessive and unsustainable credit expansion before the crisis, funded by channeling cheap money from the European money market to banks in foreign ownership in the CESEE, the countries were faced with external and internal imbalances. The subsidiaries deleveraging process started as part of the Vienna Initiative project and led to a decline in cross-border parent-bank financing. However, it is present in each instance as an alternative to deposit sources. This capital flow makes Euribor rates highly relevant for euro deposit interest rates for households and non-financial corporations.

The domestic loan-to-domestic deposit ratio is an indicator that conveys the effects of subsidiaries' recalibrated strategy based on the domestic sources of funding. It shows to what extent domestic loans are financed by domestic deposits. At the onset of the

global financial crisis, this ratio varied between 100% and 150% across the CESEE countries, the average ratio being 130% (Vienna Initiative, 2019). The ratio declined afterwards, only to reach the average level of 100% in the late 2010s, emphasizing the shifting of funding from foreign sources to the domestic deposit base, primarily local euro deposits. This surge in the importance of local euro deposits justifies the analysis of the imported interest rate pass-through which this paper includes.

## EMPIRICAL RESULTS AND DISCUSSION

Checking if no single series is integrated of order two is a precondition for utilizing ARDL models. An augmented Dickey-Fuller test was employed and, depending on the series properties, a different version of the ADF test and the test statistics were used, namely including a trend and an intercept, an intercept or no deterministic components. The level data and the first differences of the interest rates were tested for the unit root, and the obtained

**Table 4** The augmented Dickey-Fuller unit root test

| Household deposit interest rates                                | ADF unit root test | Non-financial corporation deposit interest rates                | ADF unit root test |
|-----------------------------------------------------------------|--------------------|-----------------------------------------------------------------|--------------------|
| Deposits with a maturity of up to one year in RSD               | $I(0)$             | Deposits with a maturity of up to one year in RSD               | $I(1)^*$           |
| Deposits with a maturity of over one and up to two years in RSD | $I(1)^*$           | Deposits with a maturity of over one and up to two years in RSD | $I(0)$             |
| Deposits with a maturity of over two years in RSD               | $I(0)$             | Deposits with a maturity of over two years in RSD               | $I(0)$             |
| Deposits with a maturity of up to one year in EUR               | $I(1)$             | Deposits with a maturity of up to one year in EUR               | $I(1)$             |
| Deposits with a maturity of over one and up to two years in EUR | $I(1)$             | Deposits with a maturity of over one and up to two years in EUR | $I(1)^*$           |
| Deposits with a maturity of over two years in EUR               | $I(1)^*$           | Deposits with a maturity of over two years in EUR               | $I(0)$             |
| Market interest rates in RSD                                    | ADF unit root test | Market interest rates in EUR                                    | ADF unit root test |
| 3M BELIBOR                                                      | $I(1)$             | 3M EURIBOR                                                      | $I(1)^*$           |
| 6M BELIBOR                                                      | $I(1)$             | 6M EURIBOR                                                      | $I(1)$             |
|                                                                 |                    | 12M EURIBOR                                                     | $I(1)^*$           |

\*These time series were estimated as  $I(0)$  at the 10% significance level.

Source: Authors

results confirm that some series are  $I(0)$ , whereas the first differences of those that do not pass the test at the level of 5% significance were further analyzed and validated as stationary. Also, five time series were  $I(0)$  processes but at the 10% significance level; nevertheless, it was deemed needed to continue the testing until the series were stationary at the 5% significance level or lower.

To allow for the comparability of the coefficients across the models, each deposit rate was estimated and, in parallel, a cointegration relationship with the two market interest rates most relevant to that deposit rate was modeled.

The Belibor rates with 3-months and 6-months maturities were selected as relevant market interest rates for dinar deposits. However, it should be kept in mind that the transactions volume on the money market for these maturities is either low or nonexistent, primarily due to the high level of

liquidity in the banking system, and the fact that these rates predominantly serve as a benchmark for variable-rate loans in the domestic currency. In terms of its relevance, this remark does not apply to the Euribor market interest rates for which three maturities were selected, and the transaction volume is satisfactory. Also, European banks' surveys show that 3-months, 6-months and 12-months Euribor rates serve most commonly as the reference interest rate employed as the underlying rate in many contracts (loan, hedging). Matching market interest rates with bank interest rates of comparable maturity excludes the effect of the term structure in the pass-through from the effect of marginal costs whose effects the paper is inherently interested in.

First, the domestic deposit interest rate pass-through of the Serbian monetary policy will be observed. Based on the F-bounds test results that indicate the existence of a cointegrating relationship between money market rates in Serbia and dinar deposit rates,

**Table 5** The domestic deposit interest rate pass-through of the Serbian monetary policy

| Household deposit interest rates                                | Reference rate | Lag structure | F-bounds test         | Immediate pass-through | Long-term pass-through | Adjustment speed     | Long-term constant  |
|-----------------------------------------------------------------|----------------|---------------|-----------------------|------------------------|------------------------|----------------------|---------------------|
| Deposits with a maturity of up to one year in RSD               | BELIBOR 3M     | (7,2)         | 4.105 <sup>*(1)</sup> | 0.10 <sup>*</sup>      | 0.63 <sup>***</sup>    | -0.14 <sup>***</sup> | 1.22 <sup>***</sup> |
|                                                                 | BELIBOR 6M     | (7,5)         | 2.59                  | 0.11                   | 0.54 <sup>***</sup>    | -0.096 <sup>*</sup>  | 1.43 <sup>**</sup>  |
| Deposits with a maturity of over one and up to two years in RSD | BELIBOR 3M     | (7,7)         | 39.63 <sup>***</sup>  | 0.55 <sup>***</sup>    | 0.77 <sup>***</sup>    | -0.34 <sup>***</sup> | 1.33 <sup>***</sup> |
|                                                                 | BELIBOR 6M     | (5,3)         | 11.81 <sup>***</sup>  | 0.56 <sup>***</sup>    | 0.81 <sup>***</sup>    | -0.25 <sup>***</sup> | 1.06 <sup>**</sup>  |
| Deposits with a maturity of over two years in RSD               | BELIBOR 3M     | (8,1)         | 10.63 <sup>***</sup>  | 0.11                   | 0.52 <sup>***</sup>    | -0.20 <sup>***</sup> | 2.54 <sup>***</sup> |
|                                                                 | BELIBOR 6M     | (8,1)         | 36.19 <sup>***</sup>  | 0.09                   | 0.53 <sup>***</sup>    | -0.20 <sup>***</sup> | 2.43 <sup>***</sup> |
| Non-financial corporation deposit interest rates                |                |               |                       |                        |                        |                      |                     |
| Deposits with a maturity of up to one year in RSD               | BELIBOR 3M     | (6,7)         | 3.65 <sup>*(1)</sup>  | 0.40 <sup>***</sup>    | 0.57 <sup>***</sup>    | -0.06 <sup>***</sup> | 1.51 <sup>**</sup>  |
|                                                                 | BELIBOR 6M     | (3,2)         | 3.57 <sup>*(1)</sup>  | 0.45 <sup>***</sup>    | 0.45                   | -0.05 <sup>***</sup> | 1.92                |
| Deposits with a maturity of over one and up to two years in RSD | BELIBOR 3M     | (2,4)         | 7.17 <sup>***</sup>   | -0.50                  | 0.76 <sup>***</sup>    | -0.34 <sup>***</sup> | 0.08                |
|                                                                 | BELIBOR 6M     | (2,4)         | 6.98 <sup>***</sup>   | -0.60                  | 0.76 <sup>***</sup>    | -0.34 <sup>***</sup> | -0.04               |
| Deposits with a maturity of over two years in RSD               | BELIBOR 3M     | (8,4)         | 13.16 <sup>***</sup>  | -0.29                  | 0.62 <sup>*</sup>      | -0.55 <sup>***</sup> | -0.8                |
|                                                                 | BELIBOR 6M     | (8,4)         | 12.98 <sup>***</sup>  | -0.29                  | 0.63 <sup>**</sup>     | -0.56 <sup>***</sup> | -0.93               |

<sup>(1)</sup> Inconclusive at the significance level of 5%, but significant at the 10% level.

Source: Authors

the respective relationship is denied in only one case (household deposits up to one year and 6M Belibor), whereas it is only marginally present (at a 10% level) for the other three cointegrating relationships tested vis-à-vis deposits up to one year maturity.

In the case of the deposits with a maturity of over one and up to two years, and over two years, the cointegrating relationship is broadly confirmed across both types of depositors, which allows for further considering the size and significance of the coefficient estimates.

The value of the long-term pass-through coefficient normally takes the value between zero and one but a value greater than one cannot be excluded a priori. The value of one indicates a complete pass-through, where change in the money market rate is one-for-one transmitted to bank interest rates. The estimates of the long-term pass-through coefficients are overall high, and in the case of the deposits with a maturity of over one and up to two years approach to unity for both household (0.77-0.81) and non-financial corporation deposits (0.76), with the still present gap to complete the pass-through. The long-term pass-through coefficient for the rate on non-financial corporation deposits with a maturity of up to one year is not significantly different from zero, which further puts into question the relevance of the cointegrating relationship for this class of deposits (the 6M Belibor benchmark), and is marginally significant for the deposits with a maturity of over two years (the 3M Belibor benchmark). The long-term pass-through for the rest of the deposits may be described as moderate and incomplete, simultaneously strongly present as well.

The short-term pass-through coefficient indicates a contemporary change in the deposit interest rates initiated by contemporary change in the benchmark rate (i.e. change within a month after the change in the benchmark market rate). If the immediate pass-through coefficient is not significant, it means that no measurable change in the deposit interest rate occurs within a one-month period after the benchmark rate adjustment. The larger the immediate pass-through coefficient, the more impactful the first-round effect

of the benchmark rate correction. Only with regard to the rate on the household deposits with a maturity of over one and up to two years (0.55-0.56) and the non-financial corporation deposits with a maturity of up to one year (0.40-0.45) is it noticeably large and significant. However, in all the other cases, it is basically not different from zero. Hence, and overwhelmingly, deposit rates react sluggishly to changes in benchmark market rates, which points to the fact that the short-term pass-through is weak.

The next important estimate is the speed of adjustment to the long-term equilibrium. It shows how much of the remaining deviation from the long-term equilibrium is corrected within a single period. For example, the value of the adjustment speed for the non-financial corporation deposits with a maturity of two years (which is -0.55) is interpreted as the 55% of the disequilibrium between 3M Belibor and the respective deposit rate corrected within a single period (a period of one month). The negative and significant adjustment speed coefficient warrants that the deposit rates are to converge in a conceivable future to the long-term equilibrium relationship between them and the benchmark rate. In all the sub-models that passed the F-bounds test, the adjustment speed is negative and significant.

Additional information may be derived by transforming the adjustment coefficient speed, i.e. obtaining the time required for the long-term equilibrium to be reached. The inverse of the adjustment speed parameter implies the time lag (measured in months) after which change in the market interest rate is fully passed through to the level of deposit interest rates. For instance, the non-financial corporation deposits with a maturity of two years exhibit a very fast speed of adjustment, because it takes them less than two months to fully adjust to changes in the market interest rate. On the other hand, the non-financial corporation deposits with a maturity of up to 1 year show a slow speed of adjustment, with more than 16 months needed for a full pass-through. The period needed to reach the final pass-through for household deposits ranges from 3 to 7 months.

The long-term constant originating from the estimated ARDL model with a restricted constant has an economic interpretation as well. It effectively incorporates a bundle of the time-invariable influences that are beyond inclusion in the equilibrium term, i.e. it represents the other factors that stand behind the spread between the market interest rate and retail bank rates. The long-term constant for the non-financial corporation deposit rates is different from zero only for the category of the deposits with a maturity of up to one year (the 3M Belibor benchmark). The irrelevance of the long-term constant of the non-financial corporation deposits is at odds with the significance of the long-term constant for the rates on the household deposits that are significant in all the sub-models.

Having considered the results and the features of the domestic monetary policy pass-through, which includes the impact of the interest rate decisions of the National Bank of Serbia, attention can be focused

on the transmission of the key policy rate formulated in the euro area to the euro deposit interest rates in Serbia. The discussion will focus on the comparison between the dinar interest rate pass-through and the euro deposit interest rate pass-through.

The first step in the analysis implies dealing with the existence of the cointegrated relationship between market interest rates in the euro area and euro deposit interest rates in Serbia. For this purpose, the F-bounds test is used again, showing that 11 out of the 12 examined cointegrating relationships are significant at the level of at least 5%, while one cointegrating relationship is significant at the level of 10%. These results are better than the results obtained upon examining the cointegration relationships of the domestic monetary policy pass-through, where one relationship was not significant and three relationships were significant at the 10% level.

When considering the size of the obtained long-term pass-through coefficients, several observations can

**Table 6** The euro deposit interest rate pass-through of the cross-border (the euro area) monetary policy in Serbia

| Household deposit interest rates                                | Reference rate | Lag structure | F-Bounds test | Immediate pass-through | Long-term pass-through | Adjustment speed | Long-term constant |
|-----------------------------------------------------------------|----------------|---------------|---------------|------------------------|------------------------|------------------|--------------------|
| Deposits with a maturity of up to one year in EUR               | EURIBOR 3M     | (4,2)         | 4.53**        | 0.095                  | 0.59***                | -0.09***         | 0.99***            |
|                                                                 | EURIBOR 6M     | (5,8)         | 4.3**         | 0.03                   | 0.63**                 | -0.10***         | 0.92***            |
| Deposits with a maturity of over one and up to two years in EUR | EURIBOR 6M     | (2,4)         | 4.18**        | -0.51                  | 0.4**                  | -0.10***         | 1.29**             |
|                                                                 | EURIBOR 12M    | (2,4)         | 3.89*(1)      | -0.3                   | 0.53***                | -0.10***         | 1.22***            |
| Deposits with a maturity of over two years in EUR               | EURIBOR 6M     | (10,8)        | 10.72***      | -0.02                  | 0.006                  | -0.16***         | 1.03**             |
|                                                                 | EURIBOR 12M    | (4,7)         | 6.99***       | -0.19                  | 0.11**                 | -0.10***         | 1.14***            |
| Non-financial corporation deposit interest rates                |                |               |               |                        |                        |                  |                    |
| Deposits with a maturity of up to one year in EUR               | EURIBOR 3M     | (6,8)         | 9.57***       | 0.93***                | 0.56***                | -0.22***         | 0.80***            |
|                                                                 | EURIBOR 6M     | (3,8)         | 7.72***       | 0.72***                | 0.59***                | -0.19***         | 0.78***            |
| Deposits with a maturity of over one and up to two years in EUR | EURIBOR 6M     | (3,1)         | 5.74***       | 0.78                   | 0.54***                | -0.36***         | 0.72***            |
|                                                                 | EURIBOR 12M    | (1,4)         | 15.43***      | 0.13                   | 0.53***                | -0.51***         | 0.69***            |
| Deposits with a maturity of over two years in EUR               | EURIBOR 6M     | (5,1)         | 6.94***       | 0.02                   | -0.003                 | -0.46***         | 0.39***            |
|                                                                 | EURIBOR 12M    | (5,1)         | 6.92***       | -0.08                  | 0.001                  | -0.46***         | 0.39***            |

(1) Inconclusive at the significance level of 5%, but significant at the 10% level.

be made. In the case of the deposits with a maturity of up to one year, the coefficients are slightly higher and statistically more significant for the euro interest rate pass-through compared to the dinar interest rate pass-through. In the case of the deposits with a maturity of over one and up to two years, the situation is reversed, namely they are relatively higher and statistically more significant in the dinar interest rate pass-through compared to the euro interest rate pass-through. Furthermore, in the case of the euro deposits with a maturity of over two years, the obtained results suggest that, in only one out of the four cointegration relationships, the long-term pass-through is significant; where it is significant, it is of a very small size. In effect, whether the cointegration relationship is genuinely valid for the longer-term euro deposits interest rates is open to question.

When considering the immediate pass-through, the results are slightly better in the dinar interest rate pass-through, but in principle they are very similar. In the euro interest rate pass-through, significance was confirmed only in the case of the deposits with a maturity of up to one year from non-financial corporations. However, the short-term pass-through is extremely big in size (0.93 and 0.72). It is intriguing that, for these deposits, the short-term pass-through is higher than the long-term pass-through, from which it follows that the initial reaction of interest rates on the deposits of non-financial corporations with a maturity of up to one year to the change in Euribor is extremely fast and the pass-through is almost complete, but in

a course of time, the effect diminishes in size and the long-term stabilization of the cointegration link is achieved at lower levels (0.56 and 0.59).

In order to provide a deeper insight into how the long-term equilibrium between 3M Euribor and non-financial corporations' deposits with a maturity of up to one year is achieved over a given time horizon, Figure 3 depicts the cumulative dynamic multiplier, showing the estimated response of the deposit interest rate on the deposits with a maturity of up to one year from non-financial corporations to the change in 3M Euribor in successive time periods. The dotted line in Figure 3 represents the new long-term equilibrium, provided that additional shocks do not occur after the initial one.

Finally, the estimated speed of adjustment to the long-term equilibrium is faster for the deposit interest rates on household deposits in the dinar interest rate pass-through than in the euro interest rate pass-through. That is to say, those deposits whose interest rate adjustment is related to the euro interest rate pass-through need between six and ten months to achieve the final pass-through. Also, the variations in the time required to achieve the long-term equilibrium for the household deposits of different maturities are smaller in the euro interest rate pass-through than in the dinar interest rate pass-through. On the other hand, in the case of the interest rates on the deposits of non-financial corporations, the performances are on average more aligned between the two interest

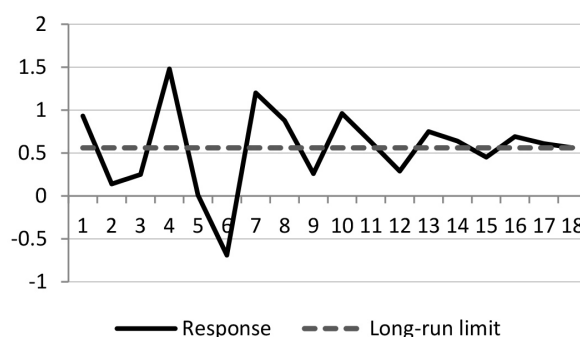


Figure 3 The cumulative dynamic multiplier

rate pass-through processes, although it should be noted that the speed of adjustment for the euro deposits with a maturity of up to one year is several times faster than the speed of adjustment of the same deposits denominated in dinars.

The long-term constant, which expresses the time-invariable factors, is significant in all 12 cointegration relationships depicting the euro interest rate pass-through, which is a strikingly better result compared to the significance of this parameter with the dinar interest rate pass-through.

The interest rates on non-financial corporations' deposits tend to respond more quickly in comparison to the households' deposits at the lower end of the term structure of the deposit interest rates (up to one year) in both pass-through processes.

In order to contextualize the empirical results obtained in this paper, the comparable empirical findings and the estimated coefficients from the selected papers were reviewed.

B. Égert and R. MacDonald (2009) report that, in the empirical studies they analyzed, the average long-term pass-through for short-term deposits and long-term deposits equaled 0.72 and 0.69, respectively. C. Kwapil and J. Scharler (2010) explore the pass-through process in the euro area and the US. They provide estimates for the long-term pass-through in the euro area for savings deposits with a maturity of up to three months, savings deposits with a maturity of over three months, and term deposits with a maturity of up to two years: 0.27, 0.60, and 0.66, respectively. The estimated long-term pass-through coefficients in the US are higher. For instance, for the Time Certificate of Deposit for deposits with a maturity of one month, the Time Certificate of Deposit for deposits with a maturity of three months and for deposits with a maturity of one year, the coefficients are 1.04, 1.01, and 0.74, respectively. In the US, the long-term pass-through is close to unity and decreases with reference to the deposit maturity. In the euro area, the long-term pass-through is below unity and increases with the deposit tenor. The weighted average long-term pass-through is more than twice higher in the US than in the euro area, 0.74 to 0.32, respectively.

A recent study by Deutsche Bundesbank (2023) dealt with the pass-through to the interest rates aggregated across households and non-financial corporations in the euro area and in Germany. For the euro area, the long-term pass-through was not significant for overnight deposits and term deposits, so the cointegrating relationship between the retail interest rates and the market interest rates did not appear to exist at all. The situation differs for the savings deposits, where the estimated long-term pass-through was 0.60. In Germany, the respective long-term pass-through for the overnight deposits, the savings deposits and the term deposits was 0.50, 0.65, and 0.85, respectively, confirming the bias of the long-term coefficient rising with deposits' maturity extension, which is the argument that has already been discussed. The fact that the bank deposits of a longer maturity were in fierce competition with the other longer-term investment alternatives may be a possible reason for this.

R. Ferstl, B. Graf and C. Kwapil (2023) examined the cointegrating relationship among overnight deposits and time deposits in the euro area and in Austria. As is the case with the empirical results of this paper, they investigated the long-term equilibrium relationship separately for the deposits of households and the deposits of non-financial corporations. They did not validate the cointegrating relationship for the households' deposits in the euro area. Only for the time deposits of households in Austria, the long-term pass-through was significant, with the value 0.83. The long-term pass-through for the time deposits of non-financial corporations in the euro area was 0.79, and for the overnight and time deposits of non-financial corporations in Austria, it was 1.15 and 0.88, respectively.

F. Verheyen (2013) used EONIA as a proxy for the ECB's key policy rate. His results show that the pass-through in the euro area decreases with the rising maturity of deposits, and for deposits with a maturity of up to one year, the pass-through exceeds the proportional and is larger than unity. These findings are at odds with the results of precedent research studies.

It makes sense to compare the results of the euro interest rate pass-through in Serbia with the empirical findings of the aforementioned papers. The results obtained in this paper pertaining to the deposits with a maturity of up to one year and the deposits with a maturity of over one and up to two years comply with the long-term coefficient estimated in Deutsche Bundesbank (2023) for the savings deposits in the euro area and in Germany and C. Kwapił and J. Scharler (2010) for the savings deposits with a maturity of over three months. H. Sander and S. Kleimeier (2004) provide two long-term pass-throughs for time deposits (0.57 and 0.6), dependent on the utilized estimation time frame. In addition, T. Messer and F. Niepmann (2023) estimate the long-term pass-through of the term deposits in the euro area for households (0.56) and for non-financial corporations (0.53). D. Byrne and S. Foster (2023) reveal their long-term pass-through estimates for the term deposits of households and non-financial corporations (0.60 and 0.71, respectively).

Based on the estimates of the long-term pass-through, no noticeable difference seems to exist between the deposit interest rate pass-through in the euro area and the interest rate pass-through to euro deposits in Serbia.

However, when the speed of adjustment is concerned, the analysis carried out in this paper shows that it is markedly faster in the interest rate pass-through to euro deposits in Serbia than in the euro area, bearing in mind the results of Deutsche Bundesbank (2023) and R. Ferstl *et al* (2023) since it is in all the cases below one year.

## CONCLUSION

This paper aims to analyze how the pass-through process advances in two separate pass-through channels in a country with two currencies in effective use (a dual currency monetary system): the domestic interest rate pass-through and the cross-border (imported) interest rate pass-through. This research study was limited to deposit interest rates.

When banks operate in an environment abundant in excess reserves (as is the case in Serbia, where the NBS squeezes out excess liquidity through repo and other open market operations, banks may have a weak incentive to attract deposits and hence deposit rates become sluggish.

The analysis of the domestic interest rate pass-through carried out in this paper shows that the cointegrating relationship among the retail deposit rates and the money market rates is confirmed on the vast majority of the tested relationships. The poor evidence of the short-term pass-through is perceived to underscore a sluggish instantaneous movement of the dinar deposit rates following the change in the domestic money market rate. The long-term pass-through varies in a range lying below unity, so the pass-through from the money market rate to retail rates is incomplete. Interest rates approach their long-term cointegrating equilibrium at a relatively rapid pace.

The insights into the features of the imported (cross-border) interest rate pass-through show the even stronger evidence of the cointegrating relationships across the interest rates. These results contrast with the results reported by I. Moder (2023), where the low level of the cointegrating relationships was found for Serbia. The imported interest rate pass-through very closely mimics the interest rate pass-through in the euro area in all the relevant criteria (the long-term pass-through, the immediate pass-through, and the speed of adjustment). In light of Serbia's prospective accession to the euro area in a foreseeable future, this may be a favorable fact.

The results obtained in this study show that, in the case of Serbia, both pass-through channels are in regular operation. For the time being, the monetary policy stances in Serbia and in the euro area have been highly synchronized; as a result, the two active pass-through channels have posed neither a problem nor a challenge for monetary management in Serbia.

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## UNDERSTANDING THE KEY DRIVERS OF NON-PERFORMING LOANS IN GREECE

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This study investigates the key factors influencing the evolution of non-performing loans (NPLs) in Greece, during and after the financial crisis, which severely affected the Greek banking sector. Greece documented the highest NPL ratio among the European countries, reflecting the economic effects of the crisis. Using data pertaining to the period from 2004 to 2018, regression analysis was applied to assess the influence of the macroeconomic and banking variables. The data were mainly derived from the Bank of Greece and the Hellenic Statistical Authority. The findings highlight a strong correlation between NPLs and the macroeconomic factors which significantly affected the Greek banking system. Addressing NPLs is a challenge, and effective resolution requires reversing the impact of the crisis and restoring growth in order to support the recovery of the banking sector. While focused on Greece, a broader Eurozone data analysis is suggested due to the fact that the EU economies are interlinked. While several studies have examined the determinants of non-performing loans in Greece so far, this study contributes to the topic by applying an extensive regression model and incorporating a broad range of variables.

**Keywords:** non-performing loans, banking system, financial crisis, macroeconomic variables

JEL Classification: G01, G21, E44

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### INTRODUCTION

Bank lending is a major source of financing for businesses and households, enabling them to meet their goals. However, the financial system and its operations can be disrupted because of financial crises. Greece was hit particularly hard, and the surge

in NPLs became a defining issue, shared by several crisis-affected countries.

The evolution of NPLs in Greece has been shaped by a multifaceted interaction between macroeconomic conditions and the banking sector performance indicators over the period from 2004 to 2018. This period includes the global financial crisis of 2008, the euro area sovereign debt crisis, and the introduction of capital controls in 2015, all of which had an impact on the Greek financial system and borrowers' ability to repay their loans.

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Key banking indicators, such as the loan-to-deposit ratio, the net interest margin, and the capital adequacy ratio play an essential role in evaluating the resilience of the banking sector and are closely related to the dynamics of non-performing loans. From a macroeconomic perspective, fluctuations in Greece's gross domestic product (GDP) and the public debt levels in Greece show a strong negative correlation with non-performing loan ratios, demonstrating how overall economic performance influences credit quality.

Persistent current account imbalances and dependence on foreign capital inflows have also contributed to increased systemic vulnerabilities (Kovačević, 2025). These patterns suggest that external financial and trade conditions interact with the domestic macroeconomic environment, developing the pressures that can affect the accumulation of non-performing loans.

This study investigates the evolution of Greek banks' non-performing loans and identifies the main determinants that affected their evolution between 2004 and 2018. The period under review faces both the pre-crisis expansion and the full course of Greece's economic recession, which culminated in the capital controls of 2015 (Barisitz, 2013; Grossman & Woll, 2014). This study focused on the variables related to the institutional structure, the ownership models, and the operational efficiency of the Greek banking system (Louzis, Voulidis & Metaxas, 2012). The data were derived from the Bank of Greece, which provides comprehensive and consistent statistics on non-performing loans in all commercial banks (Bank of Greece Executive Committee, 2014, 2015).

A series of macroeconomic variables were incorporated in order to capture the broader economic context throughout the study period (Nkusu, 2011). The GDP growth rates were obtained from the Hellenic Statistical Authority, while the inflation data were derived from Eurostat. The information on the public debt (as a percentage of the GDP) and the unemployment rate was also obtained from the official data sets of the Hellenic Statistical Authority.

The multiple linear regression model utilized in the study with quarterly data (2004-2018) captures both

the macroeconomic effects and the bank-level effects. The dependent variable is a percentage change in the NPL ratio, whereas the independent variables capture both the macroeconomic conditions and the performance of the banking system. The model tests for lagged effects to identify the dynamic response of NPLs to changes in the economic and financial indicators.

This paper investigates the factors influencing the development of NPLs in Greece and addresses the following research questions:

- How do macroeconomic variables such as GDP growth, debt levels, unemployment, and inflation affect the evolution of NPLs in Greece?
- What is the relationship between the indicators related to the banking system and the development of NPLs in Greece?
- Which factors have contributed to the stability or decline of NPLs in Greece?
- How did the economic crisis in Greece trigger a reversal in trajectory of NPLs?

The paper is organized as follows. First, it provides a review of the literature and defines the research questions. This is followed by a description of the data and the methodology. The paper then presents the empirical findings and discusses those findings. Finally, the results are summarized and policy recommendations are outlined.

## LITERATURE REVIEW

Lending stands out as one of the most important functions of the banking system, and represents the primary source of income for banks. Nevertheless, this operation entails substantial risks if no due attention is given to the criteria governing loan approvals. This risk was presented with great intensity in the Greek banking system during the period of the recent economic crisis as one of the most important problems that the banking sector was facing in its efforts to recover (Claessens & Kose, 2013). The crisis deeply affected the global financial system, creating

major operational challenges. Public trust in banks declined, and many functions, including lending, were carried out under severe pressure (Antzoulatos, Panopoulou & Tsoumas, 2011).

The banking sector is deeply embedded in all parts of the economy, supporting households, businesses, and depositors across income levels. It provides critical liquidity to the real economy. A. Campbell (2007) supports the argument that an increase in NPLs can be associated with financial instability. In their study, E. Kostika and N. T. Laopodis (2022) noticed that, in Greek banks, emergency liquidity assistance played a crucial role on NPLs. More specifically, they found that the volume of NPLs had declined because the capital base of the banks had been restored through the emergency liquidity assistance process. Businesses require funds not only to sustain their market share within their respective economic sectors but also for their growth and expansion. These funds are typically secured through bank loans.

Analyzing as many as 20 emerging European economies from 2000 to 2011, D. Erdinç and E. Abazi (2014) demonstrated the relationship between financial crises and NPL growth, arguing that rapid credit expansion contributed to rising NPLs. In Greece, the unfavorable macroeconomic environment and the uncontrolled bank-lending policy prior to the recession had led to significant losses made by financial institutions. The weak monetary policy and the inability to support households and businesses contributed to shrinking credit and increasing NPLs.

In a study on a total of 16 Central, Eastern, and Southeastern European countries, N. Klein (2013) found that both the macroeconomic factors and the bank-specific factors strongly influenced the NPL levels. M. Karadima and H. Louri (2022) identified the macroeconomic factors, rather than the bank-specific factors, as the key drivers of NPLs in Greece. Their research also highlighted the positive effect of the government debt and the negative impact of the fiscal balance on NPLs, underscoring the importance of fiscal sustainability after the crisis.

S. Papadamou and K. Pitsilkas (2025) reveal that the economic uncertainty index has a strong long-term

correlation with non-performing loans in Greece. Their findings suggest that increased uncertainty undermines financial stability, discouraging investment and consumption, thus increasing the difficulties faced by households and businesses in servicing their loan obligations.

Macroeconomic variables significantly influence NPLs, especially during recessions. GDP and public debt proved to negatively affect NPL levels (Fogila, 2022). Analyzing a total of nine Greek financial institutions in the period from 2003 to 2009, D. Louzis *et al.* (2012) found that unemployment, GDP, and interest rates had an adverse influence on NPL ratios, simultaneously also confirming the links between NPLs and the efficiency/profitability ratios and stressing the role of regulatory oversight in bank risk management. Similarly, D. Anastasiou, H. Louri and M. G. Tsionas (2019) observed the post-2008 rise in the euro area's NPLs due to deteriorating macroeconomic conditions.

Recent studies have also highlighted the role of technological innovation in shaping trends in non-performing loans. H. Wang, K. Mao, W. Wu and H. Luo (2023) show that investments in financial services technologies (Fintech) - particularly in IT personnel, software, and hardware - significantly reduce the risk of non-performing loans by improving data governance, compliance, and internal control mechanisms. Their findings reveal that, for every 1% increase in Fintech investment, non-performing loan rates significantly decrease, suggesting that digital transformation enhances banks' ability to identify, monitor, and manage credit risk. This information is relevant to the Greek context, where the ongoing digitization of the banking sector can further support reduction in non-performing loans through improved risk analysis and early warning systems.

In addition to the macroeconomic and banking determinants, institutional frameworks are also shown to play a critical role in shaping the dynamics of non-performing loans. A. Zervas, A. Fasianos and K. Loizos (2023) analyzed the Home Protection Scheme, introduced in Greece in 2010, and showed that, although its initial form encouraged some

strategic defaults, later changes helped reduce NPL ratios alongside the economic recovery. These findings show that policy choices and institutional settings can directly shape NPL trends, either making credit risk worse or helping to reduce it.

Furthermore, H. Fukuyama, R. Matousek and N. G. Tzeremes (2024) suggest an innovative methodological framework that uses a material balance approach to model the production processes of banks in the presence of non-performing loans (NPLs). Considering non-performing loans as undesirable outcomes, they argue that the efficiency of banks can be better assessed when non-performing loans are explicitly incorporated into the production function within a generalized G-disposability framework. Based on Japanese banking data, their findings suggest that differences in loan quality and risk heterogeneity should be incorporated into bank performance models. This methodological development provides a valuable perspective for future studies of the dynamics of non-performing loans in Greece, where loan quality significantly varies across institutions.

The evidence from the COVID-19 period highlights additional dimensions in the NPL determinants. Focusing on the Vietnamese banking system, K. Q. T. Nguyen (2022) finds that the leverage ratio significantly and negatively affects NPLs, underscoring the role of the bank capital structure in mitigating credit risk during crises. These results complement the discussion of capital adequacy and are particularly relevant for the case of Greece, where the equity ratio has been repeatedly emphasized as a safeguard against shocks.

To enhance the interpretive capacity of the regression model utilized in this study, it was considered appropriate to incorporate macroeconomic indicators, which ensures that the research results reflect the transformations that had occurred in the broader economic landscape of Greece over the review period (Nkusu, 2011).

A percentage change in Greece's Gross Domestic Product (GDP) was used. The data pertaining to the GDP were extracted by the Hellenic Statistical Authority. The inflation index data were extracted by the European Statistical Authority. The data on

the public debt, as the percentage of the Greek GDP, were drawn from the Hellenic Statistical Authority of Greece. Finally, the unemployment rate in Greece was included. The data on the unemployment rate were collected from the Hellenic Statistical Authority.

## METHODOLOGY

To determine the factors that affect NPLs, the variables closely related to the Greek banking system were used. Those variables change depending on the policies implemented by banks, their ownership structure, and their effectiveness. Therefore, the following variables: the loan-to-deposit ratio, the net interest margin, and the equity ratio were included in the analysis carried out in this study. This was based on similar studies for the Greek banking system. Studies at the European level and the global level were also considered. Those variables help to understand if the conditions of the banking system have affected the evolution of NPLs or not. The data for the above-mentioned variables were taken from the published statistics held by the Bank of Greece for the Greek banking system. The statistics are constantly updated.

This study adopts a linear modeling approach to examine the factors influencing the evolution of NPLs in Greek banks from 2004 to 2018. Considering the introduction of time lags for several variables, the effective sample comprised 60 quarterly observations covering the period from 2004 to 2018. Drawing on the data from the Bank of Greece's statistics, the research integrates the macroeconomic indicators and the bank-specific variables to comprehensively analyze the determinants of NPL trends in Greece during the period marked by significant economic turbulence.

The dependent variable in the model is the percentage change in the NPL ratio, which captures variations in the proportion of the loans classified as non-performing. This metric provides an insight into the underlying dynamics driving credit risk in the Greek banking sector.

To identify the determining factors in the evolution of the banking sector, the following independent

variables were used: the loan-to-deposit ratio, the net interest margin, and the Equity Ratio. With respect to these variables, (i) the loan-to-deposit ratio (LDR) measures the liquidity and lending practices of Greek banks, shedding light on their risk exposure, (ii) the net interest margin (NIM) indicates profitability and provides insights into banks' ability to manage income in the face of rising NPLs, and (iii) the equity ratio (ER), although initially included for the purpose of completeness, was excluded from the final regression due to its low significance.

In addition, the following macroeconomic variables were included: (i) the gross domestic product (GDP), which represents overall economic performance, with the declines linked to higher NPLs due to the borrower's reduced repayment capacity, (ii) the public debt (PD), which represents fiscal health, with higher debt levels often being associated with increased systemic risk, (iii) the inflation rate (IR) influences the borrower's purchasing power and the real value of the debt, thus influencing default rates, (iv) the unemployment rate (UNP), which serves as a critical indicator of the labor market conditions, with higher unemployment strongly correlating with increased NPLs.

The employed linear model is guided by the international literature, providing the theoretical and empirical bases for examining NPL trends. By linking the percentage change in the NPL ratio to both the banking sector conditions and the macroeconomic factors, the model aims to quantify the degree of the influence each variable exerts on NPL dynamics. This approach enables the study to assess the influence of the banking sector practices and resilience of the NPL levels, investigate the role of macroeconomic instability in shaping NPL trends and detects potential policy interventions and strategies to mitigate the adverse impact of such rising NPLs.

Moreover, the GDP, the debt, inflation and unemployment were added to the model because they were connected to the macroeconomic environment and reflect overall economic conditions which indirectly influence the efficiency of banks and the conditions of the broader economic environment during the period under review.

The NPL ratio is the dependent variable used in the research. The model used in this study is a linear function model. The research model associates the percentage change in the NPL ratio with the variables directly connected with the Greek banking system and with those reflecting the macroeconomic environment and the overall situation of the Greek economy during the reference period. The equation of the regression under consideration is as follows:

$$\Delta NPL_t = \beta_0 + \beta_1 \Delta GDP_{t-1} + \beta_2 \Delta INF_{t-1} + \beta_3 \Delta Debt_{t-2} + \beta_4 \Delta UNP_{t-1} + \beta_5 ER_{t-2} + \beta_6 LDR_t + \beta_7 NIM_t + \varepsilon_t \quad (1)$$

$\Delta NPL$  stands for the dependent variable used in the research and reflects the percentage change in the NPL ratio,  $\Delta GDP$  stands for the percentage change in the gross domestic product of Greece,  $\Delta INF$  stands for the inflation index,  $\Delta Debt$  stands for the public debt as the percentage of the Greek GDP,  $\Delta UNP$  stands for the unemployment rate in Greece,  $ER$  stands for the equity ratio of the Greek banks,  $LDR$  stands for the loan-to-deposit ratio for the Greek banks, and finally  $NIM$  stands for the net interest margin for the Greek banks. All data are in quarterly frequency ( $q_i$  = quarter).

For the independent variables  $\Delta GDP$ ,  $INF$  and  $\Delta UNP$  of the model, the data of the previous quarter were used as post-test observations. The results with higher statistical significance were obtained. Moreover, for the independent variables  $\Delta Debt$  and  $ER$ , the data with a time lag of two quarters were used as after the post-test observation. The results with higher statistical significance were obtained. Thus, change in these independent variables affects the dependent variable of the model with the time lags of one quarter and two quarters, respectively (Berger & De Young, 1997; Salas & Saurina, 2002; Louzis *et al.*, 2012). The selection of the macroeconomic independent variables, such as the percentage change of the GDP, inflation, the debt as the percentage of the gross domestic product, and unemployment, was driven by the study's aim to assess whether these factors, which reflect the general economic condition, influence the evolution of the NPL ratio in Greece or not.

Table 1 portrays the basic descriptive statistics of the variables used in the regression analysis made in the

research based on the equation (1). More specifically, Table 1 include the mean, the standard error, the standard deviation, the maximum and minimum values for each variable used in the model.

According to the descriptive statistics, the model's dependent variable reflecting the percentage change in NPLs during the period under review is highly volatile as its minimum value is - 17.93% and maximum value 65.29%. The same stands for the independent variables reflecting the percentage change in the GDP and inflation, whose minimum values are -10.25% and -2.37%, and maximum values 6.77% and 5.53%, respectively.

The variables that record the change in unemployment and the debt as the percentage of the gross domestic product are also highly volatile, with the minimum values -14.28% and -10.82%, respectively, and the maximum values 45.14% and 18.74%, respectively.

As the banking variable, the equity ratio has the maximum value of 10.81%, whereas its minimum

value for the period under review is 1.02%. Finally, the interpretive variables, also related to the banking system, i.e. the loan-to-deposit ratio and the net interest margin, have the maximum values 44.55% and 4.78%, respectively, for the period under review, and the minimum values 23.67% and 2.91%, respectively, for the same period.

### Data on the NPL ratio

This variable is the dependent variable of the model and records the percentage change in the NPLs of the Greek banks compared to the corresponding quarter of the previous year. The data for this variable were collected using the statistics from the Bank of Greece and, more specifically, from the table accounting for the evolution of loans and NPLs for all commercial and cooperative banks operating in Greece. These data are collected on a quarterly basis, with the goal to present and record loans and NPLs. Moreover, the data are broken down by loan type. It should be noted that the amount of the loans was calculated based on the data related to on-balance sheet loans. Figure

**Table 1** The descriptive statistics for the variables

| ΔNPL                  |          | ΔDebt t-2           |          | ΔGDP t-1           |          |
|-----------------------|----------|---------------------|----------|--------------------|----------|
| Mean                  | 0.14456  | Mean                | 0.03927  | Mean               | -0.00702 |
| Standard error        | 0.03293  | Standard error      | 0.00975  | Standard error     | 0.00585  |
| Standard deviation    | 0.25507  | Standard deviation  | 0.07550  | Standard deviation | 0.04535  |
| Minimum               | -0.17936 | Minimum             | -0.10825 | Minimum            | -0.10251 |
| Maximum               | 0.65297  | Maximum             | 0.18745  | Maximum            | 0.06776  |
| Inflation t-1         |          | Unemployment t-1    |          | Equity ratio t-2   |          |
| Mean                  | 0.02037  | Mean                | 0.06252  | Mean               | 0.06553  |
| Standard error        | 0.00280  | Standard error      | 0.02369  | Standard error     | 0.00247  |
| Standard deviation    | 0.02169  | Standard deviation  | 0.18347  | Standard deviation | 0.01911  |
| Minimum               | -0.02379 | Minimum             | -0.14286 | Minimum            | 0.01017  |
| Maximum               | 0.05534  | Maximum             | 0.45139  | Maximum            | 0.10811  |
| Loan-to-deposit ratio |          | Net interest margin |          |                    |          |
| Mean                  | 0.33811  | Mean                | 0.04113  |                    |          |
| Standard error        | 0.00891  | Standard error      | 0.00061  |                    |          |
| Standard deviation    | 0.06904  | Standard deviation  | 0.00473  |                    |          |
| Minimum               | 0.23677  | Minimum             | 0.02907  |                    |          |
| Maximum               | 0.44551  | Maximum             | 0.04780  |                    |          |

Source: Authors

1 depicts the evolution of NPLs during the period under review.

The graph illustrates the evolution of NPLs over the review period, revealing a consistent upward trend in the banks' NPLs in the period from 2009 to 2016. This surge caused the ratio to be four times higher compared to its original value seven years ago. In the subsequent period from 2016 to 2018, marking the conclusion of the study, the indicator displays stabilizing and slightly decreasing trends. The increase in NPLs aligns with the financial crisis that profoundly affected Greece, resulting in particularly adverse consequences for the banking industry, businesses, and households. To utilize the data acquired from the Bank of Greece, the percentage change in the ratio from the corresponding quarter of the preceding year was computed. This ratio represents the percentage of the NPLs to the total volume of loans in the Greek banking system across all loan categories.

### Data on the percentage change in Gross Domestic Product

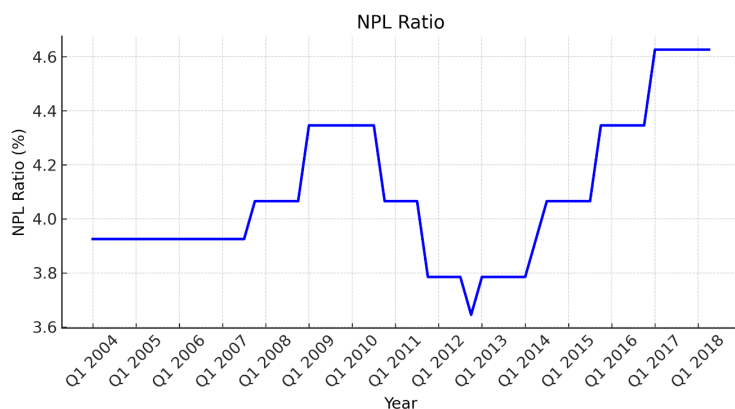
Gross Domestic Product (GDP) is the total value of goods and services produced within an economy in a year. It is a key macroeconomic indicator that reflects

the economy's economic activity. The GDP data for Greece were sourced from the Hellenic Statistical Authority and recorded quarterly.

Figure 2 depicts the growth rate of Greece's gross domestic product (GDP) over the review period, showcasing an upward trend in the period from 2004 to 2008. From 2004 to 2008, the GDP showed an upward trend, reflecting economic growth. A stabilizing trend appeared during the period from 2008 to 2009, followed by a consistent decline from 2009 to 2013, coinciding with the Greek economic crisis and the 25% drop in the GDP. Between 2013 and Q3 of 2017, the GDP stabilized with intermittent growth but did not return to the pre-crisis levels. To include the GDP in the model, its year-over-year percentage change was calculated.

### Data on the percentage change in Public debt

Public debt is the cumulative debt of the broader public sector, increasing through deficits or decreasing through surpluses. As government revenues stem from taxpayers, public debt indirectly burdens them. Creditors include individuals, banks, states, and other investors.



**Figure 1** The evolution of NPLs in Greece

Source: Bank of Greece. (2025). *Evolution of loans and non-performing loans*. Retrieved 15/01/2024 from <https://www.bankofgreece.gr/en/statistics/evolution-of-loans-and-non-performing-loans>

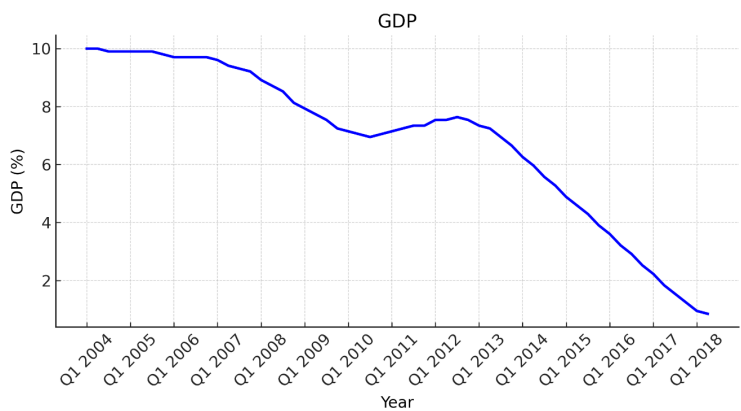
Public debt is split into internal (owed domestically) and external (owed abroad) categories. The latter is often denominated in a foreign currency, making the distinction important. Figure 3 depicts the percentage change in Greece's public debt during the period under review.

The public debt generally increased, particularly from 2008 to 2012 and from 2013 to 2014. In 2012, the debt dropped significantly due to the PSI Agreement,

involving a 53.5% haircut on EUR 206 billion of Greek bonds, with a 95.7% participation rate. The data for the debt data were sourced quarterly from Eurostat and expressed as the percentage change from the same quarter of the previous year.

### Data on the inflation rate

Inflation represents a sustained rise in general price levels, reducing the purchasing power. The data for



**Figure 2** The percentage change in the GDP

Source: ELSTAT. (2026). Hellenic Statistical Authority. Retrieved 14/02/2024 from <https://www.statistics.gr/en/statistics/economy>



**Figure 3** The percentage change in the debt

Source: ELSTAT. (2026). Hellenic Statistical Authority. Retrieved 14/02/2024 from <https://www.statistics.gr/en/statistics/economy>

Greek inflation were obtained monthly from Eurostat and aggregated quarterly for model compatibility.

Figure 4 shows that the evolution of inflation in Greece during the period under review led to intense changes in the general price level. From 2004 to 2010, the inflation remained relatively stable. A steep decline began in late 2010, followed by a sharp rise, peaking at 5.60% in Q4 2012. From 2013 to 2017, Greece experienced deflation, reaching a low of -2.38% in Q2 2017. The inflation then fluctuated but remained mostly negative, ending at -0.99% in Q4 2018.

### Data on the unemployment rate

Unemployment refers to individuals actively seeking but unable to find work. The unemployment rate is the ratio of unemployed individuals to the labor force. High unemployment often correlates positively with NPLs (Louzis *et al*, 2012).

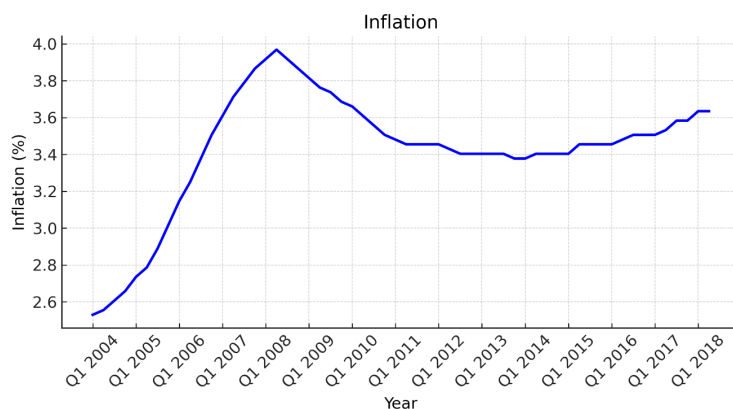
There are three main types of unemployment:

1. Structural unemployment, resulting from the mismatch between supply and demand as some sectors (or specialties, or geographical areas) are in increasing demand, and some are in declining demand.

2. Cyclical unemployment, resulting from reduced overall demand for products and services. This form of unemployment is the result of slowing growth in times of economic recession, which results in the inability to absorb labor.

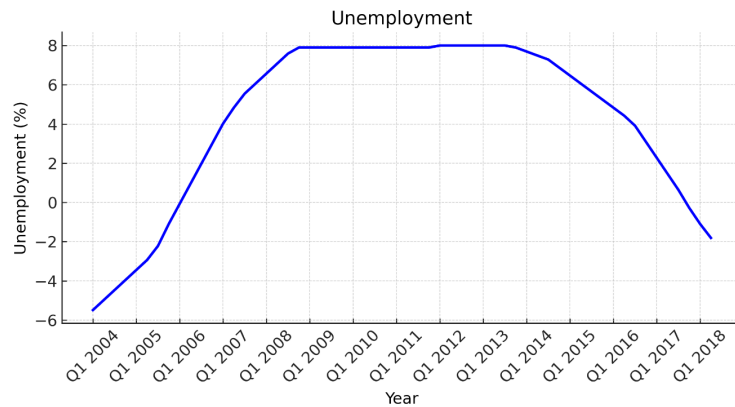
3. Frictional unemployment, resulting from temporary unemployment, which occurs when some employees leave their jobs and remain unemployed for some time until they find the next best job. This phenomenon also occurs among the mothers who return to the labor market after pregnancy, or among the young people who are looking for their first job. Frictional unemployment is a natural phenomenon observed during the job search process.

Figure 5 presents the percentage change in the unemployment in Greece, showing that the unemployment had a small downward trend from the beginning of the examined period in 2004 until the end of 2009. From 2004 to 2009, the unemployment declined slightly. It rose sharply from 2010 to 2014, peaking at 27.8% in Q1 2014 during the crisis. From 2015 to 2018, it declined but remained above the pre-crisis levels. The data were sourced quarterly from the Hellenic Statistical Authority.



**Figure 4** The inflation in Greece

Source: ELSTAT. (2026). Hellenic Statistical Authority. Retrieved 14/02/2024 from <https://www.statistics.gr/en/statistics/eco>



**Figure 5** The unemployment in Greece

Source: ELSTAT. (2026). Hellenic Statistical Authority. Retrieved 14/02/2024 from <https://www.statistics.gr/en/statistics/eco>

### Data on the equity ratio

The equity ratio shows how much of a firm's assets are financed by equity. A higher ratio indicates lower risk and less reliance on the debt, reassuring both investors and creditors.

The calculation formula of the financial indicator is as follows:

$$\text{Equity ratio} = \frac{\text{Shareholder equity}}{\text{Total assets}} \quad (2)$$

The lower the price of the ratio, the higher the risk of business, and vice versa, the higher the price of the ratio, the lower the level of risk. In combination with the other financial indicators, this indicator is used to evaluate the financial performance of each business. Therefore, the high price of this indicator gives positive signs to potential investors, because it shows a lower level of risk as it presents a high level of investment by investors. Moreover, it gives a good sign to the creditors of the company that the money owed to them is not in danger and shows that the company does not have significant costs arising from the loan funds.

According to Figure 6, which shows the evolution of the equity ratio of the Greek banks, there were strong changes in the ratio during the period under review.

From 2004 to mid-2012, the equity ratio declined, reaching its lowest point in Q2 2012. A sharp rise followed until 2017, surpassing the levels of 2004. In 2018, the ratio declined slightly. The data were derived from the monthly reports issued by the Bank of Greece and converted to quarterly frequency.

### Data on the net interest margin

The net interest margin is the difference between income from interest and expenses from interest as the percentage of earning assets. It reflects a bank's profitability and efficiency. Its formula is as follows:

$$\text{Net interest margin} = \frac{\text{Interest revenue} - \text{Interest expenses}}{\text{Earning assets}} \quad (3)$$

A possible increase in the bank lending rate is a barrier to borrowers with floating rate loans and is likely to lead to delays in smooth payments until the repayment of their loan installments. Therefore, the interest rate is one of the major determinants of NPLs.

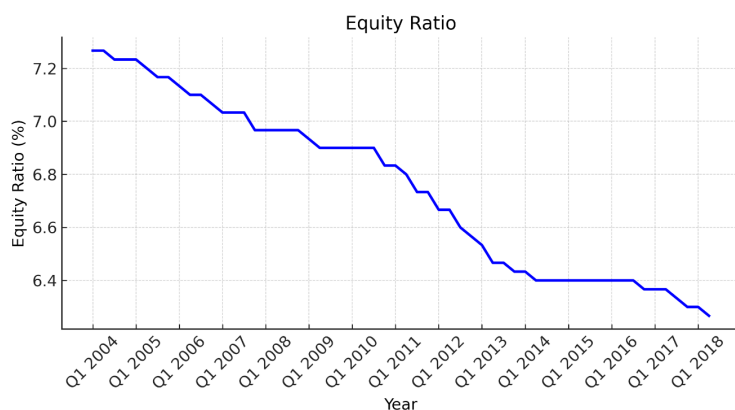
Figure 7 shows the evolution of the net interest margin during the period under review. From 2004 to 2012, the indicator declined, especially during the years 2011 and 2012, amid the crisis. From 2013 to 2018, it increased. The data were sourced from the reports issued by the Bank of Greece on new deposit and loan interest rates, adjusted quarterly.

## Data on the loan-to-deposit ratio

The loan-to-deposit ratio is used by many analysts as a liquidity indicator. The loan-to-deposit ratio (LDR) is a liquidity measure. Loans are assets, while deposits are key funding sources. A high ratio may signal liquidity risk but also confidence in the banking system. An LDR near 0.70 is often considered ideal.

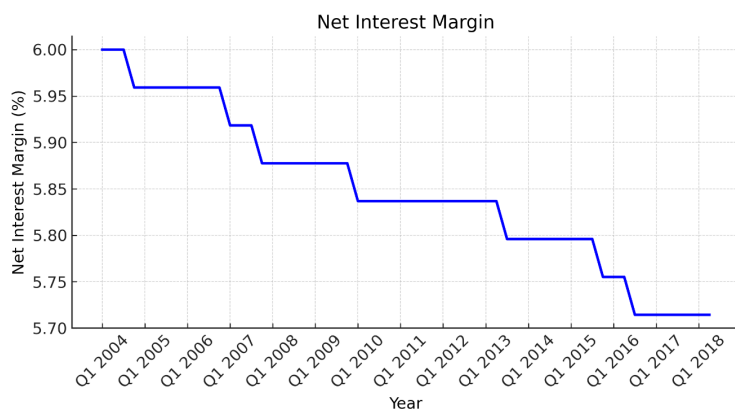
According to Figure 8, which shows the evolution of the loan-to-deposit ratio variable for the Greek

banking system during the period under review, the ratio had a declining trend during this period. From 2004 to 2009, the LDR fell, then rose back near the levels of 2004. From 2010 to 2016, it dropped nearly 50%, reflecting the crisis and the deposit outflows due to the fears of the instability of the banking system. From 2016 to 2018, the ratio rose slightly but did not fully recover. The data were derived from the reports issued by the Bank of Greece, aggregated quarterly.



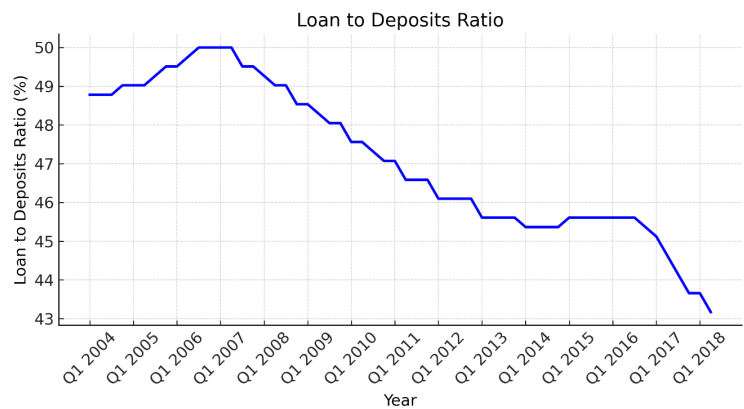
**Figure 6** The equity ratio of the Greek banks

Source: Bank of Greece. (2025). *Evolution of loans and non-performing loans*. Retrieved 15/01/2024 from <https://www.bankofgreece.gr/en/statistics/evolution-of-loans-and-non-performing-loans>



**Figure 7** The net interest margin in Greece

Source: Bank of Greece. (2025). *Evolution of loans and non-performing loans*. Retrieved 15/01/2024 from <https://www.bankofgreece.gr/en/statistics/evolution-of-loans-and-non-performing-loans>



**Figure 8** The loan-to-deposit ratio in Greece

Source: Bank of Greece. (2025). *Evolution of loans and non-performing loans*. <https://www.bankofgreece.gr/en/statistics/evolution-of-loans-and-non-performing-loans>

RESULTS

To enhance the interpretive power of the regression model, a series of diagnostic tests were conducted at various stages of the analysis (Tables 2, 3 and 4). These steps ensured the consistency and reliability of the results. The data used spanned a period of 14 years (2004-2018) at a quarterly frequency over. However, these variables were found to be statistically insignificant across all the tests. Furthermore, specific efforts to isolate the period of the economic crisis (2009-2018) and assess its distinct effects on the dependent variable yielded no statistically significant outcomes.

The final results of the multiple regression analysis summarized in Tables 5, 6, and 7 provide critical insights into the relationships between the dependent variable and the independent variables. After successive iterations, the equity ratio variable was excluded due to its low statistical significance, which allowed for a refined model with improved explanatory power.

The findings reveal that the macroeconomic variables, including the GDP growth, the inflation, and the public debt, as well as the indicators of the banking system, such as the net interest margin (NIM) and the loan-to-deposit Ratio (LDR), significantly influenced

the evolution of the NPLs in Greece. The key highlights from the analysis include:

**GDP growth:** The percentage change in the GDP showed a statistically significant negative relationship with NPLs, affirming that economic expansion reduced the likelihood of loan defaults. This aligns with prior research (e.g. Perotti, 1996; Salas & Saurina, 2002; Rinaldi & Sanchis-Arellano, 2006; Cifter, Yilmazer & Cifter, 2009; Reinhart & Rogoff, 2010), which underscores the critical role of economic activity in shaping the trajectory of NPLs.

**Inflation:** A negative and statistically significant relationship was found between the inflation and the NPLs, indicating that higher inflation correlated with reduced NPLs. This finding may reflect the positive

**Table 2** The results of the multiple regression

| Regression Statistics |          |
|-----------------------|----------|
| Multiple R            | 0.969535 |
| R square              | 0.939998 |
| Adjusted R square     | 0.931921 |
| Standard error        | 0.066553 |
| Observations          | 60       |

Source: Authors

impact of inflation on borrowers' ability to repay the debt, as nominal income often increases during inflationary periods. Similar to M. Nkusu (2011), the results obtained in this study may suggest that moderate inflation can alleviate real-debt burdens and increase nominal income, thus facilitating loan repayment.

**Public debt and unemployment:** Both variables showed a positive relationship with the NPLs, highlighting the adverse effects of economic stress on the banking system. A rising public debt typically signals economic downturns, while higher unemployment consistent with the studies by L. Rinaldi and A. Sanchis-Arellano (2006) and D. Louzis *et al.* (2012) reduces households' disposable income, thus leading to loan delinquencies.

**Net interest margin (NIM):** NIM emerged as the most influential independent variable, exhibiting a strong negative relationship with the NPLs, which suggests that the efficient performance of banks, reflected by higher NIM values, reduces the volume of NPLs.

**Loan-to-Deposit Ratio (LDR):** The LDR displayed a positive relationship with the NPLs, emphasizing that the periods of reduced liquidity in the banking system exacerbated loan defaults. As liquidity constraints tighten, banks face greater difficulty managing delinquent loans, thus contributing to a rise in NPLs.

A relevant comparison can be made with the Slovenian banking sector during the COVID-19 pandemic. K. Grivec and R. Devjak (2023) claimed that household deposits in Slovenia increased significantly during the crisis, providing Slovenian banks with a stable source of funding and supporting credit activity. However, the Greek banking system

experienced severe deposit outflows between 2010 and 2015, which eroded liquidity and intensified the rise of the NPLs. This divergence illustrates the crucial role of household deposit dynamics in shaping the resilience of the banking sector.

**Crisis Effect:** Although attempts were made to isolate the period of the Greek financial crisis (2009-2018), the results did not yield the statistically significant evidence of differing dynamics during this period. Nonetheless, the overall findings confirm that the macroeconomic downturn during this time profoundly impacted the banking sector.

The analysis demonstrates that macroeconomic indicators, particularly GDP growth, unemployment, inflation, and the public debt, are the significant determinants of the NPL evolution in Greece. Simultaneously, the banking system's variables, such as NIM and the LDR, play an essential role in influencing loan performance. These results highlight the interconnectedness of macroeconomic conditions and the efficiency of banks in addressing the persistent challenge of NPLs. Future policy-related efforts should aim to create a balanced approach that will address both the vulnerabilities of the economic system and the banking system so as to ensure sustainable financial stability.

VIF values greater than 10 mean that the variable should not be included in the model since it is strongly correlated with the other variables. There is no such limitation in Table 7.

Figure 9 depicts the standardized residuals of the regression. They are very closed in normal distribution.

**Table 3** The statistics df, SS, MS, F and Significance F

|            | df        | SS       | MS       | F          | Significance F |
|------------|-----------|----------|----------|------------|----------------|
| Regression | 7.000000  | 3.608341 | 0.515477 | 116.377756 | 0.000000       |
| Residual   | 52.000000 | 0.230326 | 0.004429 |            |                |
| Total      | 59.000000 | 3.838667 |          |            |                |

Notes df: the degrees of freedom, SS: the sum of squares, MS: the mean sum of squares, F: the F-statistic and the significance F are computed from the F value

**Table 4** The statistics coefficients, the standard error, t Stat and the P-value

|                       | Coefficients | Standard error | t stat    | P-value  |
|-----------------------|--------------|----------------|-----------|----------|
| Intercept             | 0.474454     | 0.137888       | 3.440876  | 0.001152 |
| Debt t-2              | 0.429989     | 0.170267       | 2.525385  | 0.014644 |
| GDP t-1               | -2.196861    | 0.451899       | -4.861402 | 0.000011 |
| inflation t-1         | -4.323454    | 1.065044       | -4.059412 | 0.000166 |
| Unemployment t-1      | 0.720264     | 0.106823       | 6.742569  | 0.000000 |
| Equity Ratio t-2      | 0.826647     | 1.125742       | 0.734313  | 0.466056 |
| Loan-to-deposit ratio | 1.244576     | 0.284486       | 4.374828  | 0.000059 |
| Net interest margin   | -19.309085   | 3.221007       | -5.994735 | 0.000000 |

Source: Authors

**Table 5** The regression statistics after the rejection of the independent variable equity ratio

| Regression Statistics |           |
|-----------------------|-----------|
| Multiple R            | 0.96921   |
| R square              | 0.93938   |
| Adjusted R square     | 0.93251   |
| Standard error        | 0.06626   |
| Observations          | 60.000000 |

Source: Authors

**Table 6** The statistics df, SS, MS, F and significance F after the rejection of the independent variable equity ratio\*

|            | df       | SS      | MS      | F         | Significance F |
|------------|----------|---------|---------|-----------|----------------|
| Regression | 6.00000  | 3.60595 | 0.60099 | 136.87417 | 0.000000       |
| Residual   | 53.00000 | 0.23271 | 0.00439 |           |                |
| Total      | 59.00000 | 3.83867 |         |           |                |

Source: Authors

The normalized residuals show a good model fit (Figures 9 and 10).

## Diagnostic tests

To validate the robustness and reliability of the regression model, a series of standard diagnostic tests were conducted. The Durbin-Watson (DW) statistic (Durbin & Watson, 1950) was 1.74, close to the reference value of 2, indicating a mild positive autocorrelation in the residuals and suggesting that serial correlation does not constitute a major concern for the model.

The Breusch-Pagan test (Breusch & Pagan, 1979) was done to test for heteroscedasticity. The results (LM = 7.17, F = 1.20,  $p > 0.30$ ) suggest that the null hypothesis of homoscedastic errors cannot be rejected. Therefore, the residuals have a constant variance across all the observations.

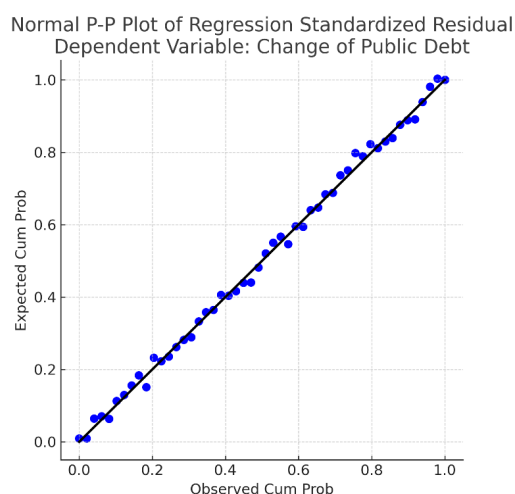
Variance Inflation Factors (VIF) were also performed to assess potential multicollinearity. All the values reported in Table 7 are well below the conventional threshold of 10, suggesting that multicollinearity is not a concern.

Although possible endogeneity cannot be ruled out, particularly regarding the GDP growth and

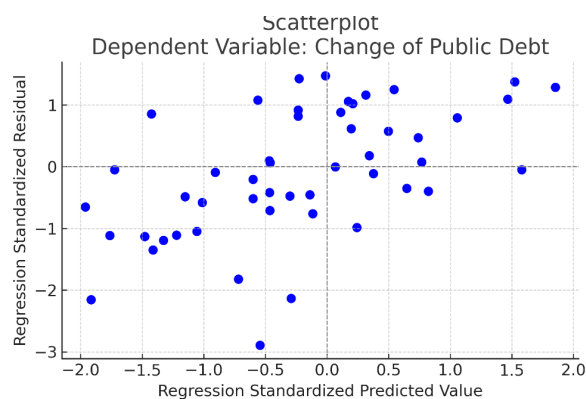
**Table 7** The statistics: the coefficients, the standard error, t stat and the P-value after the rejection of the independent variable equity ratio

|                        | Coefficients | Standard Error | t Stat   | P-value | Tolerance | VIF   |
|------------------------|--------------|----------------|----------|---------|-----------|-------|
| Intercept              | 0.53447      | 0.11057        | 4.83364  | 0.00001 |           |       |
| Debt t-2               | 0.48618      | 0.15144        | 3.21035  | 0.00225 | 0.501     | 1.997 |
| GDP t-1                | -2.04260     | 0.39836        | -5.12754 | 0.00000 | 0.103     | 9.683 |
| inflation t-1          | -4.64872     | 0.96435        | -4.82059 | 0.00001 | 0.123     | 8.102 |
| Unemployment t-1       | 0.70249      | 0.10359        | 6.78130  | 0.00000 | 0.773     | 1.294 |
| Loan to deposits ratio | 1.19286      | 0.27443        | 4.34670  | 0.00006 | 0.408     | 2.450 |
| Net interest margin    | -18.86513    | 3.14997        | -5.98898 | 0.00000 | 0.599     | 1.670 |

Source: Authors

**Figure 9** The standardized residuals

Source: Authors

**Figure 10** The residuals and the predicted values

Source: Authors

the public debt, the overall diagnostic tests strongly support the reliability of the model. The residuals are homoscedastic and approximately independent, and the use of transformed variables ensures stationarity. These results indicate that the regression specification is robust and the estimated relationships can be considered reliable despite this limitation.

## CONCLUSION

This study empirically investigated the determinants significantly affecting the evolution of NPLs in Greece from 2004 to 2018. Furthermore, the study presented an overview of the Greek banking system, focusing on the changes made over time in the regulatory framework designed to address the issue of NPLs at both the international level and the domestic level.

Utilizing the data collected from the Bank of Greece on the evolution of NPLs and considering the characteristics of economic quality during the crisis, the study documented the trajectory of NPLs over the review period. Additionally, the data reflecting the macroeconomic environment and the conditions of the country's banking system were analyzed in order to draw comprehensive conclusions.

The main conclusions that emerged from the study of the evolution of NPLs during the period under review imply that, throughout the period from 2004 to 2009, during which time the Greek economy was growing,

the NPLs remained stable and, at times, showed a downward trend.

Once the economic crisis affected Greece, the previous course of NPLs was reversed, which indicated a significant increase until the end of the reference period. The global economic crisis that affected Greece has also influenced the development of the country's NPLs.

As far as the identification of the factors that influence the evolution of NPLs in Greek banking system is concerned, an economic model was used, and the data were derived from the Bank of Greece and the Hellenic and European Statistical Authorities for the period from 2004 to 2018. The survey's findings indicate that there is an association between the evolution of NPLs and the macroeconomic variables used in this model, including the percentage change in the gross domestic product, the debt, the unemployment, and the inflation.

Therefore, it was found that the macroeconomic factors that depict the condition of the Greek economy affect the condition of the country's banking system and, as a result, the course of NPLs.

These findings are in line with previous studies (Rinaldi & Sanchis-Arellano, 2006; Reinhart & Rogoff, 2010) and confirm the critical role of macroeconomic stability and the efficiency of the banking system in managing NPLs. Moreover, studies on other vulnerable economies confirm that NPLs are directed by macroeconomic instability, including GDP fluctuations, inflation, and unemployment (Sanyaolu, Siyanbola & Makinde, 2020; Efayena, Oniore & Buzugbe, 2025).

This study contributes as an initial effort to define the factors that influence the evolution of NPLs in Greece. To further examine this direction, considering the strong interrelation between the economies of the European countries and the banks of the Eurozone, it is crucial to investigate data on all the banks operating within the Eurozone.

The study highlights that managing NPLs is a complex and multifaceted problem. If not addressed

in a timely manner, it can create significant problems in various sectors of the economy. According to the findings, addressing the increase in NPLs in Greece necessitates the reversal of the negative effects of the economic recession and the restoring of the country's economy to growth. This conversion would create positive conditions for the Greek banking system, enabling it to operate smoothly and fueling its growth.

In summary, the empirical findings have confirmed all the main research hypotheses, showing that both the macroeconomic variables and the banking-specific variables significantly influence the evolution of non-performing loans in Greece. The results provide theoretical support to the macro-financial vulnerability framework, confirming that economic shocks and the efficiency of banks jointly shape credit risk dynamics. From a practical perspective, the findings underline the need for the policies that promote sustainable growth, employment, and effective bank risk management in order to prevent future NPL accumulation.

Despite its contributions, the research also has certain limitations. The analysis covers the period from 2004 to 2018 and relies on aggregated quarterly data, which may not fully capture the differences among individual banks or post-2019 developments. Moreover, potential endogeneity between macroeconomic indicators and NPLs could affect the strength of some relationships.

Future research could expand the model by using bank-level panel data or dynamic econometric approaches (such as VECM or GMM) to explore causal relationships more precisely. Additionally, incorporating new variables - such as policy uncertainty, the adoption of Fintech adoption, and institutional reforms - would enhance the understanding of the evolving determinants of NPLs in Greece and in other Eurozone economies.

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# UNDERSTANDING THE DIFFERENCE BETWEEN THE STATUTORY AND EFFECTIVE CORPORATE INCOME TAX RATES: THE ROLE OF TAX INCENTIVES IN THE OECD COUNTRIES

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This study examines the gap between statutory and effective corporate income tax rates, with tax incentives identified as a key factor in this divergence. The objective is to quantify the gap and analyze the relationship between statutory and effective rates in the OECD countries in the period from 2000 to 2022. The methodological framework is based on the Devereux–Griffith model and employs descriptive statistics, t-tests, and correlation analysis. The empirical results demonstrate that tax incentives significantly shape the effective tax rate, thereby contributing to its deviation from the statutory rate. The analysis confirms a positive correlation between the two rates and identifies statistically significant differences in certain years. The findings contribute to the literature on tax policy and provide practical guidelines for policymakers aimed at reducing the gap between rates and improving the transparency of tax incentives.

**Keywords:** corporate income tax, statutory tax rate, effective tax rate, tax incentives, OECD countries

JEL Classification: H25, H32, O38

## INTRODUCTION

Corporate income tax (CIT) is one of the most significant forms of taxation, playing a crucial role in stimulating economic growth and development

(Đurović Todorović, Đorđević, Mirović, Kalaš & Pavlović, 2024; Ristić Cakić, Kalaš, Đurović Todorović & Đorđević, 2025). Therefore, ensuring the efficient administration and collection of this tax is of paramount importance. The existing differences between effective and statutory tax rates highlight the issues related to tax alignment and revenue collection (Schaffer & Turley, 2019). These discrepancies often reflect broader challenges in tax governance,

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including compliance gaps and the strategic use of incentives by multinational companies. Since effective tax rates are shaped by tax incentives, the extent of this disparity largely depends on the number of tax incentives and the way they are structured.

This study examines the difference between statutory and effective corporate income tax rates, identifying tax incentives as a key factor influencing this gap. The research focuses on the analysis of tax incentives which represent a decisive element in the formation of effective tax rates. The study aims to investigate the disparity between the statutory and effective corporate tax rates in the OECD countries, assess the magnitude of the gap, and examine the relationship between the two rates. The study covers the period from 2000 to 2022, and employs the methodological approach that combines descriptive statistics, t-tests, and correlation analysis based on the Devereux-Griffith model. The findings indicate that tax incentives play a significant role in shaping the effective tax rate, thereby contributing to the difference between statutory and effective rates. The statistical analysis carried out in this paper confirmed a clear and positive association between the statutory and effective corporate tax rates (Pearson's correlation coefficient in 2022 = 0.56;  $p < 0.05$ ). A statistically significant difference between these rates was also identified in certain years (e.g. 2021:  $t(29) = 3.162$ ;  $p < 0.05$ ). This research provides valuable insights into the relationship between tax policy, tax incentives, and the effective tax burden, offering useful guidance to policymakers seeking to optimize tax systems. Furthermore, the results can help policymakers reduce the gap between statutory and effective rates and improve the transparency of tax incentives.

Tax incentives remain an open question in the literature as tax policymakers decide whether to implement them or not (McIntyre, 2017). Tax incentive policy encompasses the measures and instruments of government intervention aimed at fostering growth and development (Đurović Todorović, Đorđević & Ristić, 2018; Đurović Todorović, Ristić Cakić & Starčević, 2022). Tax incentives can be defined as benefits designed to modify taxpayers' business environment, with the ultimate goal of increasing

their investments. Additionally, tax incentives can be understood as mechanisms that reduce the tax burden on businesses, thereby influencing their behavior and encouraging them to invest in specific sectors or regions (Kigen, 2011). In the CIT domain, tax incentives represent the most important form of tax incentives, used equally across all countries, regardless of their development level (Easson, 2004). The significance of managing these tax incentives was emphasized in 2011, when the International Monetary Fund (IMF), the United Nations (UN), the OECD, and the World Bank (WB) jointly reported that efficient tax incentive policies for corporate income tax were crucial for developing countries (International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations & World Bank, 2011). It was particularly highlighted that the effectiveness of tax incentives could be compromised if they were granted broadly, thereby increasing the risk of the abuse and a potential loss of tax revenues. Guidelines were then provided to policymakers on whether to adopt tax incentives or not and how to design them most effectively.

The number of tax incentives significantly determines the gap between statutory and effective tax rates. The gap between these tax rates can jeopardize tax revenue collection and indicates that CIT is inefficient and that tax evasion is also present. Therefore, this paper examines tax incentives as a crucial element of CIT. This research aims to examine the difference between the statutory and effective corporate income tax rates in the OECD countries, assess the magnitude of the gap, and analyze the relationship between the two rates. The following hypotheses are examined:

- H1: There is a statistically significant difference between the statutory and effective corporate income tax rates in the OECD countries.
- H2: Tax incentives significantly influence the formation of the effective tax rate, contributing to the gap between statutory and effective corporate tax rates.
- H3: Statutory and effective tax rates are positively correlated.

The hypotheses are tested on a sample of the OECD countries in the period from 2000 to 2020, using descriptive statistics, t-tests, and correlation analysis. The paper is structured into four main parts, in addition to the introduction and the conclusion. The first part presents relevant research in tax incentives in the CIT domain which indicates that they are a significant factor in determining the levels of effective tax rates and the existence of the gap between the statutory and effective rates. The second part explains the impact of tax incentives on the effective tax burden. The third part evaluates the gap between the statutory and effective corporate income tax rates. The fourth part examines the relationship between the two rates and the significance of the relationship between them. The conclusion offers recommendations for tax policymakers.

## LITERATURE REVIEW

### The impact of tax incentives on investment and economic growth

Economic growth is a complex and long-term process (Gligorić Matić & Jovanović Gavrilović, 2022). The number of tax incentives offered within a tax system depends on whether the state aims to stimulate economic growth, develop specific sectors, or support certain taxpayers (Šimović & Bratić, 2009). An increasing number of developing countries are showing interest in introducing tax incentives directed towards investment, growth, and innovation (Crespi, Giuliodori, Giuliodori & Rodriguez, 2016). The use of tax incentives to encourage investment is also a well-known instrument in many countries, although empirical evidence regarding the effectiveness of this policy remains rather inconclusive (Zee, Stotsky & Ley, 2002).

Some contemporary authors argue that tax incentives do not necessarily result in greater inflows of foreign direct investment (FDI) and that FDI does not always generate sustained economic growth and development (Brauner, 2013; Viet Le & Elliott, 2023).

Nevertheless, certain examples (such as China) demonstrate that well-designed tax incentives can contribute to high investment rates and are becoming one of the main drivers of economic development. These findings suggest that tax incentives can exert a significant, though not always consistent, impact on economic growth, thereby raising questions regarding their long-term effectiveness. At this point, another strand of the literature emerges, emphasizing the shortcomings and limitations of tax incentives.

### Critiques and limitations of tax incentives

Although tax incentives are often regarded as instruments for enhancing equity and competitiveness (Callihan, 1994; Đurović Todorović *et al*, 2018), part of the literature identifies them as inequitable and inefficient tools for stimulating economic activity, arguing that they introduce distortions, create a “deadweight subsidy effect,” and generate unequal effective tax burdens for firms of a similar economic capacity.

Their selective nature undermines the neutrality of the tax system, while their complexity and high administrative costs further constrain their application (Appelt, Bajgar, Criscuolo & Galindo-Rueda, 2025). In the literature, they are often referred to as “tax expenditures,” as they reduce corporate income tax revenues and require continuous monitoring by tax authorities (Brauner, 2013). The evidence also indicates that tax incentives may fail to attract highly skilled labor or substantial FDI in the long run (Ivanov, 2018).

Building on these critiques, the recent literature increasingly shifts the focus towards specific forms of tax incentives – particularly green and R&D incentives – which are seen as responses to the challenges of sustainable development and technological innovation.

### Green and R&D tax incentives

The contemporary literature underscores the role of tax incentives in advancing green transition and

innovation. The use of tax incentives directed at environmental protection has become increasingly common (Zeng, Ji & Huang, 2025). A growing number of studies have been assessing the effectiveness of such incentives and their impact on green transition, thereby creating favorable conditions for sustainable investment. Furthermore, R&D tax incentives have become the primary instrument used to encourage firms to invest in research and development (Appelt *et al*, 2025). The rising interest in environmental protection has also led to the introduction of incentives targeting the development of renewable energy sources and environmentally friendly technologies (Zeng *et al*, 2025; Yin, Zhang, Cai, Zhang & Zhu, 2025). These incentives are closely tied to the achievement of sustainable development goals and ESG standards.

Particular importance is attributed to R&D tax incentives, which have become the dominant tool for promoting innovation in the OECD countries. S. Appelt *et al* (2025) demonstrate that, although micro- and macro-level evidence is not always consistent, well-designed incentives can substantially increase R&D investment. Similarly, J. F. Sapar and E. R. H. Kusuma (2025) emphasize that tax policy must be integrated with other fiscal measures – such as subsidies and “green financing” – in order to achieve sustainable development objectives.

These recent studies indicate that, although tax incentives are frequently criticized, they do remain an indispensable instrument of fiscal policy. Their significance is increasingly measured by their contribution to the sustainability and innovation capacity, rather than solely by their traditional impact on investment.

## THE IMPACT OF TAX INCENTIVES ON THE GAP BETWEEN THE STATUTORY AND EFFECTIVE CIT RATES IN THE OECD COUNTRIES

The relevance of tax incentives within the OECD framework is also confirmed by the structural

reforms implemented in the countries such as the United States, Japan, and Switzerland, which all have introduced competitive preferential tax regimes aimed at attracting foreign investment and stimulating capital inflows. Such fiscal measures have intensified divergences in corporate taxation systems, giving tax incentives an international dimension and making them the subject of global tax competition. Appropriate statistical procedures including descriptive statistics, t-tests, and correlation analysis were applied so as to conduct a quantitative analysis of the dynamics of effective corporate tax rates, assess the gap relative to the statutory rates, and examine their interdependence.<sup>1</sup>

The data comparable across the analyzed countries were obtained from the reports issued by the Centre for European Economic Research (Zentrum für Europäische Wirtschaftsforschung – ZEW, 2025). Although the applied methodological framework based on the Devereux-Griffith model combined with descriptive statistics, t-tests, and correlation analysis provides a reliable assessment of the differences between the statutory and effective corporate income tax rates in the OECD countries, certain limitations must be acknowledged.

First, the calculation of effective tax rates relies on the modeled assumptions that do not fully reflect the complexity of national tax systems and the various forms of tax incentives. Consequently, discrepancies may arise between the computed and the actually paid effective tax rates. Second, the analysis is focused on the aggregate level and cross-country comparability within the OECD, whereas microeconomic aspects (e.g. firm- or sector-level data) are not included. This omission limits the insights into the heterogeneity of tax incentive effects across industries and types of firms. Third, the applied statistical techniques (t-tests and Pearson’s correlation) allow for the identification of differences and associations, but not for causal inferences between the variables. In other words, the results reveal the existence of the relationship between the statutory and effective rates but cannot determine the direction or underlying mechanisms of causality. Finally, the study spans from 2000 to 2022; however, specific circumstances (e.g. the effects of

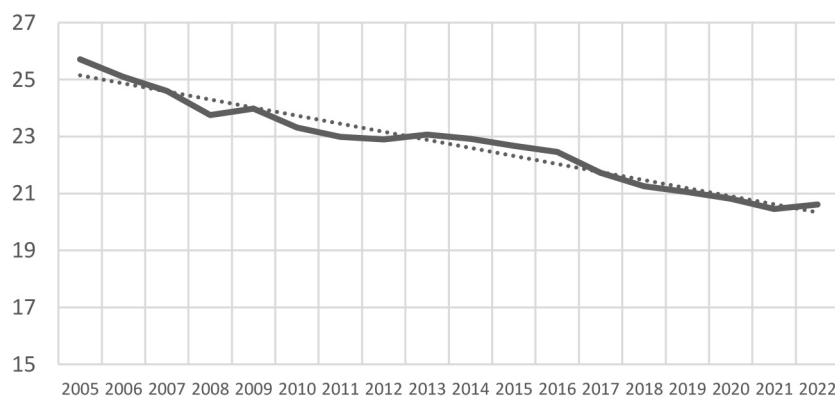
the global financial crisis or the COVID-19 pandemic) may have temporarily disrupted usual patterns, thereby limiting the generalizability of the findings to other time horizons.

Figure 1 shows the average effective CIT rate in the OECD countries, which leads to the conclusion that the tax policies vary between the OECD countries. Estonia has the lowest effective tax rate, whereas Japan has the highest. Interestingly, between 2005 and 2018, the United States had the highest effective tax rate, which was significantly reduced following the reforms aimed at repatriating income from abroad and stimulating the economy. The trend of the average effective tax rate in the OECD countries showed a tendency to decline from 2005 to 2022.

In Figure 1, a slight decrease in the effective tax burden can be observed. Unlike the EU market, the OECD countries rely much more on financial incentives. The reason for this policy is their flexibility, which distinguishes these incentives from tax incentives. Significant tax incentives were introduced at the end of 2008 in order to mitigate the

consequences of the crisis. At that time, the United States created its policy for recovery from the crisis by introducing new tax incentives, including accelerated depreciation incentives. This policy provided good results, considering that redesigning tax incentives was effective during the global financial crisis. In addition to the special tax regimes used in the OECD countries to compete for capital, the harmonization of tax rules can also be said to be a desirable trend here.

In the OECD countries, the highest number of reforms took place in 2009, following the Global Economic Crisis. Between 2009 and 2020, effective tax rates gradually decreased in order to mitigate the effects of the crisis and stimulate economic activity. The biggest reductions in the effective tax burden from 2005 to 2020 occurred in Greece (-9.5% in 2010), Turkey (-9.1% in 2006), and the U.S. (-9% in 2019). The maximum increase in the effective tax rate was recorded in Greece (+8.7% in 2009). The years following the COVID-19 pandemic crisis significantly deviated from the other years. The most recent year analyzed showed the highest number of changes in the effective tax rates among the OECD countries. This dynamic



**Figure 1** The trend of the average effective CIT rate in the OECD countries (in %)

Source: Authors, based on the data obtained from the ZEW (2025)

**Table 1** The intensity of tax competition in the OECD countries (the number of changes in the effective tax rate)

| Year          | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | *   |
|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| Total changes | 15   | 16   | 15   | 17   | 13   | 13   | 13   | 14   | 15   | 15   | 12   | 16   | 13   | 11   | 6    | 204 |

Source: Authors

of the tax policy adjustments aimed at reducing tax burdens and creating more favorable conditions influenced both the economic development of and tax revenues in the OECD countries. According to the latest analyzed data (Table 2), the effective tax rates suffered from as many as 24 changes. The increase can explicitly be linked to the COVID-19 crisis. Notably, Italy and the United Kingdom significantly lowered their rates (-6.8%), as did the U.S. (-6.4%).

**Table 2** The changes of the effective tax burden in the OECD countries (in %)

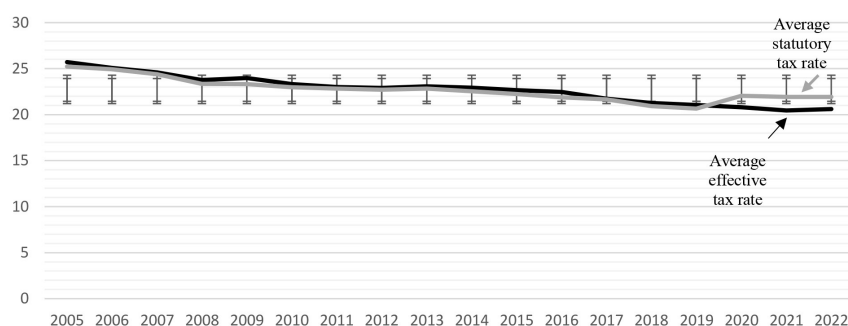
| Country        | 2021 | 2022 |
|----------------|------|------|
| Austria        |      | 1.7  |
| Belgium        |      | 1.2  |
| Greece         | -1.8 | -0.6 |
| Denmark        | 0.8  |      |
| Estonia        | -1.9 | 6.2  |
| Ireland        | -4.7 | 3.4  |
| Italy          | 0.1  | -6.8 |
| Japan          | -6.6 | 7.6  |
| Canada         | -0.1 | -0.1 |
| Latvia         |      | 2.6  |
| Lithuania      |      | 3.4  |
| Luxembourg     |      | 2.1  |
| Hungary        |      | -0.3 |
| Germany        |      | -1.9 |
| Norway         |      | 1.3  |
| Poland         | 0.8  | -0.8 |
| Portugal       |      | 6.1  |
| USA            |      | -6.4 |
| Slovakia       |      | 2.2  |
| Slovenia       |      | 0.4  |
| Turkey         | -0.9 | 5.4  |
| UK             |      | -6.8 |
| Finland        |      |      |
| France         | -3.4 | -2.1 |
| Netherlands    |      | 0.7  |
| Czech Republic | 0.3  |      |
| Switzerland    | -1.2 | 0.7  |
| Sweden         | -0.7 |      |
| Spain          |      |      |
| Total changes  | 13   | 24   |

Source: Authors

## THE DISCREPANCY BETWEEN THE STATUTORY AND EFFECTIVE CIT RATES AS THE BASIS FOR THE DEVELOPMENT OF FISCAL POLICY IN THE OECD COUNTRIES

With the exclusion of the last two years, when the movement of the gap was largely influenced by the consequences of the COVID crisis and no accurate picture of the discrepancy between the effective and statutory CIT rates was possible to see, the gap in the OECD countries was not expected to be significantly large. Figure 2 illustrates the gap between the rates in the OECD countries from 2005 to 2022. The trend of the rates shows a continuous and mild decline, which is the result of tax competition within this organization.

On the global capital market, there is clear competition among countries in attracting investors through tax incentives and other fiscal benefits. By setting the effective tax rate at an appropriate level, the OECD countries define the intensity of the tax burden and thereby engage in international competition in the field of corporate taxation. The discrepancy between the effective and statutory tax rates varied over the observed period. It can be perceived, however, that the gap between the average effective and statutory rates in the OECD countries is considerably narrower than in the European Union member states, suggesting that the OECD countries pursue a strategy of broadening the tax base, while simultaneously reducing the statutory rates in order to stimulate economic activity (European Commission, 2025). Unlike the EU, the OECD less relies on the policies in which tax incentives and fiscal adjustments decisively shape economic outcomes; instead, the OECD member countries more consistently follow the theoretical principles aimed at narrowing the statutory-effective tax rate gap. Although this difference in the OECD countries is relatively small, it cannot be concluded that the statutory rate has no effect on the effective tax rate without further empirical investigation. Table 3 shows the descriptive statistical indicators of the statutory and effective corporate income tax rates in the OECD countries and serves as the basis for further quantitative analyses of their discrepancy.



**Figure 2** The deviation of the effective tax rate from the statutory tax rate in the OECD countries (in %)

Source: Authors

The data accounted for in Table 3 point to several relevant facts. The average effective corporate income tax rate in the OECD countries was 25.71% in 2005, while the average statutory rate in the same year was 25.22%. By 2022, these values had declined, with the effective rate standing at 20.39% and the statutory rate standing at 20.18%. In 2005, the range of the effective tax rates extended from a minimum of 12.70% (Lithuania) to a maximum of 41.70% (Japan), whereas the statutory rates ranged from 8.5% (Switzerland) to 35% (the United States). In the final year observed, the picture had shifted – the effective rates had ranged from 10.80% (Estonia) to 27.50% (Japan), while the statutory rates had varied from 8.5% to 30%. The values of the standard deviation, as a summary statistical indicator, confirm the existence of a certain interval of oscillation between the effective and statutory corporate tax rates in the OECD countries, indicating relative homogeneity in their movement over the analyzed period.

The data analysis suggests that there was greater consistency in the years before the COVID-19 crisis, when a significant gap emerged between the effective and statutory tax rates (Table 4). The results of the Kolmogorov-Smirnov (K/S) test indicate that the data follow a normal distribution, which justifies the application of further analysis. The K/S test is statistically significant ( $p > 0.05$ ). The results obtained from the t-test showed no statistically significant differences between the observed tax rates (Table 5).

**Table 3** The descriptive statistics of the statutory and effective CIT rates

| Variable | Minimum | Maximum | Average value $\bar{x}$ | Standard deviation $s$ |
|----------|---------|---------|-------------------------|------------------------|
| S/2005   | 8.50    | 35.00   | 25.2260                 | 7.09657                |
| S/2006   | 8.50    | 35.00   | 24.9219                 | 6.73985                |
| S/2007   | 8.50    | 35.00   | 24.4071                 | 6.43764                |
| S/2008   | 8.50    | 35.00   | 23.3322                 | 6.45642                |
| S/2009   | 8.50    | 35.00   | 23.3240                 | 6.29999                |
| S/2010   | 8.50    | 35.00   | 22.9791                 | 6.53110                |
| S/2011   | 8.50    | 36.10   | 22.8369                 | 6.68956                |
| S/2012   | 8.50    | 36.10   | 22.6990                 | 6.83257                |
| S/2013   | 8.50    | 38.00   | 22.8393                 | 6.87229                |
| S/2014   | 8.50    | 38.00   | 22.5290                 | 6.86011                |
| S/2015   | 8.50    | 38.00   | 22.2480                 | 6.73490                |
| S/2016   | 8.50    | 35.00   | 21.8836                 | 6.33351                |
| S/2017   | 8.50    | 44.43   | 21.6546                 | 7.53558                |
| S/2018   | 8.50    | 34.43   | 20.9212                 | 5.82891                |
| S/2019   | 8.50    | 34.43   | 20.6567                 | 5.65093                |
| S/2020   | 8.50    | 32.00   | 19.9522                 | 5.57527                |
| S/2021   | 11.10   | 31.70   | 22.2241                 | 5.45158                |
| S/2022   | 8.50    | 30.00   | 20.1876                 | 4.91120                |
| E/2005   | 12.70   | 41.70   | 25.7103                 | 7.74506                |
| E/2006   | 14.30   | 41.70   | 25.0897                 | 7.60777                |
| E/2007   | 14.30   | 41.30   | 24.6000                 | 7.39841                |
| E/2008   | 12.70   | 41.30   | 23.7517                 | 7.05239                |
| E/2009   | 13.80   | 41.70   | 23.9759                 | 7.02143                |
| E/2010   | 11.80   | 41.70   | 23.3103                 | 7.06568                |
| E/2011   | 12.20   | 41.70   | 22.9931                 | 6.95197                |
| E/2012   | 12.40   | 40.10   | 22.8931                 | 6.94946                |
| E/2013   | 12.10   | 40.10   | 23.0655                 | 6.89463                |
| E/2014   | 13.60   | 38.30   | 22.9172                 | 6.85467                |
| E/2015   | 13.60   | 38.30   | 22.6690                 | 6.93872                |
| E/2016   | 13.60   | 38.40   | 22.4621                 | 6.72742                |
| E/2017   | 11.10   | 36.50   | 21.7310                 | 6.66125                |
| E/2018   | 11.00   | 34.10   | 21.2552                 | 5.99533                |
| E/2019   | 11.10   | 34.10   | 21.0517                 | 5.79264                |
| E/2020   | 11.10   | 34.10   | 20.8138                 | 5.64109                |
| E/2021   | 9.40    | 34.10   | 20.3483                 | 5.82480                |
| E/2022   | 10.80   | 27.50   | 20.3931                 | 4.30390                |

Note: S – the statutory CIT rate; E – the effective CIT rate.

Source: Authors

**Table 4** The results of the Kolmogorov-Smirnov normality test

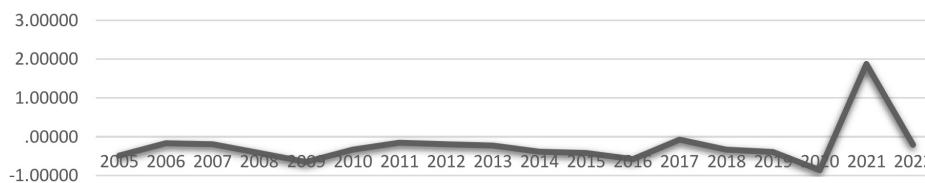
| Test/Variables       | S/05  | S/06  | S/07  | S/08  | S/09  |
|----------------------|-------|-------|-------|-------|-------|
| K/S S                | 0.582 | 0.489 | 0.476 | 0.642 | 0.658 |
| Sig.(2-tailed)       | 0.888 | 0.970 | 0.977 | 0.805 | 0.780 |
| Test/Variables       | S/10  | S/11  | S/12  | S/13  | S/14  |
| K/S S                | 0.561 | 0.606 | 0.549 | 0.357 | 0.483 |
| Sig.(2-tailed)       | 0.911 | 0.856 | 0.924 | 1.000 | 0.974 |
| Test/Variables       | S/15  | S/16  | S/17  | S/18  | S/19  |
| K/S S                | 0.611 | 0.562 | 0.841 | 0.883 | 0.772 |
| Sig.(2-tailed)       | 0.849 | 0.910 | 0.479 | 0.417 | 0.591 |
| Test/Variables       | S/20  | S/21  |       | S/22  |       |
| K/S S                | 0.842 | 0.750 |       | 0.878 |       |
| Sig.(2-tailed)       | 0.478 | 0.628 |       | 0.423 |       |
| Test/Variables       | E/05  | E/06  | E/07  | E/08  | E/09  |
| Kolmogorov-Smirnov S | 0.483 | 0.756 | 0.689 | 0.494 | 0.632 |
| Asymp.Sig.(2-tailed) | 0.974 | 0.618 | 0.729 | 0.968 | 0.819 |
| Test/Variables       | E/10  | E/11  | E/12  | E/13  | E/14  |
| K/S S                | 0.558 | 0.626 | 0.599 | 0.551 | 0.777 |
| Sig.(2-tailed)       | 0.914 | 0.829 | 0.866 | 0.922 | 0.581 |
| Test/Variables       | E/15  | E/16  | E/17  | E/18  | E/19  |
| K/S S                | 0.642 | 0.676 | 0.673 | 0.424 | 0.530 |
| Sig.(2-tailed)       | 0.805 | 0.750 | 0.755 | 0.994 | 0.941 |
| Test/Variables       | E/20  | E/21  | E/22  |       |       |
| K/S S                | 0.645 | 0.531 | 0.703 |       |       |
| Sig.(2-tailed)       | 0.800 | 0.941 | 0.706 |       |       |

Source: Authors

**Table 5** The results of the t-test

| Year | Average value of the difference $\bar{x}$ | Standard deviation | Significance (2-tailed) |
|------|-------------------------------------------|--------------------|-------------------------|
| 2005 | -0.48431                                  | 4.86989            | 0.596                   |
| 2006 | -0.16776                                  | 4.92988            | 0.856                   |
| 2007 | -0.19293                                  | 4.77235            | 0.829                   |
| 2008 | -0.41948                                  | 5.04949            | 0.658                   |
| 2009 | -0.65190                                  | 5.13974            | 0.500                   |
| 2010 | -0.33121                                  | 4.95797            | 0.722                   |
| 2011 | -0.15617                                  | 4.86070            | 0.864                   |
| 2012 | -0.19410                                  | 4.68255            | 0.825                   |
| 2014 | -0.22617                                  | 4.87099            | 0.804                   |
| 2015 | -0.38824                                  | 4.54468            | 0.649                   |
| 2016 | -0.42100                                  | 4.84217            | 0.643                   |
| 2017 | -0.57845                                  | 4.78539            | 0.520                   |
| 2018 | -0.07641                                  | 5.44101            | 0.940                   |
| 2019 | -0.33397                                  | 5.49878            | 0.746                   |
| 2020 | -0.39500                                  | 5.27351            | 0.690                   |
| 2021 | -0.86155                                  | 5.75286            | 0.427                   |
| 2022 | 1.87586                                   | 3.19516            | 0.004                   |
| 2023 | -0.20552                                  | 4.35447            | 0.801                   |

Source: Authors



**Figure 3** The differences in the average values for the effective and statutory rates in the OECD countries

*Source:* Authors, based on the data obtained from ZEW (2025), Effective tax levels using the Devereux-Griffith methodology

When comparing the mean values, it is important to highlight that the mean values for both the effective corporate income tax rate and the statutory corporate income tax rate do not differ significantly. Moreover, it can be concluded that these differences are much smaller compared to those observed in the EU member countries. The paired sample t-test revealed which set of results had higher mean values. In 2022, no significant difference was found between the tax rates,  $t(29) = 0.254$ ,  $p > 0.05$ . However, in 2021, a significant difference was found between the rates,  $t(29) = 3.162$ ,  $p < 0.05$ .

The magnitude of the difference in the paired samples t-test, or the calculation or determination of the difference between these rates, can be seen through the interpretation of the eta squared indicator.

$$e_{2021} = \frac{(3.162)^2}{(3.162^2 + 29 - 1)}; e_{2021} = \frac{9.998244}{37.998244}; e_{2021} = 0.26 \quad (1)$$

$$e_{2022} = \frac{(0.254)^2}{(0.254^2 + 29 - 1)}; e_{2022} = \frac{0.064516}{28.064516}; e_{2022} = 0.002 \quad (2)$$

The value of the coefficient in 2022 was 0.002, which shows that there was a small difference between the rates in the OECD countries in that year. In other words, there is a small difference between the effective and statutory CIT rates in the OECD countries. Over the observed period from 2005 to 2022, no significant difference was noticed between the analyzed rates, except in 2021, when the effective tax rate significantly deviated from the statutory tax rate.

### THE EMPIRICAL ASPECTS OF THE RELATIONSHIP BETWEEN THE STATUTORY AND EFFECTIVE CIT RATES IN THE OECD COUNTRIES

The results of the correlation analysis presented in Table 6 indicate the intensity and direction of the interdependence between the statutory and effective tax rates in the OECD countries. The application of Pearson's correlation coefficient as a parametric indicator of linear association reveals a strong and statistically significant positive correlation between the variables under observation. In the final year analyzed, the coefficient reached the value of 0.56 ( $p < 0.05$ ), confirming that the dynamics of the statutory rates largely determine the level of the effective rates.

The economic implications of this finding suggest that the statutory rate remains the key benchmark for shaping the tax burden, while tax incentives and adjustments function as the modifiers that either mitigate or amplify its actual impact. In other words, a higher statutory rate generally leads to a higher effective tax burden, although the ultimate intensity depends on the scope and design of incentives. This result indicates that tax incentives are an important policy instrument through which states can strategically influence the gap between the statutory and effective tax rates, albeit within the boundaries set by the statutory framework.

In all the observed years, a strong and statistically significant positive correlation was confirmed between the statutory and effective tax rates, thus demonstrating the existence of a robust relationship

**Table 6** The results of the correlation analysis of the statutory and effective tax rates

| Year                              | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Pearson's correlation coefficient | 0.788 | 0.770 | 0.771 | 0.724 | 0.707 | 0.737 | 0.747 | 0.769 | 0.750 |
| Significance                      | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Year                              | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  | 2022  |
| Pearson's correlation coefficient | 0.780 | 0.750 | 0.733 | 0.713 | 0.568 | 0.576 | 0.474 | 0.841 | 0.560 |
| Significance                      | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.009 | 0.000 | 0.002 |

Source: Authors

between these variables. As early as 2005, the value of Pearson's correlation coefficient was 0.788 ( $p < 0.001$ ), indicating a very strong association. In the final analyzed year, the coefficient value was somewhat lower but still reflected a strong and statistically significant correlation, implying the relative stability of the relationship over a longer time horizon. The results suggest that, in the OECD countries, the differences between the statutory and effective tax rates appear within a limited scope as the dynamics of the effective rate are largely dependent on the statutory framework. At the same time, the positive linear relationship demonstrates that the statutory rate represents the primary determinant, while tax incentives function as the modifiers that influence the final level of the effective tax burden. In other words, a higher statutory rate is generally associated with a higher effective burden, although the actual strength of this relationship depends on the scope and structure of tax incentives. Compared to the EU countries, the narrower gap in the OECD countries is associated with differences in the tax policy. The OECD countries tend to pursue strategies for broadening the tax base and lowering statutory rates, whereas the EU member states often retain a broader range of tax incentives. It may also be concluded that the OECD countries rely less on selective, sector-specific incentives compared to the EU countries, thereby reducing the gap between the statutory and effective rates.

However, a substantial divergence between these rates was recorded during the times of crisis. The changes in the effective tax rates during the 2008 global

financial crisis and the COVID-19 pandemic were linked to the measures aimed at stimulating economic activity. Governments introduced expansionary tax incentives (e.g. accelerated depreciation in the United States, rate reductions in Turkey and Greece) so as to encourage investment and preserve liquidity. During the COVID-19 crisis, many OECD countries temporarily reduced tax rates or allowed deferred tax payments (e.g. Italy, the UK, and the US), which led to a record number of changes in the effective tax rates (Table 2).

## CONCLUSION

This study provides a comprehensive analysis of the relationship between the statutory and effective corporate income tax rates in the OECD countries, emphasizing the influence of tax incentives on these dynamics. The findings are particularly relevant in the context of global tax policy shifts, such as the OECD's Inclusive Framework on Base Erosion and Profit Shifting (BEPS) which seeks to standardize corporate taxation and limit profit shifting.

The research highlights that well-structured tax incentives play a pivotal role in shaping corporate investment behavior and enhancing economic competitiveness. The countries that have strategically implemented tax incentives, such as reduced tax rates, tax holidays, accelerated depreciation, and tax credits, have managed to attract foreign direct investment and stimulate innovation and sustainable

growth. However, the study also identifies challenges, including the risk of the tax base erosion and the potential for a revenue loss when incentives are applied too broadly.

The results of the conducted research confirm all the hypotheses posed and emphasize the key role of tax incentives in shaping the effective tax rate. First, a statistically significant difference was found between the statutory and effective CIT rates in the OECD countries, confirming the hypothesis H1. This difference indicates the presence of the factors that contribute to reduction in the effective tax rate compared to the statutory tax rate, further highlighting the importance of analyzing tax incentives. Furthermore, the analysis showed that tax incentives had a significant impact on the formation of the effective tax rate, confirming the hypothesis H2. A greater number of tax incentives contributes to a larger gap between the rates, which aligns with the emerging literature on “tax expenditure efficiency,” which argues that incentives should be regularly audited in order to ensure that they meet their intended economic goals. Finally, a positive correlation between the statutory and effective tax rates was confirmed, which aligns with the hypothesis H3. This finding implies that the countries with higher statutory tax rates also generally have higher effective tax rates, although their final value is significantly influenced by tax incentives and other fiscal instruments. Moreover, the correlation analysis confirms a strong positive relationship between the statutory and effective tax rates, indicating that adjustments to statutory tax rates significantly impact the actual tax burden on corporations, which suggests that policymakers must carefully design and implement tax incentives in order to balance the goals of competitiveness and fiscal sustainability.

The overall results of the research provide important insights for tax policymakers, emphasizing the need to align the use of tax incentives as instruments for stimulating economic growth with the preservation of stable tax revenues. Policymakers should prioritize transparency (e.g. public registers of incentive beneficiaries) and adopt dynamic frameworks for evaluating the performance of tax incentives against

macroeconomic indicators. An efficient design of tax incentives can contribute to optimizing fiscal policy, reducing inefficiencies, and increasing the transparency of the tax system. Another recommendation is to direct tax incentives towards sectors with high multipliers (e.g. innovation, green technologies).

The limitations of this research study relate to its aggregate-level approach and the inability to establish long-term causal relationships. Future research should incorporate microeconomic-level data (e.g. firms or sectors), as well as the advanced econometric techniques that can more precisely identify the effects of the specific types of tax incentives.

## ENDNOTE

- 1 Given the complexity of calculating effective tax rates and their lack of transparency, Australia, Chile, Iceland, Israel, South Korea, Mexico, and New Zealand were excluded from the group of the OECD countries. The effective tax burden was measured using the Devereux-Griffith model (Spengel, Schmidt, Heckemeyer, Nicolay, Bartholmeß, Ludwig, Steinbrenner, Buchmann, Bührle, Dutt, Fischer, Spix & Stage, 2020).

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## FROM TRUST TO BETTER LEADERSHIP OUTCOMES: THE MEDIATING ROLE OF PSYCHOLOGICAL EMPOWERMENT

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Trust is an essential feature of leadership that can often go unrecognized until it weakens. The study aims to investigate the relationship between trust in leadership and leadership outcomes, as well as the mediating role of psychological empowerment in this relationship. The sample consists of 351 employees from organizations operating in Serbia. The hypotheses are tested using the PLS-SEM and the results show that there is a statistically significant positive relationship between trust in the leader and leadership outcomes, and that the psychological empowerment of employees also has a significant mediating role in this relationship. Motivated by the insufficiently explored concepts of trust and psychological empowerment in the sphere of leadership within the business environment of developing countries, including Serbia, the authors contribute to the field by examining the mediating role of psychological empowerment, while also advancing the understanding of trust and highlighting their importance in achieving positive leadership outcomes.

**Keywords:** trust, psychological empowerment, effectiveness, satisfaction, extra effort, intention to quit

JEL Classification: M12, D23

### INTRODUCTION

Bearing in mind the fact that human capital is the most valuable resource and one of the most important factors for gaining a competitive advantage of modern organizations (Oliveira, Andrade, Ratten & Santos, 2023) and, particularly in times of change, that business success depends on the focus on human

resources (Savović, 2017), the questions arise how to encourage them to achieve better results, i.e. be more successful, what motivates and drives them to work harder and be more satisfied, how to keep them in the organization, and what the leader's role in all this is. The literature indicates that psychological empowerment has significant positive effects on employee behavior and performance. In their work, A. Ergeneli, G. S. Ari and S. Metin (2007) present the results of previous research that explore how psychological empowerment contributes to increasing profits, reducing costs, greater customer satisfaction,

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increased loyalty to the organization, greater efficiency, effective problem solving, and problem prevention. Many factors contribute to the psychological empowerment of employees, trust in the leader being one of them (Ergeneli *et al*, 2007). Trust represents the fundamental basis of every leader–follower relationship as it enables open communication, cooperation, and the joint achievement of goals. The development of the leader–follower relationship is based on a realistic assessment of the role and abilities of both the leader and the followers, which constitutes a prerequisite for building mutual trust and support (Stojanović-Aleksić, 2016). According to F. X. Frei and A. Morriss (2020), trust is a critical form of capital for any leader. However, cultivating trust often demands a shift in how leadership is perceived. Leadership is not primarily about the leader themselves; it is rather about enabling and empowering others through their presence. Trust in the leader is considered a very important factor that contributes to a better and more pleasant climate and is one of the essential factors that contribute to a healthy work culture, which is in line with the results of a study conducted in the U.S. in 2023, involving a sample of 1,027 members of Generation Z (18 to 26 years of age), which revealed that Generation Z held clear beliefs about the key elements of a healthy work culture. One of the most critical factors identified was trust in leaders and coworkers (The Center for Generational Kinetics, 2023). Trust in leaders is related to the positive effects of leadership, and K. T. Dirks and D. L. Ferrin (2002) point out that a high level of trust in managers is strongly related to a high level of job satisfaction, job commitment and low intention to leave the organization.

The literature review shows that trust in leaders and psychological empowerment are broadly recognized as important topics in management and attract the attention of many researchers. However, in our business environment, as well as in developing countries in general, these topics have not been sufficiently explored, which motivated the conduct of the study presented in this paper. The constructs of trust in leaders, psychological empowerment, and leadership outcomes have previously been examined individually, and in relation to two of the

three mentioned concepts as well: trust in leaders and leadership outcomes (Gillespie & Mann, 2004; Henriques, 2015), trust in leaders and psychological empowerment (Ergeneli *et al*, 2007), and psychological empowerment and leadership outcomes (Kumar, Singh & Rangnekar, 2018; Ambad, Kalimin, Ag Damit & Andrew, 2021). However, what has not yet been done is the development of a research framework that integrates all the three constructs, thereby providing a deeper understanding of the role and importance of employee psychological empowerment as a mechanism that strengthens the relationship between trust in leaders and leadership outcomes. An additional value of this study lies in the fact that the research was carried out in Serbia, a developing country, where such studies are much less common compared to developed countries.

Based on the above-mentioned, the research aims to determine the relationship between trust in leaders and leadership outcomes, as well as the mediating role of psychological empowerment in this relationship. The sample consists of 351 employees from organizations operating in Serbia. The data were collected using an instrument composed of standardized questionnaires measuring trust in leaders (Podsakoff, MacKenzie, Moorman & Fetter, (1990), psychological empowerment (Spreitzer, 1995), and leadership outcomes (Krishnan, 2005). To test the model and the hypotheses, the Partial Least Squares Structural Equation Modeling (PLS-SEM) method was applied.

The paper is organized into five main sections. Following the introduction, the second section focuses on the theoretical framework, providing the explanations of the key concepts such as trust in leadership, psychological empowerment, and leadership outcomes, along with the review of prior research in the interrelationships among these concepts. The third section outlines the research methodology, describing the survey instrument used for data collection and the characteristics of the sample. The fourth section presents the findings of the study, accompanied by a discussion of the results. Lastly, the conclusion summarizes the key findings of the study, and theoretical and practical implications are discussed.

## LITERATURE REVIEW

*Trust in the leader* is a multidimensional construct characterized by the follower's positive belief or perception of the relationship with the leader (Karikumpu, Häggman-Laitila, Romppanen, Kangasniemi & Terkamo-Moisio, 2024). A shared element across many definitions of trust is the perception of the leader as an individual who earns the trust of their followers; the degree of trust a leader establishes is crucial in determining whether people will choose to follow or ignore them (Harper, 2017). According to J. L. Morrow, M. H. Hansen and A. W. Pearson (2004), trust is comprised of the two components: cognition-based trust and affect-based trust. Trust is cognitively driven, as individuals determine who to trust, in what contexts, and under which conditions. This decision is based on the cognitive evaluations of the empirical evidence of trustworthiness, including the factors such as competence, responsibility, reliability, and dependability (Costigan, Insinga, Berman, Ilter, Kranas & Kureshov 2006; Barton & Barton, 2011). Affective trust is built on emotional bonds, interpersonal interests, and support between individuals (Costigan, Ilter & Berman, 1998). P. M. Podsakoff *et al* (1990) conceptualized trust as faith in and loyalty to the leader. To measure these dimensions, six items were used. Three items assessed the followers' faith in their leaders' intentions, while the remaining three measured the followers' sense of loyalty and allegiance to their leaders. This approach was applied in the current study. There is a large amount of the research focused on trust in the leader that has proven that a higher degree of trust in the leader contributes to better outcomes. In their study, K. T. Dirks and D. L. Ferrin (2002) emphasized that trust in leadership was positively associated with job satisfaction, organizational commitment, organizational citizenship behavior, and job performance. According to D. Ivziku, V. Biagioli, R. Caruso, M. Lommi, A. De Benedictis, R. Gualandi and D. Tartaglini (2024), trust in leadership fosters greater organizational commitment, which in turn reduces the chances of employees considering leaving their current positions. K. T. Dirks and D. P. Skarlicki (2004)

emphasize that trust is a crucial element of effective leadership.

B. M. Bass and B. J. Avolio (1990) define leadership outcomes as a result of leader behavior. In this research, the authors considered the four leadership outcomes: perceived effectiveness, satisfaction with leaders, extra effort and intention to quit. According to M. Kotze and I. Venter (2011), effective leadership refers to how successful an individual in the leadership position is in motivating and encouraging employees to achieve better performance, both at an individual level and within the organization. Leadership effectiveness is greatly influenced by how followers perceive the leader and their leadership style (Yan & Hunt, 2005). Based on the above-mentioned, as a leadership outcome, perceived effectiveness can be explained by how followers perceive the leader in terms of achieving organizational goals and presenting their interests to higher hierarchical levels, and how effective their trust in the leader is (Bass & Avolio, 1997). As a leadership outcome, satisfaction with the leader refers to the extent to which employees or followers are satisfied with their leader's leadership style, including whether they apply adequate techniques and methods or not. As a leadership outcome, extra effort refers to whether the leader works to encourage their employees to do more than they initially thought possible or not, boosting their desire and self-confidence to work harder, perform better, and be more successful. As a leadership outcome, an additional effort can also be defined as the level of motivation that subordinates feel from their manager to exceed the expectations and achieve more than what was initially defined. Intention to quit can be defined as the degree to which an employee wishes to move out of his or her workplace (Lacap, 2020). The decision to leave an organization is influenced by many factors, one of the most significant being the leader's behavior, especially how employees perceive their leaders.

Psychological empowerment is one of the most broadly discussed concepts in the literature on contemporary management and leadership. However, despite its popularity, it remains a relatively underexplored topic, especially in the context of the

business environment. As defined by G. M. Spreitzer (1995), psychological empowerment is a motivational concept that represents an individual's proactive mindset and their perception of having the ability themselves to influence their own work role; it is characterized by the four key aspects: meaning, competence, self-determination, and the impact (Llorente-Alonso, García-Ael & Topa, 2024). Spreitzer's model of psychological empowerment in the workplace is one of the most broadly supported and consistently validated organizational empowerment frameworks in the literature. Therefore, it is this model that the authors base their presentation and analysis of the psychological empowerment variable. According to G. M. Spreitzer (1995), meaning is defined as a sense of commitment to job goals, competence refers to an individual's belief with respect to their ability to successfully and skillfully perform their tasks. Meaning refers to the value of the work goal evaluated in relation to an employee's personal ideals and standards. According to P. Y. Permarupan, A. A. Mamun, N. K. Samy, R. A. Saufi and N. Hayat (2020), meaning also facilitates the enhancement of employees' psychological connection with the organization. Competence refers to the degree of the skill demonstrated by an individual in a required task. Self-determination refers to the autonomy that an individual has to decide how they will perform their tasks and relates to the feeling of freedom and autonomy in performing work, whereas the impact indicates the intensity with which an individual feels that they can influence the place they works in and the work they perform. Psychological empowerment is associated with improved work performance (Rania, Rahmanb & Yusakc, 2021), job satisfaction (Mathew & Nair, 2022), commitment and innovative behavior (Sinha, Priyadarshi & Kumar, 2016), and organizational citizenship behavior (Saira, Mansoor & Ali, 2021). The results of previous studies also indicate that higher psychological empowerment reduces turnover intentions (Sinha *et al*, 2016; Islam, Khan & Bukhari, 2016; Kumar *et al*, 2018).

The research carried out so far has linked some of the mentioned variables from the presented research model, but there has been no research that has included all the three mentioned variables in a single

model. When speaking about the correlation between trust in the leader and psychological empowerment, A. Ergeneli *et al* (2007) conducted a study on a sample of 220 respondents from the banking sector in Ankara (Turkey), with the aim to determine the relationship between trust (cognition- and affect-based trust) in the leader and overall psychological empowerment (meaning, competence, self-determination and the impact). The results showed that there was a direct positive correlation between cognition-based trust and overall psychological empowerment, competence and the impact, but the connection with the self-determination aspect was not statistically significant. The authors relied on G. M. Spreitzer (1995) to explain that self-determination was an individual's sense of having a choice in initiating and regulating actions. Additional analysis showed that cognition-based trust had a positive relationship with meaning and competence, whereas affect-based trust was a strong predictor of the impact dimension (Ergeneli *et al*, 2007). When the relationship between trust in leaders and leadership outcomes is concerned, the most studied relationships are those between trust in leaders and intention to quit. However, connections with the other outcomes have been less investigated. The study that should be highlighted in this section is the research conducted in the project teams of a large public R&D organization in Australia. The data were gathered from a total of 33 teams across two divisions. The results of the study indicated that trust in the leader was strongly positively correlated with the team members' satisfaction with their leader, the perceived effectiveness of the leader, and the extra effort that the team members had invested in their work (Gillespie & Mann, 2004). The results of a study conducted on a sample of 496 employees from organizations operating in South Africa revealed a significant negative correlation between trust in leadership and intention to quit (Henriques, 2015). This finding suggests that, when employees lack trust in their leaders, they are more likely to contemplate leaving the organization, which is often due to concerns about the decisions leaders may make driven by the perceptions of a lack of integrity, fairness, honesty, or competence, which in turn leads employees to avoid potential risks associated with working under such leadership.

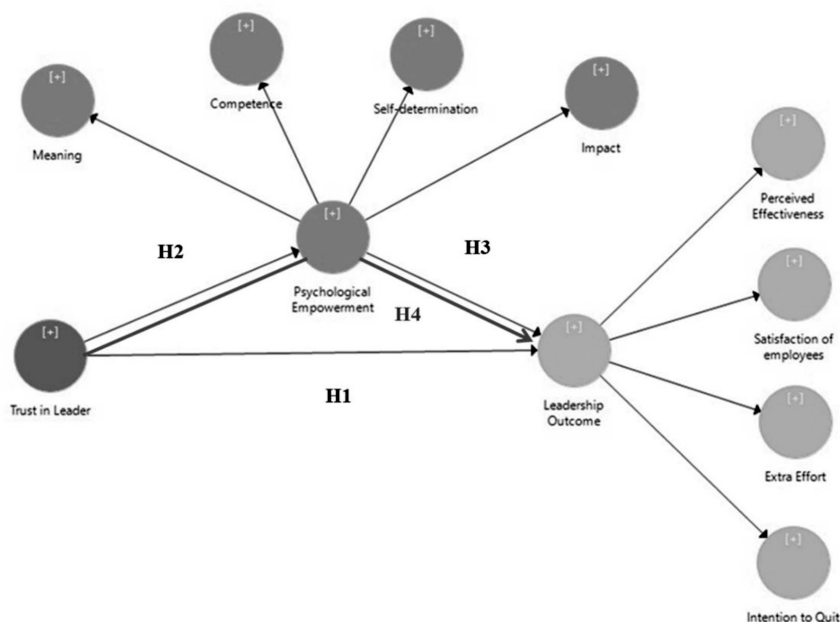
When the relationship between psychological empowerment and leadership outcomes is concerned, the relationship between psychological empowerment and intention to quit was most frequently the research subject, whereas the relationship between psychological empowerment and the other outcomes was less frequently studied. S. N. A. Ambad *et al* (2021) highlighted that empowered employees made an extra effort and creatively committed to their tasks, which generally resulted in improved job performance. The results of a study conducted on a sample of 315 respondents from the first four ranks of the Indian Air Force showed the presence of a direct negative correlation between psychological empowerment and intention to quit (Kumar *et al*, 2018). This finding aligns with the existing literature, which suggests that psychological empowerment can negatively influence the intention to leave a job. Specifically, high levels of perceived psychological empowerment can reduce the likelihood of seeking alternative employment, thereby decreasing intention to quit (Griffeth, Hom & Gaertner, 2000; Prati & Zani, 2015). The mediating role of psychological empowerment in the relationship

between trust in leaders and leadership outcomes has not been the research subject until now, which is also the key contribution of this research study.

Based on the theoretical framework and the results of previous research, the following hypotheses were set:

- H1: There is a positive relationship between trust in the leader and leadership outcomes.
- H2: There is positive relationship between trust in the leader and psychological empowerment.
- H3: There is a positive relationship between psychological empowerment and leadership outcomes.
- H4: Psychological empowerment mediates the relationship between trust in the leader and leadership outcomes.

Based on the previously outlined theoretical framework, the proposed research framework is presented in Figure 1.



**Figure 1** The research framework

# METHODOLOGY

## The questionnaire

The instrument used to conduct the research consists of the standardized questionnaires that measure the following research variables: trust in the leader, psychological empowerment and leadership outcomes. The questionnaire developed by P. M. Podsakoff *et al* (1990) was used to measure the trust in the leader variable, and consists of a total of six questions, including the statements such as: *I feel quite confident that my leader will always try to treat me fairly.* and *I feel a strong loyalty to my leader.* G. M. Spreitzer (1995) developed a questionnaire (which is also a standardized questionnaire) that was used in this research to measure the psychological empowerment variable. The questionnaire consists of a total of 12 questions related to the dimensions which psychological empowerment reflects through: meaning, competence, self-determination, and the impact. The statement: *The work I do is very important to me.* relates to meaning; the statement: *I am self-assured about my capabilities to perform my work activities.* relates to competence; the statement: *I can decide on my own how to go about doing my work.* relates to self-determination, and the statement: *I have a significant influence on what's happening in my department.* relates to the impact. The last part of the questionnaire refers to leadership outcomes, which are observed through the perceived effectiveness of the leader, employee satisfaction, extra effort and intention to quit. For this purpose, the questionnaire used by the author V. R. Krishnan (2005) was used in this research. Some of the questions used to measure leadership outcomes are as follows: *Compared to the other teams in your organization, how do you evaluate the effectiveness of your own team?* *All things considered, how satisfied are you with the leadership methods applied by your supervisor?* *My supervisor boosts my motivation to succeed.* *I often think about quitting my job.* A five-point Likert scale was used for all the statements. Details of the sample are presented in Table 1.

In addition to the above-mentioned, the instrument includes the questions related to the respondents' demographic characteristics (gender, age, the level of education) and the organizational characteristics (the organization size and sector).

**Table 1** The questionnaire details

| Variable                  | Number of statements | Original Source                     |
|---------------------------|----------------------|-------------------------------------|
| Trust in the leader       | 6                    | P. M. Podsakoff <i>et al</i> (1990) |
| Psychological empowerment | 12                   | G. M. Spreitzer (1995)              |
| Leadership outcomes       | 12                   | V. R. Krishnan (2005)               |

Source: Authors

## The sampling procedure and the sample

The data were collected using an online survey (*Google forms survey*) conducted during 2023. Participation in the study was on a voluntary basis, and the respondents' anonymity was assured. A total of 700 questionnaires were distributed to employees across various companies operating within the business environment of the Republic of Serbia. Of those, 360 responses were received, resulting in the response rate of 51.43%. After excluding incomplete or improperly filled-out surveys, the final sample consisted of 351 valid responses. The data analysis was conducted using the IBM SPSS and SMART PLS pieces of software. The descriptive statistics were obtained applying the IBM SPSS, whereas the partial least squares structural equation modeling (PLS-SEM) in SMART PLS was applied to test the model and the hypotheses. Based on the "10-times rule" (Hair, Ringle & Sarstedt, 2011), according to which the sample size should be at least 10 times the maximum number of the inner or outer model links pointing to any latent variable in the model (Goodhue, Lewis & Thompson, 2012), it can be concluded that the sample size is adequate for obtaining results and testing the validity of the model through the application of partial least squares structural equation modeling (PLS-SEM).

The detailed characteristics of the sample are given in Table 2.

**Table 2** The sample characteristics

|                   |                                                    | Number of the respondents | Percentage proportion (%) |
|-------------------|----------------------------------------------------|---------------------------|---------------------------|
|                   | Total respondents                                  | 351                       | 100                       |
| Gender            | Male                                               | 131                       | 37.3                      |
|                   | Female                                             | 220                       | 62.7                      |
| Age               | Under 25                                           | 95                        | 27.1                      |
|                   | 25-34                                              | 137                       | 39.0                      |
|                   | 35-44                                              | 61                        | 17.4                      |
|                   | 45-54                                              | 43                        | 12.3                      |
|                   | Over 55                                            | 15                        | 4.3                       |
| Education         | High school                                        | 92                        | 26.2                      |
|                   | Three-year vocational studies                      | 34                        | 9.7                       |
|                   | Bachelor's degree                                  | 132                       | 37.6                      |
|                   | Master's study                                     | 89                        | 25.4                      |
|                   | Master's degree (the Serbian equivalent: Magistar) | 2                         | 0.6                       |
|                   | Ph.D. study                                        | 2                         | 0.6                       |
| Organization size | Small                                              | 107                       | 30.48                     |
|                   | Medium                                             | 98                        | 27.9                      |
|                   | Large                                              | 146                       | 41.6                      |
| Sector            | Production                                         | 100                       | 28.49                     |
|                   | Services                                           | 251                       | 71.51                     |

Source: Authors

## RESULTS AND DISCUSSION

Model testing is the first step. Given that the model which the research is based on is reflective, it is necessary to define the reflective model testing criteria that include indicator reliability, where the loading for each indicator should be equal to or greater than 0.7; internal consistency, where the composite reliability of each construct should exceed 0.7; convergent validity, where the average variance extracted for each construct should be greater than 0.5; and discriminant validity, which can be tested using the cross-loadings approach, the Fornell-

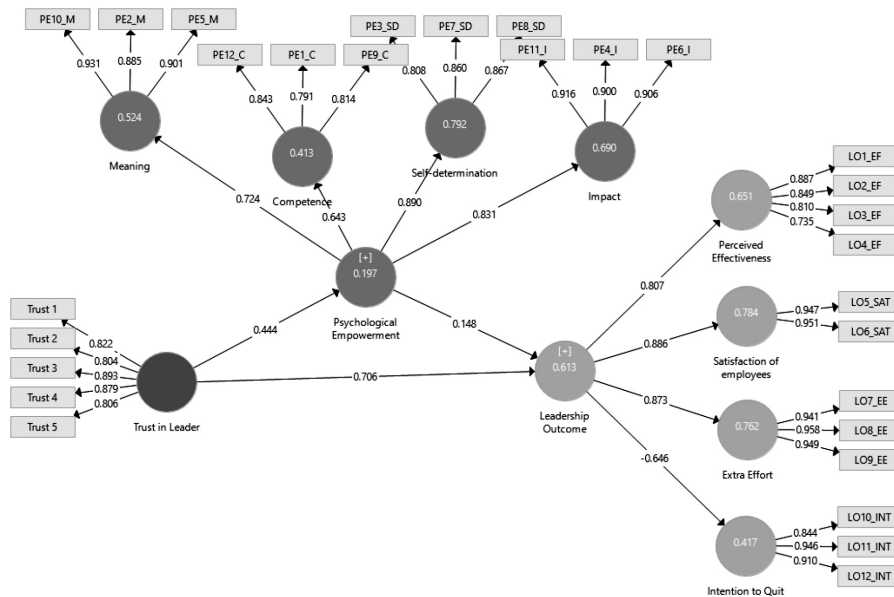
Larcker criterion, and the Heterotrait-Monotrait ratio (HTMT) (Hair *et al.*, 2011; Grubor & Milićević, 2019). Figure 2 presents the loadings for each indicator.

The indicators presented in Figure 2 have values ranging from 0.735 to 0.958, and all are above the acceptable threshold of 0.708 (Hair, Risher, Sarstedt & Ringle, 2019). One indicator, *Trust 6*, was excluded from the further analysis because its value fell below the acceptable threshold. Although J. Hair, T. C. Hult, C. Ringle and M. Sarstedt (2017) suggest that indicators with the values between 0.4 and 0.7 can be retained, provided they do not compromise the reliability of the measurement model, this was not the case in the current model. Specifically, the excluded indicator did not meet the required composite reliability (CR) or average variance extracted (AVE) values. Table 3 presents the results of the reliability test conducted by calculating Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE).

According to J. Hair *et al.* (2017), the lowest acceptable limit of Cronbach's Alpha is 0.7, whereas according to S. Dakduk, Á. González and A. Portalanza (2019), the threshold is 0.6. The values of Cronbach's  $\alpha$  range from 0.751 to 0.945. As shown, all Cronbach's  $\alpha$  values for the constructs exceed the acceptable threshold. The composite reliability values range from 0.857 to 0.965, with the acceptable lower threshold for composite reliability set at 0.7 (Hair *et al.*, 2017). As is shown in Table 3, these results confirm that the composite reliability criterion was met. Convergent validity was assessed based on the analysis of average variance extracted (AVE). The AVE values range from 0.666 to 0.901. Given that the minimum acceptable threshold for AVE is 0.5 (Hair *et al.*, 2017), it can be concluded that convergent validity is satisfied for all the constructs.

The next step implies the testing of discriminant validity. The authors tested discriminant validity using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio.

According to the Fornell-Larcker criterion, the square root of the average variance extracted (AVE) for each latent variable should be greater than the correlations between that latent variable and all the other latent



**Figure 2** The reliability of the indicators (the outer loadings)

Source: Authors

**Table 3** The reliability and validity of the constructs

|                         | Cronbach's Alpha | Composite reliability | Average variance extracted (AVE) |
|-------------------------|------------------|-----------------------|----------------------------------|
| Trust in leadership     | 0.896            | 0.924                 | 0.708                            |
| Meaning                 | 0.891            | 0.932                 | 0.821                            |
| Competence              | 0.751            | 0.857                 | 0.666                            |
| Self-determination      | 0.800            | 0.883                 | 0.715                            |
| Impact                  | 0.892            | 0.933                 | 0.823                            |
| Perceived effectiveness | 0.839            | 0.893                 | 0.676                            |
| Extra effort            | 0.945            | 0.965                 | 0.901                            |
| Employee satisfaction   | 0.890            | 0.948                 | 0.901                            |
| Intention to quit       | 0.883            | 0.928                 | 0.812                            |

Source: Authors

variables (Fornell & Larcker, 1981; Ahire, Golhar & Waller, 1996). As demonstrated in Table 4, the discriminant validity of the model is confirmed.

The HTMT ratio values below 0.9 suggest that the constructs are sufficiently distinct from one another, indicating that they represent different constructs (Hair *et al*, 2019). The results presented in Table 5 indicate that all the HTMT values are below 0.9, thereby confirming that the discriminant validity criterion was met.

The coefficient of determination (R-squared) for psychological empowerment as the dependent latent variable is 0.197, meaning that 19.7% of the variance in this variable is explained by trust in the leader as the independent latent variable. The coefficient of determination for leadership outcomes as the dependent latent variable is 0.61, indicating that 61% of the variance in leadership outcomes is explained by the direct effects of trust in the leader as the independent variable, and through the indirect effect mediated by psychological empowerment as well.

**Table 4** The discriminant validity of the model (the Fornell-Larcker criterion)

|                              | Competence | Extra effort | Impact | INT    | Meaning | EF    | SAT   | SD    | Trust in the leader |
|------------------------------|------------|--------------|--------|--------|---------|-------|-------|-------|---------------------|
| Competence                   | 0.816      |              |        |        |         |       |       |       |                     |
| Extra effort                 | 0.017      | 0.949        |        |        |         |       |       |       |                     |
| Impact                       | 0.358      | 0.286        | 0.907  |        |         |       |       |       |                     |
| Intention to quit (INT)      | -0.137     | -0.413       | -0.172 | 0.901  |         |       |       |       |                     |
| Meaning                      | 0.311      | 0.448        | 0.407  | -0.433 | 0.906   |       |       |       |                     |
| Perceived effectiveness (EF) | 0.265      | 0.554        | 0.360  | -0.356 | 0.370   | 0.822 |       |       |                     |
| Employee satisfaction (SAT)  | 0.073      | 0.763        | 0.322  | -0.454 | 0.377   | 0.642 | 0.949 |       |                     |
| Self-determination (SD)      | 0.528      | 0.284        | 0.714  | -0.271 | 0.489   | 0.348 | 0.272 | 0.845 |                     |
| Trust in the leader          | 0.140      | 0.734        | 0.366  | -0.405 | 0.455   | 0.541 | 0.787 | 0.357 | 0.841               |

Source: Authors

**Table 5** The discriminant validity of the model (Heterotrait-monotrait HTMT)

|                              | Competence | Extra effort | Impact | INT   | Meaning | EF    | SAT   | SD    | Trust in the leader |
|------------------------------|------------|--------------|--------|-------|---------|-------|-------|-------|---------------------|
| Competence                   |            |              |        |       |         |       |       |       |                     |
| Extra effort                 | 0.041      |              |        |       |         |       |       |       |                     |
| Impact                       | 0.425      | 0.312        |        |       |         |       |       |       |                     |
| Intention to quit (INT)      | 0.186      | 0.449        | 0.192  |       |         |       |       |       |                     |
| Meaning                      | 0.374      | 0.490        | 0.455  | 0.492 |         |       |       |       |                     |
| Perceived effectiveness (EF) | 0.338      | 0.609        | 0.417  | 0.413 | 0.423   |       |       |       |                     |
| Employee satisfaction (SAT)  | 0.090      | 0.832        | 0.362  | 0.510 | 0.425   | 0.729 |       |       |                     |
| Self-determination (SD)      | 0.675      | 0.328        | 0.846  | 0.326 | 0.575   | 0.431 | 0.324 |       |                     |
| Trust in the leader          | 0.177      | 0.794        | 0.409  | 0.449 | 0.510   | 0.609 | 0.879 | 0.423 |                     |

Source: Authors

The results given Table 6 show that there is a statistically significant positive correlation between trust in the leader and leadership outcomes ( $\beta = 0.772$ ,  $t = 31.836$ ,  $p = 0.000$ ), then between trust in the leader and psychological empowerment ( $\beta = 0.444$ ,  $t = 9.947$ ,  $p = 0.000$ ), and between psychological empowerment and leadership outcomes ( $\beta = 0.147$ ,  $t = 3.076$ ,  $p = 0.002$ ).

The presented results show that a higher degree of trust

in the leader encourages better leadership outcomes, which reflects in a higher degree of the perceived effectiveness of the leader by the employees, then in a higher degree of employee satisfaction, the additional effort that the employee invests in performing their tasks and in the presence of lower intention to leave organizations (H1), which is consistent with previous research (Gillespie & Mann, 2004; Henriques, 2015).

**Table 6** The results of the bootstrapping analysis (the direct and indirect effects)

|                                                                         | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | t-statistics ( O/STDEV ) | p-values | Hypotheses |
|-------------------------------------------------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|------------|
| Trust in the leader -> Leadership outcomes                              | 0.772               | 0.775           | 0.024                      | 31.836                   | 0.000    | ✓          |
| Trust in the leader -> Psychological empowerment                        | 0.444               | 0.446           | 0.045                      | 9.947                    | 0.000    | ✓          |
| Psychological empowerment -> Leadership outcomes                        | 0.147               | 0.150           | 0.048                      | 3.076                    | 0.002    | ✓          |
| Trust in the leader -> psychological empowerment -> Leadership outcomes | 0.065               | 0.067           | 0.023                      | 2.881                    | 0.004    | ✓          |

Source: Authors

The results suggest that, when employees trust their leaders, they are more likely to feel secure and valued, which in turn motivates them to put in extra effort at work. Trust also leads to higher perceptions of leader effectiveness as employees view the leaders who act with integrity, fairness, and competence as making well-informed decisions aligned with organizational goals. This positive cycle reinforces employees' belief in their leaders' ability to guide the team towards achieving success. Furthermore, trust fosters a sense of respect and support, which enhances satisfaction with leaders. Conversely, when trust is low, employees may experience uncertainty about their future within the organization, increasing turnover intentions. In contrast, high trust in leadership creates a stable work environment, where employees feel more secure, aligned with organizational goals, and less likely to seek alternative employment. Trust in leadership, therefore, plays a crucial role in reducing turnover intentions and fostering greater organizational commitment.

Then, psychological empowerment increases as employees' trust in their leaders increases (H2), which is consistent with the findings of the study conducted by Ergeneli *et al* (2007). Trust in leaders helps overcome the traditional perceptions of authority, which have often limited employees' sense of empowerment in an organizational context. The last direct link that has been proven is the link between psychological empowerment and leadership outcomes (H3), which indicates that, if employees are psychologically empowered, they will perceive

their leaders as more effective, then they will be more satisfied, they will invest extra effort to perform better and their intentions to leave the organization will be reduced. This is partially consistent with the findings of previous studies (Kumar *et al*, 2018; Ambad *et al*, 2021). It follows from the above-mentioned that the first three hypotheses (H1, H2 and H3) are confirmed.

In addition to the direct relationships between the mentioned variables, their indirect relationship was also examined, more precisely the mediating role of psychological empowerment in the relationship between trust in the leader and leadership outcomes. The obtained results presented in Table 6 indicate that there is a statistically significant indirect correlation between trust in the leader and leadership outcomes through psychological empowerment ( $\beta = 0.065$ ,  $t = 2.881$ ,  $p = 0.004$ ). Psychological empowerment mediates the relationship between trust in leadership and the key leadership outcomes by influencing employees' perceptions, attitudes, and behaviors. Trust in leaders creates a supportive environment where empowerment can flourish, leading to higher levels of an extra effort, greater satisfaction with leadership, enhanced perceptions of leader effectiveness, and reduced turnover intentions. Understanding this mediating role highlights the importance of building trust in leadership as a means of fostering an empowered workforce, which in turn drives better organizational outcomes.

## CONCLUSION

Managers must be aware of the fact that trust is hard to build and easy to break. Therefore, in addition to creating a climate of trust within the organization, maintaining it is even more critical. Furthermore, the trust that managers build with employees, as well as the trust employees have in them, can significantly contribute to employees feeling better and being psychologically empowered, which in turn leads to better outcomes, as demonstrated in this study. Additionally, managers must recognize that the process of implementing empowerment is gradual and will yield positive results in the medium run and in the long run. It is truly worthwhile to invest effort into fostering such an environment.

The theoretical implication is that the mediating role of psychological empowerment has not been thoroughly examined in previous research. This study, therefore, addresses the gap in the existing literature by exploring how psychological empowerment mediates the relationship between trust in leadership and the key leadership outcomes, including perceived effectiveness, employee satisfaction, an extra effort, and turnover intention. The proposed theoretical model requires further exploration across different research and cultural contexts. Additionally, future research could investigate the relationship between various leadership styles, such as transformational, authentic, and inclusive leadership, and trust in leaders, as well as their impact on psychological empowerment and leadership outcomes.

The practical implication refers to pointing out and raising the awareness of the importance of gaining and fostering trust between employees and leaders, as well as proposing concrete measures so that leaders could encourage psychological empowerment. In different types of training courses, leaders could be taught how to improve their communication skills, how to openly share information with their employees, develop empathy and strengthen interpersonal relationships, which creates conditions for creating and nurturing a climate of trust. On the other hand, training courses and programs could be designed so that leaders first learn and then

apply different strategies for encouraging employee psychological empowerment. Based on the paper by M. Oliveira *et al* (2023), the following suggestions were made for the ways to increase employee psychological empowerment. For the *meaning* dimension, it is important to add a value proposition when assigning new tasks. This approach ensures that employees understand the purpose and significance of their work, aligning individual tasks with personal growth and organizational goals. Additionally, taking more time to engage with employees with respect to work/life balance can help reinforce the connection between their roles and broader life satisfaction, further enhancing the sense of meaning in their work. In relation to the *competence* dimension, organizations should offer continual education and training programs to help employees develop and refine their skills. By fostering opportunities for professional growth, organizations can enhance employees' belief in their ability to perform tasks effectively and with confidence. Moreover, encouraging peer learning and engagement practices supports a collaborative environment, where employees can share expertise, build new competences, and increase their collective knowledge. To encourage *self-determination*, it is essential to maintain the strategies that support autonomy and empowerment. This involves providing a clear value proposition when assigning new tasks, helping employees recognize the significance and impact of their contributions. Finally, for the *impact* dimension, organizations should publish comparative data about best practice standards to demonstrate how employees' work contributes to organizational success. This transparency can help individuals understand the broader effect of their contributions. Additionally, regularly monitoring and reviewing performance outcomes can highlight the impact of individual efforts, providing recognition and reinforcing the importance of each employee's role within the organization.

The limitation of this study lies in the sample size, and from this perspective, the authors believe that it affects the ability to generalize the results and conclusions of the research. Therefore, it will be necessary to expand the sample in the next cycle of the study. In addition, one possible limitation relates

to the perceptual nature of measuring leadership outcomes, as the results are based on the respondents' subjective assessments rather than on the objective indicators of leadership outcomes. To address this limitation, future studies should incorporate objective measures of leadership outcomes. However, despite these limitations, given the detailed statistical analysis of the collected data and the thorough testing of the validity of the questionnaire, the results provide a good starting point for more extensive research using this new combination of constructs in one model.

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of the manuscripts submitted to the Editorial Board of the Journal in 2025

On behalf of the Editorial Board of the scientific journal *Economic Horizons*, and on my own behalf, I would like to express my sincere appreciation to the reviewers whose professional, impartial, and well-reasoned evaluations made a significant contribution to the assessment of manuscripts submitted to the Journal during 2025.

The manuscripts encompass research in the fields of economics, business economics, management, and related academic disciplines. Through their expertise and critical approach, the reviewers listed herein provided invaluable support to the Editorial Board in conducting the double-blind peer review process, thereby contributing to the maintenance and enhancement of the Journal's overall scholarly quality.

The editorial policy of *Economic Horizons* is firmly committed to the continuous improvement of the quality of published papers, a commitment that relies to a great extent on the expertise and dedication of its reviewers. Their well-substantiated evaluations and constructive comments constituted an important basis for editorial decisions regarding the acceptance of manuscripts for publication and their categorization. At the same time, their specific suggestions and insightful recommendations enabled authors to further improve the quality of their manuscripts, thereby making a substantial contribution to the continued development and strengthening of the Journal's academic reputation.

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**Introduction:** Manuscripts submitted to the Editor-in-Chief of the journal should be original, unpublished, and they must not be in the review process by any other journal. Manuscripts should be written in the standard grammatical and stylistic **Serbian and English**, i.e. only in **English**, for the authors whose native language is not **Serbian**. Authors are advised to comply strictly with these journal requirements. All manuscripts are subjected to double-blind review process.

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