DOI: 10.55643/fcaptp.1.54.2024.4304

ASSESSMENT OF THE CONNECTION BETWEEN THE BANK'S CAPITALIZATION LEVEL AND THE COUNTRY'S MACROECONOMIC STABILITY

Iryna Pozovna
PhD in Economics, Senior Lecturer, Sumy State University, Sumy, Ukraine;
ORCID: 0000-0003-1934-7031

Natalia Arkhireiska
PhD in Economics, Associate Professor of the Department of Banking and Financial Services, University of Customs and Finance, Dnipro, Ukraine;
ORCID: 0000-0001-9867-6655

Iryna Panaseyko
PhD in Economics, Associate Professor of the Department of Finance, Banking and Insurance, University of Customs and Finance, Dnipro, Ukraine;
ORCID: 0000-0002-2815-6643

Serhiy Panaseyko
PhD in Economics, Associate Professor, Head of the Internal Audit Department, "ALAN" LLC, Dnipro, Ukraine;
ORCID: 0009-0004-6949-6355

Kostyantyn Serdyukov
D.Sc. in Economics, Professor of the Department of International Economic Relations and Regional Studies, University of Customs and Finance, Dnipro, Ukraine;
ORCID: 0000-0002-3834-8761

Alina Yefimenko
PhD Student of the Department of Economic Cybernetics, Sumy State University, Sumy, Ukraine;
e-mail: a.yefimenko@uabs.sumdu.edu.ua
ORCID: 0000-0002-2810-0965
(Corresponding author)

Received: 08/01/2024
Accepted: 05/02/2024
Published: 29/02/2024

ABSTRACT

A well-capitalized banking system is crucial for maintaining macroeconomic stability, preventing financial crises, and bolstering the economy's resilience to shocks. Governments often strive to ensure adequate bank capitalization to foster stable economic growth. This article aims to assess the relationship between bank capitalization and macroeconomic stability in 34 European countries from 2010 to 2021, based on World Bank statistics.

The study utilizes the principal components method to identify relevant indicators of bank capitalization and macroeconomic stability, canonical analysis and regression analyses to detail the interconnections between these blocks. The canonical analysis confirms a link between bank capitalization and macroeconomic stability indicators with a coefficient of determination of 0.617 signifying that 61.8% of the variance in macroeconomic stability is explained by fluctuations in bank capitalization.

The article presents one fixed-effect and two random-effect regression models detailing the directions and strength of influence of independent variables (NPL, ROA, ROE - indicators of the bank capitalization level) on dependent variables (INFLATION, UNEMPL, GINI - indicators of macroeconomic stability). The Wald criteria and a p-value less than 0.05 indicated that the models with random effects (UNEMPL, GINI) were statistically significant.

The results reveal that a 1% increase in non-performing loans correlates with a 0.25% rise in the unemployment rate, and a 1% increase in return on assets leads to a 0.08% increase in the unemployment rate. Additionally, a 1% increase in non-performing loans raises the Gini index by 0.05%, while a 1% increase in return on equity decreases the Gini index by 0.03%. Notably, the impact of return on assets on the unemployment rate and the Gini coefficient is not statistically significant (p-value greater than 0.05).

These results can inform the forecasting of national indicators, the development of tools to ensure sufficient bank capitalization, and the formulation of effective macroeconomic policies, taking into account fluctuations in banks' capitalization levels as key financial intermediaries.

Keywords: apitalization, bank, macroeconomic stability, inflation rate, return on equity, canonical analysis, panel regression

JEL Classification: E44, G21, G32

INTRODUCTION

A crucial task for banks is to ensure their financial stability, achieved by maintaining an adequate level of capitalization. Bank capitalization is the proportion of capital held by banks as a percentage of their total assets. Capital serves as a buffer, absorbing losses and thereby reducing the risk of insolvency during financial stress. Consequently, the relationship between the bank capitalization level and macroeconomic stability is complex and multifaceted.

Inadequate capital can trigger a downward spiral where bank failures erode confidence, limit credit availability, decrease economic activity, and elevate unemployment. Con-

versely, a well-capitalized bank can mitigate systemic risk by absorbing losses and maintaining confidence in the financial system. It's noteworthy that well-capitalized banks possess a greater capacity to extend loans to businesses and households, stimulating economic growth by facilitating easier access to credit services.

As of the end of 2020, the average ratio of regulatory capital to risk-weighted assets in 107 countries was 19.63%. Notably high values were observed in Maldives (46.35%), Moldova (27.07%), Latvia (26.82%), Estonia (26.53%), and Ireland (25.47%). Conversely, lower values were noted in Chad (5.97%), Cameroon (11.23%), and Bangladesh (11.64%). Since the beginning of 2021, this indicator has been declining due to global economic adaptations to the COVID-19 pandemic and Russia's full-scale invasion of Ukraine in early 2022.

In 2022, the capital adequacy ratio of the International Bank for Reconstruction and Development, the largest lender of development projects worldwide, was 22.0%, a 0.6% decrease from 2021. This decline is attributed to increased overall risks compared to the rise in available capital (World Bank, 2022). Given the predominance of European countries in regulatory capital adequacy, the analysis focuses on data from 34 European countries with varying levels of socioeconomic development.

Thus, studying the relationship between bank capitalization and macroeconomic stability is relevant and holds significant practical importance.

LITERATURE REVIEW

The scientific literature actively explores not only individual aspects of the "bank capitalization level - macroeconomic stability" relationship but also their interconnectedness.

Researchers such as Rusmanto et al. (2020), Gambacorta & Shin (2018), and Buriak et al. (2015) have delved into the level of capitalization of the banking sector, defining it as a guarantee of bank sustainability during financial crises. Patel et al. (2023) characterize the level of capitalization as a tool for mitigating financial risks in developed countries, while Shair et al. (2019) regard it as the foundation of institutional performance. Kryklii & Jayasundera (2023) conducted studies assessing approaches to managing liquidity, non-performing loans, and bank profitability. Tam Phan Thanh (2023) examined the level of capitalization through the lens of ensuring a sufficient level of equity capital, measured by the minimum ratio that safeguards risky assets. In contrast, Conti & Signoretti (2023) presented new estimates of the impact of shocks on bank capital requirements. Habiba (2023) views the Basel Accords as regulatory instruments ensuring bank performance. Kuznichenko et al. (2018), and Lutsyk et al. (2022) considered methodological approaches to assessing the market risk of banks (in particular, SA, IMA, and R-SbM approaches) recommended by the Basel Committee on Banking Supervision in terms of standardization and unification of the regulatory framework for capital requirements for Ukrainian banks. In the area of monetary policy, Calmfors (2015), Kuznyetsova et al. (2020), The Economist (2022) identified the following effective tools: the introduction of inflation targeting and greater independence for the central bank. IMF (2016) described a resilient banking system with low levels and high capital ratios.

Macroeconomic stability has been considered by various entities. The United Nations (2022) viewed it through the prism of the state's ability to ensure the protection and defence of its citizens, and Madhuri Thakur (2020) considered human resource management through the prism of human resource management. Banca D'Italia (2022) recognised the following indicators of macroeconomic stability: household consumption, consumer prices, employment and unemployment rates, and others. The Bank of England (2022) equated "financial security" and "financial stability" as the ability of the financial system to fully and efficiently perform its functions: accumulation, distribution, and redistribution of funds. Oliynyk et al. (2017) viewed the insurance sector as a key element of the financial system. The World Bank (2022) identified it with financial stability, characterized by the absence of system-wide episodes of crisis shocks. Oe et al. (2022) emphasized that focusing on innovation, sustainability, and leadership is key to supporting businesses in the post-COVID-19 crisis environment. Loucanova & Olsiakova (2022), focused on comparing the use of innovative and digital technologies in banking, and Hakobyan et al. (2022) noted social interaction between banks and businesses.

Examining the relationship between the banking system and the real sector, Olajide et al. (2023) explored the interaction of exchange rates, interest rates, and economic development indicators in Nigeria. Khan et al. (2011) identified the main determinants of bank profitability, taking into account bank-specific variables in Pakistan. Swiety et al. (2023) and Kuznyetsova et al. (2020) identified an approach to assessing the relationship between bank resilience indicators, including capital adequacy ratio, going concern ratio, NPL ratio, and liquidity coverage ratio, and macroeconomic stability indicators, such as GDP growth, GDP growth rate, interest rates, and unemployment rate. Neogi and Behera (2020), and Blankson et al. (2022) studied the role of regulatory bank capital in influencing credit flows and GDP growth. Vasylyeva et al. (2014)

DOI: 10.55643/fcaptp.1.54.2024.4304

scrutinized more detailed interrelationships between the level of capitalization of the banking system and the macroeconomic stability of the state through the study of the countercyclical capital buffer as a macroprudential tool for regulating the banking sector, and Le et al. 2023 noted that the macroeconomic outlook affects bank performance. Simon (2021) defined the impact of capital requirements as a trade-off between financial intermediation and financial stability in a macroeconomic model. In contrast, Pozo (2023) notes that the stricter the fixed leverage requirements, the better banks are able to cope with a financial crisis, which reduces long-term consumption and welfare. FIN-FSA (2019) states that the regulatory framework aims to improve banks' risk-bearing capacity by strengthening their solvency and liquidity, as well as their risk management. In contrast, Feinstein and Hałaj (2023) examined the impact of external shocks on bank capitalization. Messaoudi et al. (2023) studied the impact of public administration on the independence of banks, Bilan et al. (2019) considered the synchronization of the financial, business, and trust cycles, and Stolz and Wedow (2011) found that undercapitalised banks do not reduce risk-weighted assets during business cycle downturns. Aryati et al. (2023) noted that macroeconomic stability can be improved by increasing capital inflows and investment in profitable sectors.

AIMS AND OBJECTIVES

Well-capitalized banks can more effectively withstand economic shocks, thereby decreasing the risk of financial crises and promoting overall economic stability. Accordingly, this paper aims to assess the relationship between bank capitalization level and a country's macroeconomic stability, utilizing a sample of 34 European countries for canonical and regression analyses. Beyond this overarching aim, the study encompasses a set of specific objectives:

- Identification of macroeconomic stability indicators and bank capitalization;
- Conducting canonical modelling to explore the interaction between a bank`s capitalization level and macroeconomic stability. An essential aim of this research task is to examine and unveil the intricate interrelationships between these components;
- Conducting regression modelling to analyze the functional relationships of the bank capitalization impact on the country's macroeconomic stability.

This research article seeks not only to evaluate the relationship between the level of bank capitalization and the country's macroeconomic stability but also to contribute to a broader understanding of how capitalization and economic development intersect.

METHODS

In the first stage of the research, we compile an array of input data, which includes statistical annual reports on banking activities and macroeconomic stability. The selected countries for analysis encompass Austria, Albania, Bulgaria, Belgium, Estonia, France, Finland, Germany, Iceland, Ireland, Cyprus, Czech Republic, Croatia, Denmark, Latvia, Italy, Lithuania, Malta, Luxembourg, the Netherlands, Moldova, Poland, Norway, Romania, Slovakia, Portugal, Spain, Serbia, Slovenia, Switzerland, United Kingdom, Sweden, and Ukraine for the years 2010-2021. The indicators for analysis are sourced from the World Bank databases (Table 1).

Table 1. Input indicators for assessing the relationship between bank capitalization level and macroeconomic stability. (*Source: author's development based on World Bank, 2022; Didenko and Yefimenko, 2023)*

Bank capitalization level		**Macroeconomic stability indicators**	
Indicator	**Designation**	**Indicator**	**Designation**
Return on assets	ROA	Gross domestic product volume	GDP
Return on equity	ROE	Inflation rate	$INFLATION$
Non – performing loans level	NPL	Unemployment rate	$UNEMPL$
Capital to assets ratio	$BCAR$	Gini index	$GINI$
Bank branches number	CBB	Gross national income growth rate	GNI
The ratio of regulatory capital to risk – weighted assets	BRC		
Cost to income rate	CIR		
Depth of financial services penetration	$BDtGDP$		

The 'Bank Capitalization Level' block comprises indicators directly influencing the bank's capitalization level, such as the assets-to-capital ratio, the regulatory capital-to-risk-weighted assets ratio, and the return on equity ratio. Additionally, it includes other indicators indirectly impacting the formation of sufficient capitalization.

The 'Macroeconomic Stability' block encompasses indicators characterizing economic growth ($GDP, GNI, GINI$), employment ($UNEMPL$), and price levels ($INFLATION$) as the main indicators of the country's economic stability.

In the second stage, we conduct standard normalization of the input data, considering the average value of the indicator and the standard deviation.

The third step involves the identification of statistically significant indicators using factor analysis in Statistica. This analysis, utilizing the principal component method, allows for the extraction of factors equal to the number of variables, where each factor corresponds to the explained variance.

Subsequently, we perform canonical analysis to assess the relationship between the bank's capitalization level and the country's economic stability. Canonical correlation is commonly used to examine commonalities between two sets of variables in an experimental context. The primary objective of the canonical analysis is to find the maximum correlation between a group of capitalization indicators and a group of macroeconomic stability indicators. Key elements of the canonical analysis include the formation of canonical variables as weighted sums of the original variables in two groups.

Eigenvalues in the canonical analysis represent values of the correlation matrix, indicating the proportion of the variance explained by the correlation between the respective canonical variables. These values are calculated in descending order of magnitude. Canonical correlations (canonical roots) are correlation coefficients between canonical variables, calculated as the square root of their values. The number of canonical roots is equal to the number of variables in the smallest set.

Canonical weights are coefficients in the weighted sum corresponding to the canonical root. These weights are determined for standardized variables. Canonical values represent the values of the canonical variables, which are weighted sums of the values of the original variables.

For this study, the canonical function (1) was used:

$$\text{У} = f\ (x), \tag{1}$$

where x - the canonical variables for capitalisation; Y - canonical variables to characterise a country's macroeconomic stability indicators.

Formula 2 illustrates the canonical function based on the selected relevant indicators of the banks' capitalization level.

$$X = a_0 + a_1x_1 + a_2x_2 + a_3x_3 \tag{2}$$

where x_1 - $non-performing\ loans\ level, \%\ (NPL)$; x_2 - $return\ on\ assets, \%\ (ROA)$; x_3 - $return\ on\ equity, \%\ (ROE)$.

Formula 3 shows the canonical function based on the selected relevant indicators of the country's macroeconomic stability.

$$y = b_0 + b_1y_1 + b_2y_2 + b_3y_3, \tag{3}$$

y_1 - $inflation\ rate, \%\ (INFLATION)$;

y_2 - $unemployment\ rate, \%\ (UNEMPL)$;

y_3 - $GINI\ index\ (GINI)$.

The final stage involves constructing a panel regression is a crucial statistical method of data analysis facilitated using StataSE 18 software. Panel data is a two-dimensional array, where one dimension is 'spatial' (1 < i < N) and the other is 'temporal' (1 < t < T). Thus, panel data is characterized by two indices (i, t), resulting from observing the indicators of capitalization and macroeconomic stability from 2010 to 2021 in 34 European countries with varying levels of socio-economic development.

Panel data sets combine spatial samples and time-series data, offering both cross-sectional and time-series perspectives for each moment in time and each object in the sample population, respectively. Two types of models are employed: regressions with fixed individual effects and models with random individual effects.

DOI: 10.55643/fcaptp.1.54.2024.4304

A fixed-effects model is a straightforward linear regression model where the intercepts vary by economic unit i. Panel data, compared to a single time series or a single-moment sample, allows for the consideration and analysis of individual differences among sample units and explains why a specific sample unit behaves differently in different time periods. Additionally, panel data are characterized by a large number of observations, increasing the degrees of freedom and reducing multicollinearity, enabling more efficient estimates.

During the panel regression construction, it is essential to perform special statistical tests (Hausman, Breusch-Pagan) to identify the best type of model (fixed or random effects). The Hausman test assesses the hypothesis that the best model is a random effects model rather than a fixed effects model, essentially testing whether unique errors (ui) are correlated with the regressors. The null hypothesis is that they are not correlated.

Random effects are also tested by estimating the Lagrange Breusch-Pagan (LM) multiplier, assisting in choosing between random effects regression and simple regression. The null hypothesis in the LM test posits that the variances between the objects are zero, indicating no significant difference between units (i.e., no panel effect).

In general, the regression model for panel data takes the following form (Formula 4):

$$Uit = ß1\ Xit + ... + ßk\ Xkt + eit, \quad (4)$$

where Uit - the value of the variable along the regression line, ßk - the angular regression coefficient, eit - a free term in the equation.

The next step in the research involves examining panel regression equations with the dependent variables: $inflation\ rate\ (INFLATION)$ (Formula 5), $unemployment\ rate\ (UNEMPL)$ (Formula 6), and Gini index (GINI) (Formula 7). The independent variables include $non-performing\ loan\ level\ (NPL)$, $return\ on\ assets\ ratio\ (ROA)$, and $return\ on\ equity\ (ROE)$.

$$INFLATION = ß1*NPL + ß2*ROA + ß3*ROE + uit, \quad (5)$$

$$UNEMPL = ß1*NPL + ß2*ROA + ß3*ROE + uit, \quad (6)$$

$$GINI = ß1*NPL + ß2*ROA + ß3*ROE + uit, \quad (7)$$

where ßk - the angular regression coefficient, uit - the free term of the equation.

The quality criteria for the constructed regression model include the F-criterion, t-criterion, and p-value. An F-value below 0.05 suggests the model's adequacy. In this context, confirming the hypothesis of a relationship between the dependent variable ($INFLATION, UNEMPL, GINI$) and the independent variables (NPL, ROA, ROE).

P-values assess the hypothesis that each coefficient is different from 0. To reject this hypothesis, the p-value should be less than 0.05, indicating the significance level of the factor attribute.

T-values evaluate the hypothesis that each coefficient differs from 0. Rejecting this hypothesis requires a t-value exceeding 1.96 (for a 95% confidence level). If met, we can assert that the variable significantly influences the dependent variable (y), with higher t-values indicating greater variable relevance.

In conclusion, these methods provide a comprehensive assessment of the relationship between the level of bank capitalization and macroeconomic stability based on annual data from 34 European countries.

RESULTS

After normalizing the indicators of banks` capitalization level, identify the ones that exert the most significant impact. The principal components method is employed for this purpose. Table 2 shows the results of selecting the main indicators of bank capitalization.

Table 2. Eigenvalues and total variance share for the factors formed by the banks' capitalization level indicators.

Factors		Eigenvalues	% of total variance (TV)	Cumulative % of TV
Factor 1		2,366	29,581	29,581
Factor 2		1,522	19,028	70,419

Referring to Table 1, the cumulative percentage of the total variance explained by the factors is 70.419%. At the same time, the first factor accounts for 29.58% of the total variance, and the second factor explains 19.02%. This implies that the variables within the first factor (ROA, ROE) exert a more pronounced impact on the level of banks' capitalization. Both factors exhibit eigenvalues exceeding one. The next step involves identifying the factor loadings (Table 3).

Table 3. Results of the principal components method.

Indicator	Factor 1	Factor 2
$BCAR$	-0.485	0.381
NPL	-0.143	-0.749
CBB	0.428	-0.469
$BDtGDP$	0.377	0.692
ROA	0.794	0.318
BRC	-0.585	-0.080
ROE	0.740	0.397
CIR	0.463	0.076
TV	2.337	1.519
Percentage of total	0.292	0.189

The first factor includes indicators with a more pronounced impact on the bank`s capitalization level. As seen in the second column (Table 3), cells with statistically significant factor loadings for variables within the first factor are shaded in grey. Notable indicators in this regard include ROA (0.794) and ROE (0.740). In the second selected factor, the NPL indicator shows a statistically significant impact, as indicated by the obtained factor loading value of -0.749. It is noteworthy that all the mentioned indicators have absolute factor loadings exceeding 0.7. Thus, these indicators of bank capitalization level hold significance and are suitable for canonical analysis and constructing panel regression models.

The subsequent step involves identifying statistically significant macroeconomic stability indicators. The results of the factor analysis are presented in Table 4.

Table 4. Results of the principal components method using.

Indicator	Factor 1	Factor 2
GDP	-0.491	0.660
INFLATION	0.755	0.017
UNEMPL	-0.808	-0.074
GINI	-0.448	-0.743
GNI	0.244	-0.333
Total variance	1.726	1.105
Percentage of total	0.345	0.221

The variables found to be statistically significant are INFLATION (0.755), UNEMPL (-0.808), and GINI (-0.743). Therefore, these indicators of a country`s macroeconomic stability are deemed significant and suitable for use in canonical analysis and panel regression.

The next step involves conducting a canonical analysis to explore the relationship between the level of bank capitalization and the country`s macroeconomic stability. Firstly, it is imperative to examine the correlation matrix (Table 5).

DOI: 10.55643/fcaptp.1.54.2024.4304

Table 5. Correlation matrix between bank capitalization ratios and country`s macroeconomic stability.

Index	INFLATION	UNEMPL	GINI	NPL	ROA	ROE
INFLATION	1.000	-0.416	-0.191	0.181	0.013	-0.005
UNEMPL	-0.416	1.000	0.273	-0.206	-0.168	-0.170
GINI	-0.191	0.273	1.000	0.093	-0.132	-0.191
NPL	0.181	-0.206	0.093	1.000	-0.149	-0.247
ROA	0.013	-0.168	-0.132	-0.149	1.000	0.685
ROE	-0.05	-0.170	-0.191	-0.247	0.685	1.000

Thus, a weak inverse relationship exists between the inflation rate (INFLATION) and the unemployment rate (UNEMPL), with a correlation coefficient of -0.416. In other words, as the inflation rate increases, the unemployment rate decreases. Additionally, there is a moderate direct correlation of 0.685 between return on assets (ROA) and return on equity (ROE). These correlations are visually depicted in Figure 1, illustrating the relationships between the bank's capitalization and the country`s macroeconomic indicators.

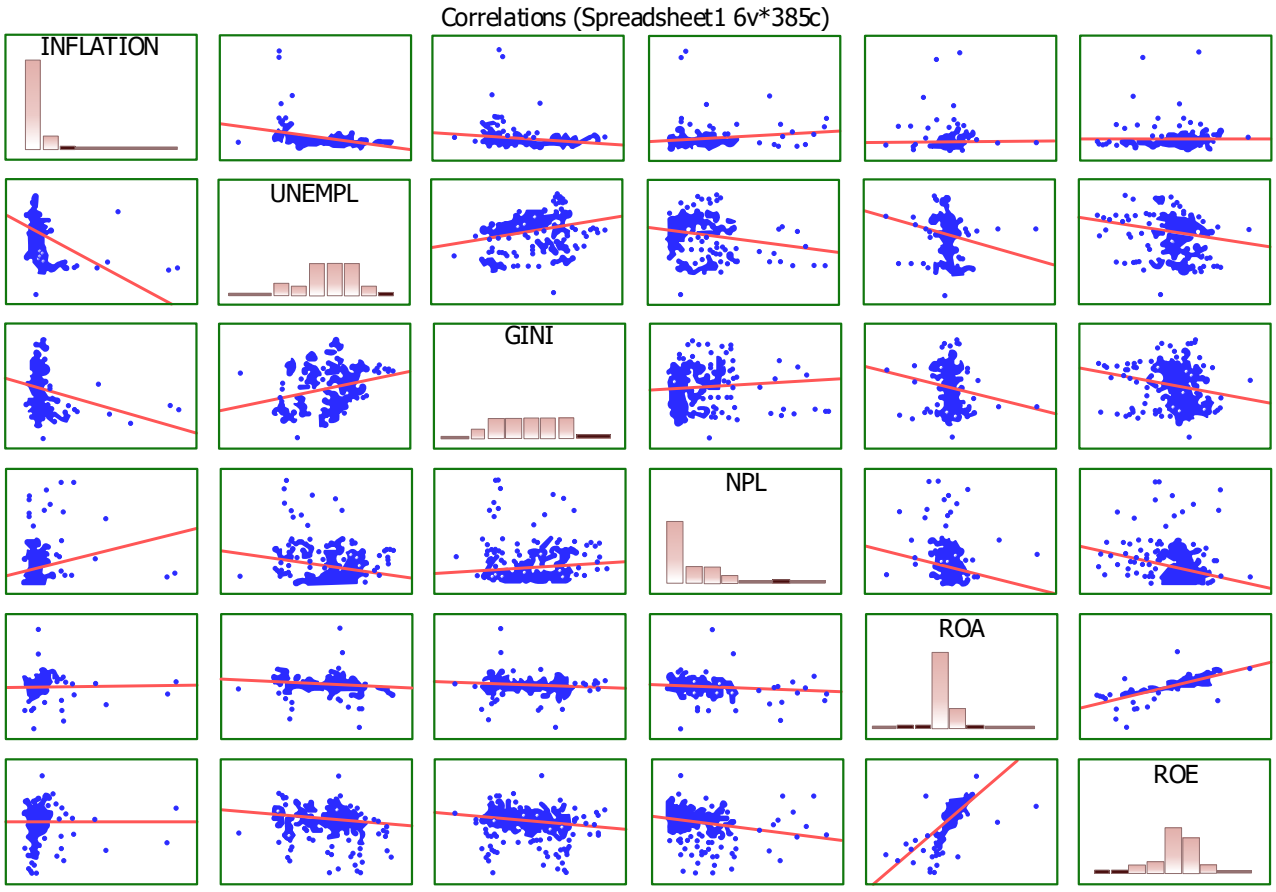

Figure 1. Matrix graphs of correlation between bank`s capitalization level and macroeconomic stability in 34 European countries.

There is a trend indicating that the strength of the relationship between indicators is proportional to the proximity of points to the line. Notably, return on assets, return on equity, and inflation exhibit a strong correlation, as evidenced by their close alignment with the line. In contrast, the unemployment rate, Gini index, and NPL ratio display a considerable dispersion of points from the line, suggesting a weaker relationship between these indicators.

Figure 2 depicts a scatter plot of bank capitalization and the country`s macroeconomic stability indicators, presenting the data distribution through quartiles and highlighting the mean and standard deviations.

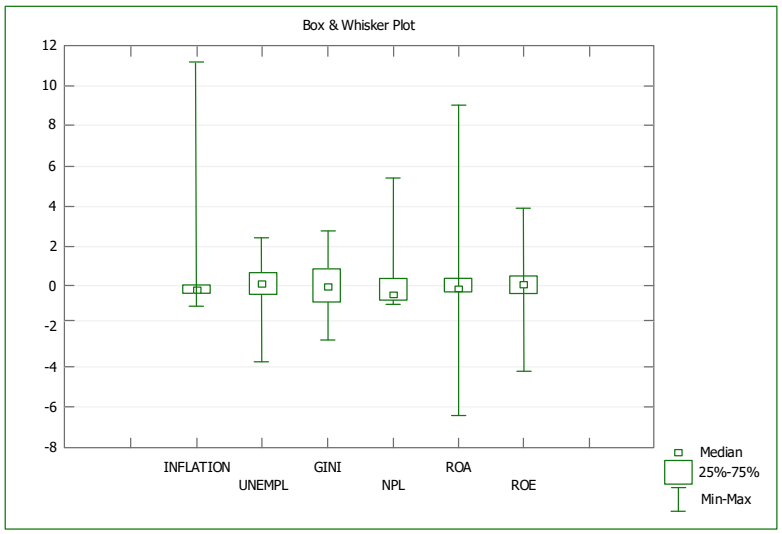

Figure 2. Scope diagrams.

Figure 2 presents deviations in mean values and variations, especially in inflation and return on assets. Return on equity exhibits the widest variation, indicating diverse approaches among European countries in managing macroeconomic policy, particularly within the banking system.

It is worth noting that the closeness of the relationship between canonical variables is quantified by the canonical correlation coefficient R^2, which stands at 61.77%. This implies that 61.77% of the changes in macroeconomic stability indicators among European countries can be explained by fluctuations in the bank's capitalization level. The three roots comprehensively describe 100% of the variance in the set of capital indicators and 100% of the set of macroeconomic stability indicators. Utilizing the values of the capital ratios and the obtained canonical roots, an average of 5.73% of the variance in the left set and 6.09% of the variability in the right set can be explained.

Therefore, following the canonical analysis, the regression analysis was structured with the country`s macroeconomic stability indicators as dependent variables and bank capitalization indicators as independent variables.

Figure 3 presents a scatter plot of canonical variables illustrating the interdependence of indicator sets.

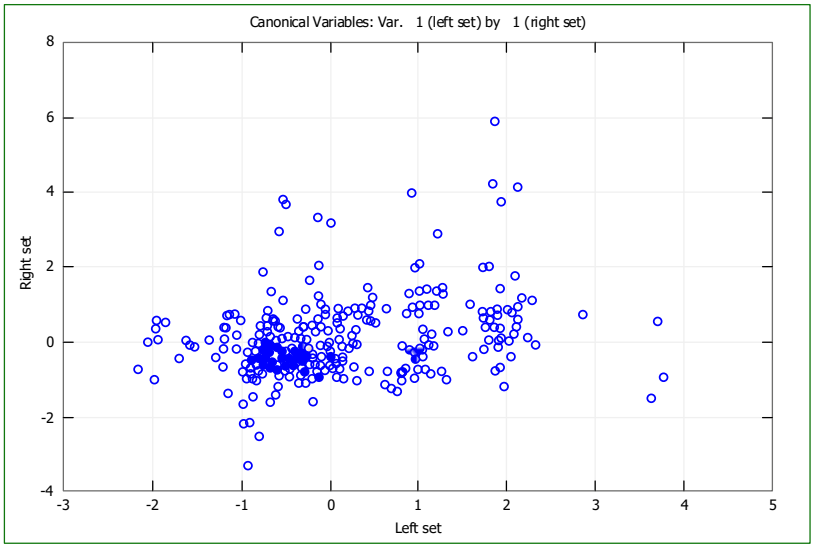

Figure 3. Scatterplot of canonical variables.

Figure 3 shows minimal deviations from the regression line, indicating a direct impact of banks' capitalization ratios on macroeconomic stability indicators.

The final stage of evaluating the relationship between bank capitalization level and the country`s economic stability involves the calculation and economic interpretation of panel regression models. At this stage, conducting tests to determine

DOI: 10.55643/fcaptp.1.54.2024.4304

the use of fixed or random effects models, such as the Hausman test and the Breusch-Pagan Lagrange multiplier, is crucial. The results of these tests are presented in Table 6.

Table 6. Results of the Hausman test and Breusch-Pagan Lagrange multiplier.

Resultant attribute (Y)	Hausman test chi2 < 0.05	Breusch-Pagan Lagrange Prob > chi2
$INFLATION$	Fixed effects chi2 = 0.0000	Fixed effects Prob < chi2 = 0.0000 chi2 =285.10
$UNEMPL$	Random effects chi2 = 0.4075	Random effects Prob > chi2
$GINI$	Random effects chi2 = 0.6402	Random effects Prob > chi2

The tests indicate that a fixed-effects model is required for the model with the inflation rate as the dependent variable, a random-effects model for the model with the unemployment rate as the dependent variable, and a random-effects model for the model with the Gini index as the dependent variable. The results of these calculations are presented in Table 7.

Table 7. Results of the panel regression with inflation as the outcome variable.

INFLATION	Coefficient	Std.err.	t (norm t > 1.96)	p (norm p < 0.05)
NPL	-0,003	0,026	-0,15	0,881
ROA	-0,255	0,152	-1,68	0,094
ROE	0,025	0,030	0,84	0,404
cons	2,623	0,295	8,87	0,000

The fixed-effects panel regression equation with INFLATION as the dependent variable is (9):

$$INFLATION = -0.003*NPL - 0.255* ROA + 0.025* ROE + 2.623. \quad (9)$$

Considering the result of the Wald criterion and the p-value (greater than 0.05), the model appears to be statistically insignificant. The impact of the bank capitalization indicators, as indicated in Table 7, does not exhibit a statistically significant effect on the dependent variable - inflation ($INFLATION$). The value of the t-test and the corresponding p-value (more than 0.05) confirm this.

The next step involves determining the parameters of the random effects model, with the outcome variable being the unemployment rate ($UNEMPL$). Table 8 presents the results of the calculations.

Table 8. Results of estimating the parameters of the panel regression model with random effects, where the dependent variable is the unemployment rate (UNEMPL).

UNEMPL	Coefficient	Std.err.	z	p (norm p < 0.05)
NPL	0.248	0.018	13.58	0.000
ROA	0.080	0.107	0.75	0.452
ROE	-0.108	0.021	-5.13	0.000
cons	6.581	0.613	10.72	0.000

Considering the result of the Wald test and the p-value (less than 0.05), the model is deemed statistically significant. A 1% increase in NPL corresponds to a 0.25% increase in the unemployment rate (UNEMPL), and a 1% increase in ROE leads to a 0.08% increase in UNEMPL. The impact of these indicators of bank capitalization exhibits a statistically significant effect on the dependent variable, as confirmed by the t-test and the p-value (less than 0.05). Importantly, it is observed that the impact of ROA on the UNEMPL coefficient is not statistically significant, with the p-value exceeding 0.05.

Equation 10 represents the panel regression equation with random effects:

$$UNEMPL = 0.248 * NPL + 0.080 * ROA - 0.108 * ROE + 6.581. \quad (10)$$

The Non-Performing Loans Rate serves as an indirect indicator of a bank's capitalization, marked by overdue payments on assets extending beyond 90 banking days. This interrelation is notably linked to the rise in loan delinquencies, often stemming from customers facing financial constraints due to job instability. Prompt evaluation of credit risk and judicious restructuring, when needed, stand as pivotal elements for ensuring sustained bank viability. Moreover, return on assets is intricately tied to the NPL`s level, exerting a direct influence on the country's unemployment rate. In contrast, the inverse impact of banks' ROE can be attributed to the augmentation of banks' internal funds and profits.

In addition, the research includes another regression model with random effects, where the dependent variable is GINI. Table 9 presents the results of the calculations.

Table 9. Results of estimating the parameters of the panel regression model with random effects, where the dependent variable is the INI.

GINI	Coefficient	Std.err.	z	p > z (norm p < 0.05)
NPL	0.047	0.014	3.31	0.001
ROA	0.110	0.083	1.33	0.185
ROE	-0.027	0.016	-1.65	0.009
cons	30.586	0.649	47.07	0.000

Considering the result of the Wald test and the p-value (less than 0.05), the model demonstrates statistical significance. A 1% increase in NPL corresponds to a 0.05% increase in the $GINI$ coefficient, while a 1% increase in ROE leads to a 0.03% decrease in the GINI ratio. These indicators of bank capitalization have a statistically significant effect on the dependent variable, as confirmed by the t-test and the p-value (less than 0.05). Notably, the impact of ROA on the $GINI$ coefficient is not statistically significant, with the p-value exceeding 0.05.

Equation 11 represents the panel regression equation with random effects:

$$GINI = 0.047 * NPL + 0.110 * ROA - 0.027 * ROE + 30.586. \quad (11)$$

Thus, the built panel regression models confirm and detail the relationships between macroeconomic stability indicators as dependent variables and bank capitalization indicators as independent variables.

DISCUSSION

Comparing the results obtained in this study with similar research areas reveals notable distinctions. Many authors predominantly focus on the internal volatility of capitalization levels, driven by changes in banks' profitability, liquidity, and solvency, without explicitly linking it to fluctuations in the country's socio-economic environment during crises.

In contrast, our approach offers significant advantages over studies such as Shair et al. (2019), which explore the impact of risk and competition on the profitability of the banking industry in Pakistan but overlook key indicators of the country's socio-economic development. Our study provides a detailed assessment of the relationship between bank capitalization levels and macroeconomic stability, drawing insights from the experiences of 34 European countries with varying levels of socioeconomic development.

Similarly, Tam (2023) identifies internal factors affecting the capital adequacy ratio of commercial banks but does not consider the external volatility of the bank's environment, including macroeconomic processes. While Olajide et al. (2023) examine the relationship between exchange rates, interest rates, and economic development in Nigeria, our study extends beyond by incorporating the impact of bank capitalization ratios as fundamental to financial stability.

Moreover, Habiba's (2023) examination of the Basel Accords focuses on the consistency of regulations with the core ideas of risk reduction and financial sector stabilization, particularly in Algerian commercial banks. However, it only partially considers qualitative external aspects of capitalization volatility, primarily related to political inhibitors, without delving into the quantitative indicators of macroeconomic stability.

DOI: 10.55643/fcaptp.1.54.2024.4304

In conclusion, our paper introduces an enhanced approach to assess the relationship between bank capitalization level and macroeconomic stability. By providing a more detailed analysis of the canonical and regression relationships between these blocks, our study contributes valuable insights to the existing literature.

CONCLUSIONS

The study aimed to assess the relationship between the level of bank capitalization and macroeconomic stability in 34 European countries from 2010 to 2021. A literature review of existing approaches confirmed the practical significance of this topic.

In the initial stages of the study, relevant indicators for banks' capitalization levels (NPL, ROA, ROE) and the country`s macroeconomic stability ($INFLATION, UNEMPL, GINI$) were identified using factor analysis. These indicators formed the basis for the canonical analysis.

The canonical analysis validated the existence of a link between the level of bank capitalization and macroeconomic stability, with a coefficient of determination of 0.617, indicating a moderate density of the relationship. Approximately 61.77% of the change in the country`s macroeconomic stability indicators in European countries is explained by fluctuations in the bank`s capitalization. A moderate direct correlation of 0.685 was observed between the return on assets level and the return on equity ratio.

To explore how bank capitalization influences a country's macroeconomic stability, we constructed one fixed-effects regression model, where the dependent variable is the inflation rate, and two random-effects models, with the dependent variables being the unemployment rate and $GINI$ index. The models with random effects were found to be statistically significant based on the result of the Wald test and p-value (less than 0.05).

According to the coefficients obtained from the panel regression, a 1% increase in the NPL leads to a 0.25% increase in the $unemployment$ rate and a 1% increase in ROA results in a 0.08% increase in the $unemployment$ rate. Similarly, a 1% increase in NPL corresponds to a 0.05% increase in the $GINI$ index, while a 1% increase in ROE leads to a 0.03% decrease in the $GINI$ index. It was determined that the impact of ROA on the $unemployment$ rate and the $GINI$ coefficient is not statistically significant, as the p-value is greater than 0.05.

In summary, the canonical analysis and panel regression models confirmed the existence and nature of the relationship between the elements of the chain 'level of bank capitalization - macroeconomic stability". These findings can be valuable in forecasting national indicators and developing anti-crisis measures during economic turbulence, considering the fluctuations in the banks` capitalization levels as crucial financial intermediaries for the country.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

Conceptualization: *Iryna Pozovna, Alina Yefimenko*
Data curation: *Alina Yefimenko*
Formal Analysis: *Iryna Pozovna, Natalia Arkhireiska, Iryna Panaseyko, Serhiy Panaseyko, Kostyantyn Serdyukov, Alina Yefimenko*
Methodology: *Iryna Pozovna, Alina Yefimenko*
Software: *Iryna Pozovna*
Resources: *Iryna Panaseyko, Serhiy Panaseyko*
Supervision: *Iryna Pozovna, Kostyantyn Serdyukov*
Validation: *Iryna Pozovna*
Investigation: *Natalia Arkhireiska, Alina Yefimenko*
Visualization: *Alina Yefimenko*
Project administration: *Alina Yefimenko*
Funding acquisition: *Iryna Pozovna*
Writing – review & editing: *Iryna Pozovna, Natalia Arkhireiska, Iryna Panaseyko, Serhiy Panaseyko, Kostyantyn Serdyukov*
Writing – original draft: *Alina Yefimenko*

FUNDING

The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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Позовна І., Архірейська Н., Панасейко І., Панасейко С., Сердюков К., Єфіменко А.

ОЦІНКА ЗВ'ЯЗКУ РІВНЯ КАПІТАЛІЗАЦІЇ БАНКІВ ТА МАКРОЕКОНОМІЧНОЇ СТАБІЛЬНОСТІ КРАЇНИ

Добре капіталізована банківська система є ключовим елементом підтримки макроекономічної стабільності. Вона допомагає запобігати фінансовим кризам, підтримує доступність кредитів і підвищує стійкість економіки до кризових зрушень. Уряди країн часто працюють над забезпеченням достатнього рівня капіталізації банків, щоб сприяти стабільному економічному розвиткові. Метою дослідження є оцінка зв'язку рівня капіталізації банків із макроекономіч-

ною стабільністю на прикладі 34 європейських країн протягом 2010-2021 років на основі статистичних даних Світового банку. Мета досягається шляхом визначення релевантних показників капіталізації банків та макроекономічної стабільності на основі використання методу головних компонент, проведення канонічного й регресійного аналізів.

Проведений канонічний аналіз підтвердив наявність зв'язку між рівнем капіталізації банків та індикаторами макроекономічної стабільності. Коефіцієнт детермінації становив 0,617, тобто зміна індикаторів макроекономічної стабільності на 61,77% пояснюється коливаннями рівня капіталізації банків.

У статті представлені 1 регресійна модель із фіксованим ефектом та 2 – з випадковими, які деталізують напрями та силу впливу незалежних змінних (NPL, ROA, ROE – індикатори рівня капіталізації банків) на залежні (INFLATION, UNEMPL, GINI – індикатори макроекономічної стабільності). З огляду на отриманий результат критеріїв Wald та p-value (менше ніж 0,05) побудовані моделі з випадковими ефектами (залежні змінні – UNEMPL, GINI) є статистично значущими.

Визначено, що при збільшенні рівня непрацюючих кредитів на 1% рівень безробіття збільшується на 0,25% та при збільшенні рівня рентабельності активів рівень безробіття збільшується на 0,08%. Також при збільшенні рівня непрацюючих кредитів на 1% індекс Джині збільшується на 0,05%, а при збільшенні рівня рентабельності власного капіталу банків – зменшується на 0,03%. Вплив рентабельності активів на рівень безробіття та коефіцієнт Джині не є статистично значущим (p-value більше за 0,05).

Результати дослідження можуть бути використані при прогнозуванні національних показників, розробці інструментів забезпечення достатнього рівня капіталізації банків та забезпечення ефективної макроекономічної політики, оскільки вони враховують коливання рівня капіталізації банків як головних фінансових посередників країни.

Ключові слова: капіталізація, банк, макроекономічна стабільність, рівень інфляції, рентабельність власного капіталу, канонічний аналіз, панельна регресія

JEL Класифікація: E44, G21, G32

DOI: 10.55643/fcaptp.1.54.2024.4304