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PANEL INVESTIGATION OF THE FACTORS DETERMINING THE SUPPLY OF BANK LOANS IN BULGARIA USING MICROECONOMIC DATA

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ABSTRACT

This paper studies the factors affecting Bulgarian commercial banks' loan supply over the period between Q1 2007 and Q4 2024. The analysis employs a panel of indicators derived from individual (microeconomic) commercial banks' balance sheets and income statements, alongside macroeconomic variables. Combining cointegrated I(0) and I(1) data suggests the use of the Pooled Mean Group (PMG) ARDL model in panel data of Pesaran, et al. (1999). Our main findings are that the capital adequacy ratio (CAR), cost-to-income ratio (CTOI), yield on government bonds, and return on assets (ROA) exhibit negative association with loan growth, while market share (MS), loan-to-deposit ratio, interest rate on liabilities, GDP growth, housing prices, and inflation positively influence lending activity. The negative value of the Error-correction term of -0.11 and the p-value of 0.016 support the validity of a long-run relationship, indicating that loan growth adjusts toward the equilibrium state at a speed of 11% per quarter. Short-run dynamics reveal that changes in CAR, market share, and loan-to-deposit ratios significantly affect loan growth, while bank lending, economic growth, and bank efficiency indicators display lagged effects. The results of this study offer important insights into the operation of credit markets in small, open, and bank-dependent economies such as Bulgaria.

Keywords: *bank lending, bank loans supply, bank efficiency, panel econometrics, panel ARDL, cointegration, error-correction term, Pooled Mean Group Estimation of Panels*

1. INTRODUCTION

Bank lending is the main source of external financing for Bulgarian firms and households, due to the underdeveloped capital market and the lack of working alternatives. The financial system in the country is bank-centric, turning banks into the most important intermediaries between savings and investments, with commercial banks having the best knowledge and specialty for dealing with information asymmetries at the lowest costs and providing affordable financing for firms and households. Therefore, it is vital to study the factors influencing the supply of bank loans for policymakers and regulators. Furthermore, it is essential for bank managers and investors, considering the circumstances of the 2008 financial crisis and the recent shocks to the economy, including the COVID-19 pandemic.

Though bank lending is highly significant in Bulgaria, there is a lack of empirical work on the determinants of loan supply that blends bank-level (microeconomic) factors and broader macroeconomic conditions. Earlier studies appear to concentrate more on the demand-driven side of the bank lending behavior or employ aggregate data that hide significant differences between individual banks. In order to fill this gap, the current study adopts a dynamic panel approach with quarterly microdata from 21 Bulgarian commercial banks, covering the period from Q1 2007 to Q4 2024. The empirical analysis incorporated bank-specific factors like capital adequacy, cost-to-income ratios, market share, loans-to-deposits ratio, and return on assets, alongside macroeconomic indicators such as real GDP, house prices, inflation, and government bond yields.

From a methodological perspective, the Pooled Mean Group (PMG) Autoregressive Distributed Lag (ARDL) estimator created by Pesaran et al. (1999) has been adopted as it allows a heterogeneous short-run response across banks while maintaining a homogeneous long-run relationship. Such an approach fits the characteristics of the Bulgarian banking system, whereas institutions differ by size, ownership, and risk exposure but operate with the same monetary policy and regulatory environment.

This study fills the gap by identifying short-term and long-term loan supply factors in the banking sector of a post-transition economy. The timespan of the analysis encompasses several crises, including the 2008 Global financial crisis, the 2014 local banking crisis in Bulgaria related to the default of the fourth-largest bank, and the 2020 COVID-19 pandemic, which is also unique for the analysis of the Bulgarian banking system and the credit supply, in particular.

The study contributes to existing literature in a number of ways. First, it represents one of the most comprehensive panel studies of bank loan supply in Bulgaria, consolidating institution-level data collected on a quarterly basis. Second, it combines micro and macro factors, blended with a coherent dynamic approach. Third, it employs advanced econometric techniques that effectively separate short- and long-run impacts, while considering non-stationarity and heterogeneity. The results aim to enhance macroprudential regulation, credit policy, and the structuring of counter-cyclical capital buffers.

The object of this research is the bank loan supply in Bulgaria during the period 2007–2024. The particular subject is the factor determination of loan supply by using a mix of microeconomic and macroeconomic quarterly data. The aim is to identify the factors that influence loan supply in the short- and long-term, using panel data for 21 commercial banks, through the methodology of Pesaran et al. (1999) and Pesaran et al. (2001).

The scientific paper is structured as follows: Following the introduction, Section 2 reviews the theoretical and empirical literature on bank lending, focusing on credit supply in Bulgaria. Section 3 explains the dataset and the methodology framework. Section 4 translates the conceptual model into empirical findings, forming the basis for further discussion. Section 5 provides policy implications. Section 6 concludes the analysis with a summary of main findings.

2. LITERATURE REVIEW

2. 1. THEORETICAL BACKGROUND OF BANK LENDING DYNAMICS

The debate between the horizontalist and structuralist schools of thought creates the theoretical foundations of credit dynamics. Each of these schools has its unique view concerning credit creation and the involvement of banks during the monetary transmission. Advocates of the horizontalist view, rooted in the post-Keynesian monetary theory, believe that credit is created as a response to demand. Furthermore, banks are said to satisfy loan applications at given interest rates, which is made possible by central banks providing the needed reserve liquidity. This scenario results in the horizontal credit supply curve being fully elastic in the short term,

as stipulated in the influential works of Moore (1988), Lavoie (2000), and Wray (2007).

On the other hand, proponents of the structuralist theory believe that credit supply cannot be infinitely elastic and instead argue that it is constrained by banks' internal decision-making, portfolio preferences, and capitalization. Under this assumption, banks actively examine credit risk and have the right to alter their interest rate policies, which subsequently leads to the possibility of non-lending even when there is ample liquidity. As demonstrated by Palley (1994, 2008), Dow (2006), and Fontana (2003), these factors result in the upwardly sloping credit supply curve which embodies liquidity constraints and endogenous risk aversion.

These two perspectives can coexist without disregarding or rejecting the other. A more nuanced view considers them relatively flat during macroeconomic stability periods and steep during heightened risk or increased regulatory scrutiny periods, capturing their cyclical nature. Setterfield (2007) and Wray (2007) accentuate this stance, arguing that the credit supply elasticity changes over the economic cycle depending on how banks manage changing risks or governance stress during different periods of regulatory change.

The dynamic behavior of credit supply is interlinked with the functioning of the credit channel, which is an important mechanism for monetary policy transmission to real economic activity. While credit is a key instrument in conveying policy signals, banks may choose not to lend additional funds to the real economy unless they gain confidence about macroeconomic prospects. This situation depends, among other factors, on the strength and stability of their balance sheets. Here, Lavoie (1984), Bernanke & Blinder (1988), and later Bernanke & Gertler (1995) point out that the effectiveness of monetary transmission, unlike the accessibility of liquidity, is dependent on the banks' internal assessments of risk, the creditworthiness of borrowers, and broader financial stability.

Monetary transmission channels are rooted in a key friction within the financial system - the uneven distribution of information between borrowers and lenders. The foundational theoretical model by Stiglitz & Weiss (1981) demonstrates that, under asymmetric information conditions, banks may ration credit optimally rather than increase interest rates, as higher rates may worsen adverse selection and moral hazard among borrowers. With regard to this framework, Mishkin (1996) identifies two fundamental monetary transmission channels: the bank lending channel and the balance sheet channel. There are multiple factors described for credit rationing that stem from monetary policies. Banks face higher funding costs and increased macroeconomic uncertainty during monetary tightening episodes. This creates a shift in credit supply through the bank lending channel when a certain bank's balance sheet, reserves, or capital buffers become strained. Simultaneously, the balance sheet channel exacerbates this effect. Strained financial health for borrowers, coupled with decreased asset prices under tighter policy conditions, causes increased debt servicing costs while net worth declines, making borrowers appear less creditworthy. Mishkin emphasizes that these credit rationing mechanisms most strongly affect firms, especially SMEs that lack access to capital markets for alternative funding.

Within this focus, in regard to Bulgaria, most EU member states, and other countries with a bank-dominated financial system, the credit channel gains additional importance. Empirical evidence supporting its presence is provided by Favero, Giavazzi & Flabbi (1999), Gambacorta & Marques-Ibáñez (2011), Heryán & Tzeremes (2017), and Altavilla, Boucinha, Peydró, & Smets (2020). These studies jointly confirm capitalization, NPLs, and liquidity of banks as key factors supporting the effectiveness of the credit channel across EU countries.

2. 2. UNPACKING THE LOAN SUPPLY FUNCTION: INSIGHTS FROM EMPIRICAL LITERATURE

A notable body of literature underscores the importance of specific bank balance sheet indicators in determining credit supply relative to the interdependent macroeconomic and financial system dynamics. Among the pioneering contributions to the empirical modeling is the work of Bernanke & Blinder (1988). In their model, the supply of bank loans is positively associated with the share of loans in total bank assets and with excess reserves. The authors further demonstrate that loan supply increases with higher lending interest rates, while it decreases with rising bond yields, which are interpreted as the opportunity cost of extending credit. This risk-sensitive dimension of credit behavior was explicitly formalized by Chin (2011), reinforcing the view that credit supply is not only liquidity-driven but also deeply influenced by banks' risk assessments and asset allocation decisions.

Similarly, Kapounek et al. (2017) consider the loan-rate spread as a proxy measure of credit risk and identify it as one of the primary channels through which capital and asset quality factors influence credit supply, particularly among larger institutions that rely on market-based funding. Changes in bank stock prices are considered to be ahead-of-time indicators for credit supply dynamics, as higher equity valuations may reduce external financing constraints but also increase vulnerability to the shifting tides of investor sentiment. Even during periods of high market valuation, elevated price volatility may signal investor uncertainty (Blundell-Wignall & Gizycki, 1992), which can prompt more cautious credit supply behavior by banks.

The aforementioned market-based indicators depend significantly on conventional balance sheet metrics, which are part of almost all empirical estimations of credit supply functions. Liquidity and capital adequacy are widely acknowledged as key bank-specific determinants of lending across various institutional contexts and over time (for example, see Blundell-Wignall & Gizycki, 1992; Hülsewig, Winker & Worms, 2001; Hurlin & Kierzenkowski, 2007; De Mello & Pisu, 2009; Cornett, McNutt, Strahan & Tehranian, 2010; Alper, Hulagu & Keles, 2012; Montoro & Rojas-Suarez, 2012). Even so, their impact directions are context-sensitive and often ambiguous. During an economic downturn or an asset price market correction, banks tend to cut back on lending while simultaneously bolstering liquidity and capital positions as a defensive manoeuver to contain escalating credit risk. Conversely, banks tend to be far more aggressive during expansionary periods and increase the proportion of loans to total assets while reducing excess liquidity and operating just above the regulatory capital minimum.

Also, impactful empirical works by Blundell-Wignall & Gizycki (1992), Pazarbasioglu (1996) and following studies suggest that credit supply is positively influenced by loan interest rates and net interest margins and negatively associated with inflation. However, the impact of inflation remains ambiguous. Demand-driven price increases may, in some contexts, support lending through expectations of stronger repayment capacity, and such positive impact can be found in the results of De Mello & Pisu (2009) and Guo & Stepanyan (2011). Inflation is also closely related to asset price dynamics in real estate and financial markets. Yet, they represent another determinant of loan supply with a positive effect, as they enhance collateral values and improve the funding conditions of banks (Gambacorta & Marques-Ibanez, 2011).

Deposit accumulation also plays a dual role. First, it improves credit availability by increasing bank reserves available for lending. During times of financial stress, however, deposit growth tends to be a sign of liquidity hoarding and not lending (Berrospide, 2012). For example, when sovereign bond yields increase, banks shift their funding to purchase government securities, which diminishes private sector lending (Gennaioli, Martin, & Rossi, 2018). This crowding-out effect is further amplified when regulatory capital frameworks, such as Basel III, and liquidity

coverage ratios (LCRs) assign preferential treatment to sovereign bonds.

The structural responses and risk-sensitive supply shifts are reinforced by more recent empirical work by Altavilla, Boucinha, Peydró, & Smets (2020), who use big data from 15 European credit registers to analyze the impact of changes in supervision and monetary policy framework. Their study shows that the banks under centralized supervision (i.e., the ECB's Single Supervisory Mechanism) tend to be more averse to extending credit to high-risk customers, especially in regions with heightened sovereign risk. Additionally, these banks are found to be more responsive to surprise changes in monetary policy, suggesting that bank size and market positioning significantly mediate their lending behavior.

Also, it can be stipulated that banks with large holdings of sovereign bonds or excess liquidity are more reactive to unconventional monetary measures such as quantitative easing and negative interest rate policy. In this context, Altavilla, Boucinha, Holton, and Ongena (2021) confirm that unconventional measures in the eurozone broadly bolstered the supply of loans for such banks, even after controlling for borrower quality and overall macroeconomic conditions. This provides another insight into the credit channel functioning.

Beyond the aforementioned scientific articles bank lending in CEE and small open economies has attracted the interest of: Altar et al. (2021); Banai et al. (2011); Beck et al. (2015); Brasliņs et al. (2022); De Haas & van Lelyveld (2006); Egert et al. (2006); Everaert et al. (2015); Halimi et al. (2025); IMF (2016); Jakubik et al. (2015); Kanapickiene et al. (2023); Kraft & Jankov (2005); Popov & Udrea (2012).

Capital adequacy is analyzed as a factor for lending in the works of IMF (2016), Egert et al. (2006), Mihaylova-Borisova (2023), while the market share as a credit determinant is addressed in the analysis of Banai et al. (2010) and De Haas & van Lelyveld (2006). Factors such as strong funding bases, GDP growth and inflation affect credit in emerging economies, according to the works of Kanapickienė et al. (2023), Brasliņs et al. (2022) and Altăr et al. (2021). House prices are introduced as a credit factor in IMF (2017), while De Haas and van Lelyveld (2006) relate significant market shares of foreign-owned banks with increased lending during economic slumps, contributing to lending stability. The results of Everaert et al. (2015) suggest that supply-side constraints became more distinct during a post-crisis period.

2. 3. TRACING LOAN SUPPLY PATTERNS IN BULGARIA

The supply of bank loans in Bulgaria has been researched from various perspectives by Hristov & Mihaylov (2002), Frömmel & Karagyozova (2008), Erdinc (2009), Peshev (2015), Mihaylov (2017), and Karamisheva (2021). Ranging from vector error correction models and disequilibrium modelling to panel microdata approaches, the variety of methodologies employed in these studies presents a strong analytic basis to help unravel the complex interplay of factors that shape loan supply in the country.

Table 1. Loan Supply Determinants in Bulgaria: Comparative Overview of Econometric Findings

Study	Methodology	Data Type	Period	Significant Regressors (Direction)
Hristov & Mihaylov (2002)	Disequilibrium Model	Aggregate macroeconomic + balance sheet data	1997-2002	Lending rate (+), Interest rate spread (-), Inflation expectations (+) Expected industrial output (+) Regulatory dummy (-)
Frömmel & Karagyozova (2008)	MS ECM	Aggregate credit and macro variables	1999-2006	Deposits (+), Net foreign assets (+), Real estate prices (+)
Erdinç (2009)	Panel regression	Bank-level microeconomic data	1999-2006	Capital (-), Loan-loss provisions (-), Bank size (+), Foreign ownership (+), Net interest income (+GMM only)
Peshev (2015)	Engle-Granger ECM, Johansen Cointegration	Quarterly macroeconomic and sectoral banking indicators	2000-2012	Capital adequacy (-), Liquidity (-), Net interest income (+), Market concentration (-), Foreign ownership (+), Producer price index (+), Construction index (+) Crisis dummy (-)
Mihaylov (2017)	Disequilibrium model	Macroeconomic + bank-level microeconomic indicators	2000-2016	Resource base (+), Interest rate spread (-), Foreign liabilities (+), Housing prices (+)
Karamisheva (2021)	Panel regression	Bank-level + qualitative BLS data	2003-2019	Credit standards (+), Capital-to-assets ratio (+), Net interest income (+)

Source: Authors` summary

Frömmel & Karagyozova (2008) study the development of bank lending in Bulgaria during the pre-EU accession period with a Markov Switching Error Correction Model (MS-ECM). The authors identify two structural regimes in bank lending - one dominated by classic supply-side considerations and the other by real estate price movements. The influence of the latter is found to be particularly strong when explaining the expansion of household loans, while corporate loans appear to be much more sensitive to resource constraints such as deposits and foreign liabilities.

Erdinç (2009) analyzes in detail supply-side factors influencing the lending behavior of banks, being one of the first empirical studies that uses micro data from Bulgarian banks and sophisticated panel estimation methods. To assess the loan supply function, the author employs variables that stem from the balance sheets and income statements of 30 Bulgarian banks, covering the period 1999-2006 with quarterly frequency. Both FE, RE, and GMM estimations in the study maintain the same outcome of a negative statistically significant correlation between capital and loan expansion, illustrating that weaker capital buffer banks expand credit more aggressively. This indicates a moral hazard of some sort and underpricing of risk, which is further corroborated by the result that lagged loan-loss provisions negatively affect lending, specifically among lower-capital banks. Among other supply-side determinants within the model, the foreign ownership dummy variable and bank size emerge as notable positive determinants of lending. Conversely, net interest income as a measure of bank profitability does not significantly influence lending within the FE and RE models, and is significant in the dynamic GMM framework.

With its strong methodological sophistication, Erdinç (2009) provides particularly valuable insights into the risk architecture of the Bulgarian banking system during the transitional period from 1999 to 2006. Nonetheless, the relatively short duration of the study, along with substantial changes in structure and regulations in subsequent years, weakens its conclusions and calls for validation through an analysis with more recent data to evaluate if the relationships still stand.

In this regard, Peshev (2015) makes a timely and methodological extension by analyzing the

supply and demand of loans in Bulgaria using cointegration and error correction models, which are well suited for the study of transitional systems. The data set includes quarterly observations from 2000 to 2012 and thus allows capturing the pre-crisis credit boom and post-2008 lending contraction simultaneously. While confirming some of Erdinç's findings, Peshev's results consistently emphasize the importance of bank-specific balance sheet factors on credit supply. Additionally, his empirical analysis broadens the understanding by including some external and structural factors. For instance, market concentration is found to have a negative impact on credit supply in the long term (but not in the short term), suggesting that more oligopolistic bank structures may cause some dominant banks to restrain aggressive lending. Conversely, foreign bank ownership and gross external debt are shown to positively impact loan supply, demonstrating the role of external resources in enhancing banking intermediation in small open economies such as Bulgaria. Moreover, anticipated components from credit supply exhibit a positive lagged impact for most models, whereas introducing crisis dummy variables shows a strong negative impact on loan supply. These findings suggest that the 2008 financial crisis created a fundamental change in the credit intermediation process, affecting the banks' operational practices and the accessibility of credit for years to come.

In contrast to error correction or panel models, Mihaylov (2017) takes a disequilibrium approach where the lesser of two functions determines the observed credit volume. This enables the model to account for quantity limitations and market frictions more accurately, resulting in a more realistic portrayal of credit dynamics in Bulgaria. Importantly, this empirical analysis highlights several distinct periods characterized by credit supply constraints. During 2002–2004, banks were post-1990s crisis risk-averse, seeking to preserve fund liquidity by directing temporarily stagnant lending toward foreign assets rather than domestic lending. The second and more pronounced supply-driven phase occurred from early 2007 to the end of 2009, which spanned the tail end of the economic boom and the onset of the global financial crisis. During the boom period preceding 2008, the Bulgarian National Bank (BNB) put macroprudential restrictions on the credit available. This meant that, while demand for credit surged due to optimistic economic sentiments, banks were regulated and unable to lend aggressively. During the crisis, credit supply fell sharply as banks became highly risk-averse. Further supply-side contractions occurred during 2011-2013 due to external financing cost increases and again in 2015-2016 when banks began preparing for asset quality reviews, leading a shift in focus toward balance sheet repair and credit risk containment.

Hristov and Mihaylov (2002) simultaneously make important strides toward Mihaylov's subsequent analysis, creating a cohesive empirical trajectory, which is built upon the same methodological lines. While extending the dataset to include 2016, Mihaylov (2017) also analyzes the supply function by adding a greater set of explanatory variables. His model increasingly reflects Bulgaria's integration into global financial markets. External liabilities and EURIBOR, for example, represent dependence on foreign funding and its cost, while loan-rate spreads depict bank pricing and risk perception.

Karamisheva (2021) broadens the empirical perspective further by integrating qualitative data from the Bank Lending Survey (BLS) with the supervisory balance sheet data of Bulgarian banks. Unlike Mihaylov's equilibrium model, which predicts supply constraints based on credit volumes and macro-financial variables, Karamisheva uses banks' self-reported credit standard tightening or easing directly. Her micro-level panel analysis with quarterly data from 2003 to 2019 shows that the easing of credit standards is, to some degree, statistically significant and has a positive correlation with long-term credit growth, suggesting that bank sentiment and internal policy changes are critical determinants of credit supply. While this is notable, it is particularly interesting that higher capital-to-assets ratios also tend to indicate an increased credit supply.

This contradicts to the findings of Erdinç (2009), Peshev (2015), and Mihaylov (2017) that capital adequacy consistently has a negative impact on credit expansion in the Bulgarian banking sector. Kramisheva's result is likely a reflection of a more mature and stable financial climate in the latter years of the global financial crisis, framed by enhanced supervisory regimes and better risk management, which enabled well-capitalized banks to comfortably exceed regulatory bounds while in the meantime expanding their lending. Still, it is important to explore whether this shift in the capital–credit relationship indicates a structural change in bank behavior as the Bulgarian banking sector adapts to the shift in the European regulatory context.

While not concentrating solely on Bulgaria, the country's participation in some panel and cross-country studies allows for the validation of nationally-centered findings within a wider regional context.

In the panel analysis of 38 emerging market economies, Guo and Stepanyan (2011) investigate the credit growth using quarterly data spanning 2002-2010. The authors apply a dynamic approach using the Arellano-Bond GMM estimator to handle endogeneity and unobserved heterogeneity. Results for the EU-EMEs sample underscore a greater dependence on foreign liabilities as a funding source, making credit expansion in these countries particularly vulnerable to shifts in external financial conditions.

Klein (2013) performs an empirical analysis of NPLs for 16 countries in Central, Eastern and South-Eastern Europe, utilizing annual macroeconomic and balance sheet data from the ten largest banks in each country. While credit quality is the main focus of concern in this study, the results suggest that risk-taking during the expansion phase is intimately linked to the later onset of credit constraints. As bad loans accumulate and profitability is under pressure, banks become increasingly apprehensive. This results in either scaling back lending or setting more stringent credit standards.

Peshev (2014) studies the credit dynamics of the EU member states outside the Eurozone by applying an Engle-Granger VECM approach. This method is quite helpful for identifying and isolating the more localized Bulgarian banking sector from broader regional trends. What distinguishes Bulgaria in this study is the fact that the crisis dummy variable has no discernible effect on the credit supply, which is not the case for the other five CEE countries, where the global financial crisis had a direct constraining effect. In Bulgaria's case, the lending slowdown during and following the crisis is likely not causally related to the crisis event, but rather reflects other deep-rooted structural issues that predate the event and are embedded in the banks' balance sheets.

Mihaylova-Borisova (2023) offers an additional insight into the CEE region. Albeit analyzing a similar country group, this study differs from Peshev (2014) in terms of dataset composition and methodological approach, as Mihaylova-Borrisova employs a macro-level panel model with yearly data spanning from 2008 to 2021. Her results confirm a significant and positive influence of GDP growth and deposit accumulation on credit dynamics in CEE countries, and a negative effect of NPLs. However, the analysis lacks a clear distinction between demand and supply-side factors.

In general, the scientific literature concerning the supply of bank loans in Bulgaria points to a consensus integrating macroeconomic factors alongside bank-specific ones. Different methodological approaches used by authors demonstrate that banks' capital sufficiency, risk control, and funding strategies consistently influence their lendability. Namely, capital adequacy, non-performing loans, and risk exposure are commonly identified as constraints on credit supply in Bulgaria, while higher loan-to-deposit ratios and liquidity are positively associated with bank lending. The effects of foreign ownership are mixed. On one hand, it supports credit expansion by increasing available resources, but on the other, it makes banks more vulnerable to external shocks and rapid pullbacks during times of crisis. In addition to this, the behavior of banks is

influenced by macroeconomic factors such as the growth of the GDP, inflation, and real estate prices, which showcase a procyclical pattern of lending. The common observation within the Bulgarian context of a time-varying credit supply function emphasizes the need for dynamic econometric techniques that are able to capture short-term fluctuations and long-run adjustments.

3. DATA AND METHODOLOGY

This study combines microeconomic bank data and macroeconomic aggregate variables for the period Q1 2007-Q4 2024, i.e., T=72. A panel of 21 banks is analyzed using publicly available data of the Bulgarian National Bank (BNB). We combine balance sheet and income statement data of selected banks to derive crucial ratios as indicators alongside with other variables used as explanatory and dependent variables. Table 2 provides a detailed list of the commercial banks included in the analysis, with their names and unique identifiers assigned by the BNB. Some of the banks included in the panel are branches and part of international financial groups, complying with group-level rules and policies, such as capital adequacy on a consolidated basis, but still following local requirements on Anti-money laundering and other nationally applicable legislation and rules. We analyze a balanced panel of credit institutions, hence, banks without data for the whole analyzed period were excluded from the database. Furthermore, some of the excluded banks were acquired by the remaining credit institutions covered in the study.

Microeconomic (individual banks') panel data is combined with macroeconomic variables, such as real GDP, CPI, House Prices, money market, and government bond yields. Review of literature on the topic supports data selection process, together with data availability and various testing procedures, e.g., finding a long-term association between dependent and explanatory variables through cointegration.

Table 2. List of commercial banks covered in the analysis

bank id	Bank name
120	TB INVESTBANK
130	MUNICIPAL BANK
145	ING BANK N.V.-SOFIA branch
150	FIRST INVESTMENT BANK
160	BULGARIAN-AMERICAN CREDIT BANK
200	UNITED BULGARIAN BANK
230	PROCREDIT BANK (BULGARIA)
240	COMMERCIAL BANK D
250	CITY BANK N.A.-SOFIA branch
260	TOKUDA BANK
300	DSK BANK
310	NLB BANK WEST-EAST
350	TE-DZHE ZIRAT BANK-SOFIA branch
440	BNP PARIBAS S.A. - SOFIA branch
470	INTERNATIONAL ASSET BANK
545	CHPB TEXIM
561	ALLIANZ BULGARIA COMMERCIAL BANK
620	NASARCHITELNA BANK
660	UNICREDIT BULBANK
790	CENTRAL COOPERATIVE BANK
920	BULGARIAN POSTAL BANK

Source: Bulgarian National Bank

3. 1. VARIABLES

The data selection process supports the use of the following dependent and explanatory variables, as detailed in Table 3.

Table 3. Variables

Variable	Description
$lnloans_{ij}$	Natural logarithm of deflated (with GDP deflator) value of loans of the i^{th} commercial bank in the j^{th} period
car_{ij}	Capital to assets ratio: common equity divided by assets of i^{th} bank in j^{th} period
$ctoi_{ij}$	Cost to income ratio: operating expenses divided by net banking income for i^{th} bank in j^{th} period
roa_{ij}	Return on assets: after-tax income of the quarter divided by assets for i^{th} bank in j^{th} period
ms_{ij}	Adjusted market share: asset share of the bank from total assets of all analyzed banks in j^{th} period
$loans\_to\_deposits_{ij}$	Loans to deposits ratio: loans and advances lent divided by deposits received for i^{th} bank in j^{th} period
$interesliab_{ij}$	Interest rate on liabilities: quarterly interest expenses on interest-bearing liabilities for i^{th} bank in j^{th} period
$lngdp_{ij}$	Natural logarithm of real, seasonally adjusted quarterly GDP in the j^{th} period
$lnhpr_{ij}$	Natural logarithm of house price index in the j^{th} period
$lncpi_{ij}$	Natural logarithm of Consumer Price Index in the j^{th} period
$yieldbg\_gbonds_{ij}$	Yield of 10-year Bulgarian government Eurobonds in the j^{th} period
D1	Dummy variable for Corporate Commercial Bank (KTB), equals 1 from Q3 2014 onward
D2	COVID-19 crisis dummy variable, equals 1 from Q2 2020 onward

Source: Compiled by the authors

3. 2. UNIT ROOTS

A common unit root testing procedure has been applied to our data. Table 4 reveals the results from the Levin, Lin & Chu (LLC) and Im, Pesaran and Shin (IPS) tests, with the specific statistic for each test at levels and first differences (if needed) and the probability for accepting the Null hypothesis of a unit root, i.e., data is non-stationary. The formal representation of both tests is revealed in Eq. (1) and Eq. (2), respectively. The LLC procedure, as developed by Levin, et al. (2002), assumes a common unit root process, with using a common autoregressive homogeneity across panel data. The IPS approach, proposed by Im et al. (2003), allows for heterogeneity of panel data.

The LLC approach of Levin et al. (2002) uses the Augmented Dickey-Fuller (ADF) test for a homogenous unit process, through common unit-i, as follows:

$$\Delta Yit = \alpha i + \rho * Yi, t - 1 + \sum_{i=1}^{pi} \quad \sum \beta ij * \Delta Yi, t - j + \varepsilon it \qquad (1)$$

Where:

ΔYit is the first difference of the variable for cross-section id-i over the time period-t

αi is an individual-specific intercept for cross-section id-i over time period-t

ρi is the common autoregressive coefficient for all cross sections (units)

pi is the lag length for cross-section id-i

εit is the error term for cross-section id-i over the time period-t.

The IPS approach of Im et al. (2003) uses the Augmented Dickey-Fuller (ADF) test for each cross-sectional unit-i over each time period-t, as follows:

$$\Delta Yit = \alpha i + \rho i * Yi,t - 1 + \sum_{j=1}^{pi} \quad \sum \beta ij * \Delta Yi,t - j + \varepsilon it \qquad (2)$$

Where:

ΔYit is the first difference of the variable for cross-section id-i over the time period-t

αi is an individual-specific intercept for cross-section id-i over time period-t

ρi is the autoregressive coefficient for cross-section id-i, allowing for heterogeneity

pi is the lag length for cross-section id-i

εit is the error term for cross-section id-i over the time period-t.

Table 4 reveals the results from both testing procedures. Greater weight is assigned to the IPS test results, as it is natural for banks to experience differences in size, ownership, autoregressive behavior and reaction during shocks, etc. The IPS test also allows for some of the banks' variables to be stationary at level, while others are stationary at first differences, while the LLC test assumes common behavior and stationarity for all banks in the sample (see Levin et al., 2002 and Im et al., 2003).

As can be seen from the Unit root tests' results in Table 4, most variables are non-stationary at levels but stationary after first differencing, being integrated of order one: I(1). The Variables Stationary in First Differences are as follows: D(LNLOANS), D(CAR), D(MS), D(LOANS_TO_DEPOSITS), D(INTERESLIAB), D(LNGDP), D(LNHPR), D(LNCPI), D(YIELDBG_GBONDS). None of the variables are I(2), meeting ARDL model's requirements. The Variables Stationary at Levels are CTOI and ROA_Q.

Table 4. Unit Roots

Variables	Statistic or probability	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat
Series: LNLOANS	Statistic	1.06	3.29
	Prob.	85.6%	100.0%
Series: D(LNLOANS)	Statistic	-9.92	-19.53
	Prob.	0.0%	0.0%
CAR	Statistic	-0.24	-2.17
	Prob.	40.6%	1.5%
D(CAR)	Statistic	-13.19	-19.91
	Prob.	0.0%	0.0%
CTOI	Statistic	-5.15	-7.96
	Prob.	0.0%	0.0%
ROA_Q	Statistic	-5.49	-8.92
	Prob.	0.0%	0.0%
MS	Statistic	1.92	2.46
	Prob.	0.97	0.99
D(MS)	Statistic	-5.87	-19.64
	Prob.	0.0%	0.0%
LOANS_TO_DEPOSITS	Statistic	-0.73	-1.35
	Prob.	23.2%	8.9%
D(LOANS_TO_DEPOSITS)	Statistic	-8.62	-19.94
	Prob.	0.0%	0.0%
INTERESLIAB	Statistic	-1.30	-0.26
	Prob.	9.7%	39.8%
D(INTERESLIAB)	Statistic	-8.85	-15.97
	Prob.	0.0%	0.0%
LNGDP	Statistic	5.55	9.61
	Prob.	100.0%	100.0%
D(LNGDP)	Statistic	-11.19	-14.26
	Prob.	0.0%	0.0%

Variables	Statistic or probability	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat
LNHPR	Statistic	9.24	9.64
	Prob.	100.0%	100.0%
d(LNHPR)	Statistic	-7.56	-12.29
	Prob.	0.0%	0.0%
LNCPI	Statistic	8.27	11.18
	Prob.	100.0%	100.0%
d(LNCPI)	Statistic	-13.58	-10.33
	Prob.	0.0%	0.0%
YIELDBG_GBONDS	Statistic	-0.25067	1.65054
	Prob.	40.1%	95.1%
d(YIELDBG_GBONDS)	Statistic	-10.1981	-12.9071
	Prob.	0.0%	0.0%

Note: Different unit root tests use different statistics, e.g., t-stat, w-stat, while the probability is associated with the probability of accepting the null hypothesis of the unit root process

Source: Authors' calculations

3. 3. DESCRIPTIVE STAT

The Descriptive stat section lays out summarized descriptive statistics together with revealing main data dynamics and trends. Descriptive stats in Table 5 summarize the main features of the data. Skewness, Kurtosis and Jarque-Berra p-values suggest that LnLoans, LNGDP, LNHPR, LNCPI, YIELDBG experience mildly non-normal, acceptable to normal features, while the rest of the variables experience either Kurtosis, Skewness, or probably outliers, which may cause potential issues. Modelling data with such features needs to be interpreted carefully.

Table 5. Descriptive stat summary

	LN-LOANS	CAR	CTOI	ROA_Q	MS	LOANS_TO_DEP	INTERESLI-AB	LNGDP	LNHPR	LNCPI	YIELDBG
Mean	13.80	0.13	0.71	0.00	0.04	0.79	0.00	10.27	4.83	8.83	3.20
Median	13.68	0.11	0.61	0.00	0.01	0.79	0.00	10.25	4.78	8.79	3.42
Maximum	17.18	0.74	28.16	0.09	0.20	3.72	0.03	10.49	5.45	9.18	7.76
Minimum	9.57	-0.02	-18.96	-0.09	0.00	0.09	-0.19	10.10	4.56	8.52	0.14
Std. Dev.	1.53	0.11	1.15	0.01	0.05	0.29	0.01	0.11	0.24	0.15	2.10
Skewness	-0.05	2.42	8.17	-1.10	1.74	2.95	-17.59	0.50	0.82	0.77	0.23
Kurtosis	2.62	10.44	311.65	78.73	5.07	26.23	536.21	1.99	2.76	3.32	2.17
Jarque-Bera	10	4960	6018415	361599	1032	36191	17989567	128.3	173.7	156.4	57.1
Prob. J-B	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	20860.5	201.7	1068.3	3.9	57.4	1198.5	6.2	15530.5	7302.8	13356.8	4831.5
Sum Sq. Dev.	3536.0	18.9	1994.0	0.1	3.8	124.4	0.1	17.3	84.9	34.7	6684.5
Observations	1512	1512	1512	1512	1512	1512	1512	1512	1512	1512	1512

Source: Authors' calculations

The average Compound annual growth rate (CAGR) for the Loans variable is 8.8% per year on average, over the 17-year period (end of 2007 to end of 2024). The best performing institutions are those with IDs: 350, 310, 240, reporting a CAGR between 16.45 and 17.30% yearly. On the contrary, the slowest CAGR, and even decline, is evident from banks with IDs: 250 (-1.71%), 440(1.28%) and 260 (+1.99%).

Banks in the sample maintain an average CAR of 13.3%. At the end of the period, the following banks (IDs) are with the highest CAR: 320 (41.2%), 310 (16.7%) and 300 (13.4%). On the contrary, the banks (IDs) with the lowest CAR at the end of the period are 250 (2.3%); 440 (2.4%) and 145 (6.8%). From all the banks in the sample, 12 improved their CAR over the 17-year period, while 9 decreased their CAR ratio. Over the observed period, the most tremendous decline in the CAR variable was recorded by banks (IDs): 350 (-55.2 pp), 545 (-19.6 pp) and 160 (-9.1 pp), probably due to the fast compound growth rate of loans and assets in comparison to the growth in equity. On the other hand, the following banks (IDs) experienced the fastest growth of the CAR variable: 620 (17.6 pp); 310 (5.7 pp); 120 (3.9 pp). In our calculations, the CAR ratio divides common equity by all assets; otherwise, using risk-weighted assets as denominators would further improve the CAR ratio. Bulgarian banks in the sample are well capitalized and fulfil BASEL III capital requirements by a significant margin.

Banks in the sample dramatically improve their efficiency over the analyzed period. The CTOI ratio declined by 8 pp in 2024 in comparison to 2007. Mergers and acquisitions in the sector and improving business models may be the leading factors for the CTOI decline. Out of the 21 analyzed banks, 13 improved their CTOI ratio by average of 26 pp, while the other 8 worsened their efficiency, increasing the CTOI ratio by 21 pp on average.

During the analyzed period, the banks deteriorated their ROA ratio by 0.1 pp on average per quarter. Low interest rates, the swift growth rate of assets and liabilities, and competition among banks may turn out to be the factors for, otherwise, a modest decline of the indicator.

The market share (MS) variable shows a very high association with the dependent variable. By the end of 2024, 10 banks in the sample lost market share in comparison to 2007, on average by 1.3 pp, while 11 banks lost 1.2 pp on average. The following banks (IDs) experienced the largest declines in market share: 920 (-6.3 pp), 150 (-2.5 pp), and 440 (-1.1 pp). Banks (IDs) with the largest surge in MS are as follows: 200 (+6.1 pp), 300 (+2.5 pp), and 310 (1.3 pp). Mergers and acquisitions in the sector, as well as variations in the pace of loan growth, are associated with the market share dynamics. It could also be true that banks with higher MS are well recognized, and this probably also leads to a higher loan growth rate.

Over the analyzed period, 15 of the 21 banks in the sample reduced their loans-to-deposits ratio by 22% on average, indicating that banks are more risk-averse and more liquid at the end of the period. The average decline for the banks in the sample stood at 13.4 pp. Banks with following IDs went through tremendous loans to deposit ratio decline: 350 (-83.7 pp); 250 (-83 pp) and 545 (-48.1 pp), while Banks with IDs 240 (+20.3 pp), 120(+19.6 pp) and 561 (+9.6 pp) experienced highest growth over the analyzed period.

Interest rates on liabilities declined throughout the analyzed period by 0.5 pp on average, and by the end of 2024, banks paid on average 0.236% on their liabilities, compared to 0.8 pp at the beginning of the period. Banks (IDs) with the highest declines in interest rates are those with 920 (-1.22 pp), 150 (-0.96 pp) and 160 (-0.92 pp), and no bank from the sample increased the interest rate payable on interest-bearing liabilities.

Macroeconomic variables, such as natural logarithm of CPI, the House price index, real GDP, and the yield to maturity on Bulgarian government bonds, have been used. All of them, except government bond yields, show a distinct uptrend due to the ongoing process of income, productivity and prices convergence. In contrast, government bond yields declined by 1.15 pp, from 5.08% in 2007 to 3.93% in 2024.

3. 4. COINTEGRATION TEST

Automatic lag-selection using the Akaike info Criterion of the Kao (1999) test, based on the

Engle and Granger test on I(1) data, suggests the presence of cointegration, with a t-stat of -5.62 and a p-value of 0.00 for accepting the null hypothesis and testing only data stationary at first differences. Adding CtoI and ROA_q variables stationary at levels, also indicates cointegration, with a t-stat of -6.13 and a p-value of 0.00. The Kao test (based on Engle and Granger) is best suited for data stationary at first differences, i.e., I(1) data (see Kao, 1999).

Using mixed I(0) and I(1) data is best handled with the Pooled Mean Group (PMG) estimator of Pesaran et al. (1999).

3. 5. METHODOLOGY

The formal model, as shown in Eq. (3) suggests that the natural logarithm of loans (the dependent variable) is a function of the following explanatory variables: CAR_{it}, $CTOI_{it}$, ROA_Q_{it}, MS_{it}, $LOANS\_TO\_DEPOSITS_{it}$, $INTERESLIAB_{it}$, $\ln(GDP_{it})$, $\ln(HPR_{it})$, $\ln(CPI_{it})$, $YIELDBG\_GBONDS_{it}$.

$$\ln(LOANSit) = f(CAR_{it}, CTOI_{it}, ROA\_Q_{it}, MS_{it}, LOANS\_TO\_DEPOSITS_{it},$$

$$INTERESLIAB_{it}, \ln(GDP_t), \ln(HPR_t), \ln(CPI_t), YIELDBG\_GBONDS_t) \quad (3)$$

Where:

$\ln(LOANS_{it})$ – natural logarithm of the loan value deflated by the GDP deflator of the i^{th} commercial bank in the t^{th} period;

CAR_{it} – the capital-to-assets ratio, derived as the ratio between common equity and assets of i^{th} bank in the t^{th} period;

$CTOI_{it}$ – cost-to-income ratio of the i^{th} bank in the t^{th} period, calculated as operating expenses divided by net banking income. Operating expenses include marketing expenses, salaries, rent, utilities, administrative expenses and other expenses related to running the bank. Net banking income accounts for net interest income, net fee income, net investment income, and other charges and income;

ROA_Q_{it} – return on assets on a quarterly basis, measured as the after-tax income of the respective quarter divided by the value of assets for the i^{th} bank in the t^{th} period;

MS_{it} – adjusted market share of the i^{th} bank in the t^{th} period from the analyzed sample, measured as the asset share of the bank from all analyzed banks (excluding the asset value of banks omitted from the sample);

$LOANS\_TO\_DEPOSITS_{it}$ – the ratio between assets and advances lent and deposits received of the i^{th} bank in the t^{th} period;

$INTERESLIAB_{it}$ – the interest rate on liabilities, measured as quarterly interest expenses paid on incurred interest-bearing liabilities, mostly deposits of the i^{th} bank in the t^{th} period;

$\ln(GDP_t)$ – natural logarithm of deflated (real), quarterly seasonally adjusted GDP in the t^{th} period;

$\ln(HPR_t)$ – natural logarithm of the house prices index in the t^{th} period;

$\ln(CPI_t)$ – natural logarithm of the Consumer Price Index in the t^{th} period;

$YIELDBG\_GBONDS_t$ – yield of 10-year Bulgarian government Eurobonds in the t^{th} period.

Working with I(0) and I(1) can produce viable results in outlining long-term and short-term interdependencies between the dependent and explanatory variables using the approach of Pesaran et al. (1999), as shown in Eq. (4). We use the Pooled Mean Group (PMG) estimator of Pesaran et al. (1999), solved through Python and/or Eviews software applications. The PMG estimator assumes homogeneity of long-run coefficients across all groups (cross-sections), while allowing for heterogeneity across short-run coefficients (see Pesaran et al., 1999).

$$\Delta y_{it} = \phi_i * (y_{i,t-1} - \beta' * x_{i,t-1} \quad) + \sum_{j=1}^{p-1} \lambda_{ij} * \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}' * \Delta x_{i,t-j} + \mu_i + \epsilon_{it} \qquad (4)$$

Where:

y_{it} is the dependent variable (LnLOANS) for the i^{th} cross-sectional unit (bank) over a period t

x_{it} is vector of explanatory variables for the i^{th} cross-sectional unit (bank) over a period t

ϕ_i is Error correction term coefficient for the i^{th} cross-sectional unit (bank)

β is common long-run coefficient (assumed homogeneous across groups)

λ_{ij} is Short-run coefficients for the i^{th} cross-sectional unit (bank)'s dependent variable with j-lags

δ_{ij} is Short-run coefficients for the i^{th} cross-sectional unit (bank)'s explanatory variable with j-lags

μ_i is Group-specific fixed effects, the intercept term for each cross-sectional unit (bank) i.

ϵ_{it} is the Error term for the i^{th} cross-sectional unit (bank) over a period t.

Since we combine macroeconomic variables with exponential growth (GDP, Prices, Bank loans, Bank deposits, Bank assets, etc.) and ratios common for the banking industry (Capital adequacy ratio, Loans-to-deposits ratio, Cost-to-income ratio, Market share, Return on assets ratio, Return-on-equity ratio), we use a semi-log model. We combine log-transformed macroeconomic variables and bank specific ratios and indicators used in financial analysis, which is a common practice for combining macroeconomic and financial variables and indicators, as can be seen in the works of Levine, R. (2005), Beck et al. (2006), Demirgüç-Kunt & Huizinga (1999) and others. Mixing logs and ratios is not only acceptable but often necessary and methodologically appropriate.

Level variables such as GDP, CPI, bank Loans and Deposits are often log-transformed in order to stabilize variance, address skewness and exponential growth, and to interpret coefficients as elasticities (e.g., Demirgüç-Kunt & Huizinga, 1999; Wooldridge, 2019; Gujarati & Porter, 2009; Baltagi, 2021).

Our dependent variable is the natural logarithm of deflated bank loans. The explanatory variables are ratios, including the Capital adequacy ratio, cost-to-income ratio, Market share ratio, Loans-to-deposits ratio, and interest rates, together with the natural logarithm of real GDP and the natural logarithm of CPI. The following interpretation applies to our semi-log model's variables: a 1% change in loans is associated with a 1 unit (pp) change in CAR and other non-log variables for log dependent and ratio/interest rate explanatory variables; a 1% change in loans is associated with 1% change in GDP for log dependent and log explanatory variables.

The Pooled Mean Group (PMG) ARDL model of Pesaran et al. (1999) is well-suited for dynamic panel data analysis involving a mix of I(0) and I(1) variables. Their approach does not require all variables to be integrated of the same order (see ibid.), which makes it more advantageous than traditional panel cointegration techniques of Pedroni (1999) or Kao (1999), which require variables to be non-stationary in their levels.

Unlike fixed effects or pooled OLS models, PMG-ARDL estimates both long-run equilibrium relationships and short-run dynamics. It allows for heterogeneity in short-run coefficients and error variances across cross-sectional units, while implying a common long-run relationship, which is suitable when banks are subject to the same macroeconomic and regulatory environment.

Unlike System-GMM and Difference-GMM approaches (see Arellano & Bover, 1995; Blundell & Bond, 1998), the PMG-ARDL model avoids the challenges of instrument proliferation and validity, which can bias estimates in finite samples. Besides that, ARDL models are appropriate when the time range is large, and with 72 quarters, our model allows lag structure modelling and reduces small-sample bias often present in GMM techniques.

4. MODEL AND RESULTS

This section reveals long-term and short-term associations between the dependent variable (supply of bank loans) and explanatory variables following the modelled relationship through the approach of Pesaran et al. (1999).

The study cautiously discusses all coefficients as associations rather than causations, since endogeneity is a common and significant concern in working with macroeconomic and financial data, particularly when modelling loan supply. Bank-specific ratios, such as Return on equity ratio, Return on assets ratio, Cost-to-income ratio, Loans-to-deposits ratio, Net interest rate margin, and interest-bearing liabilities, may be jointly determined by loan dynamics and demand-side factors. For example, loan supply may impact profitability and efficiency ratios, and vice versa. Similarly, Loan-to-deposit ratios may be affected by changes in loan supply and by shifts in deposit demand or central bank policy.

A persistent challenge in banking research is the identification of loan supply and isolating loan demand effects since it is common for some variables to affect both and be affected by equilibrium loan dynamics (see Bernanke & Blinder, 1988; Peek & Rosengren, 1995; Peshev, 2014 and Peshev, 2015). One of the ways to address the problem of endogeneity is through adding lagged explanatory variables, reducing the contemporaneous feedback, as suggested by Pesaran et al. (1999). Future research could implement System-GMM (see Arellano & Bover, 1995; Blundell & Bond, 1998), adding instrumental variables for overcoming the endogeneity problem.

This section provides both the long-term and short-term results, and refers them to the results of studies for emerging (small) economies, amplifying the analysis with a short discussion/interpretation of main findings.

The Long-run (cointegration) equation (Eq. 5) (see also Table 6) provides information on the long-term interdependencies between the dependent variable and the explanatory variables.

A 1 percentage point (pp) change of the capital adequacy ratio (CAR) variable leads to a 3.82% decline in bank loans and, hypothetically, capital tightening reduces credit supply. The negative association between CAR and credit supply is in line with prudential expectations, i.e., higher CAR requirements reduce leverage and credit expansion. Karamisheva (2021) and De Haas and van Lelyveld (2006) find a positive association between the CAR variable and lending. Erdinç (2009)'s results point to a positive association between the common equity variable and lending, while Peshev (2015) supports the negative association between the CAR variable and lending. However, he uses aggregate bank and economic activity data. Mihaylova-Borisova (2023) found that stringent capital requirements can reduce lending. Other studies in emerging markets confirm that tighter capital constraints reduce credit growth. IMF (2016) for the Czech Republic and Banai et al. (2010) for Hungary find negative long-run effects of the capital adequacy ratio, which is consistent with our results. Popov and Udrea (2012) also support the negative association between both variables, justifying our results.

A 1 pp change of the Cost-to-income ratio (CtoI) variable leads to a 0.075% decline in bank loans, leading to the conclusion that inefficient banks lend less, and increased efficiency supports credit growth. Klein (2013) finds a similar negative association between credit supply and CtoI ratio, i.e., bank inefficiency reduces credit supply.

A 1 pp change of the quarterly Return on Assets ratio (ROA_Q) variable leads to an 11.8% decline in bank loans, indicating that more profitable banks rely less heavily on mass lending and probably become more conservative after higher profitability periods. Jakubik and Moinescu (2015) and De Haas and van Lelyveld (2006) support the positive association between profitability and lending. Kraft and Jankov (2005) find that lending booms precede crisis and instability, suggesting that banks in Bulgaria tend to be risk-averse over the course of the peri-

od, supporting the negative link in our results.

A 1 pp change of the market share ratio (MS) variable leads to a 44.94% increase in bank loans, suggesting market share-driven lending behavior. Peshev (2015) finds that there is a negative association between market concentration and lending and a positive association with foreign ownership. The latter confirms partially our results since the largest lenders in Bulgaria are foreign-owned and they manage to increase their market share. Banai et al. (2010), Brasliņs et al. (2022) and Erdinç (2009) also identify the positive association between lending and foreign ownership, partially confirming our results. De Haas and van Lelyveld (2006) observed that foreign-owned banks in the region have a negative association with lending, and usually, those are the foreign-owned banks, subject to greenfield investments. The large positive coefficient should be interpreted cautiously, since there are banks that increase their MS and others that decrease it. Thus if the variable has a very strong link with the dependent variable at an individual level, at an aggregate level the effect would be netted off by banks with decreasing MS. Banks with higher market share have the capacity to increase their loan portfolios more aggressively, likely due to their specialty in better risk assessment and better dealing with information asymmetry, also due to their economies to scale and their market power. Also, there might be a bi-directional association, since outpacing growth for a specific bank leads to higher market share.

A 1 pp change of the Loans-to-deposits ratio (LOANS_TO_DEPOSITS) variable leads to a 2.27% increase in bank loans, reflecting banks' willingness to transform deposits into loans and to take on higher risk. A higher loan-to-deposit ratio suggests banks increase their lending by the growth of deposits and transform cash holdings into loans faster. We assume that liquidity supports credit growth. As in our model, studies such as Kanapickienė et al. (2023), Mihaylova-Borisova (2023), and Egert et al. (2006) support the hypothesis that a strong funding base allows greater loan supply across CEE countries.

A 1 pp change of the Interest rate on liabilities (INTERESLIAB) variable leads to a 33.61% increase in bank loans, reflecting banks' desire to lend more and, for that purpose, paying higher interest on liabilities, or due to pressure to earn from lending. Hristov & Mihaylov (2002) and Mihaylov (2017) see a positive indirect association between interest rate on liabilities and bank loans, justifying our results.

Higher sovereign yields pull capital from private lending, evidencing a possible crowding-out effect, with a 1 pp change in yields on government bonds leading to a 0.061% decline in bank loans. Banks would prefer to invest in less risky assets, such as government bonds, instead of taking the higher risk of lending, hence, higher yields on government bonds lead to a lower supply of loans. Beck et al. (2015) and Egert et al. (2006) find a weak or very small association between credit and bond yields. Everaert et al. (2015) indirectly validate our results.

Economic growth fuels credit growth, with a 1% increase in quarterly real GDP leading to a 0.74% increase in bank loans. Our results are in line with the findings of Hristov & Mihaylov (2002) and Altăr et al. (2021).

Rising house prices increase collateral value and stimulate the supply of loans, with a 1% increase in quarterly House prices leading to a 0.52% increase in bank loans. Our results are supported by the findings of Frömmel & Karagyozova (2008), Mihaylov (2017), IMF (2017) and Egert et al. (2006).

The supply of bank loans is in positive association with inflation, with a 1% increase in CPI leading to a 1.16% increase in lending, probably reflecting adaptive lending behavior. Inflation makes credit depreciate in real terms, making it easier for borrowers to repay it. Also, during a post-crisis recovery, modest inflation may stimulate economic rebound, reducing risk-aversion. Lower real interest rates make borrowing cheaper, stimulating credit growth. If inflation makes repaying bank liabilities easier, banks can pass on some of that benefit to borrowers. The

positive link is justified in the works of Hristov & Mihaylov (2002), Peshev (2015), while a negative association can be identified in the works of Mihaylova-Borisova (2023), Egert et al. (2006) and Altăr et al. (2021), directly or indirectly.

$$LNLOANSt=-3.823*CARt^{***}-0.075*CTOIt^{***}-11.811*ROA\_Qt^{***}+$$
$$+44.940*MSt^{***}+2.274*LOANS\_TO\_DEPOSITSt^{***}+$$
$$+33.610*INTERESLIABt^{***}+0.742*LNGDPt^{**}+$$
$$+0.521*LNHPRt^{***}+1.156*LNCPIt^{***}-0.061*YIELDBG\_GBONDSt^{***}+\varepsilon t \quad (5)$$

Where:

***, and ** denote the significance level at 1% and 5%, respectively.

The representation of the cointegration equation (Eq. 5) follows the information summarized in Table 6.

Table 6. Long-run equation of LnLOANS (Dependent variable) and Explanatory variables

EXPLANATORY VARIABLES	COEF.	STD. ERROR	T-STAT	PROB.
CAR	-3.823***	0.401	-9.526	0.000
CTOI	-0.075***	0.026	-2.945	0.003
ROA_Q	-11.811***	4.267	-2.768	0.006
MS	44.940***	4.440	10.121	0.000
LOANS_TO_DEPOSITS	2.274***	0.064	35.293	0.000
INTERESLIAB	33.610***	3.589	9.364	0.000
LNGDP	0.742**	0.369	2.012	0.045
LNHPR	0.521***	0.109	4.795	0.000
LNCPI	1.156***	0.146	7.917	0.000
YIELDBG_GBONDS	-0.061***	0.005	-11.101	0.000

Note: ***, and ** denote the significance level at 1% and 5%, respectively

Source: Authors' calculations

Following the Wald test procedure on the long-term coefficients in the panel PMG model, as suggested by **Pesaran et al. (1999),** proves the presence of cointegration (see Table 7). Performing a Wald test on the long-term coefficients confirms the cointegration equation, with a high F-Stat and Chi-square value and low probability for accepting the null hypothesis that the coefficients are equal individually and jointly to zero and that there is less than 0.001% chance that this result occurred randomly (in the case of the Chi-square interpretation). This rejects the null hypothesis and supports the presence of cointegration of the ARDL (PMG) model.

Table 7. Wald test

Test Statistic	Value	df	Probability
F-statistic	452.0168	(10, 515)	0.0000
Chi-square	4520.168	10	0.0000

Note: we tested whether following coefficient are equal to zero, C(1)=C(2)=C(3)=C(4)=C(5)=C(6)=C(7)=C(8)=C(9)=C(10)=0

Source: Authors' calculation

Equation (6) represents the reduced and simplified form of Eq. (7). The full model and information in Table 8 reveal the short-term dynamics of the bank loan supply model, following the methodology of Pesaran et al. (1999).

$$\Delta LNLOANSt = -0.1109*ECT_{t-1}^{**} - 0.1912*\Delta LNLOANS_{t-2}^{***} - 1.8505*\Delta CAR_{t}^{***} - 0.0356*\Delta CTOI_{t-2}^{**} + 50.9527*\Delta MS_{t}^{***} + 1.0990*\Delta LOANS\_TO\_DEPOSITS_{t}^{***} + 0.2061*\Delta LOANS\_TO\_DEPOSITS_{t-2}^{***} + 0.3630*\Delta LNGDP_{t-2}^{**} - 0.958^{**} \quad (6)$$

Where:

***, and ** denote the significance level at 1% and 5%, respectively.

We use the Akaike info criterion (AIC) for selecting the maximum dependent lag size. The AIC model selection method suggests a short-run dynamic ARDL (4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4) of four lags for the dependent and explanatory variables, i.e., the present value of the variable and three lags of the variable.

In Eq. (6), we provide a simplified version of our short-term model. The model reveals only significant coefficients at the 1% and 5% level of significance and respective variables, linking the dependent and explanatory variables, while in Eq. (7) we provide all coefficients, regardless of their level of significance. In Eq. (6), one can clearly see significant interdependencies between the dependent and explanatory variables.

The variables with significant coefficients point out that the short-term results maintain the direction of association between explanatory variables and the dependent variables in the cointegration equation.

Short-term results are interpreted in this paragraph. The negative and significant Error correction term (ECT) confirms the existence of long-run equilibrium. About 11% of the disequilibrium is corrected each quarter in the short-term model (see Eq. (6), Eq. (7), and Table 8).

Understandably, a 1 pp increase in the current-period CAR reduces short-term loan growth by 1.85%, which is consistent with capital constraints on tightening credit supply.

The two-quarter lag of the cost-to-income ratio (CTOI(-2)) reduces loan growth by 3.6%, having a lagged efficiency impact, i.e., higher CTOI by 1 pp reduces lending with a lag of two quarters by 3.6%.

An immediate increase in the market share (MS) strongly increases lending, with a 1 pp higher MS leading to 50.95% higher bank loans (an inverse relationship and interpretation is also possible since we identify association and not causation).

An increase in the LOANS_TO_DEPOSITS by a 1 pp immediately boosts loans by 1.1%, possibly due to a surge in lending behavior and lower risk aversion. The positive association is also supported by the two-lagged association of the LOANS_TO_DEPOSITS variable and lending, despite the fact is of a lower magnitude.

Output growth, represented by the natural logarithm of real GDP, two quarters ago, of 1%, stimulates current lending by 0.36%, assuming lagged macro credit supply behavior.

The negative and statistically significant intercept of -0.96 suggests that other unobserved factors drag short-run loan growth when other variables are neutral.

Furthermore, the CCB default dummy (D1) and the COVID-19 dummy (D2) appear to be insignificant in the model, with p-values for accepting the null hypothesis that the coefficient equals zero of above 10%.

The default on liabilities of Corporate Commercial Bank (CCB) in 2014, once a top-five bank, was one of the most significant disruptions of the banking system in the post-2000 period. In June 2014, a run on the bank occurred following media reports and political statements about its stability. Bulgarian National Bank put the CCB under special supervision and the bank was closed on June 20, 2014. The Bulgarian deposit insurance fund compensated all insured depos-

itors (up to EUR 100,000 per person), which required the government to inject liquidity into the Deposit Insurance Fund. Over EUR 2 billion were paid out, making it the most expensive (in nominal terms) bank failure in Bulgarian history. This led to a deposit shuffling initially and to new liquidity entering the system, which later led to higher lending ability. Deposits placed in locally owned banks initially decreased at the expense of increasing depositing in large and internationally owned banks. Not long after that, the banking system normalized its state and functioning, proving that the Deposit Insurance fund, BNB and other institutions properly managed this crisis. As can be seen from Table 8, our dummy variable (D1) for the CCB crisis, although statistically marginal, has a positive sign, suggesting that loan supply modestly increased following the crisis. This may be due to the regulatory or policy-induced response aimed at stabilizing the banking system, and due to new liquidity entering the bank system (the paid-out insured deposits by the Deposit Insurance Fund) and the money flow to larger and renowned banks.

The COVID-19 dummy (D2) is also low in significance with a p-value of 0.10, not much further by the 0.05 threshold, and the negative coefficient of –0.0093 suggests a moderate contraction in loan supply during the pandemic, which is consistent with global findings of risk aversion, uncertainty, and reduced credit demand and supply during the early stages of COVID-19.

$$
\begin{aligned}
\Delta LNLOANSt = & -0.1109*ECT_{t-1}^{**} - 0.1076*\Delta LNLOANS_{t-1} \\
& -0.1912*\Delta LNLOANS_{t-2}^{***} + 0.0783*\Delta LNLOANS_{t-3} - 1.8505*\Delta CAR_t^{***} \\
& +0.1063*\Delta CAR_{t-1} - 0.3219*\Delta CAR_{t-2} + 0.4026*\Delta CAR_{t-3} - 0.0054*\Delta CTOI_t \\
& -0.0125*\Delta CTOI_{t-1} - 0.0356*\Delta CTOI_{t-2}^{**} - 0.0174*\Delta CTOI_{t-3} \\
& +2.4287*\Delta ROA\_Q_t + 1.0599*\Delta ROA\_Q_{t-1} + 0.0960*\Delta ROA\_Q_{t-2} \\
& +0.0850*\Delta ROA\_Q_{t-3} + 50.9527*\Delta MS_t^{***} + 19.5114*\Delta MS_{t-1} \\
& +6.2165*\Delta MS_{t-2} - 7.8622*\Delta MS_{t-3} + 1.0990*\Delta LOANS\_TO\_DEPOSITS_t^{***} \\
& +0.0435*\Delta LOANS\_TO\_DEPOSITS_{t-1} \\
& +0.2061*\Delta LOANS\_TO\_DEPOSITS_{t-2}^{****} \\
& -0.1273*\Delta LOANS\_TO\_DEPOSITS_{t-3} - 8.8845*\Delta INTERESLIAB_t \\
& +0.8017*\Delta INTERESLIAB_{t-1} - 0.8178*\Delta INTERESLIAB_{t-2} \\
& -4.6152*\Delta INTERESLIAB_{t-3} - 0.0578*\Delta LNGDP_t + 0.1462*\Delta LNGDP_{t-1} \\
& +0.3630*\Delta LNGDP_{t-2}^{**} - 0.0202*\Delta LNGDP_{t-3} + 0.2448*\Delta LNHPR_t \\
& -0.1349*\Delta LNHPR_{t-1} + 0.0374*\Delta LNHPR_{t-2} - 0.0165*\Delta LNHPR_{t-3} \\
& +0.2677*\Delta LNCPI_t - 0.1694*\Delta LNCPI_{t-1} - 0.1622*\Delta LNCPI_{t-2} \\
& +0.1669*\Delta LNCPI_{t-3} + 0.0041*\Delta YIELDBG\_GBONDS_t \\
& -0.0042*\Delta YIELDBG\_GBONDS_{t-1} - 0.0013*\Delta YIELDBG\_GBONDS_{t-2} \\
& -0.0034*\Delta YIELDBG\_GBONDS_{t-3} + 0.0137*D1_t - 0.0093*D2_t - 0.9576^{**} + \varepsilon_t \qquad (7)
\end{aligned}
$$

Where:

***, and ** denote the significance level at 1% and 5%, respectively.

Table 8. Short-run equation

EXPLANATORY VARIABLES	COEF.	STD. ERROR	T-STAT	PROB.
ECT	-0.111**	0.046	-2.406	0.017
D(LNLOANS(-1))	-0.108	0.071	-1.522	0.129
D(LNLOANS(-2))	-0.191***	0.053	-3.601	0.000
D(LNLOANS(-3))	0.078	0.063	1.237	0.217
D(CAR)	-1.850***	0.438	-4.229	0.000
D(CAR(-1))	0.106	0.338	0.315	0.753
D(CAR(-2))	-0.322	0.258	-1.250	0.212
D(CAR(-3))	0.403	0.423	0.951	0.342
D(CTOI)	-0.005	0.014	-0.393	0.695
D(CTOI(-1))	-0.013	0.014	-0.870	0.385
D(CTOI(-2))	-0.036**	0.016	-2.173	0.030
D(CTOI(-3))	-0.017	0.012	-1.480	0.140
D(ROA_Q)	2.429	1.476	1.646	0.100
D(ROA_Q(-1))	1.060	0.899	1.179	0.239
D(ROA_Q(-2))	0.096	0.638	0.150	0.881
D(ROA_Q(-3))	0.085	0.819	0.104	0.917
D(MS)	50.953***	14.459	3.524	0.001
D(MS(-1))	19.511	11.912	1.638	0.102
D(MS(-2))	6.216	3.217	1.932	0.054
D(MS(-3))	-7.862	6.847	-1.148	0.251
D(LOANS_TO_DEPOSITS)	1.099***	0.109	10.090	0.000
D(LOANS_TO_DEPOSITS(-1))	0.044	0.108	0.402	0.688
D(LOANS_TO_DEPOSITS(-2))	0.206**	0.079	2.614	0.009
D(LOANS_TO_DEPOSITS(-3))	-0.127	0.085	-1.490	0.137
D(INTERESLIAB)	-8.885	6.191	-1.435	0.152
D(INTERESLIAB(-1))	0.802	5.161	0.155	0.877
D(INTERESLIAB(-2))	-0.818	4.551	-0.180	0.857
D(INTERESLIAB(-3))	-4.615	5.896	-0.783	0.434
D(LNGDP)	-0.058	0.138	-0.419	0.676
D(LNGDP(-1))	0.146	0.124	1.176	0.240
D(LNGDP(-2))	0.363**	0.168	2.157	0.031
D(LNGDP(-3))	-0.020	0.228	-0.089	0.929
D(LNHPR)	0.245	0.133	1.847	0.065
D(LNHPR(-1))	-0.135	0.156	-0.864	0.388
D(LNHPR(-2))	0.037	0.125	0.298	0.766
D(LNHPR(-3))	-0.016	0.149	-0.111	0.912
D(LNCPI)	0.268	0.268	1.001	0.318
D(LNCPI(-1))	-0.169	0.178	-0.952	0.342
D(LNCPI(-2))	-0.162	0.242	-0.670	0.503
D(LNCPI(-3))	0.167	0.161	1.034	0.302
D(YIELDBG_GBONDS)	0.004	0.006	0.665	0.507
D(YIELDBG_GBONDS(-1))	-0.004	0.004	-1.158	0.247
D(YIELDBG_GBONDS(-2))	-0.001	0.002	-0.602	0.547
D(YIELDBG_GBONDS(-3))	-0.003	0.003	-1.154	0.249
D1	0.014	0.009	1.587	0.113
D2	-0.009	0.006	-1.636	0.102
C	-0.958**	0.404	-2.370	0.018

Note: *** and ** denote the significance level at 1% and 5%, respectively

Source: Authors' calculations

Table 9 provides model summarized information. The Mean Dependent variable of 0.021 suggests that the average quarterly growth of the dependent variable (natural logarithm of bank loans) amounts to 2.1%. The standard deviation of the change amounts to 17%, which is not considered substantial. The residuals have a small standard error of 3.5%, indicating a good model fit. The Sum of the squared residuals of 0.68 for over 1428 observations suggests a tight fit of the model. The model presented in the study was selected among other set-ups of the model and with other variables due to the highest Log Likelihood value and lowest Akaike Info Criterion. The low standard error and log AIC/SC/HQ info criterion values indicate that the dynamic ARDL(4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4) set-up fits the data very well, regardless of the large number of lags.

Table 9. Key summarized information for the short-term model

Mean dependent var.	0.021	S.D. dependent var.	0.170
S.E. of regression	0.035	Akaike info criterion	-4.014
Sum squared resid.	0.640	Schwarz criterion	-0.505
Log likelihood	4031.7	Hannan-Quinn criter.	-2.708

Source: Authors' calculations

It could be summarized that in the short run, loan supply is most sensitive to capital adequacy, market share, and loan-to-deposit ratio, while in the long run, structural indicators like profitability, cost efficiency, interest rate on liabilities, and macroeconomic factors matter more. The error correction term confirms valid long-run cointegration.

5. POLICY IMPLICATIONS

Our study may help regulators in identifying regulatory tools for a heterogeneous bank environment and for mitigating the cyclical behavior of banks and the impact of lending on stimulating the economic cycle. We can use the following scenarios supporting specific policy measures:

Scenario 1. Rising capital adequacy ratio (CAR) during recessions having a procyclical impact. If the central bank raises CAR from 10% to 12% to strengthen capital adequacy during an economic downturn, it could have a procyclical effect. Based on the long-run coefficient of -3.82, a 1 pp increase in CAR would reduce the long-term level of loans by approximately 3.8%, or by 7.84% in the case of CAR strengthening to 12% from 10%. The slump in bank lending would deepen the recession, hence, this regulatory tightening could amplify credit contraction, deepening the downturn, getting a classic procyclical effect. The bottom line is that the central bank should consider an effective countercyclical capital buffer framework. A probable adoption of the euro in Bulgaria in the near future would dramatically reduce the capital adequacy ratio, and if it happens in a way against the risks enlisted in the work of Gechev et al. (2020), banks would increase their lending capacity.

The Bulgarian National Bank has such an instrument at its disposal, but its efficiency should be often reviewed and tested for fine-tuning. The countercyclical capital buffer is a macroprudential instrument provided for in BNB Ordinance No. 8, in accordance with the requirements of Directive 2013/36/EU and the amendments introduced by Directive (EU) 2019/878. The primary purpose of the buffer is to serve as a safeguard for the banking system against potential losses arising from the build-up of cyclical systemic risk during periods of excessive credit growth.

Scenario 2. Applying different capital requirements based on bank market share or size. Our results suggest that banks with larger market share tend to lend considerably more in the long run, with the market share coefficient around 45, i.e., a 1 pp increase in market share leads to 45% larger bank loans (however, if a bank gains market share, others lose it, usually smaller

banks). Rather than applying uniform CAR thresholds, regulators could impose heterogeneous capital buffers based on bank size and systemic relevance. As a result, smaller banks would get higher lending flexibility, while strengthening the capital base and sustainability of large banks.

Also, a similar approach can be used for banks with higher marginal lending, strengthening their capital base.

Scenario 3. Loan Supply and Profitability Trade-off. Our model shows that higher ROA is associated with lower loan supply, probably due to risk aversion or reliance on non-loan related income. Policies that incentivize profitability, e.g., through ROA or ROE-based capital requirements, may discourage lending, especially to riskier segments like SMEs. Introducing Lending-based incentives, such as targeted credit guarantees or capital relief for SME lending, can balance profitability concerns with economic growth needs.

Scenario 4. Inflation and Credit Expansion management. The CPI coefficient is positive and significant. In an inflationary environment, banks may expand lending. The central bank should monitor real (deflated) credit supply, and not just nominal volumes, when assessing credit overheating. Risk buffers could target real loan growth measures.

6. CONCLUSION

Using quarterly panel data from 21 commercial banks, this study analyzes the loan supply determinants in Bulgaria during the period 2007Q1-2024Q4. The empirical analysis utilizes the Pooled Mean Group (PMG) Autoregressive Distributed Lag (ARDL) estimation technique, which encompasses both short-run and long-run equilibria between loan supply and an extensive array of bank-specific and macroeconomic factors.

The findings validate the presence of stable long-run relationships between credit supply and its determinants. A number of factors contribute to the bank lending decision process in the Bulgarian context. Interestingly, capital adequacy, cost-to-income ratio, return on assets, and government bond yields are found to have a negative impact on loan supply, supporting the body of literature that addresses capital-based lending constraints and the crowding-out effects associated with public debt markets.

On the contrary, the market share, the loan-to-deposit ratio, interest-bearing liabilities, GDP, inflation (CPI), and house prices are all found to be statistically significant and with a positive impact on loan supply in the long run. This suggests that greater macroeconomic opportunities, enhanced funding ability, and appreciation in asset prices facilitate further expansion in bank credit. The market share exhibits a very high impact on lending growth in both the long-run (coefficient of 44.94) and short-run (coefficient of 50.95), which implies that a greater market share supports the loan supply. This means that market-dominant banks expand lending more aggressively than smaller ones, but in turbulent times, they cause a larger constraint on lending as well. The association between interest rate liabilities and bank lending highlights the importance of addressing liabilities management in driving long-term credit expansion.

The loan supply demonstrates positive relationships with macroeconomic indicators such as real GDP, inflation rates and housing prices, which proves that economic fundamentals still play an essential role in supporting credit supply.

Derived results also show that the responsiveness of changes in operational efficiency, monetary policy, the state of the economy, and capital performance relative to growth in loans is smaller and subject to lags in the short run. The negative error correction term confirms that step-wise changes from the equilibrium long-term relationship with the model can be achieved, but not without some delay, as evidenced by the approximate 11% adjustment speed limit per quarter set by gradual changes.

These findings bear valuable information for management and policy within the banking sector. From a regulatory viewpoint, imposing stricter capital requirements or incentivizing greater operational efficiency tends to cut credit supply. Therefore, macroprudential policy must strive to achieve financial stability without restricting credit access to the real economy. To prevent credit procyclicality, the BNB needs to use flexible, data-based approaches to activate countercyclical capital buffers during economic booms and to relax them during economic downturns.

Regulators should focus on larger banks when they implement countercyclical policy measures, as banks that control large market shares may create credit booms by taking excessive risks to defend or increase their market leadership. The BNB, alongside the ECB, needs to perform strict monitoring of lending standards together with risk-taking actions by these institutions.

This study also contributes to the empirical literature by focusing on unit record data from a small open economy that incorporates both micro- and macro-level factors into a single inter-temporal framework. Other model dimensions could integrate non-performing loans, indicators from the ongoing digital transformation, or ESG-focused banking practices. Furthermore, analyzing other emerging economies from Central and Eastern Europe could provide valuable perspectives.

SUPPLEMENTARY DATA

The panel dataset utilized in this study is available upon request from the corresponding author.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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