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THE DYNAMIC INTERPLAY BETWEEN CREDIT RISK AND MONETARY POLICY IN ALBANIA'S BANKING SECTOR: A COMPREHENSIVE ANALYSIS

Rovena Vangjel (Troplini), Skënder Uku, Xhevrije Mamaqi-Kapllani

Abstract

The study examines the relation between credit risk and monetary policy in Albania's banking sector from 2015 to 2023, utilizing the Autoregressive Distributed Lag (ARDL) model. It analyzes post-crisis developments, particularly the Central Bank's (CB) stabilization efforts and the write-off of NPLs. The findings show that higher CB rates increase NPLs in the short and long term.

Following the 2008 financial crisis and the COVID pandemic, measures such as NPL write-offs and loan repayment postponements helped mitigate credit risk. Inflation contributed to credit stability by easing debt repayment burdens.

Inflation and higher rates ease debt repayment and enhance credit stability. The Loan/Deposit Ratio influences NPLs, as managed decreases in LDR lower credit risk. Additionally, increased CB rates reduce new loan issuance, deterring high-risk borrowers and curbing NPL growth. The study highlights the effectiveness of Albania's monetary policy in maintaining banking sector stability and supporting economic recovery.

JEL classification: *E52, E50, E31, O4, C23*

Keywords: *Monetary Policy, central bank ratio, inflation, GDP, ARDL*

Rovena Vangjel (Troplini), PhD
Associate Professor
(Corresponing author)
Finance Accounting Department
Faculty of Business
University Aleksandër Moisiu of Durrës
Rruga Miqësia, Kampusi Universitar, Godina 2, 2001
Albania
Email: rovenatroplini@uamd.edu.al
ORCID: 0000-0002-9150-2019

Skënder Uku, PhD
Associate Professor
Finance Accounting Department
Faculty of Economy and Agrobusiness
Agriculture University of Tirana,
Rruga Pajsi Vodica, Tirana 1029
Albania
Email: suku@ubt.edu.al
ORCID: 0009-0003-5175-0936

Xhevrije Mamaqi-Kapllani, PhD
Associate Professor
Department of Economic Analysis
Faculty of Economics and Business
University of Zaragoza
Gran Vía, 50005
Spain
Email: mamaqi@unizar.es
ORCID: 0000-0002-4711-9792

1. Introduction

The global financial crisis of 2008 and the COVID-19 pandemic have significantly altered the structure and application of monetary policy, highlighting the vital importance of aligning these policies to maintain financial stability.

As Bernanke and Gertler (1995) explain, monetary policy affects credit quality through its impact on credit channels: a tightening policy can increase default risks, particularly among weaker borrowers, while easing conditions can reduce borrowing costs and enhance repayment capacity. Against this global backdrop, Albania presents a compelling case study. Emerging from its post-communist transformation, which began in 1990, Albania undertook significant financial system reforms during the early 1990s, with notable developments occurring after 2000. Foundational legislative changes, such as those established in the laws "On the Bank of Albania" and "On the Albanian Banking System," adopted between 1992 and 1998, created the framework for a market-oriented financial system that also aimed to ensure macroeconomic stability and safeguard social interests. Today, Albania's banking sector operates largely on free market principles and remains predominantly banking-centric, with banks accounting for approximately 85–90% of the financial sector (Bethlendi, Mérő, and Orlovits 2024; BOA, 2023).

Regarding the nonbanking sector, there has been a gradual improvement over the years, with a notable increase in the contribution of Albania's non-bank financial sector from 5 mld ALL in 2014 to over 18 mld ALL in 2024 (BoA/ H2 2024).

Before the 2008 crisis, Albania underwent a period of rapid credit expansion that spurred economic growth while raising concerns about the sustainability of lending practices. As Moinescu and Codirlașu (2013) noted, excessive credit growth, especially when followed by a prolonged period of subdued credit flow, can lead to higher ratios of non-performing loans (NPLs). Skrabic and Konjusak (2017) similarly conclude that various forms of credit growth require approximately two years to lead to a heightened risk of credit.

The financial crisis revealed vulnerabilities within the credit market, prompting the Bank of Albania to write off significant bad loans. In response to the rising NPLs, commercial banks tightened their lending criteria, which, although designed to reduce credit risk, also pushed some borrowers toward informal lending channels and impeded broader economic development. Simultaneously, to boost lending and economic growth, the Bank of Albania implemented a relatively relaxed monetary policy, although this approach carried the potential risk of an increase in non-performing loans. These policy measures, including the strategic write-off process, ultimately decreased NPLs from 22.9% in March 2015 to 18.2% in December 2015 (Leka, Bajrami, and Duci 2019; Bauze 2019).

The onset of the COVID-19 pandemic further complicated Albania's economic landscape. Quarantine measures and forced business closures resulted in an immediate downturn in employment, production, consumption, and investment, reflecting a synchronized global recession. Following these profound disruptions, the Bank of Albania adjusted its monetary policy by again lowering interest rates and offering loan restructuring options to help stabilize the banking sector. The focus of this study is based on this dual experience of post-crisis recovery and pandemic-induced challenges, which examines the period following the 2008 write-off process. Focusing on data from 2015 to 2024—a period marked by enhanced legislative transparency and stable quarterly disclosures—this analysis offers a more precise and comprehensive view of Albania's current credit risk landscape, while also reflecting the effects of the COVID-19 crisis.

This study investigates the distinctive relationship between credit risk measured through NPLs, and monetary policy in Albania, as reflected by the central bank's interest rate and inflation levels. The key results offer empirical insights into the extent to which the monetary policy rate and other relevant control variables affect the dynamics of non-performing loans in the Albanian context.

The structure of the paper is as follows: Section 2 provides a literature review focusing on the relationship between non-performing loans and monetary indicators, with particular attention to studies concerning Albania from 2015 to 2024. Section 3 details the empirical methodology employed, while Section 4 discusses the main findings. Finally, Section 5 concludes the paper by outlining key policy implications.

2. Related literature issue

Credit risk, as measured by NPLs, is a vital indicator of a nation's financial health and economic progress. However, the factors influencing NPLs are essential for making significant macroeconomic policy decisions. There is a wealth of literature on financial and macroeconomic indicators in this regard.

Economic crises significantly impact the rise of NPLs. Most Western Balkan countries and various other regions experienced a sharp increase in loan levels after 2008, coinciding with the observable effects of the 2007-2008 financial crisis (IMF 2017). This

phenomenon accounts for the substantial rise in scientific research focused on identifying factors influencing NPLs and providing guidance primarily to commercial banks and public bank authorities.

Tight monetary policy increased long-term credit risk, while macro-prudential measures reduced it, and monetary easing lowered risk in the short term (Anwar et al. 2023). The study finds that higher monetary policy rates reduce bank risk-taking, while credit expansion increases it, offering valuable insights for central banks in the Western Balkans (Gashi and Fetai 2023).

Various microeconomic and domestic factors influencing bad loans have been identified, primarily associated with financial performance indicators: banks' profitability, loan loss reserves relative to total loans (Messai and Jouini 2013), capital adequacy ratio, the previous year's non-performing loan rate, and return on equity (Gashi and Fetai 2023; Salifu et al. 2025). However, these factors are less significant than macroeconomic factors (Klein 2013). Our study focuses on the macroeconomic factors that affect NPL, providing recommendations for banking institutions, particularly the central bank.

Various studies highlight the relationship between NPLs and GDP growth. Petkovski, Kjosevski and Jovanovski (2018) observed that GDP growth has an inverse relationship with NPLs in Czech banks, whereas unemployment displays a positive correlation. Similarly, Bogdan (2017) found that both the inflation rate (CPI) and GDP growth decrease the NPLs in Central and Eastern European banks, with unemployment again having a positive effect. In a study by Mazreku et al. (2018) involving 10 transition countries in the CEE, it was found that GDP growth exhibited the strongest inverse relationship with NPLs, with Albania included in this analysis.

A study by Staehr and Uusküla (2017) examined Western European and CEE countries and identified four key factors influencing non-performing loans (NPLs) in both regions: GDP growth, inflation, debt, and unemployment. It was found that GDP growth, inflation, and debt all had inverse relationships with NPLs.

Other indicators considered in similar studies included GDP growth, the monetary aggregate M2, and loan interest rates (Leka, Bajrami, and Duci 2019). Baholli, Dika, and Xhabija (2015) also discussed the role of the financial crisis in increasing NPLs, emphasizing the impact on the banking system and associated credit risk.

According to Mahrous, Samak, and Abdelsalam (2020), the negative and significant relationship between the credit-to-deposit ratio and NPLs in MENA countries suggests that, in these regions, increased lending relative to deposits did not result in a rise in NPLs, as one might expect, but instead emphasized a negative relationship.

Most empirical studies have investigated the macroeconomic variables of non-performing loans (NPLs) in various economies, such as Benazic and Radin (2015) in Croatia, Adeola and Ikpesu (2017) in Nigeria, and others in Arab countries like Morocco, Tunisia, Saudi Arabia, and Oman (Touny and Shehab 2015). Estimations have also been conducted in developed countries such as Greece, Italy, and France (Messai and Jouini 2013). These studies employed regression analysis using macroeconomic variables such as inflation, exchange rates, lending rates, and GDP as key explanatory factors. Haniifah (2015) examined the economic factors influencing bad loans in Ugandan banks, analyzing data from 25 banks between 2000 and 2013. Inflation and interest rates showed an inverse relationship with bad loans.

To the best of our knowledge, no prior research has utilized quarterly data to examine the impact of the Monetary Policy Rate (MPR) on Albania's credit risk in both the short and long term. Appendix 1 summarizes the authors, geographical coverage, sample size, time horizon, methods, variables, and key findings of studies related to NPLs and the macroeconomic factors influencing them.

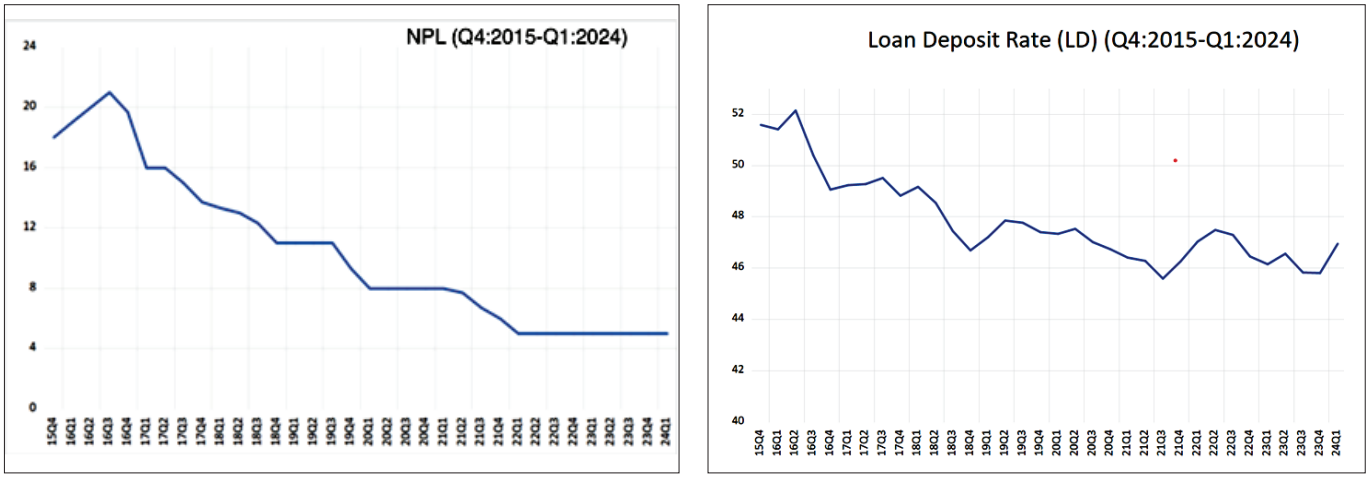
2.1. Banking Sector Developments and Policy Responses in Albania (2014–2024)

The graph demonstrates that increased prudence in the lending practices of Albania's banking sector has contributed to a decline in NPLs. Simultaneously, the loan-to-deposit ratio indicates a trend of reduced lending activity compared to bank deposits. According to Figure 1, the NPL level in Albania fell from 2014 to 2023 as banks tightened their approval procedures.

According to Figure 1, there are two time points when a downward trend in NPLs is observed: in 2016, influenced by controlling non-payment defaults (lowering the numerator), bank portfolio cleaning activities, and a stagnating loan portfolio (lowering the denominator); and in 2020, when moratoria and proactive bank interventions, such as restructuring and writing off bad loans, helped decrease NPLs after the pandemic. Additionally, the LDR steadily declined, reflecting a cautious approach to new lending, which helped banks manage credit risk amid economic challenges.

Many policies have been implemented to support financial activity and aggregate demand. The Bank of Albania increased weekly auctions to inject additional liquidity into the financial system, adopting a strategy

Figure 1. NPL and Loan to Deposit performance during the years.



Source: Bank of Albania (2024).

of unlimited liquidity injection through auctions with no limits on amounts and fixed prices. Interest rates were lowered to a historic low of 0.5% (IMF 2020), and the amount of liquidity injected into the system was increased (BoA 2020). These actions aimed to reduce economic debt service costs and support ongoing financial intermediation. In close consultation with the banking sector, targeted temporary regulatory measures were established to encourage loan deferment or consensual restructuring for distressed yet promising borrowers.

Additionally, at the end of March 2020, it intervened in the forex market to mitigate volatility resulting from the economy's closure and the country's overall activity. Lastly, micro and macroprudential measures were enacted to strengthen banks' balance sheets and preserve their lending capacity (BoA 2021). A moratorium was introduced on loan installment payments for individuals and companies affected by the pandemic. It provided temporary regulatory relief and allowed banks to adjust to the moratorium without negatively impacting their banking health and mediation activity indicators (Sejko 2021). Given the liquidity challenges companies and individuals face, the Bank of Albania extended the temporary suspension of credit risk management obligation requirements until August 31, 2020, before the classification and granting of loans to all client categories. In 2020, the next measure involved adopting a regulation that allows banks to restructure loans without incurring further provisioning costs and without improving the borrowers' situations. The enforcement of stricter requirements for the classification and granting of restructured loans has been postponed until 2022, along with the regulation "On the out-of-court treatment of borrowers in financial difficulty" (Sejko 2021).

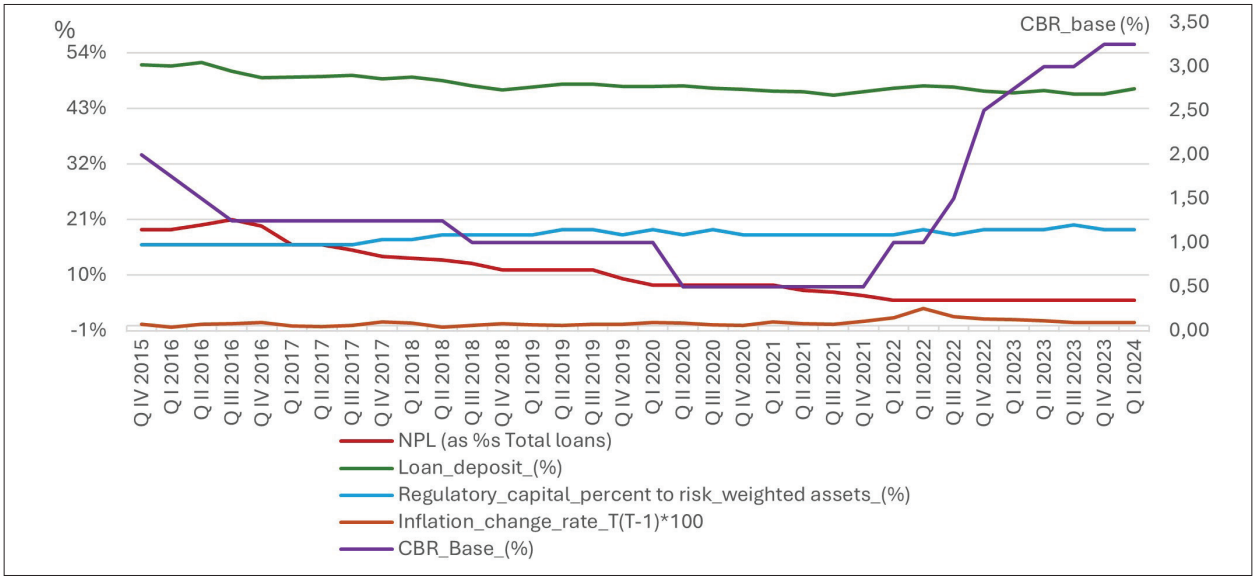
From a fiscal perspective, the Government of Albania provided fiscal relief by i) allocating additional funds to support the health sector, ii) expanding social packages to compensate for income loss, and iii) offering temporary tax relief for businesses along with the introduction of sovereign loan guarantee schemes to enhance their access to financing. This set of measures, coordinated and comprehensive, was implemented at the right time to mitigate the significant economic impact and maintain monetary and financial stability, which is essential for future economic recovery. In terms of post-pandemic monetary policies: i) ensuring price stability, ii) maintaining an inflation rate of 3%, and iii) establishing a legal framework to manage and prevent bad lending.

In the post-pandemic period, Albania entered a phase of economic recovery. The Bank of Albania began normalizing its monetary policies by raising interest rates to control inflation and prevent excessive debt accumulation. Additionally, between 2022 and 2024, it established a legal framework for debtors, credit, and capital risk (BoA 2022).

According to Figure 2, regarding CBIR, the Bank of Albania has upheld a more accommodating monetary policy due to lower inflationary pressures in the country. In early 2022, the Bank of Albania sought a monetary adjustment in response to rising inflation. In March, it raised its primary interest rate by 25 basis points to 3%, then to 3.5% in May. As the cost of lek-denominated loans increased for households and businesses, demand for loans began to ease in the fourth quarter of 2022.

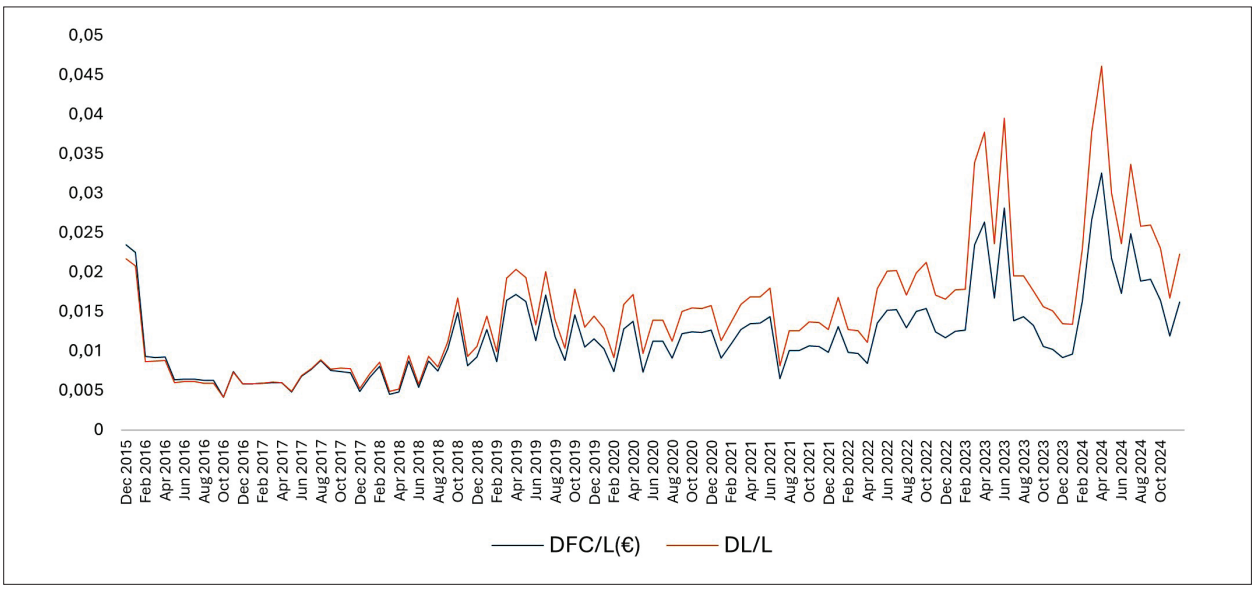
Figure 3 presents the evolution of the deposit of foreign currency denominated in euro (DFC/L in Euro) and the Deposit of Albanian lek (DL/L) from 2015 to 2024. Both ratios remained relatively stable in the

Figure 2. Trends in Key Financial Indicators Over Time



Source: Author calculated with data published by the Bank of Albania, 2015-2024.

Figure 3. Variation loan to foreign deposit in euro and lek.



Source: Author calculated with data published by the Bank of Albania, 2015-2024.

early years, but the diminishing effect of the lek's exchange rate appreciation significantly impacted deposit performance from 2019 to 2023.

Deposits in lek increased by 0.6%, while those in foreign currency decreased by approximately 2%. Deposits by currency rose by about 3%. Nevertheless, the performance of deposits in foreign currency, when measured in the original currency, shows a notable increase of about 5%. Following the changes in 2019, we have experienced nearly equivalent exchange rates between the euro and lek for several years, with the lek becoming somewhat stronger during the summer months when euro inflows surge significantly. These are the Bank of Albania's decisions on exchange rates that support strengthening the country's currency and stabilizing macroeconomic indicators. To achieve this stability, they combine monetary policy and macroprudential measures to maintain Albania's external debt at around 62% of GDP and ensure price stability.

2.2. Bank-level determinant factor

Credit risk factors include the Capital Adequacy Ratio (CAR) and the Loan Deposit Ratio (LDR), which indicate capital levels and bank liquidity. According to Mdaghri (2022), in a study conducted in MENA countries, bank liquidity is inversely related to non-performing loans, meaning that higher bank liquidity reduces NPLs by providing banks with the resources to manage financial stress, offer better support to borrowers, and lower overall credit risk.

This aligns with our idea of including LDR as a bank-specific variable (Ahmed et al. 2021), noting that higher bank liquidity reduces non-performing loans. An increase in NPLs raises the likelihood of defaults in the private sector and diminishes the value of private investments, resulting in decreased credit availability. Factors such as credit to the private sector increase the NPLs, indicating that a rise in these variables corresponds with higher NPL levels (Akinlo and Emmanuel 2014). Boussaada, Hakimi, and Karmani (2022) also found that increased bank liquidity is associated with an increase in bad loans. Additionally, Velliscig, Floreani, and Polato (2022) included CAR and discovered that bank credit risk decreases with a higher capital ratio.

2.3. Macroeconomic factor

The study analyzes essential macroeconomic factors, including the central bank interest rate (CBIR), inflation rates (IR), gross domestic product (GDP), construction cost index, consumer price index (CPI), and producer price index (PPI).

Erdas and Ezanoglu (2022) and Koju, Koju, and Wang (2018) note that inflation influences credit risk, where Erdas and Ezanoglu (2022) argue that inflation increases NPLs. This study posits that when inflation increases without a corresponding rise in debtors' profits, their ability to repay loans weakens, resulting in heightened credit risk. Higher inflation can diminish the purchasing power and the real value of income, making it more challenging for fixed-income earners with fixed-interest rate loans to fulfill their debt obligations. This causes inflation to exert a positive influence on NPLs. The literature presents mixed findings, and this study aims to provide additional evidence.

Following the findings of Zunic, Kozaric, and Dzelihodžic (2021) and Demid (2021), economic growth was included as a variable. Typically, a decline in GDP, which is commonly observed during a recession, indicates an economic downturn. A decrease in consumption and income among the population intensifies the struggle to repay loans, increasing the likelihood of defaults and leading to a rise in NPLs. This forces banks to increase provisions for bad loans, thereby reducing their profits.

The following hypotheses are proposed to be tested based on empirical results.

According to most empirical studies, central bank interest rates and inflation are associated with increased market volatility and risk, resulting in a higher level of non-performing loans (Maivald and Teplý 2020).

H_1: A significant positive relationship exists between CBIR and NPLs.

H_2: There is a significant positive relationship between the inflation rate and NPLs.

H_3: A statistically significant positive relationship exists between NPLs and LD.

H_4: A statistically significant inverse relationship exists between NPLs and the CAP.

3. Research methodology

3.1. Data and Variable Description

We used the Autoregressive Distributed Lag (ARDL) model because NPLs are influenced by different independent variables. The quarterly dataset from 2015 (QIV) to 2024 (QI) is available in the time series statistics session of the Institute of Statistics (INSTAT) and Albanian Central Bank. The time gap between the available data has been a determining factor, leading to the transformation of some variables from their original monthly format into quarterly periods.

3.2. Variable under study

NPL as a percentage of total loans (endogenous variable) serves as the dependent variable, indicating the credit quality of a bank, in terms of risk. The study utilized bank-level financial indicators that could influence the quantity of NPLs. The variables are detailed as shown in Table 1.

The dummy variable (D2020) is assigned a value of 1 for all quarters from 2020 through Q1 2024, capturing the period impacted by the COVID-19 pandemic, and 0 for all other periods. It is incorporated into the model to control for extraordinary events during this timeframe, particularly the pandemic-induced economic disruptions, including the sharp decline in GDP. The reference point is the collapse of GDP, which fell by 11 percentage points, and the anti-COVID economic measures will be approved in the next quarter.

Table 1. Variable in the study

Variable	Measure	Source
Financial performance indicators		
Non-Performance Loan (NPL)	As percent of total Loan (%)	Bank of Albania
Loan-deposit (LD)	Loan to deposit (in %)	Bank of Albania
Reg_capital (CAP)	Regulatory Capital (as a % of risk-weighted assets	Bank of Albania
Macroeconomic performance indicators		
Central Base Rate CBIR Inflation-change rate (IR) Gross Product Domestic growth (GDP)	Central Base Interest Rate (%) Inter-quarterly change rate (%) GDP Growth %	Bank of Albania Bank of Albania World Bank
Consumer Price Index (CPI)	Percentage point (quarterly)	INSTAT
Price Producer Index (PPI)	Percentage point (quarterly)	INSTAT
Construction Cost Index (CCI)	Percentage point (quarterly)	INSTAT
Dummy variable (D2020)	1 (Covid) and 0 (No covid)	

Table 2. Descriptive statistics

Variable	Mean	Std.Dev.	Min	Max
NPL	10.46	5.13	5	21
LD	47.84	1.70	45.60	52.16
CBIR	1.382	0.83	0.50	3.25
CAP	17.84	1.21	16.00	20.00
IR	0.56	0.70	-0.28	3.41
GPD	0.91	2.85	-8.70	11.70
CPI	1.065	0.046	1.00	1.16
PPI	1.08	0.11	0.98	1.31
CCI	1.03	0.72	1.01	1. 04

Source: Authors Calculators

Table 2 presents the descriptive statistics of the variables. According to Table 2, NPLs have an average rate of 10.46%, with a standard deviation of 5.13%. The minimum level is estimated at 5% for the given Albanian sample. The GDP experienced an average growth of 0.91%, with notable fluctuations during the biannual period of the COVID-19 pandemic. In 2021, GDP was more responsive compared to other macroeconomic indicators.

We use Principal Component Analysis (PCA) to analyze three macroeconomic price variables: the Product Price Index (PPI), the Consumer Price Index (CPI), and the Construction Cost Index (CCI). The PCA approach offers several econometric advantages by creating a composite macro price index (PI) to capture overall economic stability. First, it overcomes multicollinearity and overparameterization that would have occurred if the three adopted prices were included in the same equation. The PI accounts for 76% of the variability across the three price indicators, with the CPI being the most influential, explaining 72.30% of the variance, followed by the PPI at 21.95% (INSTAT, 2023a) and the CCI at 0.0574% (INSTAT, 2023b).

The inclusion of an aggregate index of the three macro prices—namely, the CPI, the CCI, and the PPI captures the influence of real economic conditions. These indicators collectively reflect the average variation in prices paid by consumers for a standard basket of goods and services. In contrast, interest rates signify the cost of borrowing, representing the rate at which lenders charge for loans. The interest rate (IR) is measured as the percentage change in the price index over a one period to the next, relative to the previous period.

3.3. Econometric framework

In this part, we examine the model's potential indicators of variable quality (indicators). We assess the positive relationship between CBIR, LD, and CAP with NPL, and whether the inflation rate could decrease the credit quality (NPL), particularly in Albania, an open but small economy characterized by significant foreign currency lending to unhedged borrowers.

Suhendra and Anwar (2022) identified that economic growth impacts the stability of the banking system. The consumption model connects economic growth to non-performing loans (NPLs), suggesting that borrowers experience profits as the economy expands. This relationship is supported by macroeconomic research, which indicates that economic growth enhances borrowers' financial stability and repayment capacity. Benefiting the stability of the banking industry, bad loans tend to decrease when the economy thrives. As the country's economy fluctuates, this study aims to investigate the relationship between NPL, GDP, and the PI. However, the direction could be positive or negative, given the unusual growth in 2020 due to the pandemic. Additionally, the macro price index PI is a potential determinant influencing NPLs. The study by Tham, Said, and Adnan (2021) examines the long-term effects of the CPI on NPLs.

The relationship between NPL and other variables can be written as:

$$Y_{LNP_t} = f(X_{F_t}B + X_{M_t}P) \quad (1)$$

Y_{LNP_t} endogenous variable

$X_{F_t}B$ epresent exogenous variables inthe model and describe the bank factor (LD, IR, and CAP),

$X_{M_t}P$ represent exogenous macroeconomic factors and serve as control variables in the model (CBR, GDP, PI).

This study relies on time series econometric techniques to estimate the relation between macroeconomic variables and NPLs. Traditional regression approaches often face inconsistency issues when using lagged dependent variables. In time series contexts, non-stationarity and the same order of integration are prerequisites for valid estimation. To address both short-term and long-term dynamics, the Vector Error Correction Model (VECM), proposed by Engle and Granger (1987) and Johansen (1995), is commonly used.

However, the Autoregressive Distributed Lag (ARDL) model has gained prominence due to its flexibility in handling variables of mixed integration orders (I(0) and I(1), as noted by Pesaran and Shin (1997). This method is especially reliable for small sample sizes and overcomes the constraint of requiring all variables to be integrated at the same order. Before estimating the ARDL model, unit root tests, specifically the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, are conducted to confirm that none of the variables are integrated at order I(2) or higher.

The ADF test accounts for higher-order autoregressive processes, whereas the PP test corrects for serial correlation and heteroskedasticity without requiring a predefined lag length. Using both tests together enhances the reliability of stationarity assessment..

The causality between NPL and the six exogenous variables is tested in this sense. The purpose of the procedure developed by Toda and Yamamoto (1995) for testing non-causality, as proposed by Granger, is that it has the advantage of being applicable even when variables are not ordered in the same way or there is no cointegration relationship. This procedure is also known as testing of augmented Granger non-causality, whose idea is to increase the order of the VAR, k, in the maximum order of integration d_{max} of the variables in such a way that it is estimated a VAR model with $d_{max} + k$ differentiated series of the variables, as shown in equations (2) and (3).

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Y_{t-i} + \sum_{j=k+1}^{dmax} \alpha_{2i} Y_{t-1} + \sum_{i=1}^{k} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{dmax} \beta_{2i} X_{t-1} + v_{1t} \quad (2)$$

$$X_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} X_{t-i} + \sum_{j=k+1}^{dmax} \delta_{2i} X_{t-1} + \sum_{i=1}^{k} \lambda_{1i} Y_{t-i} + \sum_{j=k+1}^{dmax} \lambda_{2i} Y_{t-1} + v_{2t} \quad (3)$$

To validate the existence of causality from X to Y, as specified by equation (2), we also need to consider causality from Y to X in equation (3), which can also be assessed using a Wald test. This approach will facilitate the analysis of the relationship between NPL and financial and macroeconomic growth. The ARDL model, which indicates the direction of causality flowing from financial and economic growth to NPL, as shown in equations (5) and (6), is the most frequently observed causality result in the literature review. However, when estimating the ARDL model, the order for considering causality will rely on the results from applying the procedure by Toda and Yamamoto-Ganger (1995) for no causality.

The standard specification of the ARDL model is:

$$Y_t = \alpha_0 + \sum \alpha_{ipi} Y_{t-1} + \sum \beta_{iqi} X_{t-1} + \sum \lambda_i X_{t-1} + \varepsilon_i \quad (4)$$

The values p and q represent the optimal lags for endogenous and exogenous variables. Based on the relationship specified in equations (1), (2), (3), and (4) for this study, it is proposed that no co-integration ARDL should be specified as follows:

$$l_{LNP_t} = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta l_{LNP\,t-k} + \sum_{k=0}^{q} \beta_1 \Delta l\_LD_{t-k} \cdot \sum_{k=0}^{q} \beta_2 \Delta l\_CBR_{t-k} + \sum_{k=0}^{q} \beta_3 \Delta l\_IR_{t-k} + \sum_{k=0}^{q} \beta_4 \Delta l\_CAPR_{t-k} + \sum_{k}^{q} \beta_5 \Delta l\_GPD_{t-k} + \sum_{k=0}^{q} \beta_{6\Delta l_{PI}+} \beta_7 d_{2020} + \lambda_1 l\_NPL_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_3 l\_CBR_{t-1} + \lambda_4 l\_IR_{t-1} + \lambda_5 l\_GPD_{t-1} + \lambda_6 l\_PI_{t-1} + \varepsilon_t \quad (5)$$

The term Δ in (3) is the difference operator of the series, and the parameter α_i corresponding lag endogenous variable β_i and λ_i is the parameter for the exogenous variable in both the short and long term. Additionally, dummy variables d_{2020}, they were included to account for the impact of the COVID-19 pandemic, which may have uniquely affected the GDP and PI at the national level.

Rewritten the equation (5) adding the term $\theta EC_{t\text{-}1}$ (error correction and (θ) (the speed adjust parameter, the cointegration VEC model is:

$$l_{LNP_t} = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta l_{LNP\,t-k} + \sum_{k=0}^{q} \beta_1 \Delta l\_LD_{t-k} + \sum_{k=0}^{q} \beta_2 \Delta l\_CBR_{t-k} + \sum_{k=0}^{q} \beta_3 \Delta l\_IR_{t-k} + \sum_{k=0}^{q} \beta_4 \Delta l\_CAPR_{t-k} + \sum_{k}^{q} \beta_5 \Delta l\_GPD_{t-k} + \sum_{k=0}^{q} \beta_{6\Delta l_{PI}+} \beta_7 d_{2020} + \lambda_1 l\_NPL_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_2 l\_LD_{t-1} + \lambda_3 l\_CBR_{t-1} + \lambda_4 l\_IR_{t-1} + \lambda_5 l\_GPD_{t-1} + \lambda_6 l\_PI_{t-1} + \theta ECT_{t-1} + \varepsilon_t \quad (6)$$

4. Results

The ARDL approach is employed in this study due to its flexibility in handling variables that are either stationary at level I(0) or integrated of the first order I(1). However, the presence of variables integrated of the second order I(2) or higher renders the F-test for cointegration invalid. Thus, it is crucial to verify that none of the variables are I(2). The results of the ADF and PP unit root tests, summarized in Table 3, show that the null hypothesis of a unit root cannot be rejected at level for most variables, but is rejected after first differencing, confirming they are I(1).

Five out of seven variables, including the endogenous NPL variable, are not stationary and integrated I(1). The price index and GDP growth are stationary at I(0).

The results of the no-causality test for Toda-Yamamoto are presented in Table 4. When the variables in the model are integrated in different orders, the Toda-Yamamoto test proves more robust in predicting causality than the Granger Pairwise test. The Wald test confirms the causal relationships of LD and CBIR on NPL at significance levels of 1% and 5%. The causality of GDP, PI, and CAP towards NPLs is only confirmed in one direction at a 10% significance level, as stated in the initial ARDL equation. A bi-directional causal relationship is not established for the IR. In the case of LD, a weak causality exists at a 10% significance level on NPLs. However, obtaining a strong relationship in the opposite direction, according to what our model states, is not necessary for this study to establish an equation with the dependent variable LD.

Table 3. Unit root time series test.

	ADF unit root test				PP stationary test		Observation
	Nivel (c)		First difference (c1)		Nivel (c)	First difference (c1)	Stationery and Integration (I)
Variable	b_0	$b_0 + b_{1t}$	b_0	$b_0 + b_{1t}$	b_0	$b_0 + b_{1t}$	
NPL	-4.07***	-1.33	-4.51***	-5.71***	-1.93	-3.89***	No stationary; I (1)
LD	-3.48***	-2.57	-4.90***	-4.12***	-2.08	-3.91***	No Stationary; I (1)
CBR	-1.84	-1.51	-3.62***	-4.29***	-1.7	-3.01**	No Stationary I (1)
CARP	-1.1	-5.28**	-3.42***	-4.07***	-1.87	-3.84***	No stationary I (1)
IR	-2.43	-2.92	-6.00***	-3.78***	-1.91	2.89**	No stationary I (1)
GPD	-6.21***	-6.11***	-5.53***	-5.82***	5.78***	-5.90***	Stationary; I (0)
PI	-2.63	-4.96***	-4.68***	-4.33***	2.13	3.62***	Stationary I (0)

Source: Author calculators

Statistical significance *** 1%, ** 5% and * 10%

Note: Null hypothesis: the series has a unit root

Table 4. Toda-Yamamoto causality test results.

Null hypothesis	Wald $\chi 2$	Sense of causality
LD does not cause NPL	10.90***	LD → NPL
NPL does not cause LD	4.45*	NPL → LD
CBIR does not cause NPL	6.95***	CBIR → NPL
NPL does not cause CBIR	1.89	NPL → CBIR (no causality)
IR does not cause NPL	1.45	IR → NPL (no causality)
NPL does not cause IR	0.89	NPL→ IR (no causality)
CAR does not cause NPL	4,20*	CAP→NPL
NPL does not CAR	1.17	NPL→CAP (no causality)
Gross Product Growth does not cause NPL	4.75**	GPD → NPL
NPL does not cause Gross Product Growth	1.81	NPL → GPD (no causality)
Price Index does not cause NPL	3.95*	PI → NPL
NPL does not cause Price Index	1.15	NPL→PI (no causality)

Source: Author calculators

Significance: *** 1%, ** 5% and * 10%.

Table 5. The optimal number of lags.

	Endogenous variable	Exogenous variables					
	NPL	LD	CBIR	IR	CAP	GPD	PI
Optimal lags	2	2	4	2	3	0	0

Source: Author calculators

Table 6. Limit for cointegration F bound test

F value			Statistical significance level					
	1%		2,5%		5%		10%	
	U-bound	**L-bound**	**U-bound**	**L-bound**	**U-bound**	**L-bound**	**U-bound**	**L-bound**
5,83	3.65	4.66	3.15	4.08	2.79	3.67	2.37	3.2

Source: Author calculators

Null hypothesis: variables are not cointegrated

Determining the optimal lag lengths for all variables in the model is another crucial requirement for parameter estimates in an ARDL dynamic model. The optimal lag lengths were selected using the Akaike (AIC) and Schwarz information criteria (Table 5).

To test the long-term model, it is necessary to confirm the cointegration between variables. In the Bounds test, the null hypothesis is that the series has no relationship in the long run or is not cointegrated. The validity test has been conducted by comparing the test value with the limits at four levels of statistical significance. If the calculated test value of the sample does not fall within these limits, the null hypothesis of non-cointegration is rejected. For an F Bound value of 5.83, the theory of no cointegration is rejected at all levels of statistical significance considered (see Table 6). The critical values for each statistical level are presented by Pesaran, Shin, and Smith (2001).

Table 7. Variance Inflation Factor for the collinearity problem.

Exogenous variables	VIF
LD	4.662
CBIR	3.049
CAP	5.444
IR	2.359
PI	6.478
GDP	1.191

Source: Author calculators

VIF: Minimum possible value = 1.0. Values > 10.0 may indicate a collinearity problem.

The boundary test provides an initial insight into the relationship of cointegration in the model. However, regarding the direction of causality and the long-term relationship, to achieve more robust results, it is essential estimating the ARDL dynamic model. Before testing the ARDL model, a standard regression model assessed multicollinearity among exogenous variables. In the model, none of the variables exhibits a Variance Inflation Factor (VIF) exceeding the allowed limits (Table 7).

4.1. Results of the ARDL dynamic model

In Table 8, the results of the estimated coefficients are presented. First, it is determined that the error correction coefficients (ECT – 1; θ = –0.82) must be both negative and statistically significant to confirm a relationship in long run between the studied variables, which would also validate the causality implied in the long run. In this regard, as indicated in Table 8, the error correction coefficient meets the previously mentioned conditions; that is, it supports the findings of limit testing in the specified models. The estimated coefficients are presented in the long term after confirming the cointegration relationship in the selected models. Additionally, the error correction indicates that most of the instability (82.00%) of the NPL ratio is due to shocks from exogenous variables (bank variables) at the initial moment, echoing the observations of Makri, Tsagkanos, and Bellas (2014), and Ahmed et al. (2021).

Furthermore, Table 8 shows the estimated coefficient for the short run, where a dummy variable (D2020) is included to ensure the stability of the parameter estimates and capture the effect of the sudden drop in the GDP variable during the COVID-19 pandemic.

D2020 is a dummy variable, and the coefficient of 0.38 in the short run is associated with the increase

Table 8. The ARDL dynamic model

	Short run		Variables	Long run	
Variables	$\widehat{\alpha_i}$; $\hat{\beta}_i$	ST. Error		$\hat{\lambda}_i$	ST. Error
(D)L__NPL (-1)	0.36**	0.12	L_LD	0.46***	0.15
(D)L__LD (-1)	0.14**	0.06	L_CBIR	0.32**	0.12
(D)L_CBIR (-1)	0.18**	0.08	L_IR	0.54*	0.29
(D)L_CBIR (-2)	0.09**	0.09	L_CAP	0.10*	0.05
(D)L_CBIR (-3)	0.06*	0.04	L_GDP	-0.23**	0.09
(D)L_CBIR (-4)	0.11*	0.03	L_PI	0.18*	0.08
(D)L_IR (-1)	-0.09*	0.05	Dummy D (2020)	-0.27	0.30
(D)L_CAP (-1)	-0.44**	0.06			
(D)L_CAP (-2)	-0.15*	0.039			
L_GPD	-0.24***	0.56			
L_PI	0.17**	0.08			
Dummy (D2020)	0.38**	0,09			
Coint (ECT-1)	-0.82***	0.20			
C (constant)	-6.9***	0.17			
@ (trend)	-7,4**	1.5			
Model estimated ARDL (2,2,4,2,3,0,0) Model selection method AIC= -7.68					

Source: Author calculators

in NPLs following COVID compared to the pre-COVID period. This increase may arise from the significant uncertainty caused by the pandemic, as it shows no significance in the long run.

The ARDL long-run results in Table 8 indicate that LD, CBIR, and CAP have a statistically significant effect on NPLs over the long term. A coefficient of 0.46 for LD suggests that a one percentage point increase in this rate results in a 0.46 percentage point increase in NPLs, holding other factors constant. These findings support the notion that the bank liquidity level, or the LD volume, directly increases NPL levels. Typically, the ideal loan-to-deposit ratio ranges from 80% to 90%. In this analysis, the ratio stands between 20 and 25 percentage points below the recommended limits (averaging 47.8%), which may explain low loan returns and establish a positive relationship with NPLs.

Regarding bank rates, a one-percentage-point increase resulted in a 0.32 percentage - point rise in NPLs. The interest rate has a weak long-term effect on the behavior of NPLs, as it is statistically significant only at the 10 percent significance level. For each percentage increase in the interest rate, NPLs increase by 0.54 in terms of the estimated coefficients, which is the factor that worsens NPLs. Regulatory capital and PI variables maintain a discreet relationship with long-term NPLs that is statistically significant at 10% and increases NPLs. The growth of NPLs is attributed to regulatory capital at 0.10% and the PI at 0.18%, while keeping the other variables in the model constant in each case. The growth rate has a coefficient with negative signs in both the short and long term. This result is corroborated by several empirical studies, such as Mazreku et al. (2018) and Petkovski, Kjosevski, and Jovanovski (2018). The interpretation is that the increase in GDP reduces the NPL rate, holding the other variables constant. In this specific case, it is logical that, except for the third quarter of 2020, which saw a decline due to the pandemic, Albania's GDP growth has steadily increased over the last decade. This trend is part of the relative stability of the economy and market stability measures.

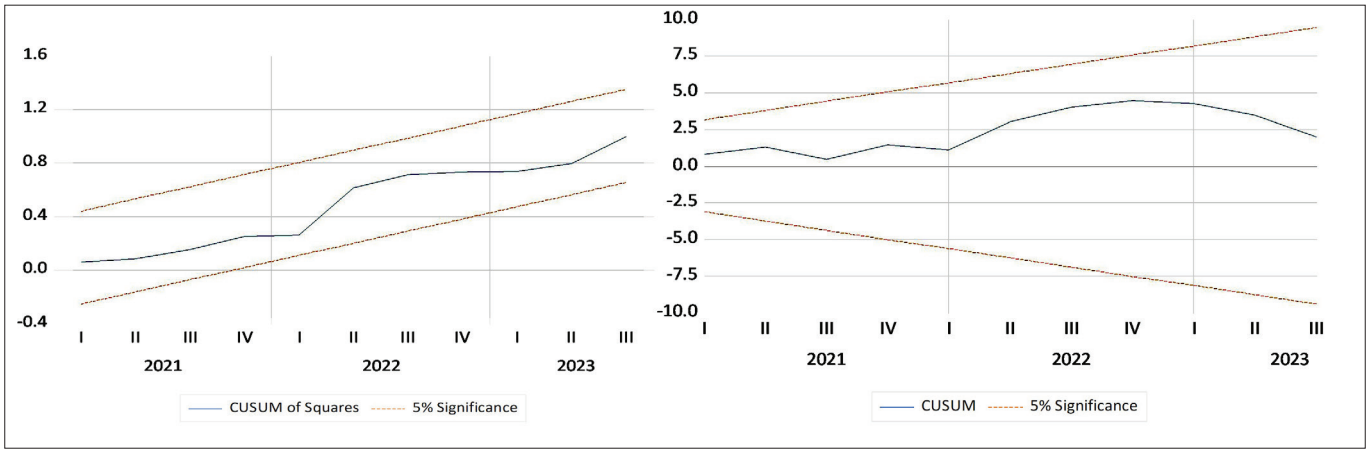
4.2. Model validation

Multiple tests have been conducted to validate the estimated model. Under the null hypothesis of variance homoscedasticity, the Breusch-Pagan-Godfrey test (level and squares) has been applied. With a χ^2 value of 23.78 (p-value 0.29), we maintain the null hypothesis of homoscedasticity, ensuring that the estimated coefficients are not inflated and that there is no heteroscedasticity in the equation. The Breusch-Pagan Serial Correlation test confirms that the null hypothesis regarding the relationship between error and error variance is consistent. With a critical value of 12.37 (p-value = 0.41), we can reject the null hypothesis.

The normality of the residuals has been verified using the Jarque-Bera test, resulting in a statistic of 0.39 (p-value = 0.67), which indicates a failure to reject the null hypothesis of normal distribution at a 5 percent significance level.

A stability test was also conducted to assess the model's stability. The results are presented in Figure 4. The graphs plot the CUSUM and the squared CUSUM. The CUSUM graph stays within the critical limits of 5%, confirming the long-term relationship between the variables and the stability of the coefficients. Similarly, the squared CUSUM statistic remains within the critical limits of 5%, further supporting the stability of the estimates in the ARDL dynamic model.

Figure 4. Stability test.



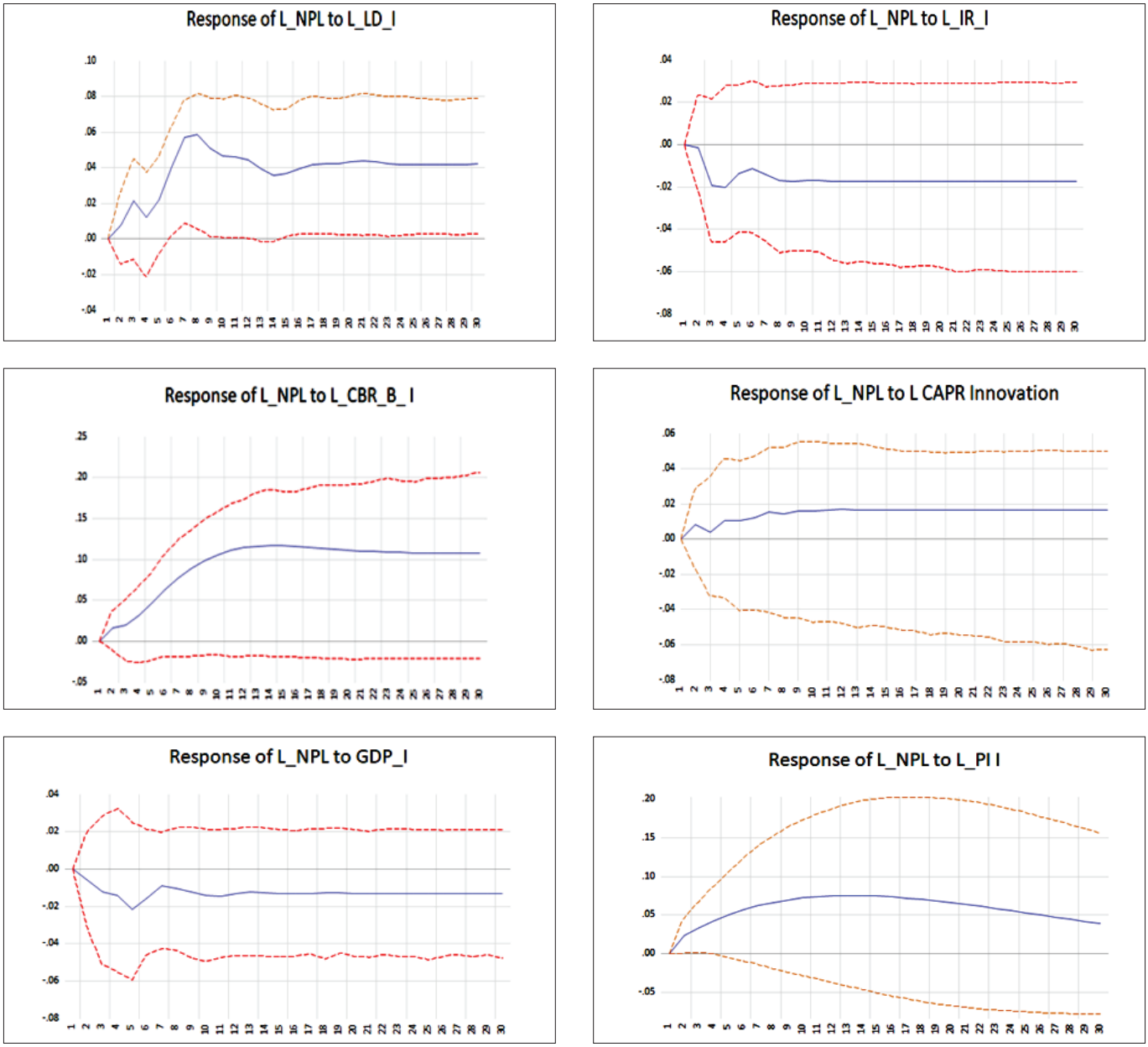
Source: Author calculators

4.3. Impulse response discussion

Impulse response analysis has been employed to examine the impact of a single shock on the exogenous variables affecting the current and future values of the endogenous variable (NPL). The NPL's response to a shock in an exogenous variable is determined using a 95% bootstrap confidence interval (CI). The results, presented graphically in Figure 5, indicate that NPLs respond differently based on the explanatory variables and the shock duration.

L_NPL's response to a loan deposit rate impulse (L_LD) shows a positive impact on the loan deposit ratio in both the short and long term. In the long run, it experiences a slight decline between the end of the first quarter and the second quarter of 2016, before recovering and increasing over the next two quarters, ultimately stabilizing in the first quarter of 2017. This indicates a long-term equilibrium that has been achieved after more than one year. When the L_LD ratio falls below 100% (approximately 50% in this study), the bank maintains its liquidity effectively, with low returns to account for the fluctuations and decrease in NPLs, which corresponds to a reduction in the percentage of loans. These results are consistent with findings from other empirical studies, such as Tham, Said, and Adnan (2021).

Figure 5. 95% CI using Standard percentile bootstraps with 999 bootstrap repetitions.



Source: Author calculators

Response to Cholesky One S.D. (d.f. adjusted)

L_NPL's response to L_Capital Regulatory (L_CARP) is positive regarding an increase in the capital adequacy ratio for both the short and long term. Over the long term, the impact decreased slightly from periods 3 to 4, then stabilized and remained consistently optimistic from the ninth quarter onward. This long-term trend aligns with initial expectations and economic theory.

Based on the impulse response of L_NPL to the graphs below, we can identify the relationship between the monetary policy of L_CBR and credit risk. The impact of NPLs is significant and critical for decisions to adjust the central bank rate. The term experiences several changes in the short run, with fluctuations continuing into the fourth quarter. It begins with a slight increase over the following five periods before stabilizing at a constant level or equilibrium from the tenth quarter onward. From that point, it remains stable while enduring a gradual long-term decline.

The response of L_NPL to a change in the inflation rate (L_IR) is asymmetric and negative in the short term. Between periods 3 and 4, a decline stabilizes as a negative constant in period 8 in the long term. However, the response of L_NPL to an impulse from the Price Index (IP) variable increases symmetrically during the initial periods and begins a slight long-term decrease after period 12.

The response of L_NPL to a shock in L_GDP growth is negative in both the short and long run. In the short term, it is asymmetrical, decreasing during periods 2, 3, and 4, and increasing during periods 5, 6, and 7. It remains negative in the long term at equilibrium. Numerous empirical studies have confirmed this negative relationship between the two variables when stability is higher. The country's GDP has shown consistent growth over the last decade, apart from the third quarter of 2020, which marked the abrupt decline in COVID-19 recovery after two periods, leading to a level that surpasses the previous drop. Therefore, the discrete variable D2020 holds significance only in the short term and indicates the current rupture.

In response to an impulse from exogenous variables, the instability of the initial periods of NPLs lasts between 8 and 12 periods. In the long run, variables such as GDP and the PI stabilize to exhibit consistent long-term behavior. The impact of macro-variables is strongest with time lags of 2, 3, and 4 quarters.

The variables of banking activity and government decision-making regarding the central bank ratio and the regulatory capital inflation rate tend to experience longer fluctuations in the long-term equilibrium of the first 12 to 14 periods.

5. Conclusion

Utilizing the ARDL approach, this study, which spans from 2015 to 2024 in Albania, examines the influence of monetary policies and various control variables on bank credit risk in Albania, confirming a long-term relationship among the variables. Increased CBIR and LD ratios contribute to higher NPLs, while economic growth and stable inflation help to mitigate them. The Bank of Albania's policies have successfully maintained price stability and reduced NPLs.

CAP also demonstrates a positive yet weaker impact. IR decreases the NPLs in the short term but has a positive long-term effect. The COVID-19 dummy variable increases the NPLs in the short term but is insignificant in the long run. LD tended to remain below the average (80%) due to the potential for an increase in NPLs in both the short and long term (Ahmed et al. 2021). A decrease in banking liquidity (an inverse increase in LD) leads to a rise in NPLs. The impulse response analysis suggests that the variables tend to respond to short-term shocks while maintaining long-term stability of the price index and promoting economic growth. Furthermore, the Bank of Albania's policies have successfully ensured price stability in consumer prices, one of the objectives of its actions (Gojčaj 2024).

The Toda-Yamamoto causality test indicates bi-directional causality between LD and NPL, as well as unidirectional causality from CBR to NPL. Model validation tests verify the absence of heteroscedasticity, serial correlation, and a normal distribution of residuals, ensuring the robustness of the ARDL model. This outcome is consistent with previous findings that highlight the impact of monetary policy, as represented by the CB rate, on credit risk. Furthermore, it supports the notion that higher interest rates imposed on borrowers can increase the likelihood of credit failures in the banking sector (Asiama and Amoah 2019).

The findings revealed that inflation has a weak negative significance on non-performing loans in the short run. The actual value of loans tends to decline with higher inflation rates, which facilitates timely repayments and reduces the risk of default. This aligns with the study by Asiama and Amoah (2019), which indicates a negative connection between inflation and NPLs in brief. The impact is positive.

The results indicate that monetary policy, as measured by CBIR, decreases credit risk, suggesting that a tightening of monetary policy, characterized by an increase in CBIR, raises NPLs due to a rise in bank credit risk. Additionally, improving macroeconomic

indicators, such as stable inflation reduction and higher economic growth, is essential for reducing NPLs in Albania's banking sector over the long term. Decreasing bank liquidity (through LD) and capital (through CAP) can lower credit risk in the long run. These findings can help bank representatives refine their lending policies regarding NPLs. A lower CAP in the short term contributes to an increase in NPLs, but in the long run, it can lead to a decrease in NPLs and vice versa, as Velliscig, Floreani, and Polato (2022) found.

The response to shocks indicates that the recovery period for various banking activities tends to be prolonged. In the short term, bank-level variables such as the IR and the CBIR play a more significant role. Meanwhile, macroeconomic variables such as GDP and the PPI exhibit greater volatility in the short term, gradually stabilizing in the long term.

Macroprudential measures were implemented to strengthen bank balance sheets and maintain lending capacity. These initiatives aimed to support financial stability and enable a sustained recovery after economic shocks. The resilience of the banking sector was further reinforced by coordinated fiscal interventions from the government, expanded social programs to mitigate income losses, temporary tax relief for businesses, and sovereign loan guarantees to improve access to financing. These combined efforts were crucial for alleviating the economic impacts of the pandemic and maintaining monetary stability.

During the COVID-19 pandemic, the Bank of Albania was compelled to follow traditional monetary policy methods. Interest rates were raised to control inflation and prevent excessive debt accumulation. Between 2022 and 2024, a legal framework was established to address debtors, credit, and capital risks. These measures ensured the continued stability of the financial system and laid a foundation for sustained economic growth.

Additionally, the government should implement more effective macro-prudential and monetary policies to mitigate credit risk within Albania's banking sector. While the study provided valuable insights, it encountered challenges, including reliance on secondary data and a limited sample size of 12 commercial banks in Albania over a short period. Future research could investigate additional bank-specific indicators, such as net loan loss provisions, as dependent or independent variables, and macroeconomic factors like remittances, unemployment, credit growth, and exchange rates.

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Appendix 1

Summary of reviewed literature: the impact of macroeconomic and bank-specific factors on NPLs

Authors	Geographical Coverage	Sample Size	Time Horizon	Methods	Variables	Main Results
Makri, Tsagkanos, and Bellas 2014	Greece, CEE	17 countries of the Eurozone	2000-2008	Panel data analysis	Profitability, oans to deposits ratio, NPLs	Identified the impact of financial performance indicators on NPLs in banks across Greece and CEE countries.
Petkovski, Kjosevski and Jovanovski 2018	Czech Republic	22 banks from the Czech Republic,	2005-2016	Generalised Method of Moments	GDP growth, unemploymen, inflation, NPLs	Non-performing loans are influenced by the real economy, with significant feedback effects from macroeconomic factors such as private sector credit, GDP growth, unemployment, and inflation.
Bogdan 2017	Central and Eastern Europe	12 countries	2005-2015	Panel Least Squares Fixed Effects Method	Inflation, GDP growth, crisis, unemploymen, bank size, cost to income ratio, NPLs	Inflation and GDP growth decrease the NPLs, while unemployment, crisis and cost to income ratio had a positive impact.
Mazreku et al. 2018	CEE countries	10 countries	2006-2016	Panel data, including Pooled OLS, Fixed and Random Effects estimation, Generalised Method of Moments (GMM) estimation	GDP growth, inflation, unemploymen, export growth, NPLs	Found that GDP growth, inflation had the strongest inverse relationship with NPLs in transition countries, including Albania.
Staehr and Uusküla 2017	Western Europe and CEE	26 EUcountries and 11 CEE countries	1997Q4 to 2017Q1.	Forecasting model with a forecasting horizon	GDP growth, inflation, Mortgage loans, Real house prices, Current account, unemploymen, NPLs	Identified GDP growth, inflation, debt, and unemployment as key factors affecting NPLs, with GDP growth and inflation having inverse relationships with NPLs.
Skrabic and Konjusak 2017	CEE	11 countries	1999-2013	Dynamic Panel Data Generalised Method of Moments (GMM) estimation.	ROA, GDP, Inflation, Interest Rate, Loan Growth NPLs	Found that ROA and GDP decrease NPLs, while Credit Growth had a positive impact.
Leka, Bajrami, and Duci 2019	Albania	11 years	-	Multiple regression	GDP growth, M2, loan interest, exchange rate, NPLs	Investigated the role of monetary aggregates and loan interest rates in determining NPLs.
Baholli, Dika, and Xhabija 2015	Albania and Italy	Not specified	Q1 2008 – Q1 2014	Regression analysis	Financial crisis,exchange rate, NPLs	Emphasized the role of the financial crisis in raising NPLs and the importance of banking system oversight.
Mdaghri 2022	MENA countries	Not specified	Not specified	Regression analysis	Bank liquidity (LDR), Loan Loss provisions, Net interest margin, Interest rate, Exchange rate, GDP growth rate, NPLs	Found that bank liquidity has an inverse relationship with NPLs in MENA countries.

Ahmed et al. 2021	Pakistani banking sector	20 banks	2008–2018	Dynamic-GMM estimations	Bank liquidity (LDR), NPLs	Found that higher bank liquidity reduces NPLs, consistent with the inverse relationship between liquidity and credit risk.
Akinlo and Emmanuel 2014	Nigeria	Banks in Nigeria	1981-2011	ECM, Cointegration	Credit to the private sector, NPLs	Identified that increases in credit to the private sector were associated with higher NPLs, suggesting higher credit risk.
Boussaada, Hakimi, and Karmani 2022	MENA countries	Not specified	2004–2017	Panel Smooth Transition Regression model	Bank liquidity, bank performance, bank capital, bank size, inflation, NPLs	Found that bank performance, bank capital, bank size, international financial crisis, and the inflation rate significantly impacts NPLs in MENA countries.
Velliscig, Floreani, and Polato 2022	22 European countries	63 listed European banks	2005Q1-2018Q4	Fixed effects panel data regression analysis,	Capital Adequacy Ratio (CAR), Asset Quality and Provisioning, Texas Ratio NPLs	Found that higher CAR reduces NPLs, indicating lower credit risk with higher capital levels.
Erdas and Ezanoglu 2022	G20 countries	Not specified	1998 and 2017	Regression analysis	Inflation, NPLs	return on equity, credit growth and credit costs have a positive impact on NPLs due to decreased repayment ability from higher inflation.
Koju, Koju, and Wang 2018	30 Nepalese commercial banks	Not specified	2003-2015	Regression analysis	Inflation, NPLs	GDP growth rate, capital adequacy and inflation decrease NPLs, as rising inflation leads to higher interest rates and reduces loan defaults.
Zunic, Kozaric, and Dzelihodžic 2021	Bosnia and Herzegovina banking system	Not specified	-	Regression analysis	GDP growth, NPLs, Loan Loss Provisions, Covid 19	By declining GDP, lead to higher NPLs. While NPLs decreases with the increase of COVID-19.
Demid 2021	Mongolian Banking System	Not specified	2002. Q1 to 2019.Q1	Heterogeneous panel SVARs and standard SVAR models	NPLs output gap; inflation; ominal exchange rate, bank-level interest rate; bank asset size and profitability	The presence of NPLs creates a feedback effect in the economy. As credit quality deteriorates due to rising NPLs, lending slows down, which in turn hampers overall economic growth.
Gashi, F., and Fetai, B. 2023	6 Western Balkan countries banking system	79 number of observation	2003-2017 annual data	Fixed and Random effects panel, pooled OLS techniques and Hausman-Taylor Instrumental IV model	NPIs, Bank Capital/Total assets, Regulatory Capital Risk-Weighted Assets (Solvency Risk GDP growth Rate, ROA, ROE, Money market rate, Loan Port. Growth	Econometric results show that higher monetary policy rates reduce bank risk-taking, while credit expansion increases it in the Western Balkans.
Salifu et al. 2025	Ghana	Not specified	2010q1 to 2022q4	ARDL) bounds testing	GDP growth, inflation rate, capital adequacy ratio, and bank performance (as measured by the return on equity)	Our findings show that monetary policy rates increase NPLs in the long run but reduce them in the short run, while global economic policy uncertainty lowers credit risk in both periods.