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UNDERSTANDING THE KEY DRIVERS OF NON-PERFORMING LOANS IN GREECE

Nikolaos Kalantzopoulos, Athanasios Mandilas, Stavros Valsamidis and
Dimitrios Kourtidis*

Democritus University of Thrace, Kavala, Department of Accounting and Finance, Greece

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

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

JEL Classification: G01, G21, E44

INTRODUCTION

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

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

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

* Correspondence to: D. Kourtidis, Democritus University of Thrace, Kavala, Department of Accounting and Finance, Greece; e-mail: kourtidis@af.duth.gr

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

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

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

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

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

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

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

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

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

LITERATURE REVIEW

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

METHODOLOGY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Data on the NPL ratio

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

Table 1 The descriptive statistics for the variables

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

Source: Authors

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

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

Data on the percentage change in Gross Domestic Product

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

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

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

Data on the percentage change in Public debt

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

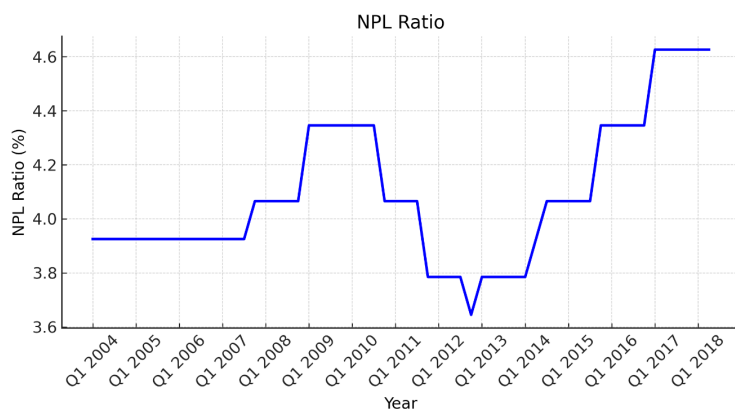


Figure 1 The evolution of NPLs in Greece

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

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

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

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

Data on the inflation rate

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

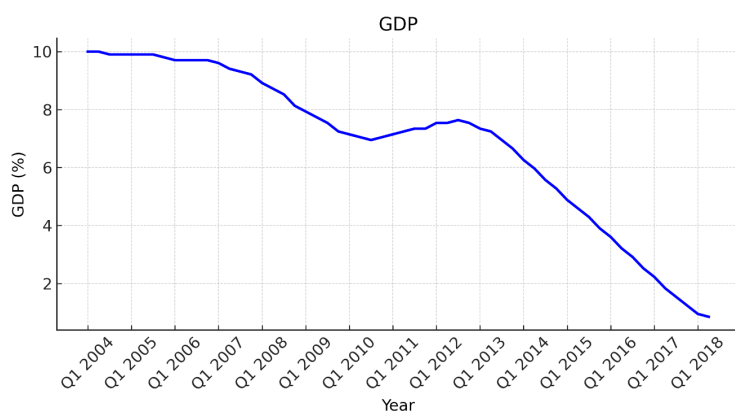


Figure 2 The percentage change in the GDP

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

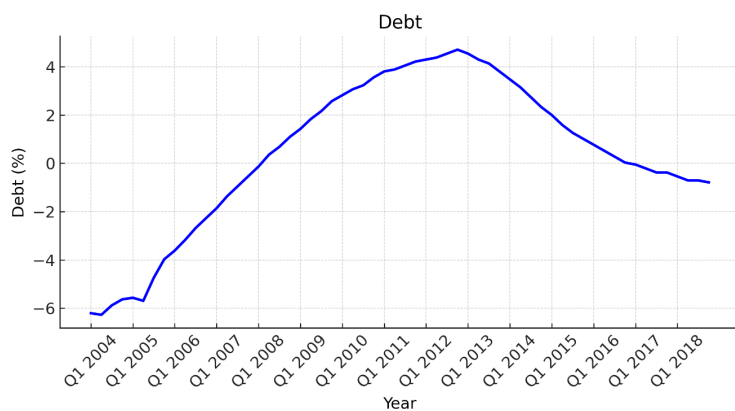


Figure 3 The percentage change in the debt

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

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

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

Data on the unemployment rate

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

There are three main types of unemployment:

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

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

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

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

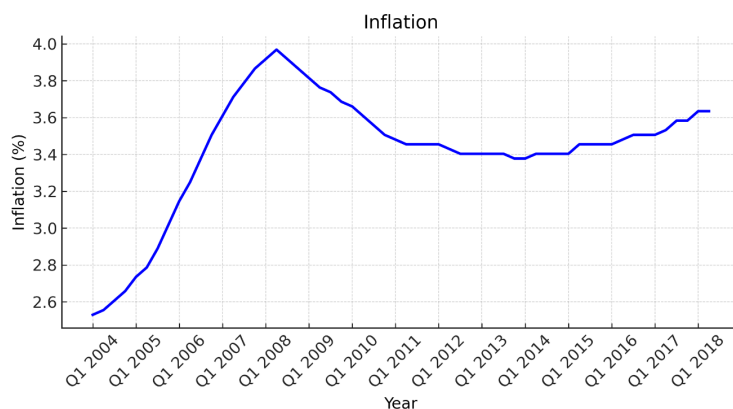


Figure 4 The inflation in Greece

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

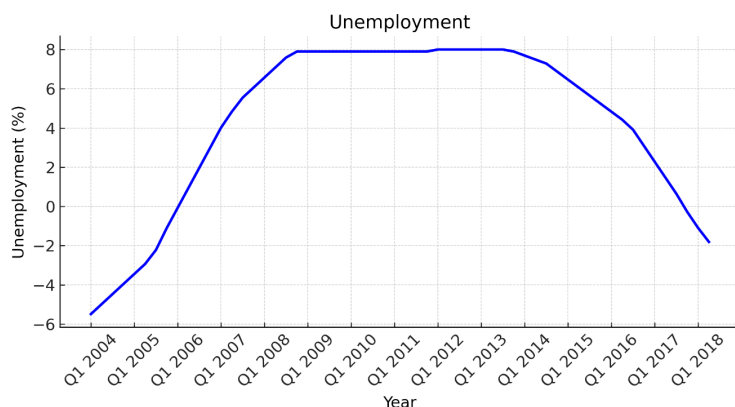


Figure 5 The unemployment in Greece

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

Data on the equity ratio

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

The calculation formula of the financial indicator is as follows:

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

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

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

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

Data on the net interest margin

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

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

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

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

Data on the loan-to-deposit ratio

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

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

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

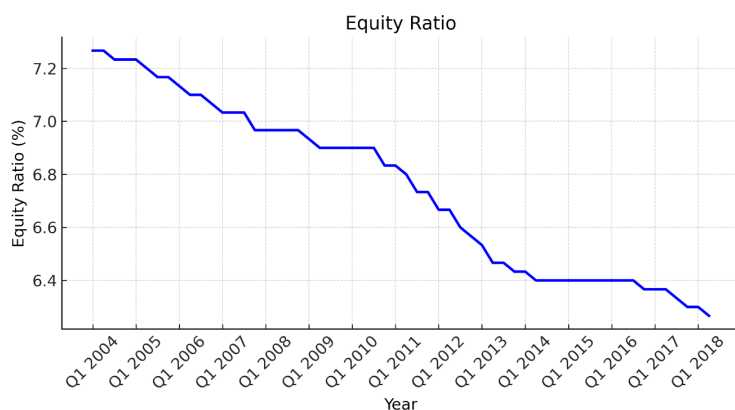


Figure 6 The equity ratio of the Greek banks

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

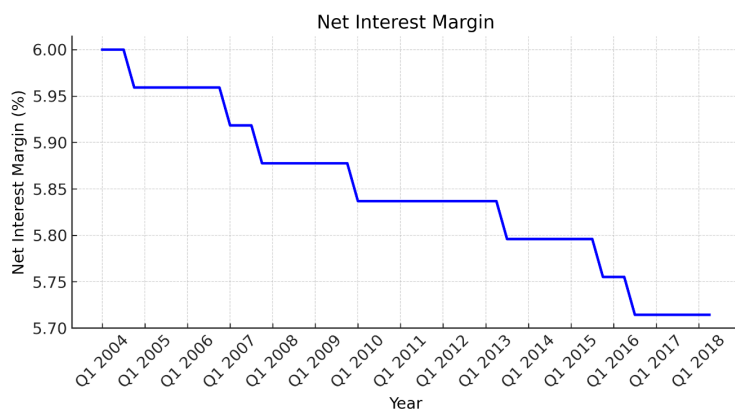


Figure 7 The net interest margin in Greece

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

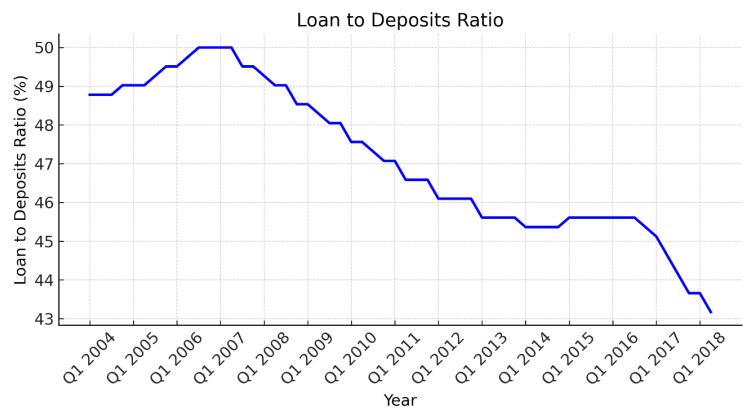


Figure 8 The loan-to-deposit ratio in Greece

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

RESULTS

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

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

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

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

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

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

Table 2 The results of the multiple regression

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

Source: Authors

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Source: Authors

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

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

Source: Authors

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

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

Source: Authors

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

Diagnostic tests

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

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

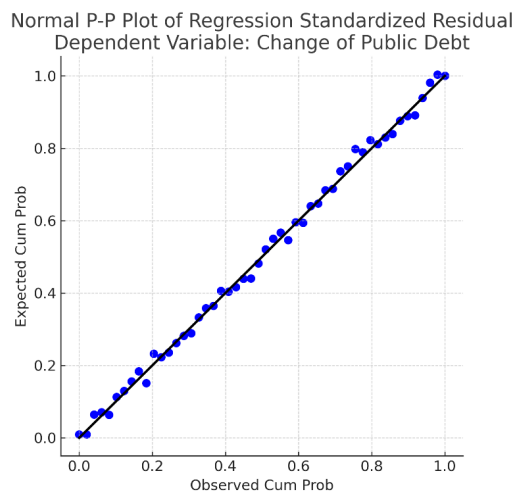
Variance Inflation Factors (VIF) were also performed to assess potential multicollinearity. All the values reported in Table 7 are well below the conventional threshold of 10, suggesting that multicollinearity is not a concern.

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

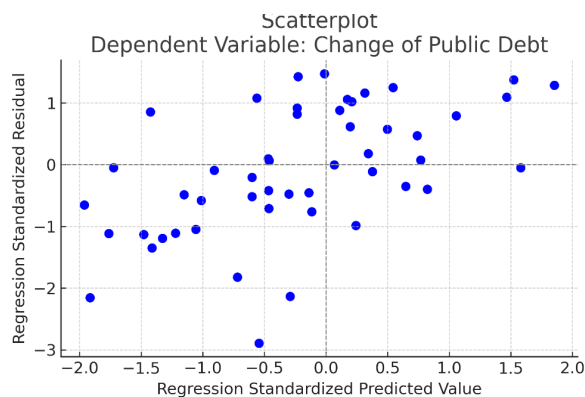
Table 7 The statistics: the coefficients, the standard error, t stat and the P-value after the rejection of the independent variable equity ratio

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

Source: Authors

**Figure 9** The standardized residuals

Source: Authors

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

Source: Authors

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

CONCLUSION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Nikolaos Kalantzopoulos is a PhD candidate in the Department of Accounting and Finance at the Democritus University of Thrace. His research interests focus on climate change accounting, the carbon footprint of businesses, and the impact of the greenhouse gas effect on financial reporting and decision-making.

Athanasios Mandilas is a Professor in the Department of Accounting and Finance at the Democritus University of Thrace. His research interests focus on international accounting, accounting education and integrated reporting. He is author of over 100 peer-reviewed publications.

Stavros Valsamidis is a Professor in the Department of Accounting and Finance at the Democritus University of Thrace. He has published over 180 papers in international journals, book chapters and conferences. His research interests include data analysis, data mining, digital disruption and web applications assessment.

Dimitrios Kourtidis is an Associate Professor in the Department of Accounting and Finance at Democritus University of Thrace. He received his PhD in Finance from Glasgow Caledonian University, UK and postgraduate and undergraduate degrees in Finance and Accounting. His research interest is Behavioural Finance.

RAZUMEVANJE KLJUČNIH DETERMINANTI NEKVALITETNIH KREDITA U GRČKOJ

Nikolaos Kalantzopoulos, Athanasios Mandilas, Stavros Valsamidis and
Dimitrios Kourtidis*

Democritus University of Thrace, Kavala, Department of Accounting and Finance, Greece

U ovoj studiji se istražuju ključni faktori koji utiču na razvoj nekvalitetnih kredita (NPL-ova) u Grčkoj tokom finansijske krize i nakon nje, a koji ozbiljno narušavaju poslovanje bankarskog sektora u toj zemlji. Grčka je dokumentovala najviši NPL ratio među evropskim zemljama, kroz koji se prelamaju ekonomski efekti te krize. U ovoj studiji se koriste podaci za period 2004-2018., a na temelju kojih je sprovedena regresiona analiza u cilju procene uticaja makroekonomskih i bankarskih varijabli. Podaci su uglavnom preuzeti iz izveštaja Centralne banke Grčke i Nacionalnog statističkog instituta Grčke (Hellenic Statistical Authority). Saznanja do kojih se u ovoj studiji došlo ističu postojanje čvrste korelacije između nekvalitetnih kredita i makroekonomskih faktora koji značajno pogađaju poslovanje grčkog bankarskog sistema. Suočavanje s problemom loših kredita predstavlja izazov, a efektivno rešavanje zahteva preokretanje uticaja krize i obnavljanje rasta u cilju pružanja podrške oporavku bankarskog sektora. Iako se studija usredsređuje na Grčku, predlaže se sprovođenje šire analize podataka koji se odnose na Evrozonu zbog međusobno isprepletanih ekonomija. Iako su se neke studije do danas bavile ispitivanjem determinanti nekvalitetnih kredita u Grčkoj, doprinos ove studije se ogleda u primeni ekstenzivnog regresionog modela i uključivanju širokog spektra varijabli.

Ključne reči: nekvalitetni krediti, bankarski sistem, finansijska kriza, makroekonomske varijable

JEL Classification: G01, G21, E44