“Non-Performing Loans and Banking Management: The Role of Corruption and Policy Uncertainty in Financial Stability and the Real Economy”.

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Abstract

The repayment of debt by all economic agents, households, and corporations remains a fundamental determinant of the banking system's stability over time. This factor has proved to be even more critical since the onset of the Global Financial Crisis (GFC) in 2008, when the ratio of Non-Performing Loans (NPLs) to total gross loans reached unprecedented levels. The sharp increase in NPLs not only threatened the viability of numerous banking institutions but, in some cases, also jeopardized the stability of entire financial systems, with the Greek banking system representing an indicative example. The financial disruptions triggered by the GFC have raised several important research questions regarding the determinants of NPL's evolution and their long-term relationship with banks' risk management strategies. Specifically, it is worth understanding how the management team of individual financial institutions approaches credit risk, and thus, it has become a key area of research. Furthermore, the extent to which Economic Policy Uncertainty (EPU) and its components influence financial stability over the long run remains an important question for both academics and policymakers. Additionally, the effects of corruption (or transparency) on financial stability (proxied by NPLs)—apart from its well-documented impact on economic growth—need further investigation, with the Russian banking sector being an explicit example.

Since our effort is to investigate the aforementioned research questions, we selected Greece and Russia as reference countries. Greece is used as the reference country for the first two research questions, while Russia is the reference country for the third one. Regarding the first research question, it examines the attitude towards risk of bank management teams at the institutional level, and for this purpose, we utilized quarterly data covering the period from Q1 2005 to Q4 2014 for the four systemically important Greek banks: EFG Eurobank, Alpha Bank, Piraeus Bank, and National Bank of Greece (NBG). These banks execute a full range of banking activities. To analyze the long-run relationship between non-performing loans (NPLs) and the Economic Policy Uncertainty (EPU) index along with its components, we retrieved data from the Bank of Greece spanning the period from Q4 2002 to Q1 2020. For the two research questions above, we perform a time-series analysis. Furthermore, to assess the impact of changes in transparency (or corruption) on

the NPL ratio, we employed annual panel data for the Russian banking system over the period from 2008 to 2014.

By employing cointegration analysis and the Vector Error Correction Model (VECM), we investigate the existence of a long-run relationship among financial stability (proxied by NPLs), capital adequacy, liquidity, and unemployment. Additionally, we employ variance decomposition analysis to investigate potential bi-directional interactions among these variables of interest. Our findings provide evidence of the existence of a long-run relationship among the variables of interest. All the Greek systemic banks converge towards a long-term equilibrium, although the rate of convergence differs across institutions. On the one hand, the variability of NPLs is explained not only by unemployment but also by the capital adequacy ratio, a factor under the discretionary control of bank management. On the other hand, the variance of both capital adequacy and liquidity is significantly influenced by NPLs in approximately half of the banks in our study. These results provide us with some important policy implications for both monetary authorities and banking supervisors. Policymakers should take into account the variant risk management strategies implemented by different banks, as well as the different philosophies regarding the composition of their loan portfolios. Such views are essential for designing more targeted and effective regulatory frameworks based on each institution's characteristics.

By utilizing cointegration analysis and the Vector Error Correction Model (VECM), we test for a long-run equilibrium with the results obtained providing evidence for the following: (1) There exists a negative, long-term co-integrating relationship between EPU and its components with financial stability. (2) Unemployment and capital adequacy are also negatively related to financial stability in the long term. (3) Our results hold even after decomposing the total NPL ratio into mortgage, consumer, and business NPLs. (4) Consumer NPLs exhibit the slowest adjustment to long-run equilibrium among the NPL subcategories, while mortgages return to the equilibrium at the fastest rate. Our findings provide us with some very important policy implications: initiatives aimed at reducing fiscal and banking policy uncertainties and fostering a stable environment for businesses

and households could effectively manage NPLs more efficiently, as uncertainty influences NPLs not only in the short run but also in the long run.

The results with the use of panel vector autoregression underline the effects of changes in corruption on banks' management quality and on the time persistence of NPLs, along with the negative impact on economic growth. A shock to NPLs reduces profitability, loan growth, and GDP. In a worsening corruption environment, these effects are stronger and more time-persistent, confirming the distorting effects of corruption on both financial stability and growth. In contrast, NPLs decline due to a shock to profitability, leverage, and GDP.

Associated Publications & Conferences

Publications

- Papadamou, S., Papadopoulos, S., & Pitsilkas, K. (2022). The Distorting Effects of Corruption on Financial Stability and Economic Growth: Evidence from Russian Banks Using a PVAR Approach. *Eastern European Economics*, *60*(3), 192–216. https://doi.org/10.1080/00128775.2022.2040366
- Papadamou, Stephanos and Pitsilkas, Konstantinos, Components of Economic Policy Uncertainty and Their Long-Term Relationship to Npls, Unemployment, Bank Capital, and Liquidity Measures. Available at SSRN: https://ssrn.com/abstract=4484579 or http://dx.doi.org/10.2139/ssrn.4484579
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Conferences

- AMEF 2018, University of Macedonia,Thessaloniki, April 2018,
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Finally, I would like to dedicate this work to my grandfather, who has always been a guiding light on the path to my dreams. Even when he was not physically present, his spirit was always there to guide me, encouraging me to believe in my abilities and pursue my goals, no matter how unattainable they seemed. All my successes, therefore, can only be attributed to him as a minimal sign of respect and love. At the same time, I dedicate this to my nieces and nephews—Giannis, Marios, Dimitra, and Giorgos—with the hope that they, too, will pursue their goals and dreams, overcoming any obstacles that may come their way.

To my grandfather

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CHAPTER 1

THESIS INTRODUCTION

1.1 Introduction

The viability and resilience of the banking system have always been matters of high priority and significance, for regulatory and supervisory authorities in each country, mainly because of the crucial role of the financial system in providing the necessary funds to the economy. All along, Non-Performing Loans (NPLs) have been one of the key indicators for assessing the quality of the loan portfolio and the overall financial health. Nonetheless, it was only after the onset of the Global Financial Crisis (GFC) of 2007-2009 that NPLs attracted the attention of the regulatory and supervisory authorities as an issue of high priority. At that period, many countries faced serious problems not only with specific banking institutions but, in some cases, with their overall financial system. This turbulence, as regards the banking sector, either emerged because of the recessionary phase of the business cycle in some countries, or it was the main reason for the recession in others. Notably, the NPLs, as a ratio of the total loans, rose from the lowest level of 0.8% to the highest level of 5% in the US at the peak of the Global Financial Crisis (GFC) (FRED St. Louis)[1]. At the same time, the challenge of a very high ratio on Non-Performing Loans (NPLs) had to be handled also by several countries like Ireland, where the NPLs ratio surged from a low of 0.48% in 2005 to a peak of about 22.37% in 2013. Additionally, in Cyprus, the ratio of non-performing loans sharply increased from the low of 3.59% in 2008 to the high of 47.75% in 2015. Similarly, in Greece, the NPLs ratio climbed from 2.47% in 2008 to 45.97% in 2017. In Italy, an increase from 5.77% in 2008 to 18.064% in 2017 took place, while Spain reached a peak of 7.12% in 2013 (World Bank)[2]. In each case, the evolution of NPLs ratio over time can be attributed to various country-specific, both microeconomic and macroeconomic key factors.

[1] https://fred.stlouisfed.org/series/DDSI02USA156NWDB

[2] https://databank.worldbank.org/country/USA/556d8fa6/Popular_countries

To a lesser extent, for the same issue, developed economies within the G7 encountered similar challenges. Among them, the United States faced the most severe challenge, with the non-performing loans ratio (NPLs) peaking in 2009 (4.9%). This increase in non-accrued loans prevents financial institutions from effectively fulfilling their primary role in the economy- no other than providing funding access to all economic agents, corporations, and households. The higher Non-Performing Loans ratio hampers the financial health and the overall stability of the banking system since the write-off of NPLs from their balance sheets requires an equivalent amount of capital to offset the losses that could be used otherwise in granting new loans to the economic agents.

Therefore, several research questions emerge. The first concerns the extent to which individual banking institutions' approaches to credit risk management influence the evolution of non-performing loans (NPLs). Specifically, does a bank's risk-taking behavior significantly affect the development of its NPLs, or, conversely, is this impact consistent across institutions, regardless of the specific management strategies employed? To investigate this question, it is appropriate to focus on a country that has faced severe challenges with NPLs and whose banking sector is sufficiently concentrated to allow for such an analysis. Greece serves as an indicative case study. Its banking industry is dominated by four systemically important institutions—Alpha Bank, Piraeus Bank, Eurobank, and the National Bank of Greece (NBG)—and has experienced substantial difficulties related to NPLs. Thus, it enables us to perform a focused and effective analysis.

The second research question to be answered in this thesis is the long-run effect of the economic and policy uncertainty index and its components on NPLs. Greece serves as a compelling case study due to the unprecedented heights of uncertainty the country faced in all aspects of social, economic, and political life, as measured by Hardouvelis et al. (2018), after the Global Financial Crisis of 2007 and the following sovereign debt crisis, which, in turn, created severe capital problems for the Greek banks.

Furthermore, how does the level of corruption (or transparency) affect the evolution of non-performing loans (NPLs) beyond its well-established impact on economic growth? Does a deteriorating corruption environment have a negative impact on the stability of the banking system through increased NPLs, or alternatively, does an improvement in

transparency levels exert an influence on the evolution of NPLs? If so, does this intensify the problem and prolong its persistence over time? This thesis investigates the relationship between changes in corruption levels and the evolution of NPLs. Russia was an economy in transition after communism collapsed in 1991 and served as a reference country since it faced severe challenges regarding corruption and, as a result, was constantly ranked low on the Corruption Perceptions Index (CPI), which is published annually by Transparency International (TI). Transparency International also, in its 2021 report, makes the claim that Russia faces severe challenges regarding corruption[3], underlining the seriousness of the issue and justifying thus why Russia is a compelling case study.

1.2 Questions to be answered in Chapter 2

In the second chapter of this thesis, the first research question posed above is examined: if each banking institution advocates separate strategies towards risk-taking. If so, to what extent does this differentiated attitude affect the Non-Performing Loans ratio in the long run? To do so, Greece is used as a reference country. Our sample consists of the four systemically important institutions (ALPHA BANK, EFG EUROBANK, PIRAEUS BANK, NBG). We perform our analysis by utilizing quarterly data over the period Q1:2005 to Q4:2014 and employing the Vector Error Correction Model (VECM) to define the long-run relationship between each bank's attitude towards risk-taking and NPLs and the rate of adjustment of the Non-Performing Loans ratio to the equilibrium. We also investigate the long-run relationship between bank-specific variables and unemployment and NPLs. We furthermore employ variance decomposition analysis to determine the existence of potential causal relations and define the factors explaining the variance of variables of interest.

[3] https://www.transparency.org/en/news/countering-russian-kleptocrats-wests-response-to-assault-on-ukraine

1.3 Questions to be answered in Chapter 3

In the third chapter, we investigate the long-run relationship between the broader Economic Uncertainty Index (EU) along with the Economic and Policy Uncertainty Index (EPU) and its components and the total non-performing loans, including the corresponding sub-categories—mortgages, business, and consumer non-performing loans. We employ the Greek financial system again to conduct our analysis. Our sample consists of quarterly time series data spanning the period between 2002: Q4 and 2020: Q1. The uncertainty indices were estimated by Hardouvelis et al. (2018) based on the methodology proposed by Bloom et al. (2016), and we used the Vector Error Correction Model (VECM). The results of this study also include important policy implications for all regulatory and supervisory authorities and policymakers, since they suggest that uncertainty hampers financial stability beyond its well-established effects on the economy.

1.4 Questions to be answered in Chapter 4

In the fourth chapter, we investigate the relationship between non-performing loans (NPLs) and corruption. Our analysis incorporates bank-specific variables, GDP, and the Corruption Perceptions Index (CPI) to assess the dynamics of NPLs under both worsening and improving corruption conditions—before and after the inclusion of corruption in the model. This study explores the intensity and time persistence of NPLs that may arise due to corruption. We also examine the broader implications of corruption for financial stability. To achieve this, we employ annual panel data for the period 2008–2014 and conduct a Panel Vector Autoregression (PVAR) analysis. In addition to the empirical results, the study provides important policy implications, emphasizing the need for the government to establish an enhanced transparency environment so that all economic agents benefit from the positive consequences of this improvement.

CHAPTER 2

IS THERE A LONG-RUN RELATIONSHIP BETWEEN NPLS, UNEMPLOYMENT, CAPITAL ADEQUACY, AND LIQUIDITY? EVIDENCE FROM THE GREEK BANKING SYSTEM.

2.1 Introduction

The debt crisis Greece experienced over the last decade impacted not only the real economy but also the soundness of the financial system. The austerity fiscal policies enacted sharpened the non-performing loan (NPL) situation in Greek banks. As a result, the NPL ratio, a crucial measure of the banking system's health and stability, peaked at around 50% of total loans. This was the highest NPL ratio among European Union and Eurozone countries and significantly higher than the EU average of less than 5%.

The NPL ratio serves as a crucial measure of the exposure of individual banks to risk and is widely regarded as an indicator of a loan's portfolio quality and the stability of a country's financial system. In this study, we investigate the speed at which each bank adjusts to the long-term equilibrium, focusing on the four systemic banks of the Greek banking sector: Alpha Bank, Eurobank, Piraeus Bank, and the National Bank of Greece. Our analysis reveals the divergent approaches adopted by the banks' management teams towards risk and the composition of their loan portfolios.

The Greek financial sector presents a rather interesting case study for two key reasons. First, the stability of the Greek banking system was severely threatened by the escalating NPL ratio—the highest in Europe—following the onset of the debt crisis in 2010. This situation necessitated the recapitalization of banks and the consequent concentration of the banking sector. Second, the Greek banking industry is now characterized by a high degree of concentration, with the four systemic banks controlling the majority of the market share. These four banks are also under the supervision of the

European Central Bank (ECB) [4] as they are classified as systemically important financial institutions. The sample period spans from 2005 to 2014. During the first sub-period (2005–2010), the country's economy experienced growth. However, from 2010 onward, the economy entered a recessionary phase, with its lowest point in 2014—the non-performing loans (NPLs) ratio began to stabilize after this year. Thus, the sample is for a period encompassing both an expansionary and a recessionary phase of the economy.

In recent years, a growing body of literature explores the potential interaction between NPLs and macroeconomic or microeconomic factors—or both (Nkusu, 2011; Reinhart & Rogoff, 2011; Klein, 2013). However, not many studies examine the long-run relationship between NPLs and macro- and/or microeconomic variables, which remain scarce and primarily focus on aggregate banking data (Konstantakakis et al., 2016). Our study differentiates from that of Konstantakakis et al. (2016) in that we incorporate in our model liquidity and capital adequacy measures while utilizing bank-level rather than aggregate data. The use of micro-level data allows for the identification of relationships that may remain concealed in aggregate analyses, offering valuable insights for policymakers and regulators seeking to ensure financial stability.

The current chapter contributes to the current literature in several ways. First, by employing micro-level banking data, it highlights the heterogeneous ways in which banking institutions manage risk. Second, it provides empirical evidence of the varying interactions between key financial variables—namely, capital, liquidity, and unemployment—and NPLs, depending on the management strategies of individual financial institutions. Third, it underlines the need for supervisory authorities to tailor their approaches to each financial institution, taking into account their specific characteristics. Fourth, it identifies the long-run relationship between NPLs, capital, liquidity, and unemployment within the banking sector. Last, but not least, it emphasizes the differing speeds at which NPLs adjust to long-run equilibrium across banks.

[4] https://www.ecb.europa.eu/stats/financial_corporations/list_of_financial_institutions/html/daily_list-MID.en.html

This chapter is organized as follows: The next section presents a brief literature review. In section 3, a discussion of the data and methodology follows. The empirical results are outlined in Section 4, while Section 5 concludes with policy implications and managerial considerations.

2.2 Literature Review

2.2.1 Studies using a VAR approach

Most studies examining the relationship between non-performing loans (NPLs) and their determinants utilize both microeconomic and macroeconomic variables. A seminal work performed by Berger and De Young (1997), focuses exclusively on microeconomic factors. In their study, they introduce four hypotheses to explain the bank-specific determinants of NPLs: (a) the bad luck hypothesis, (b) the bad management hypothesis, (c) the moral hazard hypothesis, and (d) the skimping cost hypothesis. Their key findings can be summarized as follows: (i) there exists a bidirectional relationship between NPLs and cost efficiency and (ii) the thinly capitalized banks are less capable of managing risks associated with rising NPL ratios.

On the other hand, some studies focus solely on macroeconomic variables. Boumparis et al. (2019), for instance, examine the relationship between sovereign ratings and NPLs as a measure of banking risk. By utilizing annual data from 72 countries over the period 1998–2016, they employ a panel VAR approach and identify a bidirectional influence: first, a sovereign debt downgrade leads to an increase in NPLs as a result of economic contraction, and second, rising NPLs cause a decline in sovereign ratings. These findings are in accordance with those of the study performed by Reinhart and Rogoff (2011), who analyze an extensive panel dataset covering 70 countries and conclude that NPLs serve as a strong early indicator of an upcoming financial crisis. Additionally, their results provide support for the existence of a causal relationship between sovereign debt and banking crises. They argue that as a country's credit rating declines as a result of increasing debt, it becomes more difficult for this country's banks to raise funding.

In a similar manner, further evidence of the macroeconomic implications of NPLs is provided by De Bock and Demyanets (2012). They find that a positive shock in NPLs leads to lower GDP and exchange rate depreciation. Similarly, Pierros (2020), by using data from the Greek economy, demonstrates that the utilization of productive capacity is negatively related to NPLs. Ghosh (2017) by employing quarterly data from 1984Q1 to 2019Q2 and applying GMM and VAR models, confirms with his findings the negative impact of NPLs on macroeconomic fundamentals, particularly GDP growth and employment rates.

Another study focusing on macroeconomic factors is Aysan et al. (2016), who analyze monthly time-series data from December 2002 to April 2011 to examine the determinants of NPLs in the Turkish banking sector within a VAR framework. Their results suggest that macroeconomic conditions should be considered by legal and supervisory authorities in addition to the microeconomic factors already monitored by regulatory institutions.

A separate strand of literature focuses on the combined effects of both microeconomic and macroeconomic variables on NPLs. Klein (2013) investigates the determinants of NPLs across 16 countries in South, Central, and Southeastern Europe. His findings indicate a direct relationship between NPLs, unemployment and inflation. On the contrary, NPLs are negatively associated with GDP growth and exchange rates. Additionally, his study highlights the role of microeconomic factors such as moral hazard and risk-taking behavior, while also establishing a negative relationship between NPLs and management quality.

Nkusu (2011) further confirms the significance of NPLs in linking credit market frictions and macro-financial vulnerabilities by applying an unrestricted panel VAR approach. The results of his study highlight the importance of NPLs as an indicator of systemic financial risk.

Credit expansion has also been identified as a key determinant of NPL ratios. For instance, Kjosevski and Petkovski (2017) employ a panel VAR approach for three Baltic countries and find that an increase in NPLs negatively affects credit availability, inflation, and GDP while simultaneously increasing unemployment. Conversely, positive shocks to

credit and GDP lead to a decline in NPLs, whereas increases in unemployment and inflation incur a negative impact on NPL ratios.

The relationship between credit expansion and banking system stability is further examined by Konstantakakis et al. (2016), who use a Vector Error Correction Model (VECM) to analyze aggregate data from the Greek banking system over the period 2001–2015. They detect the dynamics arising between non-performing loans and both microeconomic and macroeconomic variables. Their findings confirm that while both microeconomic and macroeconomic variables significantly influence NPLs, the reverse causality holds only for macroeconomic factors.

Furthermore, Beaton et al. (2016) investigate NPL determinants in the Eastern Caribbean Currency Union (ECCU). They utilize quarterly data from 1996Q1 to 2015Q4 and apply methodologies such as fixed and random effects models, GMM-IV, and panel VAR, and they find that, while foreign banks exhibit lower NPL ratios, bank ownership status plays a crucial role. Their results also provide support for the negative relationship between profitability and NPLs and that NPL ratios are significantly influenced by lending practices in dominant economic sectors. The negative relationship between GDP and NPLs is further confirmed in this study.

In the same context, Caporale et al. (2014) utilize monthly data from 1998 to 2012 for the Italian banking sector to examine the relationship between loan portfolio quality and credit growth. By employing a SVAR methodology, they conclude that NPLs tend to increase more sharply during economic downturns following credit expansion in periods of growth.

An additional study for Italy, a country facing challenges as regards NPLs, conducted by Marcucci and Quagliariello (2008) for the period between 1991Q1 and 2004Q1, considers the effects of the macroeconomic conditions on the banking sector and the impact of the financial sector on the real economy. Their analysis, conducted within a panel VAR framework, results in strong evidence for the impact of the macroeconomic conditions on the banking sector, while this becomes weak for the reverse.

The role of macroeconomic factors in shaping loan portfolio quality is also examined by Love and Ariss (2014). They study Egyptian banks using annual data from 1993 to 2010, with their results indicating that GDP and capital inflows are crucial determinants of loan portfolio quality, whereas interest rates exert a negative influence.

Lastly, Anastasiou et al. (2016) analyze NPL determinants in Eurozone countries over the period 2003Q1 to 2013Q3, distinguishing between core and peripheral economies. They use FMOLS and panel cointegrated VAR methods, and they find that most variables behave as expected according to the theory. The case is that the effects are significantly stronger in peripheral countries, highlighting the structural differences within the Eurozone banking sector.

2.2.2 Studies using a Single Equation approach

In another strand of literature that focuses on identifying the determinants of NPLs with the use of single-equation estimation methods, with NPLs as the dependent variable, Louzis et al. (2012) examine the key factors influencing different categories of loans, employing quarterly data from Greece over a six-year period. According to their results, mortgage loans are the most resilient to fluctuations in macroeconomic conditions, indicating that this category of lending is less sensitive to economic downturns compared to other loan types.

Using a Panel GMM approach for the period 2004–2013, Ozili (2020) investigates the effects of GDP growth and various bank-specific factors—such as capital, profitability, and loan growth—on the NPLs of both systemic and non-systemic banks. His results indicate that GDP growth is inversely related to NPLs in both categories, confirming the countercyclical nature of NPLs. Additionally, profitability is found to have a consistently negative relationship with NPLs, regardless of whether a bank is systemic or non-systemic. However, the relationship between loan growth and NPLs varies before the financial crisis, loan growth was negatively associated with NPLs in systemic banks but positively associated with NPLs in non-systemic banks. Conversely, capital exhibits the opposite pattern, reinforcing the idea that the risk-taking behavior of banks differs significantly depending on their classification.

Further to the well-established macroeconomic and microeconomic determinants of NPLs, Anastasiou et al. (2016) contribute to the literature by demonstrating that both the output gap and income taxation play a significant role in shaping NPL trends. More specifically, the results of their study provide evidence for the inverse relationship between the output gap and NPLs, implying that higher-than-potential economic output reduces bad loans. On the contrary, income taxation is directly related to NPLs, which, in turn, suggests that increased tax burdens may cause loan defaults to increase.

Similarly, Osei-Assibey and Asenso (2015) examine the banking system in Ghana using annual data from 2003 to 2012 and apply a Panel System GMM approach to explore the effects of excessive capital on NPLs. They find that both excessive capital and policy rates positively affect NPLs. Additionally, the inverse relationship between GDP and NPLs is confirmed, and the significant role of foreign ownership in moderating bad loans is underlined.

Furthermore, a range of macroeconomic variables has been found to exert considerable influence on NPLs. For instance, Kauko (2015) utilizes data from advanced economies to identify the current account deficit as a key determinant of NPLs, emphasizing the importance of external imbalances for banking sector vulnerabilities' shaping. His findings suggest that persistent current account deficits may contribute to financial instability by increasing credit risk and weakening the overall stability of the banking system. In the same manner, Beck et al. (2013) find that stock market performance exerts a significant influence on the evolution of bad loans, emphasizing the interconnectedness between financial markets and the stability of the banking sector.

Further evidence on macroeconomic and microeconomic determinants is provided by Kjosevski and Petkovski (2020), who analyze annual data from 21 banks across three Baltic states over the 2005–2016 period. By employing Fixed Effects, Difference GMM, and System GMM models, they find that GDP growth, profitability, and public debt are negatively associated with NPLs, in line with economic theory. On the contrary, loan growth, unemployment, and inflation are directly related to NPLs, confirming thus the argument that worsening economic conditions contribute to rising credit risk. Additionally, their study concludes that the financial crisis had a statistically significant and positive

effect on the NPL ratio in the Baltic states, and the long-term repercussions of economic downturns on banking sector stability are further underlined.

Regional characteristics have also been identified as important determinants of NPLs. Ghosh (2015) incorporates regional GDP as a key factor and he finds out that such regional factors should be taken into account when assessing the capital needs of banking institutions. As a corollary, policy measures aimed at stabilizing the banking sector should be tailored to regional economic conditions rather than relying solely on national-level indicators.

By focusing solely on bank-level characteristics, Laeven and Levine (2009) examine the relationship between ownership structure and risk-taking behavior, as measured by the NPL ratio. They conclude that the ownership status is positively related to the banks' attitude towards risks. In line with the results above, Us (2016) finds that the global financial crisis acted as a turning point in the relationship between ownership structure and NPLs. While the crisis did not alter the significance of ownership status for private banks, it rendered the ownership effect statistically insignificant for foreign banks. Contrarily, for the state-owned banks, ownership status was found to be insignificant before and after the crisis too.

In contrast, Iannotta (2007) presents an opposing view, finding that ownership structure is inversely related to loan quality, profitability, and risk-taking behaviour. Similarly, Salas and Saurina (2002) decompose the sample into savings and commercial banks and conclude that these two types of institutions differentiate their attitude concerning NPLs. Their study highlights the importance of institutional structure in understanding variations in credit risk exposure and management strategies.

2.3 Data and methodology

For the purpose of our analysis, we utilize quarterly data spanning from Q1 2005 to Q4 2014 for the four Greek systemic banks: Piraeus Bank, Alpha Bank, Eurobank, and the National Bank of Greece. The data were obtained from the Bank of Greece.

In this chapter of this thesis, we incorporate variables that capture banks' risk-taking behavior. Both the loans-to-deposits (LTOD) ratio and the equity-to-total-assets ratio

(EQTA) provide a clear view of how banks allocate their financial resources. Firstly, the LTOD ratio declares the proportion of deposits that a bank utilizes to issue loans and serves as a measure of liquidity. According to the theory, the relationship between liquidity and NPLs is twofold. On one hand, a higher LTOD ratio suggests that a bank has allocated a greater share of its deposits to grant new loans, thus increasing the probability for the non-performing loans ratio to be higher (Louzis et al., 2010; Makri et al., 2014; Anastasiou et al., 2016). Consequently, we expect a positive relationship between the LTOD ratio and the NPLs ratio. On the other hand, if a bank employs advanced risk assessment techniques to enhance its loan-granting processes, it can achieve lower NPL levels. In this case, improved liquidity management could exert a negative impact on NPLs (Saif-Alyousfi et al., 2020).

By incorporating these variables, our analysis aims to shed light on the extent to which Greek systemic banks' risk management practices influence the evolution of NPLs over the study period.

Additionally, the relationship between the equity-to-assets (EQTA) ratio and NPLs can be either positive or negative. If evidence for the inverse relationship is provided by the results, this supports the moral hazard hypothesis, which suggests that well-capitalized banks engage in less risky behavior, and as a result, they present a lower NPL ratio (Abedifar et al., 2018). Conversely, in the case of a direct relationship, the explanation lies in the bank managers' awareness of the high-risk nature of their loan portfolio. Thereby, they prefer, as a precautionary measure, to maintain higher capital reserves than granting new loans (Ozili, 2020).

Concerning the macroeconomic variable included in our analysis, unemployment is expected to be positively related to NPLs. This implies that higher unemployment rates increase NPLs (Louzis et al., 2012; Nkusu, 2011; Klein, 2013). We chose unemployment for three key reasons. First, while most studies focus on GDP as the primary macroeconomic determinant of NPLs, we aim to examine the direct effects of labor market conditions on NPLs. Second, unemployment is inherently tied to economic cycles—declining during periods of economic expansion and rising in times of recession, making it a strong indicator of overall economic health and a crucial factor in assessing the

evolution of NPLs. Third, there is also a connection very well established between unemployment and households' and businesses' income.

In **Table 2.1**, the descriptive statistics of the variables included in our analysis are presented. It comes out that Piraeus Bank exhibits the highest standard deviation in NPLs, indicating the greatest variability in its NPL ratio across the sample period. On the contrary, the National Bank of Greece (ETE) NPLs ratio presents the smallest standard deviation, which suggests a more stable NPL trend.

Table 2.1 Descriptive Statistics

	ALPHA BANK			ETE		
	NPLs	**EA**	**LTOD**	**NPLs**	**EA**	**LTOD**
Mean	12.43	12.47	132.55	10.40	12.13	92.13
Median	6.01	12.95	126.79	6.00	11.20	93.50
Maximum	33.6	15.9	175.8	30.10	17.50	125.00
Minimum	3.2	9.5	107.53	0.70	8.10	68.10
Std. Dev.	11.51	1.89	18.2	9.91	2.53	13.87
Skewness	0.99	-0.11	0.88	0.82	0.45	0.04
Kurtosis	2.28	1.92	2.88	2.14	1.98	2.50
Jarque-Bera	7.45	2.01	5.24	5.69	3.09	0.42
Probability	0.02	0.36	0.07	0.06	0.21	0.81
Obs.	40	40	40	40.00	40.00	40.00
	EFG			**PIR**		
	NPLs	**EA**	**LTOD**	**NPLs**	**EA**	**LTOD**
Mean	10.96	11.81	131.68	12.49	11.48	121.41
Median	5.48	11.51	129.94	5.35	11.10	116.64
Maximum	33.10	17.70	173.48	39.50	15.20	171.50
Minimum	2.40	8.10	99.80	2.05	8.80	101.00
Std. Dev.	10.46	2.30	16.86	13.04	1.81	15.40
Skewness	1.04	1.03	0.31	1.14	0.64	1.42
Kurtosis	2.60	3.97	3.04	2.68	2.37	5.01
Jarque-Bera	7.48	8.58	0.66	8.77	3.42	20.17
Probability	0.02	0.01	0.72	0.01	0.18	0.00
Obs.	40	40	40	40	40	40

Notes: NPLs is the non-performing loans, EA is the equity over assets ratio and LTOD is the loans to deposit ratio.

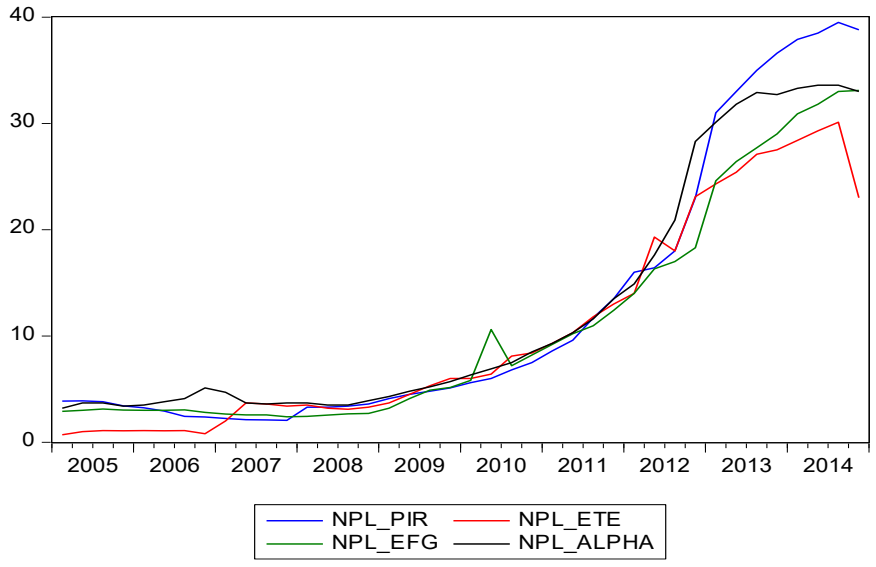
Regarding capital adequacy, measured by the equity-to-assets ratio, Alpha Bank is the most well-capitalized institution, since its mean value is the highest among the four banks. Furthermore, regarding lending practices, ETE is the most conservative bank, as it exhibits the lowest mean loans-to-deposits ratio (LTOD) of 93.5% and the lowest

maximum LTOD ratio at 125%. This indicates that ETE either maintained a low-leverage approach to lending or held a high level of deposits throughout the sample period.

By utilizing the dataset spanning the period from 2005 to 2014, we are allowed to analyze the Greek banking sector's behavior both before and during the peak of the financial crisis and dive into the lending practices, capital adequacy, and risk exposure of systemic banks when economic conditions alternate.

In **Figure 2.1**, the evolution of non-performing loans (NPLs) in Greece over the examined period is presented. In this figure, it is more than obvious that NPLs remained at relatively low levels until the second quarter of 2010, when a notable increase was observed. This sharp increase in the NPLs ratio coincided with Greece's agreement with the International Monetary Fund (IMF) in May 2010. The signing of this Memorandum of Understanding (MoU) with the IMF for a substantial financial assistance package was necessitated by the Greek government's inability to access international capital markets as a result of the severe fiscal challenges.

Figure 2.1 Evolution of NPLs



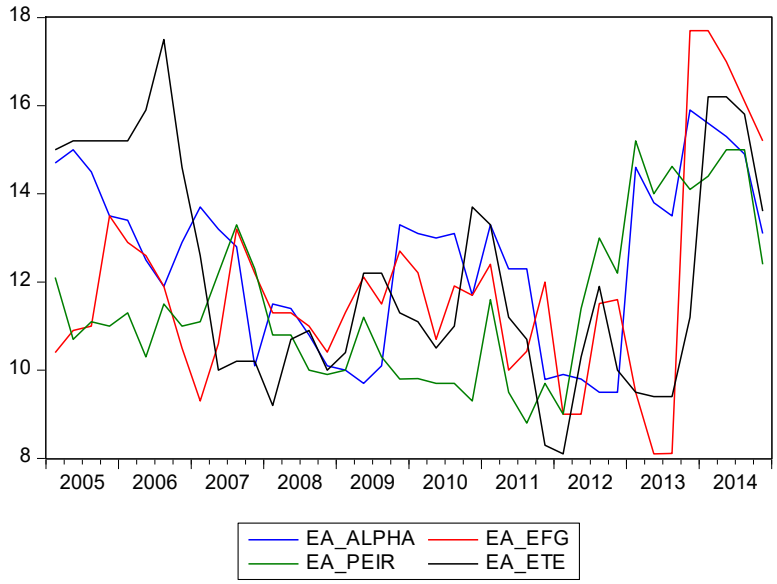
Note: The intertemporal evolution of NPLs per banking institution is presented.

Following this initial increase, the rise in NPLs became even more intense, reflecting the deepening economic distress and the impact on the banking sector. Only after the third quarter of 2014 do the data indicate signs of stabilization. The stabilization of the

NPLs ratio can be attributed to two key factors: the first lies in the fact that the measures implemented during the crisis may have started to take effect in mitigating further deterioration in loan quality. Second, the simultaneous recovery of economic activity may have improved the households' and businesses' ability to pay off their debts.

In **Figure 2.2**, the evolution of the equity-to-assets ratio for Greek systemic banks is presented. Prior to the financial crisis, the National Bank of Greece (ETE) maintained the highest capital ratio, while Eurobank (EFG) was the most thinly capitalized among the four banks. Furthermore, at the peak of the crisis in 2012, all banks faced a significant decline in their capital ratios, mirroring the severe financial distress and increased risk exposure within the banking sector. The recapitalization program that took place in that period (finished in July 2013) helped most of the banks to gradually rebuild their capital ratios. The exemption to this phenomenon was Eurobank (EFG), which faced a further decline in 2013, in contrast with the trend observed in other institutions. This period of capital recovery was interrupted by a sharp decrease in 2014, highlighting the volatility and fragility characterizing the Greek banking system as a result of the prolonged economic downturn.

Figure 2.2 Evolution of Equity-to-Assets

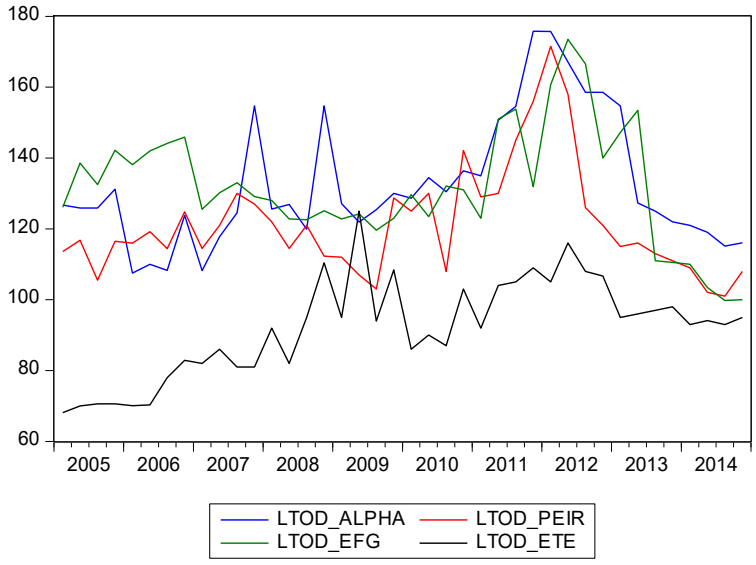


Note: The intertemporal evolution of Equity-to-Assets per banking institution is presented

In **Figure 2.3**, we present the evolution of the loans-to-deposits (LTOD) ratio for Greek systemic banks. By examining the data, it is revealed that most banks—Piraeus Bank (PIR), Alpha Bank, and Eurobank (EFG)—reached their highest LTOD ratios around 2012. This peak concurred with the financial crisis, reflecting the challenges the Greek banking sector had to face to maintain liquidity and sustain lending activity.

Following this peak, a notable decline in the LTOD ratio was observed across all banks. Two factors are mainly responsible for this decline: first, the economic uncertainty forced the banks to adopt tightened lending policies and engage in a risk-averse attitude, which resulted in a sharp contraction in credit growth; and second, the concerns for Greece's economic future had a severe impact on the level of deposits; a surge of withdrawals occurred during this period. The developments above influenced the attempts of the financial institutions to restore their balance sheets' stability, as they contributed to the further deleveraging of the banking sector.

Figure 2.3 Evolution of Loans to Deposit



Note: The intertemporal evolution of Loans-to-Deposits per banking institution is presented

Since we focus on the long-run relationships between non-performing loans (NPLs), the equity-to-assets ratio (EQTA), the loans-to-deposits ratio (LTOD), and unemployment (UN), it is crucial to account for the time series properties of our variables. Given that all variables are found to be non-stationary and integrated of order one, I(1), indicating the presence of a common stochastic trend, they are likely to be cointegrated. To

capture the long-run dynamics, we employ a Vector Error Correction Model (VECM) approach. In our case, it is more suitable than a Vector Autoregressive (VAR) model. Utilizing a VAR framework would result in misspecified relationships and inconsistent parameter estimates. By utilizing an error correction mechanism, we are also allowed to obtain more reliable insights into the determinants of NPLs within the Greek banking sector.

The general form of the estimation equation of a VAR model is as follows:

$$y_t = B_1 * y_{t-1} + \cdots + B_p * y_{t-p} + C * x_t + u_t \qquad (1)$$

Where,

$y_t = (y_{1t}, y_{2t}, \ldots., y_{kt})'$ *is a* $k \times 1$ *vector of endogenous variables*

$x_t = (x_{1t}, x_{2t}, \ldots., x_{nt})'$ *is a* $n \times 1$ *vector of endogenous variables*

B_1, B_2 ,……..., B_p *is a* $k \times k$ *matrix of the coefficients*

C *is a* $k \times n$ *matrix of exogenous variables coefficient*

$u_t = (u_{1t}, u_{2t}, \ldots., u_{kt})'$ *is a* $k \times 1$ *white noise innovation process*

Since we shall employ a VECM, we can rewrite the VAR equation as a VECM:

$$\Delta y_t = \prod \quad y_{t-1} + \sum_{i=1}^{p-1} \quad \Gamma_I \Delta y_{t-1} + v_t \qquad (2)$$

Where,

$$\prod \quad = \sum_{i=1}^{p} \quad A_i - I \qquad (3)$$

$$\Gamma_i = -\sum_{j=i+1}^{p} \quad A_j \qquad (4)$$

If there exists a cointegration relationship such that the rank of Π is r>0, this can be rewritten as Π=αβ′, and the equation (2) becomes:

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \quad \Gamma_I \Delta y_{t-1} + v_t \qquad (5)$$

Where, the $\beta' y_{t-1} = ECM_{t-1}$ represents the error correction term.

2.4 Empirical Analysis

In **Table 2.2**, the results of the unit root tests conducted for each bank and the corresponding variables separately are presented. According to the findings, the variables are not stationary at their levels, as evidenced by p-values exceeding the 0.05 significance threshold. Consequently, the null hypothesis of the Augmented Dickey-Fuller (ADF) test, which states that the variables contain a unit root, cannot be rejected. However, after taking the first differences, the variables become stationary, implying that they are integrated of order one, I(1). The time series in levels exhibit non-stationary behavior, but their first differences follow a stationary process. Hence, the use of cointegration techniques, such as the Vector Error Correction Model (VECM), is justified to investigate the equilibrium relationships among the variables over the long run.

Table 2.2 ADF Unit Root Tests*

	NPLs		EA		LTOD	
	LEVELS	**1st DIF.**	**LEVELS**	**1st DIF.**	**LEVELS**	**1st DIF.**
ALPHA BANK	0.9402	0.0496	0.1157	0.0000	0.091	0.0000
ETE	0.94248	0.0003	0.1749	0.0039	0.8488	0.0000
EFG	0.9273	0.0000	0.171	0.0001	0.4636	0.0000
PIR	0.7254	0.059	0.2664	0.0000	0.1308	0.0000

Notes :* the p-values of the test are presented
NPLs is the non-performing loans, EA is the equity over assets ratio and LTOD is the loans to deposit ratio.

Table 2.3 Johansen Cointegration Test Results

	ALPHA BANK	**ETE**	**EFG**	**PIR**
DataTrend:	Linear	Linear	Linear	Linear
TestType	intercept	intercept	intercept	Intercept
	trend	trend	trend	Trend
Trace	1	1	1	1
Max-Eig	1	1	1	1

Notes : *Critical values based on MacKinnon-Haug-Michelis (1999)
Selected (0.05 level*) Number of Cointegrating Relations by Model

Since the variables were found to be non-stationary at their levels and became stationary only after first difference, it is necessary to examine the presence of a long-run relationship among them. To this end, we apply the Johansen Cointegration test, which tests the null hypothesis of no cointegration against the alternative hypothesis that at least one cointegration equation exists. The results, presented in **Table 2.3**, provide clear evidence for the presence of a cointegration equation for the variables of interest in each bank. Thus, the existence of a long-run equilibrium relationship is confirmed.

The main results of our analysis are summarized in **Table 2.4**. After determining the optimal number of lags using lag length selection criteria (such as Akaike Information Criterion (AIC) and Schwarz Criterion (SC)), we proceed with the estimation of our models. Given our focus on the long-run dynamics, particular attention is given to the estimated coefficients of the error correction term (ECT-1). It is important to note that the ECT coefficients should fall within the range of -1 to 0. A coefficient closer to -1 indicates a faster adjustment to equilibrium—conversely, a slower adjustment process is confirmed as the coefficient approaches zero.

As shown in **Table 2.4**, all ECT coefficients are negative and statistically significant at the 1% level, as expected. This confirms that deviations from the long-run equilibrium are gradually corrected over time. Specifically, the previous quarter's deviation from equilibrium in the non-performing loans (NPLs) of ALPHA BANK is corrected at an adjustment speed of 49.84%. Similarly, the NPLs of the National Bank of Greece (ETE) adjust at a rate of 68%, while Eurobank (EFG) and Piraeus Bank (PIR) adjust at rates of 60% and 49%, respectively. Thereby, according to the findings, the NPLs of Greek systemic banks tend to converge to their long-run equilibrium in response to changes in capital, the loans-to-deposits ratio, and unemployment.

When examining each explanatory variable separately, it becomes evident that capital plays a crucial role in the banking system's stability, although its impact may vary among banks. Our findings demonstrate that the estimated coefficients for capital are statistically significant across all banks; they exhibit different signs. In the case of ALPHA BANK and ETE, capital has negative and statistically significant effects on NPLs, consistent with the findings of Baselga-Pascual et al. (2015) and Abedifar et al. (2018). On

the contrary, a direct relationship between NPLs and capital is observed for EFG and PIR. These results are following those of Chavan and Gambacorta (2019) and Delis and Staikouras (2011). These mixed findings underline the complexity of capital adequacy's influence on credit risk and suggest that bank-specific factors play a significant role in shaping this relationship.

These findings highlight the different approaches to risk management among the banks. More precisely, for ALPHA BANK and ETE, the observed negative long-run relationship between capital and NPLs provides support for the view that as these banks increase their equity, their NPL levels decrease. This is indicative of these institutions' attitude towards risk; because of their relatively higher capitalization, they were more cautious in undertaking riskier projects. Alternatively, it may imply that a capital increase strengthens their resilience, allowing them to manage credit risk more effectively.

Conversely, the positive long-run relationship between equity-to-assets and NPLs for EFG and PIR suggests that as these banks accumulate more capital, their NPL levels rise too. This constitutes a fundamentally different attitude toward risk. It also suggests that these banks recognize the need for accumulating additional capital to act as a buffer against growing credit risk. Therefore, it implies a more reactive approach to risk management rather than a preventive one. The differences in capital utilization strategies underscore the divergent approaches to risk-taking implemented by the Greek systemic banks' management teams.

Furthermore, the loans-to-deposits ratio exhibits a significant negative relationship with NPLs in the long run, though only for ALPHA BANK and PIR. These findings confirm those of Saif-Alyousfi et al. (2020) and Koju et al. (2018). This inverse relationship stems from the sharp decline in the loans-to-deposits ratio observed in the Greek banking sector from the second half of 2011 onwards. In the same period, a simultaneous rise in NPLs took place, along with widespread deposit withdrawals and a contraction in credit growth (Charalambakis et al., 2017). Additionally, this trend suggests that banks implemented improved risk assessment techniques in their loan approval processes during this period, which indicates a shift toward more conservative lending practices.

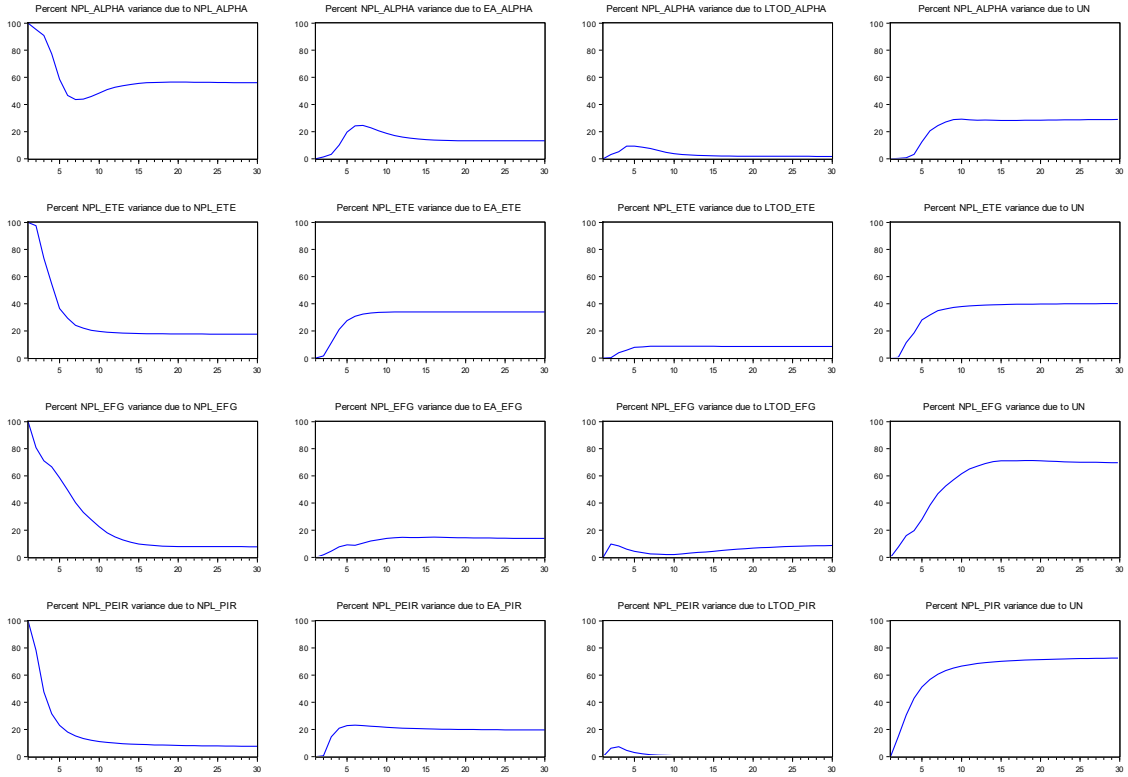
Table 2.4 VEC Model Results 1

	ALPHA	ETE	EFG	PIR
Cointegrating Eq:	**CointEq1**	**CointEq1**	**CointEq1**	**CointEq1**
Equity to Assets(-1)	**-0.51**	**-0.30**	**1.52**	**1.38**
	[-2.52]	**[-2.28]**	**[8.52]**	**[4.23]**
Loans to Deposits(-1)	**-0.05**	0.056	-0.004	**-0.13**
	[-2.13]	[1.34]	[-0.16]	**[-4.74]**
Unemployment(-1)	**125.57**	**101.08**	**91.45**	**127.73**
	[15.63]	**[11.39]**	**[12.79]**	**[11.96]**
@TREND(05Q1)	**0.24**	**0.20**	**0.17**	**0.24**
	[6.13]	**[2.65]**	**[3.61]**	**[4.38]**
C	-1.14	10.76	24.29	12.25
Error Correction:	D(NPL_ALPHA)	D(NPL_ETE)	D(NPL_EFG)	D(NPL_PEIR)
CointEq1	**-0.50**	**-0.68**	**-0.60**	**-0.49**
	[-5.15]	**[-5.45]**	**[-2.65]**	**[-6.54]**
D(NPL(-1))	0.27	**-0.39**	-0.01	0.16
	[1.80]	**[-2.35]**	[-0.05]	[1.47]
D(NPL(-2))	**0.39**		0.38	
	[2.22]		[1.79]	
D(NPL(-3))			**0.50**	
			[2.66]	
D(Equity to Assets(-1))	0.07	0.09	**-0.55**	**-0.60**
	[0.49]	[0.70]	**[-2.32]**	**[-4.35]**
D(Equity to Assets(-2))	0.12		-0.41	
	[0.95]		[-1.79]	
D(Equity to Assets(-3))			-0.12	
			[-0.84]	
D(Loans to Deposits(-1))	0.01	-0.03	**-0.06**	0.02
	[0.38]	[-1.57]	**[-2.6]**	[1.23]
D(Loans to Deposits(-2))	0.01		**-0.07**	
	[0.58]		**[-3.03]**	
D(Loans to Deposits(-3))			**-0.06**	
			[-2.27]	
D(Unemployment(-1))	**-74.21**	**-81.92**	4.32	8.17
	[-2.31]	**[-2.16]**	[0.11]	[0.49]
D(Unemployment(-2))	**-61.88**		21.31	
	[-2.32]		[0.61]	
D(Unemployment(-3))			-1.01	
			[-0.03]	
C	**0.84**	**1.22**	0.06	**0.79**
R-squared	0.73	0.60	0.61	0.79
Adj. R-squared	0.64	0.54	0.39	0.75
F-statistic	8.04	9.72	2.69	23.55
Akaike AIC	2.75	3.36	3.46	2.52
Schwarz SC	3.18	3.62	4.07	2.78
Breusch-Godfrey LM Test*	**0.183**	**0.501**	**0.459**	**0.87**

Notes :*the p-values of the test are presented

Additionally, unemployment emerges as a significant determinant of NPLs across all banks, even in the long run, as evidenced by the statistical significance of its coefficients. This finding is in line with numerous studies in the non-performing loans literature, including those by Pop et al. (2019), Anastasiou et al. (2016), and Chaibi and Ftiti (2015). This direct relationship between unemployment and NPLs provides further evidence of the view that as unemployment rises, it causes loan defaults to increase, as borrowers now face greater difficulties in paying back their debts.

Figure 2.4 NPLs Variance Decomposition



Figures 2.4-2.7 present the variance decomposition of all variables for each bank. Examining the variance decomposition of NPLs (**Figure 2.4**), it becomes evident that the loans-to-deposits ratio contributes minimally to the variation in NPLs across all banks in the long run. However, it seems that unemployment plays a more significant role in explaining the variance of NPLs, especially for EFG and PIR, whereas the impact of unemployment is more pronounced compared to ALPHA and ETE. This variation may be explained by the composition of each bank's loan portfolio. For instance, EFG and PIR

may have devoted a greater portion of their resources to granting mortgage and consumer loans, and these categories are more sensitive to employment conditions. Additionally, ALPHA BANK may have granted more loans to businesses compared to mortgages and consumer loans.

The variance decomposition analysis provides us with more information about the role of capital in shaping the NPLs ratio of different banks. For ETE, for instance, we conclude that capital variance plays a crucial role in explaining fluctuations in its NPL ratio, with a sharp increase observed until the fifth period, after which a stabilization path is observed. Thus, the capital adjustments seem to significantly influence the evolution of NPLs, mainly in the early periods before NPLs reached a steady state. In the case of PIR, capital variance exhibits a sudden rise after two periods, followed by stabilization. As a result, a delayed but sustained influence on NPLs is indicated. For ALPHA, the impact of capital variance on NPLs peaks between the third and sixth periods, after which a minor decline is observed before a stable pattern is achieved. Notably, although the importance of NPLs in explaining their own variance decreases over time for ETE, EFG, and PIR, on the contrary, in the case of ALPHA, this self-explanatory power remains significantly high, at approximately 40%, even after 30 periods. Therefore, the past NPL levels play a more persistent role in shaping ALPHA's long-term NPL trends compared to other banks.

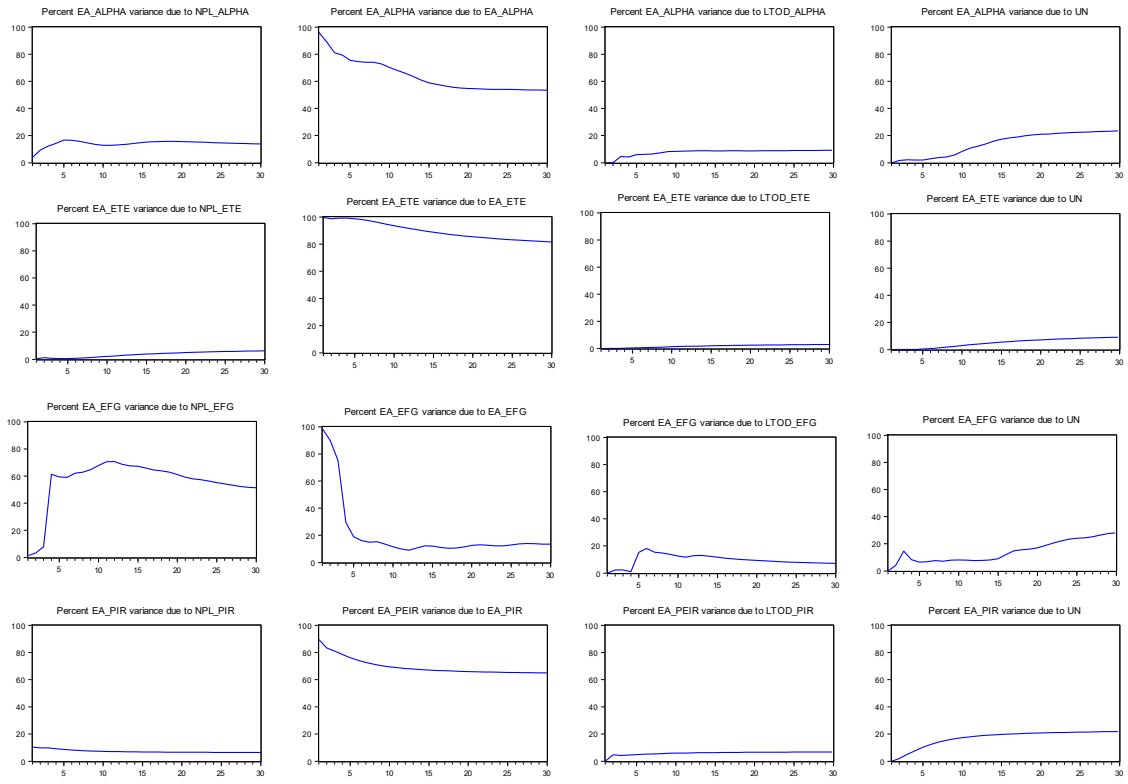
Figure 2.5 presents the variance decomposition of capital (equity-to-assets ratio). The findings indicate that for ALPHA BANK, capital is primarily self-explained, even in the long run. While other factors, such as NPLs, loans-to-deposits, and unemployment, explain to some extent the variations in ALPHA's capital, their influence is rather small. A similar pattern is observed for PIR, reinforcing the notion that these banks rely on internal capital adjustments rather than external macroeconomic conditions to manage their equity positions.

For ETE (National Bank of Greece), capital variance is almost entirely explained by itself, making the contributions of the rest of the variables negligible. Thus, capital adjustments at ETE are largely independent of fluctuations in NPLs, loans-to-deposits, and unemployment, which in turn implies a more stable and internally driven capital structure.

As for EFG, the capital variance decreases sharply over time. In the long run, only 20% of EFG's capital variance is explained by itself, indicating that other factors influence its dynamics. Among these factors, NPL variance exerts the highest impact on EFG's capital fluctuations. This suggests the existence of a strong interdependence between risk exposure and capital adequacy as regards this bank. Additionally, the variance of loans-to-deposits stabilizes after the seventh period, and its impact on capital seems to be more predictable over time. As regards the effect of unemployment on EFG's capital, it steadily increases and reaches almost 30% by the 30th period, providing evidence that the macroeconomic conditions, and specifically the labor market, exert significant influence on it, with this effect getting stronger over the long run.

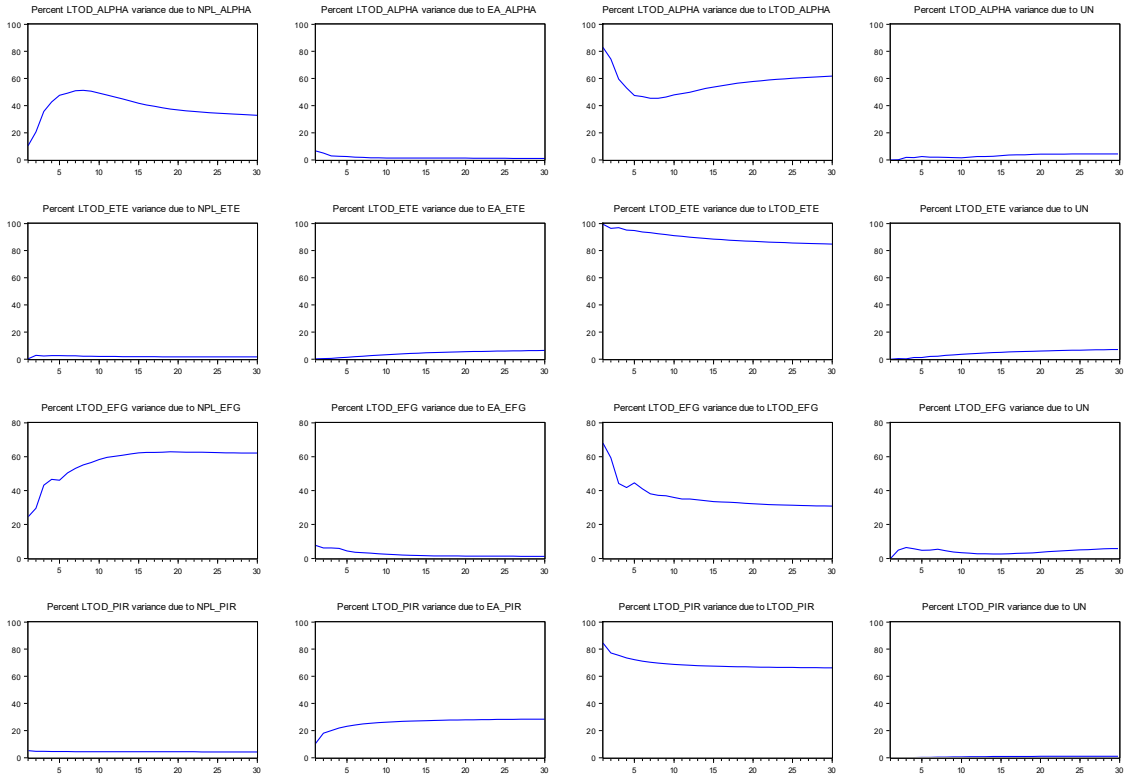
Overall, these findings point out the significant differences among the Greek banks and in the way they manage their capital in response to credit risk, lending activities, and macroeconomic conditions. As a matter of fact, while some banks, such as ALPHA and PIR, rely on internal capital adjustments, others, such as EFG, exhibit greater sensitivity to external factors, particularly unemployment and NPLs.

Figure 2.5 Equity to Assets Variance Decomposition



Regarding the loans-to-deposits ratio, **Figure 2.6** demonstrates that for ETE (National Bank of Greece), the forecast error variance is explained by itself to a very large extent. Only a slight portion of the variance decomposition of the loans-to-deposits ratio can be attributed to fluctuations in NPLs, equity-to-assets, or unemployment. Thus, as in the case of capital, ETE's liquidity is relatively independent of broader financial and macroeconomic shocks.

Figure 2.6 Loans to Deposits Variance Decomposition



For ALPHA, the forecast error variance of the loans-to-deposits ratio is influenced not only by itself but also by NPLs, providing evidence of a causal relationship running from NPLs to liquidity. This influence is particularly strong during the first two periods but stabilizes after the 10th period. By that point, liquidity variance is explained at a percentage of about 60% by its past values, 35% by NPL variance, and the remaining 5% by unemployment variance. This is in line with our expectations: a declining loans-to-deposits ratio implies cautious lending policies and improved credit risk assessment. This, in turn, results in a lower non-performing loans ratio.

For EFG (Eurobank), the influence of liquidity variance decreases sharply, while the explanatory power of NPL variance increases significantly. Stabilization occurs after the 10th period. At that time the NPL variance accounts for nearly 60% of the forecast error variance of liquidity. Furthermore, the variance of the loans-to-deposits ratio is explained by itself at a rate of 30%. A strong causal link between NPLs and liquidity emerges and suggests that rising credit risk significantly limits the bank's lending capacity, emphasizing the detrimental impact of deteriorating loan quality on financial stability.

In PIR (Piraeus Bank), liquidity variance is also self-explained, stabilizing at 70% after the third period. The remaining 30% is explained by equity-to-assets (25%) and NPLs (5%). In the same way, for ETE, liquidity variance can be explained by its past values, exceeding 80% even after the 30th horizon. Compared to the other systemic banks included in the sample, liquidity conditions at PIR and ETE are more resilient to external shocks because of a stronger deposit base or stricter lending criteria implemented.

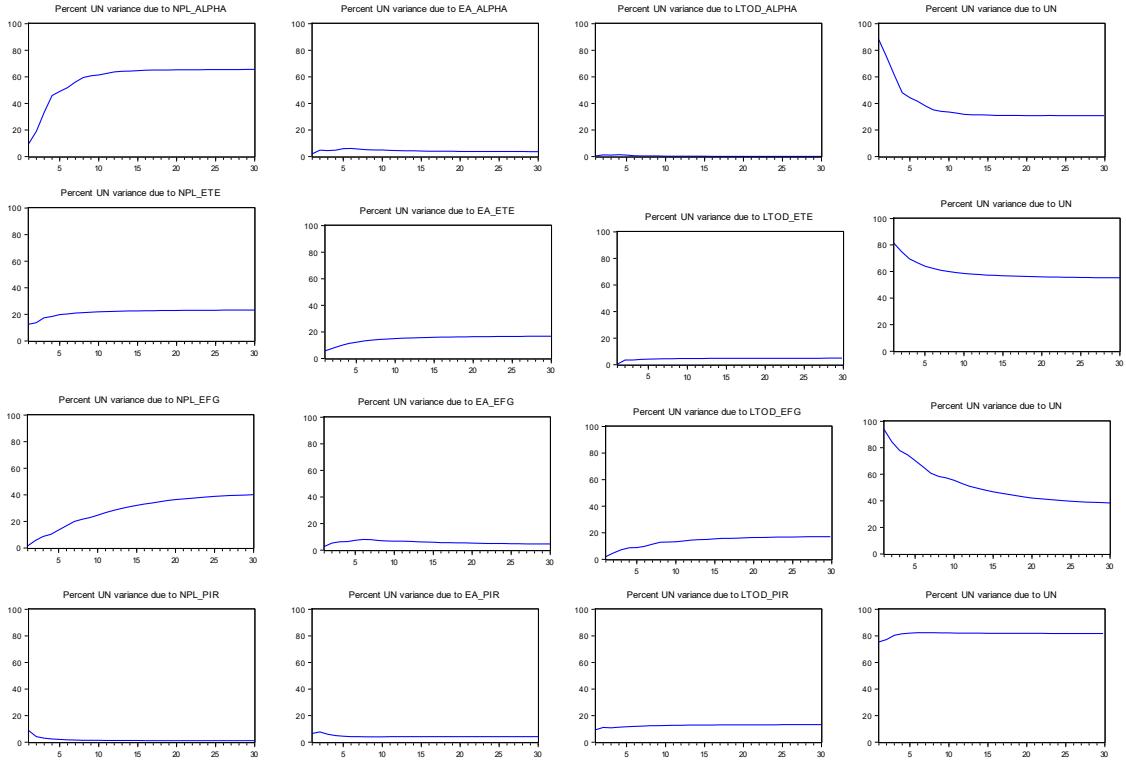
Turning to unemployment variance, **Figure 2.7** illustrates significant differences in how this macroeconomic variable interacts with banking indicators across institutions. In the case of ALPHA, up until the third period, unemployment variance is explained by approximately 50% of its past values, 40% by NPL variance, and 10% by equity-to-assets variance. After this period, this relationship reverses, with NPL variance becoming the dominant explanatory factor. By the fifth period, NPL variance reaches nearly 60% in explaining the variance of unemployment, while unemployment itself explains only 30%, and equity-to-assets variance remains at 10%. This provides support for the existence of a strong causal relationship between worsening loan quality and labor market conditions, emphasizing the consequences of financial instability in the real economy.

Conversely, for PIR (Piraeus Bank), the variance of unemployment remains self-explanatory to a great extent. Only a small fraction of the explanatory power can be attributed to loans-to-deposits, NPLs, or equity-to-assets. Nearly 80% of unemployment variance is explained by its past values. Thus, in the case of PIR, changes in unemployment affect the banking dynamics up to a certain point.

The variance in unemployment, for the case EFG (Eurobank), mainly explains itself. It explains approximately 70% of its total variance, while non-performing loans

(NPLs) contribute around 15%, capital adequacy 5%, and liquidity 10% of the total variance of unemployment. This is the case until the fifth period. However, after this period, the influence of NPLs in explaining the unemployment variance increases significantly, whereas it reaches 40%, while the ability of unemployment variance to explain itself declines to 40%.

Figure 2.7 Unemployment Variance Decomposition



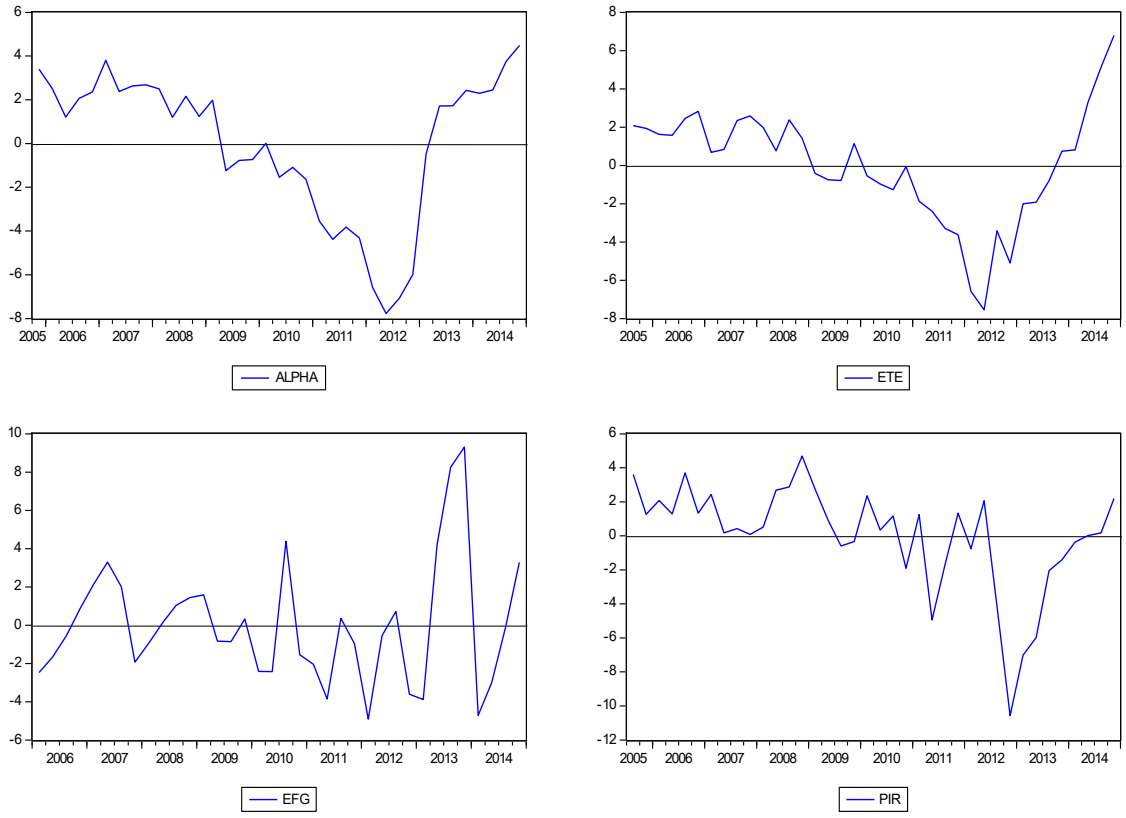
The growing impact of NPLs on unemployment variance, and thereby its greater ability to explain the unemployment variance, suggests that many businesses borrowing from EFG initially exhibited strong creditworthiness at the time they were granted the loan but encountered difficulties in debt repayment as economic conditions deteriorated.

A similar, albeit less pronounced, pattern is observed for ETE (National Bank of Greece). In this case, unemployment variance explains itself at a rate of 60% after the fifth period, while the influence of NPL variance reaches 20%, which is lower than that observed for EFG. Furthermore, equity-to-assets and liquidity contribute 15% and 5%, respectively. The fact that, for three out of the four banks in the sample, the variance of unemployment is explained by NPLs at rates ranging from 20% to 60% highlights a significant feedback

loop between financial distress and the real economy. Our findings confirm the results of prior research, including the works of Konstantakakis et al. (2016) and Ghosh (2017), which emphasize the broader macroeconomic implications of rising.

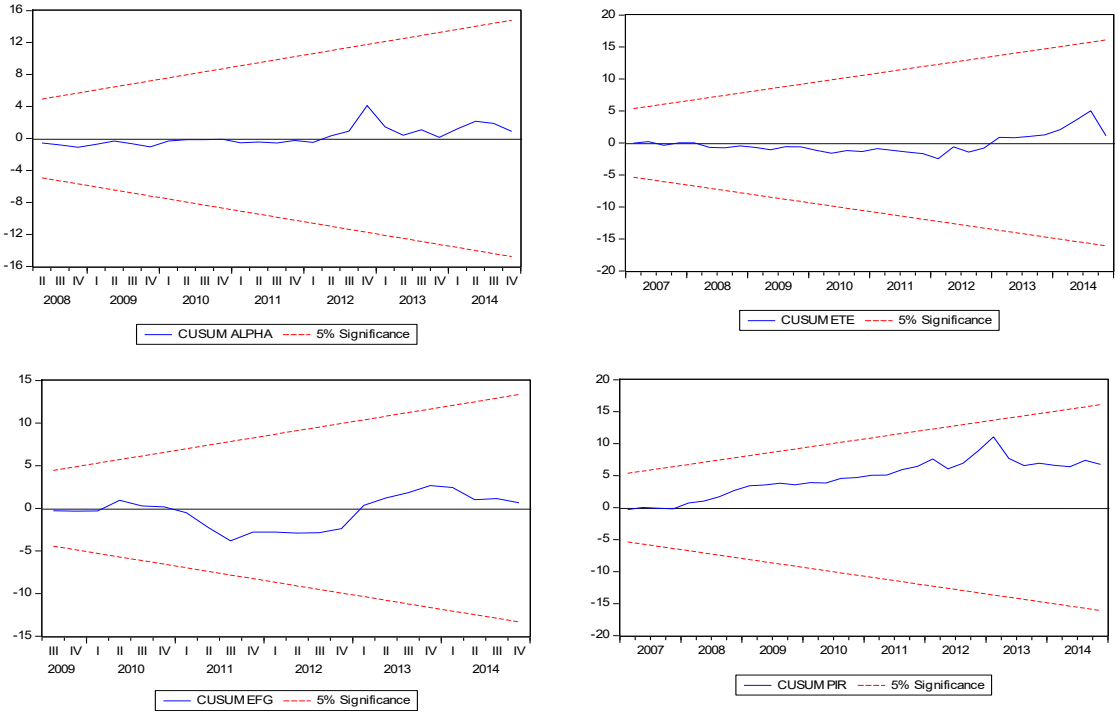
In **Figure 2.8**, the long-term adjustment of the examined variables toward equilibrium is illustrated and provides further evidence of a stable long-run relationship between NPLs, capital adequacy, liquidity, and unemployment.

Figure 2.8 Cointegration Graphs



Finally, **Figure 2.9** presents the results of stability tests for the estimated coefficients, with all coefficients falling within the 5% significance interval. It can thus be concluded that the estimated coefficients remain stable over the sample period.

Figure 2.9 Stability Test



2.5 Conclusion and discussion

In this study, we investigate the long-run relationship between non-performing loans (NPLs) in the Greek banking system and key bank-specific variables, including capital adequacy (measured by the equity-to-assets ratio), liquidity (proxied by the loans-to-deposits ratio), and the unemployment rate as a macroeconomic variable. We use a Vector Error Correction Model (VECM) for our analysis using quarterly data from Q1 2005 to Q4 2014. Our empirical findings suggest that, despite the prolonged economic recession, the NPL ratio in the Greek banking system tends to revert to its long-run equilibrium.

Our findings further indicate that banks' capital levels exert a statistically significant influence on NPLs, even though this relationship varies across different banks in our sample. Specifically, for ALPHA and ETE, the equity-to-assets ratio is negatively correlated with NPLs. This suggests that higher capitalization contributes to lower credit risk, providing evidence for the risk-averse attitude of the most capitalized banks. In contrast, for EFG and PIR, NPLs are directly related to the capital, indicating that NPLs

follow a capital increase. The aforementioned differences provide clear evidence that the Greek banks advocate distinct risk management strategies.

Furthermore, from the macroeconomic variable's perspective, the employment's evolution is directly related to the NPLs in the long run, highlighting the distorting effects of reduced economic activity on the capability of households and businesses to meet their debts.

Moreover, NPLs play an important role in explaining fluctuations in both the loans-to-deposits ratio and the capital adequacy ratio, especially in the case of two out of the four banks under consideration, as can be understood by looking at the variance decomposition results. As a result, the interconnectedness of credit risk, liquidity, and capital adequacy within the Greek banking sector is further indicated.

From a policy-making perspective, banking regulators and governmental authorities should enhance oversight of banks' risk-taking behaviors and ensure the implementation of appropriate legislative measures to safeguard financial stability. Additionally, the supervisory authorities should continuously monitor banks' loan portfolio compositions as an essential element of the effort to maintain a balanced and sustainable credit structure. A future extension of this research could involve a more in-depth analysis of the long-run relationships by disaggregating loan portfolios into distinct categories—such as mortgage, business, and consumer loans. This research extension would enable us to better understand sector-specific dynamics.

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CHAPTER 3

POLICY UNCERTAINTY AND NON-PERFORMING LOANS IN GREECE

3.1 Introduction

On the one hand, after the onset of the Global Financial Crisis (GFC) in 2008, an expanding literature on bank risk-taking as measured by non-performing loans and the determinants shaping their behaviour has been developed (inter alia Laeven and Levine 2009; Louzis et al 2012; Klein 2013; Chavan and Gambacorta 2019; Mies, 2024). The importance of Non-performing Loans in financial stability had been stated clearly by Reinhart and Rogoff (2009), who claimed that NPLs can be used as a signal of the upcoming banking crisis.

On the other hand, recently the literature on economic and policy uncertainty has gained significant interest among banking scholars with the development of Economic Policy Uncertainty (EPU) index by pioneered work of Baker (2016). In line with these two facts and motivated by the study of Larsen (2021), which argues that different aspects of uncertainty influence various aspects of the economy, our paper investigates the long-term relationship between economic and policy uncertainty (and its components) and financial stability in Greece. It utilizes the EPU index, and its sub-components as estimated by Hardouvelis et al. (2018), following the pioneering work of Baker et al. (2016).

This chapter contributes to the literature by focusing on the long-run interplay between EPU and NPLs within a VECM framework, that captures macroeconomic and banking variables. Most studies on NPLs is focused on short term horizon (Karadima and Louri 2021; Phan et al. 2021) while the only paper employing VECM for NPLs, is the one from Konstantakis et al. (2016). that captures macroeconomic variables only. Our study differs in that it incorporates the EPU index and its components, along with bank-specific and macro variables, into the analysis. The country of reference is Greece.

Greece serves as an interesting case study for further research. Since the sovereign crisis started in 2010, the Greek banks have faced consecutive credit rating degradation, and their access to markets has become difficult. The Greek government had to deal with the too-big-to-fail hypothesis. The four banks[5] that were judged to be Systemically Important Institutions by the ECB had to be recapitalized three times[6] in the period between 2013-2015, mainly due to country, credit, and liquidity risks. Moreover, the Greek government signed an agreement with the IMF, ECB, and EU that, among others, included fiscal austerity measures which led to a rather deep recession (25% GDP drop, and 25% unemployment peak). Households' income, firms' earnings, and their ability to pay off debts dropped (NPLs ratio peaked at 49%).

The mechanism which links economic and policy uncertainty with non-performing loans, as expressed by Bernanke (1983), argues that in periods of high uncertainty, firms postpone investments and hiring due to the irreversible nature of these decisions to a later period until they feel safer. This leads to decreased investment and employment, reducing, therefor, the disposable income and consumption, thereby causing aggregate demand to fall and create a vicious cycle. This reduced income makes it difficult for businesses and households to pay their debts. Thus, an increase in NPLs and a subsequent decrease in financial stability occurs.

Our results provide evidence for the existence of a strong, direct, long-run relationship between economic and policy uncertainty (EPU) and its components and non-performing loans, as predicted by the theory. Furthermore, unemployment and capital are directly related to non-performing loans in the long run, as the theory predicts. The results remain robust after decomposing the total NPL ratio into its sub-categories, namely mortgages, business, and consumer NPLs. Also, we find that the NPLs return to equilibrium, but consumer NPLs need more time according to the speed of adjustment,

[5] Alpha Bank, EFG Eurobank, National Bank of Greece, Piraeus Financial Holdings

[6] More details in: Kolliopoulos, A. (2020). The determinants of bank bailouts in Greece: testing the extreme limits of the "Varieties of Financial Capitalism" framework. LSE Research Online Documents on Economics. http://eprints.lse.ac.uk/105072/

while mortgages return to equilibrium at the fastest rate. The impact of the EPU index and its components is stronger in the case of consumer NPLs.

This chapter is organized as follows. Section 2 includes the relevant literature review, and section 3 presents the theoretical analysis and hypotheses to be tested. Section 4 provides information about the data and the main methodology of our research. In Section 5 we present our empirical results. Section 6 concludes with some general comments.

3.2 Literature Review

3.2.1 Studies on the determinants of NPLs

A great part of the NPLs literature has been devoted to the investigation of either bank-specific or macroeconomic variables solely, or both microeconomic and macroeconomic determinants. At the same time, some of the studies examined the impact that institutional factors like corruption, exert on NPLs. As regards the microeconomic determinants, a seminal work was conducted by Berger and De Young (1997), who utilized bank-specific variables to examine four hypotheses: bad luck, bad management, skimping cost, and moral hazard. These hypotheses also investigated by Louzis et al (2012), with their results lending support to the bad management hypothesis. Not only the management of a bank plays an important role in shaping the NPLs ratio, but also the ownership status, according to Laeven and Levine (2009), which is directly related to the bank risk-taking depending upon the structure of this status. Additionally, Shehzad et al (2010) find that below a certain level (50%) this relationship remains positive, while above this level the relationship turns to negative, implying that stricter control of the management team on behalf of the shareholders reduces bank risk. The moral hazard hypothesis is confirmed by Klein (2013), whose study provides evidence for a positive relationship between moral hazard and NPLs on the one hand, while a negative relationship is confirmed for NPLs and the quality of management on the other while the bad management hypothesis is confirmed by Dimitriou et al. (2016) whose study also lends support for moral hazard hypothesis for some specifications.

It is also anticipated that industry conditions play an important role in shaping banks' risk-taking attitudes. Goetz (2018) finds that higher levels of competition result in greater stability due to enhanced asset quality, which in turn improves profitability. In

contrast, Wang (2018), suggests that competition hampers financial stability. In his study, Guidi (2021) finds that the relationship between NPLs and the degree of market competition or concentration depends on the measures used. He concludes that an increase in market concentration (less competition) reduces the NPLs ratio. However, when using the Lerner index to measure competition, he finds that an increase in market power (more concentration) leads to higher NPLs. Conversely, Saif-Alyousfi et al. (2020) show that an increase in competition and market concentration decreases financial stability. During the crisis of 2008 lower competition maintained the stability of GCC banks.

Furthermore, Khan et al. (2017) claim that bank capital requirements play an important role in shaping banks' risk-taking by preventing them from undertaking excessive risks. This contradicts the findings of Us (2017), who finds that higher bank capital correlates with increased risk-taking. Conversely, Gong et al (2018) assert that undercapitalised banks tend to be riskier. Additionally, Ashraf et al (2020), find that capital requirements, when combined with explicit deposit insurance, improve bank stability even in periods of high uncertainty.

The onset of the Global Financial Crisis can also be viewed as a switching regime, in the relationship between credit expansion and NPLs. Vithessonthi (2016) observes that this relationship turned negative with the outbreak of the GFC in 2007. In contrast, Chavan and Gambacorta (2019) conclude that, for emerging economies, this relation is positive.

Additionally, the level of opacity in a bank's operations affects its attitude towards risk. It is well documented in the literature that a transparent banking system is more stable (Morgan, 2002; Fosu et al., 2017; Mies, 2024), while the study of Van Duren et. al. (2019) lends support to these findings by arguing that financial stability transparency is inversely related to NPLs.

Furthermore, the government can exert an impact on the banking system's stability by participating in it. Government-owned banks tend to be riskier, while governments are more likely to act as lenders of last resort in cases of insolvency risk (Iannotta et al., 2013). This may stem from political pressures on the management of government-owned banks and the level of corruption within a country. This is also observed by Brahan et al. (2020), who find that the level of corruption, along with the

capital and size of a bank, are directly related to bank risk. Papadamou et al. (2022) suggest that the effects of corruption on stability are more severe and long-lasting in a deteriorating corruption environment, especially in the recessionary phase of the business cycle.

From the scope of including macroeconomic variables in the analysis, a great number of studies suggest a negative impact of GDP on Non-Performing Loans (Kjosevski and Petkovski, 2020; Danisman and Demirel, 2019). This is due to the influence of business cycles on the ability of businesses and households to pay their debts.

In addition to GDP as the main component of the business cycle, unemployment is another key factor whose impact on financial stability has been extensively studied (Castro, 2013; Konstantakis et al., 2016, etc.). The unemployment and NPls are directly related because, as unemployment increases, disposable income decreases, reducing aggregate demand. Consequently, businesses decrease labor due to lower demand, which leads to an increase. This mechanism explains the decreased ability of households and firms to repay their debts.

The literature has also examined more macroeconomic variables to define their impact on NPLs. For example, interest rates (Cortés and Soriano, 2024) have a positive relationship with NPLs. This is also the case when inflation is included in the model (Staehr and Uusküla, 2021; Shabir et al., 2024), which is directly related to NPLs. Ari et al. (2021) also find that NPLs and public debt are positively related. Additionally, the output gap (Anastasiou et al.,2016) is negatively related to NPLs.

3.2.2 Studies examining the effect of uncertainty on the Economy and Banking

The Global Financial Crisis of 2008 generated significant uncertainty and had an enormous impact on various aspects, like output, investments, employment, and the banking system, which can be quantified by using the various indices proposed in academic literature. The first study on uncertainty is by Bernanke (1983). He develops the idea of the irreversibility of investment choices and analyzes its relationship with uncertainty as regards the consumption of durables to explain the cyclical fluctuations in the consumption of those goods. The results suggest that investors tend to wait in periods of uncertainty, often linked with recessions where the returns on investments are unpredictable until they feel more

confident about the returns. Consequently, they postpone their investment plans to a later, more certain period.

Later, Bloom et al. (2007) investigated firms' behavior under increased uncertainty. Their findings support the view that firms tend to reduce investments and employment during uncertain periods, confirming the results of Bernanke. As a result, fiscal or monetary policy measures may be less effective in mitigating the impact of uncertainty on real economic variables. This suggests that traditional policy tools might not fully counteract the negative effects of heightened uncertainty on the economy. These results may not be permanent, according to Bloom (2009). He argues that significant shocks lead to periods of increased uncertainty, resulting in decreased employment, investment, and productivity. This contractionary effect is temporary, as the variables return to equilibrium after a few periods. In the medium run, the macroeconomic variables of interest increase. Consequently, policymakers should be able to discern the appropriate times to implement intervention policies to mitigate the effects of uncertainty shocks and enhance economic stability.

Other scholars tried to construct new indices to check the validity of the current methodology. Jurado et al.. (2015) aimed to study the relationship between uncertainty and indicators of real economic activity. To do so, they developed a new economic uncertainty index designed to alleviate the disadvantages of traditional indices. Traditional indices often make mistakes in predicting fluctuations in economic activity because of changes in uncertainty and attribute this variation to factors irrelevant to actual changes in uncertainty. Having addressed these issues, Jurado et al. aim to provide a more accurate index for economic uncertainty. The results of their research lend support to the findings of the studies using traditional indicators. They also found that by using their index, they were able to identify fewer uncertainty shocks, which lasted longer compared to those detected by traditional indicators. The effects of uncertainty shocks have also been tested in the context of different theories or on specific variables. Basu and Bundick (2017) investigated the impact of uncertainty shocks on macroeconomic variables such as output, hours worked, and consumption, considering flexible and sticky prices within a New Keynesian model. According to their findings, the effects of an uncertainty shock are more

pronounced when prices are rigid. The effects of this shock are even stronger when the policy rate is at the zero lower bound. Furthermore, their results suggest that increased uncertainty about the future alters the future expectations of the agents without affecting the current situation contemporaneously.

Julio and Yook (2012) study the relationship between corporate investments and elections in a number of countries. Their findings suggest that corporate investments tend to decrease during the period before the elections, which can be explained by policy uncertainty. This negative effect is greater as the election's outcome becomes harder to predict. Firms decide whether to proceed with an investment only after the political situation has normalized, thus providing evidence that the more stable the political situation of a country is, the easier it is for firms to make investment decisions.

Additionally, Gulen και Ion (2015b), in their study, determine the negative effects of uncertainty on capital investment. Their findings suggest that the impact of uncertainty on capital investment depends on each firm's characteristics. By relying more on government spending, a firm faces more pronounced effects. Additionally, they assert that these adverse effects may be long-lasting before eventually transitioning to positive outcomes due to increased investments and employment as firms work to meet rising demand. According to their estimates, this adjustment period ranges from 4 to 8 quarters.

In their pioneering work, Baker et al. (2016) present a measure of global economic policy uncertainty (EPU) and study the effects of EPU on both firm and macroeconomic aspects. They conclude that the increased uncertainty drives firms to reduce or postpone investments and hirings while facing increased stock price volatility. When the economy returns to equilibrium, firms increase their investments and employment to meet the increased demand. These results are valid for industries sensitive to policymaking. The effects of uncertainty on macroeconomic variables lie in the same direction as those on firms, namely that increased uncertainty contributes to decreased investments, employment, and output. In this context, Bloom et al. (2018) study the effect of uncertainty on GDP, investment, and employment by businesses. They find that, following an uncertainty shock, output falls by approximately 2.5%. This shock also causes a reduction in investment and employment levels. These effects arise as businesses delay decisions and

actions in response to the uncertainty. As an extension of the current literature, Larsen (2021) studies the effect of various components of uncertainty on the real economy, along with variables related to firms. He uses keywords for his textual analysis, like oil prices, monetary policy, politics, financial markets, and the relevant uncertainty arising from mergers and acquisitions. The results of his research suggest that uncertainty has both negative and positive effects, and they are consistent with the relevant literature. Specifically, uncertainty related to macroeconomic indicators negatively impacts economic activity. Conversely, the uncertainty associated with mergers and acquisitions positively affects economic activity through increased investment and output.

Since uncertainty was first introduced in the literature, many studies have been performed on the effects of EPU on various aspects of banking. For example, Bordo et al. (2016) show a negative relationship between credit expansion and EPU, and Hu and Gong (2019) examine how loan growth and economic and policy uncertainty are related. Their findings suggest that this relationship is much more intense for larger and riskier banks. In contrast, in the case of liquid and diversified banks, this relationship is weakened. Additionally, Berger et al. (2022) work on bank liquidity hoarding and its relationship with uncertainty, and they define a positive relationship between EPU and bank liquidity hoarding.

Furthermore, Juelsrud and Larsen (2023) examine the relationship between macroeconomic uncertainty and bank lending. Their results indicate that this relationship is significant, and the most dominant component of macroeconomic uncertainty in this relation is the uncertainty for monetary policy, especially for Norway. Tran and Houston. (2023 study the relationship between loan loss provisions and economic and policy uncertainty and conclude that this relationship is positive. Additionally, they claim that in periods of increased uncertainty, the firms should be monitored by analysts and supervision authorities so that the management has fewer incentives for loan loss provision and discretionary behavior. This is also the case when the firm is monitored by analysts and the issuance of dividends occurs. Over the short-term, bank risks increase with EPU. Danisman, Demir, and Ozili (2021) study the relationship between Economic Policy Uncertainty Indices (EPU) and their components, with the risk measured by loan loss

provisions. They also employ bank-specific variables to examine their effects on risk. They conclude that economic policy uncertainty and its components are positively related to risk. They also conclude that in periods of turbulence, banks tend to increase their provisions for loan losses, while during periods of prosperity, they use loan loss provisions for capital management and income smoothing reasons. Not only the bank-specific variables are important in shaping NPLs, but also institutional and cultural factors.

Duan et. al. (2022) examine the relationship between economic and policy uncertainty and systemic risk. They find a direct relationship that is affected by institutional characteristics, like supervision, and national factors, like national culture. Focusing on national cultures helps protect the financial system from EPU influence. In contrast, focusing on individualism, the threats posed to the financial system by EPU increase. They also establish the argument for spillover effects from economic and policy uncertainty. This economic and policy uncertainty in developed countries affects developing countries and highlights the interconnectedness and global impact of economic and policy uncertainty on financial systems.

Additionally, Nguyen (2021) utilize a sample of 950 commercial banks for a period spanning from 2005 to 2020 in 8 European countries to study the relationship between EPU and financial stability. The results provide support for the existence of a negative relationship between EPU and financial stability. On the contrary, the variables related to supervision and regulation, are positively related to financial stability. Furthermore, these variables alleviate the negative repercussions of EPU on financial stability. Shabir et al. (2021) use a variety of econometric methodologies to examine the link between risk and EPU for a sample of 1481 banks from 24 countries using annual data from 2005 to 2019. Their findings support a positive link between risk and EPU, which intensifies in nations with weaker institutional quality and less competitiveness.

Karadima and Louri (2021) investigate the relationship arising between the economic and policy uncertainty index and non-performing loans. In accordance with the theory, this relationship remains direct, but the effects of economic and policy uncertainty weaken with the concentration of the market. The more concentrated a market, the lower the impact of economic and policy uncertainty on NPLs. Phan et al. (2021) investigate the

relation between risk and EPU for a sample of banks from 23 countries using annual data for a period spanning from 1996 to 2016. Their findings support a positive link between risk and EPU. This relationship is more intense in the case of a smaller banking system where the competition is stronger among the banks and the regulation as regards capital is more relaxed.

Orden-Cruz et. al. (2022) study the impact that EPU exerts on the credit risk of a bank by controlling profitability and solvency, among other bank-specific and macroeconomic factors. What comes out is that, of course, there is a direct and statistically significant relationship between economic and policy uncertainty and the credit risk of a bank. This relationship weakens in the case of a more profitable and solvent bank, suggesting that policymakers and bank managers should pay more attention to the category of banking institutions. Caglayan and Xu (2018) use data for 18 countries covering 15 years (1998–2013) to confirm the direct relationship between economic policy uncertainty (EPU) indices and the non-performing loans ratio, providing evidence of the view that the uncertainty in an economy creates a higher NPL ratio through the restricted activity of the economy.

Bilgin et. al. (2021) study the effect of economic uncertainty on financial stability by comparing the magnitude of this impact on conventional and Islamic banks. Their findings suggest that while conventional banks are influenced by economic uncertainty, Islamic banks are not. Shabir et. al. (2023) highlight the impact of the Economic and Policy Uncertainty (EPU) and Geopolitical Uncertainty (GPU) indexes on bank risk. Their results are consistent with those of the literature, indicating that these indices harm bank risk and, thereby, the stability of the financial system due to their direct relationship with bank risk. Wu et al. (2021) use data from seven Asian countries covering a 16-year period (2000–2016) for a sample of 500 banks to examine the relationship between risk and economic uncertainty. They use as proxies for economic uncertainty three macroeconomic indices, namely, inflation, output growth rate, and exchange rates, and find out that bank risk increases with uncertainty.

3.3 Theoretical Analysis and Research Hypothesis

Table 3.1 presents all the hypotheses to be tested in a long-run framework capturing aggregate NPLs in Greece, and their sub-categories (mortgages, business, and consumer NPLs) with unemployment, capital adequacy, liquidity risk, and different types of policy uncertainty, while **Table 3.2** presents the definitions of the variables used in our analysis along with their abbreviations.

Table 3. 1 Hypotheses to be tested in a long-run framework

Variable	Hypothesis	Expected Signs in the Long Run
Unemployment (UN)	**Business Cycle Hypothesis:** A high unemployment rate is in accordance with a high NPLs ratio. In a recessionary environment, unemployment increases, income declines, and thus the ability of households to pay back their debts is lower.	(+) Caporale et al., (2014), Ghosh (2015)
Loans to Deposits Ratio (LTD)	**Liquidity Risk Hypothesis:** High liquidity risk is in accordance with high credit risk. Based on a 'moral hazard' incentive, a higher ratio of loans with respect to deposits means easier loan granting, a risk-loving attitude, and, therefore, a higher probability of developing NPLs.	(+) Anastasiou et al., (2019)
Equity to Total Assets (EQTA)	**Bank Capitalization Hypothesis 1:** High-capitalized banks lead to reduced risk-taking behavior and a decrease in NPLs. The higher the capital of a bank, the more the shareholders will have to lose in the case of a bad loan. Thus, they become more reluctant to lend money to projects that are insecure. Similarly, based on 'moral hazard' incentives, institutions that have low capitalization levels raise loan portfolio riskiness We, thus, expect a negative sign between EQTA and NPLs.	(-) Louzis et al., (2012). Ghosh (2015)
	Bank Capitalization Hypothesis 2: High-capitalized banks leads to increased risk-taking behavior and an increase in NPLs. The idea of 'too big to fail' may lead managers of well-capitalized banks to adopt a lax credit policy, suggesting a positive correlation between capital and NPLs. The more capitalized banks are more willing to undertake more risks since they rely on the government's intervention in the event of a failure based on their importance to the banking system.	(+) Ghosh (2015)
Economic Policy Uncertainty (EPU)	**Economic Policy Uncertainty Hypothesis:** Increased Economic Policy Uncertainty coexists with increased lending rates, low investments, and increased NPLs	(+) Wu et al., (2020) Hardouvelis et al., (2018)
Banking Policy Uncertainty (EPUB)	**Banking Policy Uncertainty Hypothesis:** Increased Banking Policy Uncertainty significantly increases bank lending interest rate spreads (business and housing rates versus consumption rates) leading households and businesses to face difficulties in paying back their debts, which results in an NPLs increase.	(+)
Debt Policy Uncertainty (EPUD)	**Debt Policy Uncertainty Hypothesis:** Increased Debt Policy Uncertainty significantly increases the cost of borrowing for government, households, and businesses, respectively, that face difficulties in paying back their debts, which results in an NPLs increase.	(+)
Tax Policy Uncertainty (EPUT)	**Tax Policy Uncertainty Hypothesis:** Increased Tax Policy Uncertainty leads to low levels of investments by firms and low purchases of durables by consumers, leading firms to lower profits, higher unemployment, and higher NPLs	(+)

Table 3. 2 Variable Definitions and Abbreviations

Variable	Abbreviation	Definition
Unemployment rate	UN	The unemployment rate represents the number of individuals who do not currently work but are actively looking for it, as a share of the total number of people in the labor force.
Loans to Depostis ratio	LTD	It is the ratio of the Total Loans granted divided by the Total Deposits of a bank.
Equity to Total Assets ratio	EQTA	It is the ratio of the Equity of a bank divided by the Total Assets of this bank.
Economic Uncertainty	EU	It is a broad uncertainty index which refers to the uncertainty as regards the economy of a country.
Economic and Policy Uncertainty	EPU	It is an uncertainty index which refers to the uncertainty on economy and politics.
Economic and Policy Uncertainty index for banking	EPUB	It is an uncertainty index which refers to the uncertainty on economy and politics and especially to the banking system.
Economic and Policy Uncertainty for Fiscal Policy	EPUF	It is an uncertainty index which refers to the uncertainty for Fiscal policy.
Economic and Policy Uncertainty for Debt	EPUD	It is an uncertainty index which refers to the uncertainty of Fiscal policy and specifically to the Debt.
Economic and Policy Uncertainty for Taxing	EPUT	It is an uncertainty index which refers to the uncertainty of Fiscal policy and specifically to the Taxing policy.

In this section of the chapter, we develop the relevant information by analysing the theoretical underpinnings and the expected signs in the relevant relationships, as follows:

3.3.1 The impact of Unemployment (UN) on Non-Performing Loans (NPLs)

We expect that unemployment is positively related to NPLs in the long term. The intuition behind this is that in a recessionary environment, unemployment increases since firms reduce working hours, and thus they reduce the labor they use. Consequently, income declines, and households and businesses face difficulties paying off their obligations to the banks. This is what is found by Caporale et. al. (2014) and Ghosh (2015), among others.

Business cycle hypothesis. Unemployment (UN) is directly related to NPLs in the long run. This means that, in the long run, increased unemployment undermines financial stability.

3.3.2 The impact of Loans-to-Deposits (LTD) ratio on Non-Performing Loans (NPLs)

We expect that the loan-to-deposit ratio (LTD) is also directly related to NPLs in the long term. This is based on the 'Moral Hazard' incentive. A higher loan-to-deposit ratio means a relaxed loan-granting policy. A risk-loving attitude on behalf of the bank may cause liquidity issues and an increased NPL ratio in a bank. This is in accordance with the results of Anastasiou et al. (2019).

Liquidity Risk Hypothesis. The loan-to-deposit ratio (LTD) is directly related to NPLs in the long run. This means that, in the long run, increased risk undermines financial stability.

3.3.3 The impact of Equity-to-Total Assets (EQTA) on Non-Performing Loans (NPLs)

The effect of capital (EQTA) on Non-Performing Loans is ambiguous. We expect that the Equity-to-Total Assets ratio (EQTA) can be either positive in the 'Too-Big-to-Fail'

hypothesis' framework or negative in the 'Risk Averse' context. In the case of a positive long-run relation between capital and NPLs, we conclude that large banks have the incentive to become riskier since the government will 'save' them in case they are in danger of default (Gosh, 2015). Additionally, in the case of the negative long-run relationship between capital (EQTA) and NPLs, the conclusion should be reached is that the more capitalized banks become reluctant to take greater risks by participating in riskier projects, due to their risk-averse attitude (Louzis, 2012; Gosh, 2015). Therefore, two hypotheses follow:

Bank Capitalization Hypothesis 1 (Moral Hazard Hypothesis). The Equity-to-Total Assets ratio (EQTA) is inversely related to NPLs in the long run. This means that, in the long run, decreased capital increases NPLs and thereby deteriorates financial stability.

Bank Capitalization Hypothesis 2 (Too-Big-to-Fail Hypothesis). The Equity-to-Total Assets ratio (EQTA) is positively related to NPLs in the long run. This means that, in the long run, increased capital increases NPLs.

3.3.4 The impact of Economic and Policy Uncertainty (EPU) and its components on Non-Performing Loans (NPLs)

The effect of Economic and Policy Uncertainty (EPU) and its components on Non-Performing Loans is expected to be positive in the long run. The intuition is that in periods of increased uncertainty, the firms cut back on their investments and labor for later periods, which will be more stable. This will cause a decline in economic activity, which, in turn, will decrease the disposal income and thus the ability of firms and businesses to pay their debts. As a result of the increased uncertainty, lending rates will be higher, investment levels will be lower, and NPLs will increase (Hardouvelis et. al, 2018; Wu et al., 2020).

Economic Policy Uncertainty (EPU) and Economic Uncertainty (EU) Hypothesis. As explained, the increased uncertainty causes NPLs to increase, and thus, we expect a positive long-run relation between Economic and Policy Uncertainty (EPU) and NPLs. The same intuition is valid for Economic Uncertainty, a broader index that refers only to the economy and not politics.

Banking Policy Uncertainty Hypothesis. A direct long-run relationship exists between Banking Policy Uncertainty (EPUB) and NPLs. The increased banking uncertainty incurs an increase in the interest rate spreads (business and housing rates versus consumer interest rates). This increase makes it difficult for firms and households to pay their debts. Consequently, NPLs increase and thereby financial stability decreases.

Debt Policy Uncertainty Hypothesis. A direct long-run relationship exists between Debt Policy Uncertainty (EPUB) and NPLs. The increased debt uncertainty significantly increases the cost of borrowing for the government and households, and firms' cost of borrowing increases as well. As before, this increase makes it difficult for firms and households to pay their debts. Consequently, NPLs increase and thereby financial stability decreases.

Taxing Policy Uncertainty Hypothesis. A direct long-run relationship exists between Taxing Policy Uncertainty (EPUB) and NPLs. The increased Taxing uncertainty leads to lower investment levels and lower consumption of durables by consumers. As a result, the profits of the firms are decreased, which increases unemployment and lowers disposal income. All this sequence makes it difficult for firms and households to pay their debts. Consequently, NPLs increase and thereby financial stability decreases.

3.4 Data and methodology

Data concerning bank-specific variables (Non-performing Loans /Total Loans (NPLs), Total Loans/Total Deposits (LTD), Equity/Total Assets (EQTA)) and unemployment were retrieved from the Bank of Greece and the OECD, respectively, from 2002:q4 to 2020:q1. Our sample consists of 75 observations. For all model specifications, used variables in levels, except EPU index and its components for which their logarithms were estimated. Our paper uses the broad Economic Uncertainty Index (EU), Economic Policy Uncertainty (EPU), Banking Policy Uncertainty (EPUB), Fiscal Policy Uncertainty (EPUF), and its two sub-components, Debt Policy Uncertainty (EPUD) and Taxes Policy Uncertainty (EPUT) in Hardouvelis et al. (2018). Hardouvelis et al. (2018) based their calculations on the methodology developed by Bloom et. al. (2016). They employ textual analysis, and they

use the same keywords as Bloom et al. (2016) so that the results can be comparable. To construct the Economic and Policy Uncertainty (EPU0 index and its components for Greece, they searched articles in four well-known daily newspapers, ‘’To Vima’’, ‘’Ta Nea’’, ‘’Nautemporiki’’, and ‘’Kathimerini’’. They started by using the words Economy, Uncertainty to estimate a broader index for Economic Uncertainty, and they were adding some new keywords for the index they wanted to construct. For example, to construct the EPU index they also added the keyword Politics[7]. The indices were retrieved from the website address https://www.policyuncertainty.com/

Table 3. 3 Descriptive Statistics and Unit Root Tests

Statistics	Banking Variables						Unemployment and Uncertainty Variables						
	LTD	EQTA	NPLS_T	NPLS_H	NPLS_C	NPLS_B	UN	EPU	EPUB	EPUF	EPUD	EPUT	EU
	Loans / Deposits	Equity / Total Assets	Total NPLs	Household NPLs	Consuming NPLs	Business NPLs	Unemployment	Economic Policy Un.	Banking Policy Un.	Fiscal Policy Un.	Debt Policy Un.	Tax Policy Un.	Broad Policy Un.
Mean	113.72	12.62	24.91	21.92	33.21	24.79	16.58	101.00	99.75	100.49	99.73	102.16	99.82
Maximum	166.35	24.25	49.15	44.74	63.77	50.51	28.18	179.12	196.69	187.91	252.91	210.10	188.32
Minimum	71.16	4.00	5.22	3.61	6.12	5.18	7.65	41.97	39.44	44.50	31.44	43.04	36.98
Std. Dev.	27.80	6.24	17.68	16.48	23.03	17.73	7.01	28.66	33.20	32.40	41.74	35.12	26.58
Unit Root Tests													
Philips-Perron Test on Levels	0.64	0.81	0.84	0.97	0.83	0.77	0.64	0.30	0.19	0.15	0.08	0.17	0.33
Philips-Perron Test on First Differences	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00

Note: Descriptive statistics are presented in raw data. All data, except policy uncertainty indices, are displayed in percentages. Philips-Perron Tests are conducted on levels and first differences on all variables

Table 3.3 depicts the descriptive statistics and the Philips-Perron unit root tests (1988) for levels and first differences for all variables of interest. We used the Philips-Perron test since it is a non-parametric test, and thus, it is not necessary to specify the model and lagged parameter in the test regression. Among the NPLs categories, consumer NPLs present the highest mean value, the highest maximum and minimum value, and the highest standard deviation, providing clear evidence that this is the loan category with the biggest problems. What can also be observed is the high standard deviation of the Loans-to-Deposits ratio, showing the evolution of the liquidity risk over the sample and the difference between the minimum and the maximum value regarding the Equity-to-Total

[7] For more details see Hardouvelis et. al. (2018).

Assets ratio. It offers us a clear picture of the problem the Greek banking system had to face with the banks' capital.

In cases of uncertainty, indices debt and tax uncertainty present the maximum values. The indices were constructed to have a mean value of 100. By looking at the maximum values, we can easily understand the concerns of the people regarding political stability (maximum value of EPU is 179.12) and that the most important problems for the Greek people were Debt, Tax, and Banking since they present the highest values. Moreover, we can see that the variables of interest are integrated of order one I(1). This means the first differences of the variables should be obtained to become stationary.

Table 3. 4 ***Results of Cointegration Tests***

	EPU	EPUB	EPUF	EPUD	EPUT	EU	
	Trace Statistic						5% Critical Value
NPLs_T (r<=0)	**123.77**	**102.63**	**126.51**	**90.86**	**89.57**	**89.52**	88.80
NPLs_T (r<=1)	62.17	59.68	59.69	46.13	46.07	50.39	63.88
NPLs_H (r<=0)	**103.36**	**112.36**	**101.67**	**98.66**	**99.99**	**99.89**	88.80
NPLs_H (r<=1)	60.04	59.50	59.11	58.66	52.25	55.57	63.88
NPLs_C (r<=0)	**96.27**	**98.84**	**90.26**	**81.76**	**94.96**	**93.15**	88.80
NPLs_C (r<=1)	57.34	63.41	49.02	44.00	52.32	59.44	63.88
NPLs_B (r<=0)	**93.86**	**103.00**	**90.67**	**96.93**	**95.70**	**101.66**	88.80
NPLs_B (r<=1)	52.45	58.64	47.85	54.19	53.62	63.35	63.88

Note: NPLs_H: Mortgages Non-performing loans, NPLs_B: Businesses Non-Performing Loans, NPLs_C: Consumer Non-Performing Loans, NPLs _T refers to the aggregate measure of Non-Performing Loans. The number of cointegration equations is given by r.

Since variables of interest are not stationary in levels, but instead their first differences should be obtained to become stationary and become integrated of order one I (1), we should check whether these variables are cointegrated. For this purpose, the Johansen Cointegration test was used. In **Table 3.4**, evidence is provided for one cointegration relation for each model specification., To confirm it, the trace statistics are compared to a 5% critical value. The trace statistic is greater than the 5% critical value for all model specifications (see **Table 3.4**). The null hypothesis that there is no cointegrating relationship is rejected. Thus, one cointegrating relationship exists for each model specification, and VECM models are estimated using different types of uncertainty each

time[8]. Since the Uncertainty indices are highly correlated, they enter the analysis separately to avoid any multicollinearity issues under six different model specifications. Our attention is on the NPLs equation to identify the role of different types of policy uncertainty in non-performing loans.

$$\Delta(NPLs)_t = a_0 + b_0 ECT_{t-1} + \sum_{i=1}^{n} b_i \Delta(NPLs)_{t-i} + \sum_{i=1}^{n} c_i \Delta(EQTA)_{t-i} + \sum_{i=1}^{n} d_i \Delta(LTD)_{t-i} + \sum_{i=1}^{n} f_i \Delta(UN)_{t-i} + \sum_{i=1}^{n} k_i \Delta(EPU_j)_{t-i} + e_t$$

where Δ stands for the first differences of the variables concerned and the error correction term (ECT_{t-1}) represents the one-period lagged value of the residual from the cointegration regression; EPU_j refers to the j type of policy uncertainty, and e is the error term with the usual properties.

3.5 Empirical Results

3.5.1 Baseline Results

Table 3.5 presents baseline results for different EPU components each time. The results provide clear evidence that, first, all types of uncertainty (EPU and its components) are positively related to total NPLs in the long run, as expected by the theory. The strongest impact on total NPLs comes from fiscal uncertainty. After it is partitioned into debt (EPUD) and taxing (EPUT) uncertainty, the impact remains strong. Additionally, banking uncertainty (EPUB) is directly related to the total NPL ratio in the long term. As all types of uncertainty are positively related to total NPLs in the long run, it means that while uncertainty increases, financial stability declines. It becomes clear that the transmission mechanism is valid. Moreover, the capital (EQTA) is directly related to the total NPLs in

[8] The lag length is 2 based on the Final prediction error (FPE) and Akaike (AIC) information criteria. However, Hannan-Quinn (HQ) and Schwarz (SC) criteria indicated as best lag length for some models the one lag. By re-estimating our models using one lag length the signs of the coefficients of the variables of interests and their statistical significance do not alter.

all six model specifications in the long run, providing evidence for the Too-Big-to-Fail hypothesis.

Table 3. 5 Baseline Model for Total NPLs (NPLS_T)

Total Non-Performing Loans	**EPU (1)**	**EPUB (2)**	**EPUF (3)**	**EPUD (4)**	**EPUT (5)**	**EU (6)**
EQTA$_{(t-1)}$	**1.02**	**1.08**	**0.64**	**0.64**	**0.77**	**1.08**
	[6.99]	**[6.00]**	**[3.65]**	**[3.33]**	**[4.42]**	**[7.22]**
LTD$_{(t-1)}$	0.02	0.02	**0.07**	**0.12**	**0.05**	0.02
	[1.22]	[0.96]	**[3.25]**	**[4.65]**	**[2.12]**	[1.14]
UN$_{(t-1)}$	**1.37**	**1.51**	**1.38**	**1.29**	**1.40**	**1.41**
	[15.41]	**[13.32]**	**[13.74]**	**[11.30]**	**[14.00]**	**[14.95]**
EPU Component $_{t-1}$	**7.32**	**8.10**	**8.27**	**7.75**	**7.99**	**6.40**
	[5.48]	**[5.19]**	**[5.59]**	**[5.81]**	**[5.59]**	**[4.60]**
C	47.01	53.31	52.03	53.66	49.89	43.89
Error Correction: Δ(NPLS_T)						
CointEq1	**-0.25**	**-0.20**	**-0.22**	**-0.20**	**-0.18**	**-0.26**
	[-5.30]	**[-5.23]**	**[-5.38]**	**[-5.73]**	**[-4.24]**	**[-5.52]**
Δ(NPLS_T$_{(t-1)}$)	0.10	0.05	0.01	-0.02	0.11	0.10
	[0.88]	[0.39]	[0.05]	[-0.01]	[0.93]	[0.87]
Δ (NPLS_T$_{(t-2)}$)	0.07	0.07	0.05	0.12	0.08	0.04
	[0.63]	[0.60]	[0.50]	[1.08]	[0.72]	[0.39]
Δ (EQTA$_{(t-1)}$)	**-0.28**	**-0.29**	**-0.20**	**-0.16**	**-0.20**	**-0.31**
	[-3.53]	**[-3.52]**	**[-2.75]**	**[-2.34]**	**[-2.51]**	**[-3.81]**
Δ (EQTA$_{(t-2)}$)	-0.02	-0.05	0.03	0.10	0.03	-0.04
	[-0.29]	[-0.66]	[0.47]	[1.46]	[0.38]	[-0.57]
Δ (LTD$_{(t-1)}$)	0.00	0.01	0.01	-0.02	0.00	0.01
	[0.52]	[0.69]	[0.44]	[-1.56]	[0.12]	[0.89]
Δ (LTD$_{(t-2)}$)	-0.02	-0.01	-0.02	**-0.02**	-0.01	-0.01
	[-1.33]	[-0.75]	[-1.49]	**[-2.00]**	[-0.84]	[-1.0]
Δ (UN$_{(t-1)}$)	0.15	0.19	0.08	-0.01	0.27	0.15
	[0.88]	[1.11]	[0.44]	[-0.06]	[1.51]	[0.87]
Δ (UN$_{(t-2)}$)	0.07	0.18	0.05	-0.17	0.05	0.08
	[0.39]	[0.97]	[0.28]	[-0.92]	[0.25]	[0.46]
Δ (EPU Component$_{(t-1)}$)	**-1.67**	**-1.35**	**-1.37**	**-1.14**	**-1.10**	**-1.66**
	[-4.56]	**[-4.74]**	**[-3.97]**	**[-4.32]**	**[-3.19]**	**[-4.54]**
Δ (EPU Component$_{(t-2)}$)	-0.56	-0.60	-0.27	-0.35	-0.04	-0.55
	[-1.72]	**[-2.40]**	[-0.98]	[-1.72]	[-0.13]	[-1.58]
C	**-0.85**	**-0.14**	**-0.71**	**-0.45**	**-0.51**	**-0.83**
	[-3.74]	**[-0.92]**	**[-3.52]**	**[-2.64]**	**[-2.54]**	**[-3.83]**
@TREND	**0.03**	**0.01**	**0.03**	**0.02**	**0.02**	**0.03**
	[4.51]	**[2.95]**	**[4.59]**	**[4.23]**	**[3.50]**	**[4.67]**
R-squared	0.83	0.83	0.84	0.84	0.83	0.84
Adj. R-squared	0.79	0.79	0.81	0.81	0.79	0.80
F-statistic	22.16	21.29	23.98	23.72	21.73	22.95

Note: t- statistics are reported in parentheses. Bold numbers indicate statistical significance at 5% level of significance.

The liquidity risk hypothesis tested by the loan-to-deposit ratio is also confirmed when fiscal uncertainty and its components, debt and tax uncertainty, enter the analysis. This means that the more loans the banking system grants, the higher the total NPL ratio becomes. Unemployment is positively related to total NPLs in the long run. The results

follow the theory (Caporale et al., 2014; Ghosh, 2015). Thus, increased unemployment hampers financial stability, while decreased unemployment enhances financial stability. Policy uncertainty is negatively related to financial stability over the long term, in line with studies focusing on short-term relations only (see Caglayan and Xu, 2019; Hu and Gong, 2019; Wu et al., 2019).

Looking at the ECT coefficient, (b_0) the deviation of NPLs from equilibrium is corrected by a percentage, which ranges from 18% to 25% from one period to the next across different EPU measures. The lowest coefficient is observed when Taxing Uncertainty (EPUT) enters the analysis, while the highest one is for the broader Economic Uncertainty (EU) index. Over the short run, capital ratio and uncertainty mainly contribute to changes in the aggregate measure of NPLs, as can be seen by the high values of R^2.

3.5.2 Robustness of findings across different types of loans

To check the robustness of our findings, our models are tested across different types of NPLs for two main reasons: Firstly, disaggregation among different sub-categories may highlight an uncovered relationship that could be hidden at an aggregate level. Secondly, the existence of collateral, especially on mortgage loans, may highlight the preference of households and businesses to pay such debts first relative to others, along with the willingness of banks to grant such types of loans mainly due to collaterals.

In **Table 3.6**, evidence for the "Too-Big-to-Fail" bank capitalization hypothesis 2 has been provided by all types of NPLs apart from consumer NPLs, where evidence for the "Risk-Averse" bank capitalization hypothesis 1 is offered. For business and mortgage NPLs, the coefficient of EQTA is much higher in EPU and banking Uncertainties versus the Fiscal Uncertainty models. However, in absolute terms, the relevant coefficient is much higher in the model with Fiscal Uncertainty for consumer NPLs. Evidence for the liquidity risk hypothesis (+coefficient of Loans-to-Deposits) has been provided by all types of NPLs apart from mortgage NPLs, where an increase in the Loans-to-Deposits ratio reduces this type of NPLs because of collaterals. Moreover, all types of EPU contribute positively to all types of NPLs, although the coefficients are higher for consumer NPLs and smaller for mortgages.

Table 3. 6 Long Run estimates and ECT coefficient for different types of loans & uncertainty

Dependent Variable	Independent Variables	EPU	EPUB	EPUF	EPUD	EPUT	EU
Mortgage Non-Performing Loans	$EQTA_{(t-1)}$	**0.992**	**1.057**	**0.657**	**0.725**	**0.596**	**1.031**
		[7.866]	**[7.310]**	**[4.431]**	**[5.265]**	**[3.500]**	**[8.404]**
	$LTD_{(t-1)}$	**-0.044**	**-0.046**	-0.008	0.023	-0.016	**-0.045**
		[- 2.278]	**[- 2.095]**	[- 0.357]	[1.104]	[- 0.652]	**[-2.312]**
	$UN_{(t-1)}$	**1.023**	**1.056**	**1.017**	**0.935**	**1.078**	**1.036**
		[15.015]	**[13.771]**	**[12.881]**	**[12.336]**	**[11.841]**	**[15.645]**
	EPU Component(t-1)	**4.248**	**3.103**	**6.279**	**5.536**	**7.074**	**3.497**
		[3.352]	**[2.371]**	**[4.582]**	**[5.188]**	**[4.573]**	**[2.858]**
	$ECT_{(t-1)}$	**-0.271**	**-0.240**	**-0.215**	**-0.252**	**-0.156**	**-0.284**
		[-4.601]	**[-4.241]**	**[-4.438]**	**[-5.490]**	**[-3.525]**	**[-4.722]**
Consumer Non-Performing Loans	$EQTA_{(t-1)}$	-0.405	-0.926	**-7.592**	**-8.988**	**-4.024**	-0.702
		[-1.008]	[-0.943]	**[-5.084]**	**[-4.996]**	**[-4.322]**	[-1.419]
	$LTD_{(t-1)}$	0.037	0.031	**0.460**	**0.950**	**0.229**	0.043
		[0.711]	[0.261]	**[2.613]**	**[3.950]**	**[2.075]**	[0.648]
	$UN_{(t-1)}$	**1.895**	**2.318**	**2.655**	**2.182**	**2.389**	**2.135**
		[10.168]	**[5.434]**	**[4.220]**	**[2.675]**	**[5.998]**	**[9.115]**
	EPU Component(t-1)	**19.820**	**38.373**	**63.168**	**67.031**	**42.598**	**21.031**
		[5.498]	**[5.171]**	**[5.176]**	**[5.471]**	**[5.754]**	**[4.690]**
	$ECT_{(t-1)}$	**-0.127**	**-0.059**	**-0.036**	**-0.028**	**-0.048**	**-0.111**
		[-3.616]	**[-3.276]**	**[-3.633]**	**[-3.786]**	**[-3.107]**	**[-3.628]**
Business Non-Performing Loans	$EQTA_{(t-1)}$	**0.885**	**1.017**	**0.299**	**0.178**	**0.628**	**0.947**
		[3.864]	**[3.767]**	**[1.040]**	**[0.542]**	**[2.617]**	**[4.005]**
	$LTD_{(t-1)}$	**0.079**	0.068	**0.160**	**0.235**	**0.122**	**0.084**
		[2.481]	[1.775]	**[4.420]**	**[5.114]**	**[4.029]**	**[2.490]**
	$UN_{(t-1)}$	**1.731**	**1.971**	**1.805**	**1.697**	**1.708**	**1.766**
		[10.551]	**[9.918]**	**[9.544]**	**[7.448]**	**[10.761]**	**[9.959]**
	EPU Component(t-1)	**9.483**	**11.854**	**10.329**	**10.902**	**8.663**	**8.006**
		[4.365]	**[4.928]**	**[4.134]**	**[4.570]**	**[4.261]**	**[3.493]**
	$ECT_{(t-1)}$	**-0.210**	**-0.171**	**-0.171**	**-0.143**	**-0.193**	**-0.222**
		[-5.453]	**[-5.466]**	**[-5.931]**	**[-5.432]**	**[-5.627]**	**[-5.731]**

Note: t- statistics are reported in parentheses. Bold numbers indicate statistical significance at 5% level of significance. ECT is the error correction term.

When looking at the significance of all variables of interest, the long-run relationship defined for consumer NPLs is only intense over Fiscal (Debt and Tax) types of uncertainty. The model with tax (debt) uncertainty for mortgage (business) NPLs presents the lowest speed adjustment coefficients in absolute terms, implying high rigidity in restructuring measures for NPLs in this category. However, among all types of NPLs, this coefficient is the lowest for consumer NPLs (0.03 to 0.11).

In the Appendix, the variance of mortgage and business NPLs can be mainly attributed to unemployment (40%), to fiscal and banking uncertainties (20%). Business and consumer NPLs variability, along with fiscal uncertainties, contributes to capital ratio variability. Unemployment, along with banking and tax uncertainties for models with mortgage NPLs, explain together almost 30% of liquidity ratio variance.

3.6 Conclusions

In this chapter, we investigate the relation between the Economic Policy Uncertainty index and its components, the unemployment, the capital, and the liquidity with NPLs in the long run. Our findings highlight that unemployment and EPU components are positively related to all the categories of NPLs over the long term, meaning that increased uncertainty and unemployment hamper financial stability. This result holds for both the baseline model and the robustness specifications.

The capital ratio (EQTA) is positively related to Total NPLs for the baseline model, and in the cases of mortgage and business NPLs, providing support for the Too-Big-to-Fail hypothesis, but negatively related to consumer NPLs supporting the risk aversion hypothesis, when robustness checks performed. The liquidity risk ratio is positively related to Total NPLs in the baseline model. These results also hold for the robustness check. Loans-to-Deposits ratio is positively related to business and consumer NPLs and, on the contrary, negatively related to mortgage NPLs.

Fiscal uncertainty effects and slow speed of adjustment are identified for consumer NPLs. Unemployment, along with fiscal and banking uncertainties, contributes to mortgage and business NPLs variability. Fiscal uncertainty contributes to the variability of

capital and liquidity measures. Therefore, authorities, by taking measures to reduce debt and tax policy uncertainty along with banking, can achieve beneficial effects on the NPLs' effective management and the faster return to the long run equilibrium. The fact that uncertainty is positively related to NPLs not only in the short run but also in the long run makes it necessary for policymakers to advocate policies that offer a stable environment to firms to proceed with their investments.

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3.7 Supplementary material appendix

Variance Decomposition for Economic Policy Uncertainty components

Notes: NPLs_H: Mortgages Non-performing loans, NPLs_B: Businesses Non-Performing Loans, NPLs_C: Consumer Non-Performing Loans, NPLs _T refers to the aggregate measure of Non-Performing Loans. Loans to Total Deposits - LTD, Equity to Total Assets- EQTA); the Banking Uncertainty (LNEPUB); Fiscal Uncertainty (LNEPUF); Debt Uncertainty (LNEPUD); Taxing Uncertainty (LNEPUT); Broader Economic Uncertainty index (LNEU).

Figure 3.7.A 1 Variance Decomposition for EPUB

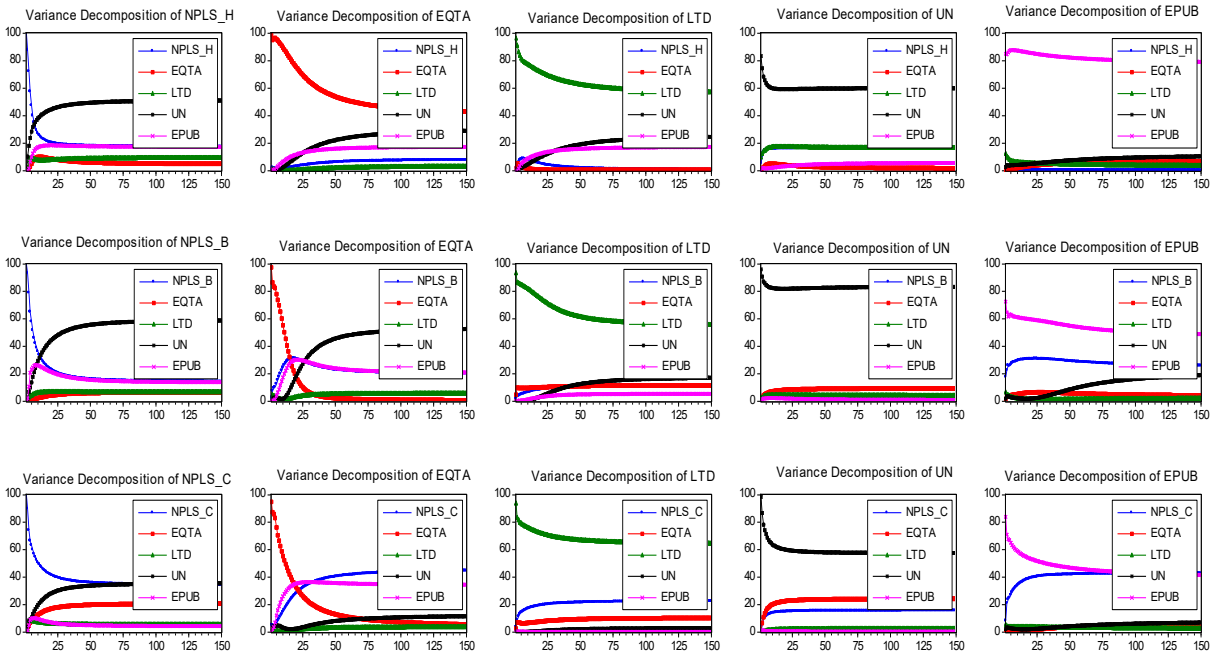


Figure 3.7.A.2 Variance Decomposition for EPUF

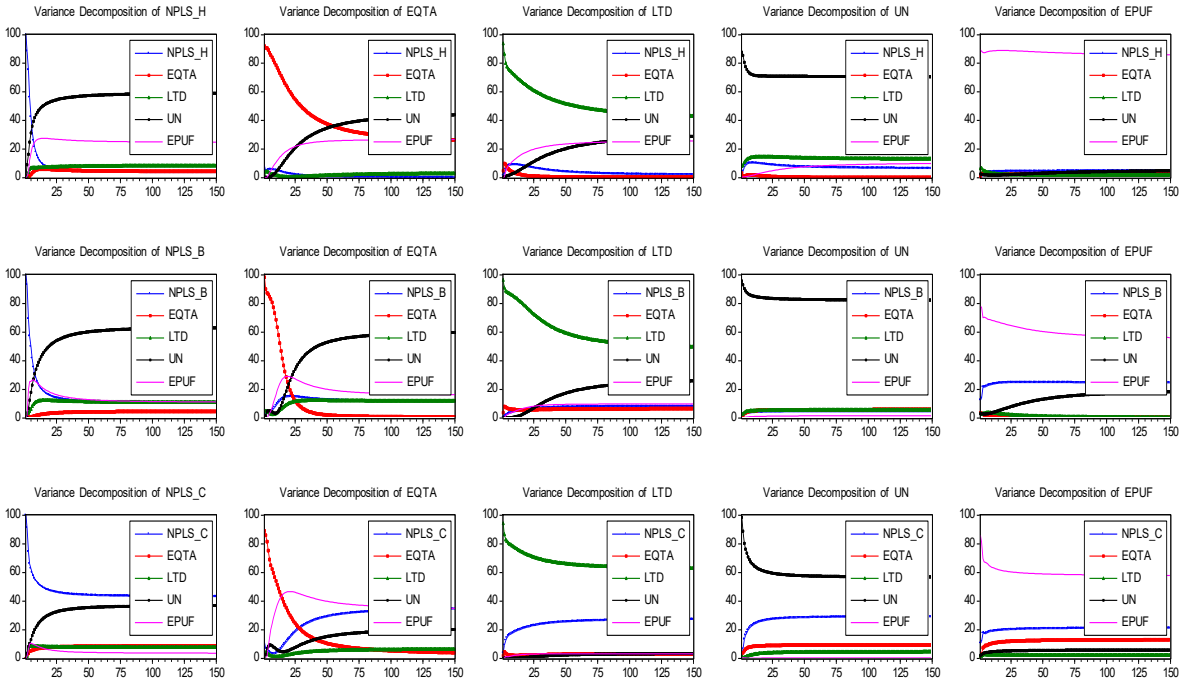


Figure 3.7.A.3 Variance Decomposition for EPUD

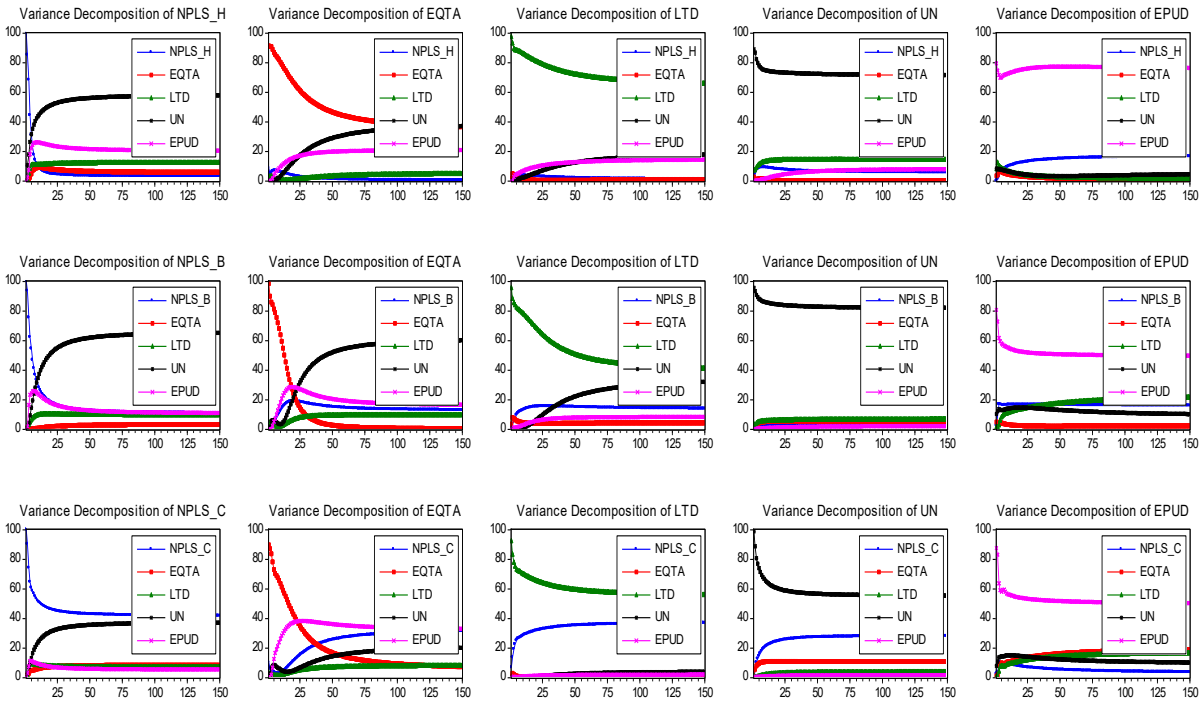


Figure 3.7.A.4 Variance Decomposition for EPUT

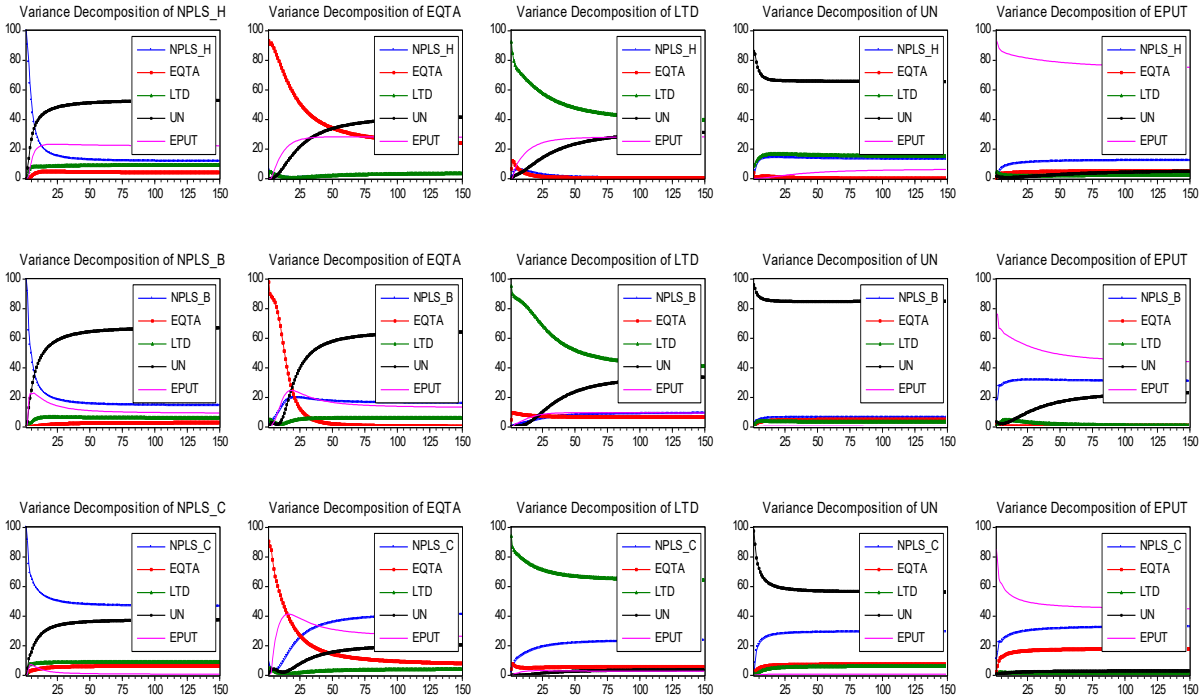
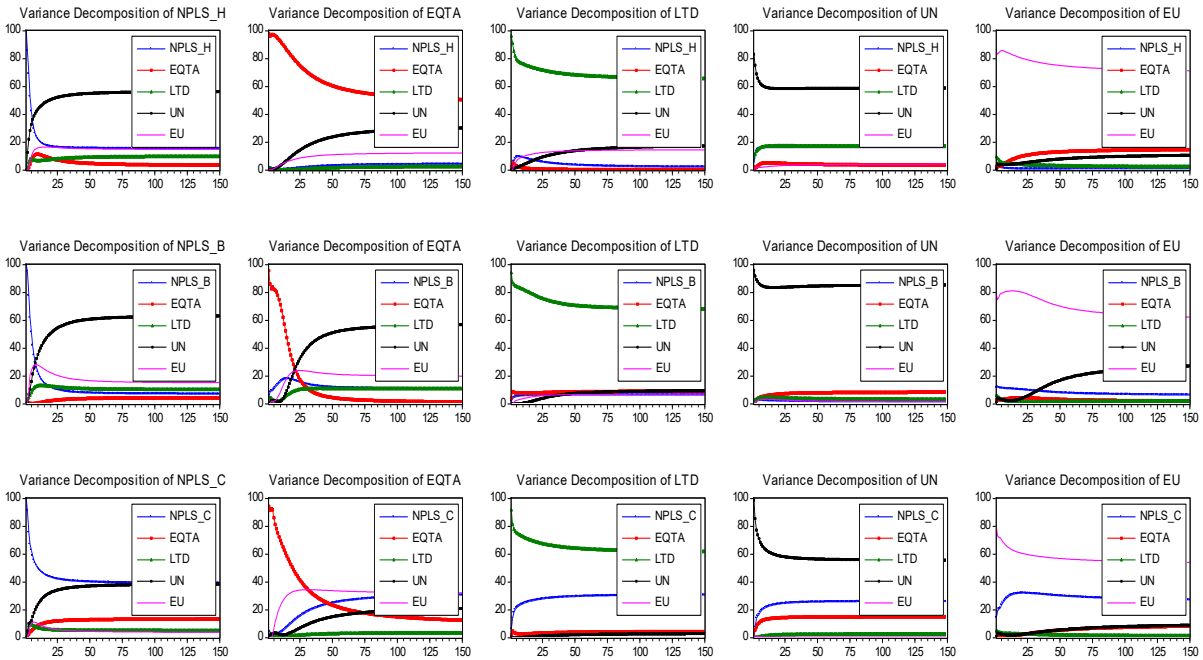


Figure 3.7.A.5 Variance Decomposition for EU



CHAPTER 4

THE DISTORTING EFFECTS OF CORRUPTION ON FINANCIAL STABILITY AND ECONOMIC GROWTH: EVIDENCE FROM RUSSIAN BANKS USING A PVAR APPROACH.

4.1 Introduction

The stability of the banking sector through the management of credit risk has become an issue of great importance, particularly since the onset of the global financial crisis (GFC) in 2008. Financial stability refers to the stability, health, and soundness of the financial system and its ability to fulfil its primary goal, which is no other than providing access to funding to businesses and households. Among the most important financial stability measures in the banking literature are Z-score, bank capitalization, and the ratio of nonperforming loans (NPLs) (see, for instance, Jayakumar et al. 2018). Although Z-score and bank capitalization measures can give a picture of the health of a bank, they cannot capture bank interdependencies, which may be uncovered through NPL ratios (see, among others, Guidi 2021; Wang 2018; Kanga, Murinde, and Soumaré 2021; Kanas, Al-Tamimi, and Albaity 2018). The increased economic growth achieved through lending activity may highlight interdependence between bank-specific variables and economic activity.

Many studies investigated the macroeconomic factors determining the evolution of non-performing loans (Nkusu 2011; Kauko 2015; Rinaldi and Sanchis-Arellano 2006; Sevogiano, Goodhart, and Hofmann 2006; Reinhart and Rogoff 2011). Other studies focused on the bank-specific (the so-called microeconomic) determinants (see, for instance, Assaf, Matousek, and Tsionas 2013; Laeven and Levine 2009; Mamatzakis, Matousek, and Vu 2016; Berger and DeYoung 1997; Vithessonthi 2016); yet other researchers combined both macroeconomic and microeconomic determinants in their

efforts to explain NPLs' dynamic behavior (Festic 2011; Carey 2002; Louzis, Vouldis, and Metaxas 2012; Anastasiou, Louri, and Tsionas 2016; Salas and Saurina 2002).

In this chapter, we examine the interdependencies arising among financial stability measured by non-performing loans ratio (NPLs), profitability (ROAA), equity-to-liabilities (EQTL) ratio, loan growth (LG), and GDP in a twofold way: first, when the concept of corruption is not included in the analysis, and secondly, when it is included in the context of either an ameliorating or a deteriorating level. When the corruption level improves it means that economic activity takes place in an environment where institutions, legislation, and transactions are more transparent. The opposite holds in the case the corruption level worsens.

As was shown by Mauro (1995) and Wei (2000), corruption has an extent profound effect on all aspects of economic activity and thus on the banking sector as well. Apart from the study of Park (2012) for a few countries, there is no study, as far as we know, to investigate the effects of corruption on banks' balance sheets.

Once we are interested in the influence of the institutional-level corruption, we use the Corruption Perceptions Index (CPI), as a measure for the level of corruption in Russia, issued every year by Transparency International (TI). Although it is not an absolute measure of corruption in the banking sector exclusively, it provides us with an indicative and clear way the economy operates. Apart from that, we believe that corruption plays a crucial role in all aspects of the economy, not only in the banking system.[9] Even though the CPI refers to the ranking of one country among all those used in the sample constructed by Transparency International (TI), it indeed presents however, in a brilliant way the sense that participants in the economic activity derive from their transactions with institutions and their representatives. It is, therefore, a reliable tool for our analysis. In our study, we make the distinction between a positive rate of change of corruption (meaning that corruption increases) and a negative one (meaning that corruption decreases; that is,

[9] Corruption is defined by TI as "the manipulation of policies, institutions and rules of procedures in the allocation of resources and financing by political decision makers, who abuse their position to sustain their power, status and wealth."

transparency increases). We use this technique to investigate the impact of a change in corruption level on the banking sector's soundness.

In this chapter, we employ a panel vector autoregression (PVAR) approach. Our research contributes to the existing literature by providing evidence about how corruption exerts influence on banks' management attitude toward NPLs. Additionally, we highlight the time-persistence of the problem of NPLs, which lasts more when the corruption level deteriorates (positive rate of change of CPI) than when the corruption level ameliorates (negative rate of change of CPI).

First, the results of our analysis reveal that, on one hand, a positive shock to NPLs significantly reduces banks' profitability, loan growth (LG), and GDP. Additionally, profitability is used to absorb any potential future losses (through provisions) which come as a result of past bad management practices. At the same time, the increased level of NPLs provides evidence of bad distribution of the financial resources of the banking system have been badly distributed in the past. Consequently, banks become more risk-averse and provide the economy with fewer loans than in the past. Furthermore, the negative response of GDP to a positive shock to NPLs depicts the reduced ability of households and businesses to handle their debts. Hence, the economic activity declines.

Second, NPLs reduce as a response to the positive shock on bank profitability (ROA), leverage (EQTL), and GDP. The negative response of NPLs because of the positive shock to GDP can be explained by the increased ability of the enterprises and households to amortize their debts because of the improved economic activity. In addition, the reduced leverage emphasizes the more conservative attitude of banks toward risk. The positive shock on bank profitability exerts a negative impact on NPLs, ratio because banks use their profits to further reduce NPLs.

When corruption enters our analysis, many interesting aspects arise. First, in a deteriorating corruption environment, a positive shock on NPLs underlines the more time-persistent credit growth decline, which is the opposite result compared to the case of an improving corruption environment, where this decline lasts less. Consequently, banks become more conservative in providing loans when operating in a deteriorating corruption level environment compared to their behavior when this environment improves. This is

also the case of the negative response of GDP when a positive shock to NPLs takes place. This decline of GDP lasts more when the corruption levels deteriorate. On the contrary, this decline lasts less when corruption improves. These results also provide clear evidence of the distorting effects of corruption on the economy through GDP. This also happens when a positive shock takes place on NPLs (increase) where profitability responds negatively but this reduction lasts more when corruption deteriorates than when it ameliorates.

The rest of this chapter is organized as follows: In the second and third sections respectively, arguments for studying the Russian economy are provided, and the advantages and disadvantages of different financial stability measures are discussed. Later, an extended literature review on NPLs and corruption is presented. Then we present the theoretical background, along with the hypotheses tested and the econometric model employed, and the basic statistical analysis is conducted. The results of our analysis are thoroughly explained with the conclusions and policy implications to be considered by government, regulators, and bank management being discussed in the last section.

4.2 The reason for studying Russia

There exist many reasons for choosing a country like Russia for our analysis. First, all studies regarding NPLs (see, for instance, Nkusu 2011; Kauko 2015; Rinaldi and Sanchis-Arellano 2006; Sevogiano, Goodhart, and Hofmann 2006; Reinhart and Rogoff 2011) have been performed either for developed countries or a cluster of countries (e.g., the OECD, developing countries, the countries of Central and Southeastern Europe). Even if Russia is included in the sample no study considers Russia on its own in the way we conduct our analysis. Second, Russia's banking system was largely affected by the global financial crisis (GFC). It still consists of many banks, which remain so, even after the mergers and acquisitions in the sector, that took place in recent years. Third, the Russian economy is one of the biggest in Eastern Europe. Fourth, a rapid credit expansion took place in recent years in Russia, since the credit-to-GDP ratio rose from 22.8% in 2004 to 52.8% in 2015 (Davydov et al. 2019) despite the 2008 global financial crisis (GFC). Fifth, Russia is ranked with a very low annual CPI by TI. This after all is clearly stated by Levin and Satarov (2000

p10), who argue “that envelopes filled with money, or later briefcases were given to bank officers.”

Apart from the situation outlined above, Russian democracy and economy have been in transition during the last three decades after Communism collapsed. According to our knowledge, there is no study taking into consideration such a big emerging economy and concurrently examining the interdependencies between non-performing loans (NPLs), profitability (ROA), equity-to-liabilities (EQTL), loan growth (LG), and GDP in the context of either an improving or a deteriorating corruption level.

4.3 Advantages and disadvantages of main financial stability measures

Z-score is a measure that is widely used in the banking literature about financial stability (Degl’Innocenti et al. 2018; Goetz 2018; Davis and Karim 2019; Amidu and Wolfe 2013; Beck, De Jonghe, and Schepens 2013; Tabak, Fazio, and Cajueiro 2012; Clark, Radić, and Sharipova 2018; Forssbæck and Shehzad 2015; Schaeck and Cihák 2014, etc.). It shows the number of standard deviations a bank is far from insolvency. A higher Z-score ratio implies a more stable banking institution. The Z-score can be estimated by the following formula:

$$Z_{i,t} = \frac{ROA_{i,t} + (\frac{E}{A})_{i,t}}{\sigma(ROA)_{i,t}} \qquad ,(1)$$

where: ROA represents the return on assets, E/A is the equity-to-assets ratio, and σ(ROA) is the standard deviation of the ROA. On the one hand, the main advantage of this ratio is that it represents the inverse probability of defaulting of a banking institution in a figure. On the other hand, its disadvantage is that it does not measure the stability of each institution separately and does not consider the interrelations among the institutions (Jayakumar et al. 2018).

A second well-known stability measure is the capital of each bank determined by the equity-to-total-assets ratio. According to Bruha and Kocenda (2018), the gain of this measure is that it depicts a bank’s capitalization and thereby its ability to absorb any potential losses.

However, the stability measure which gains increasing interest in the literature, especially after the onset of the Global Financial Crisis, is the Non-performing Loans ratio (Jayakumar et al. 2018; Fernández, González, and Suárez 2016; Guidi 2021; Wang 2018; Kanga, Murinde, and Soumaré 2021; Kanas, Al-Tamimi, and Albaity 2018; Calderon and Schaeck 2016; Kasman and Kasman 2015; Berger, Klapper, and Turk-Ariss 2009; Jiménez, Lopez, and Saurina 2013). It is measured as:

$$Non-Performing\ Loans\ Ratio = \frac{Non-Performing\ Loans}{Total\ Loans} \quad (2)$$

The preceding ratio counts the percentage of total loans overdue for more than 90 days. This percentage depicts the credit risk of the banking system in total, along with the credit risk of each bank separately. Its advantage is that it captures the interrelations among the banking institutions and gives us a brief picture of the soundness of the banking system. The stability of a banking system is highly influenced by the amount of non-performing loans (NPLs) among banks, since, in the case of a rising NPLs ratio, the banks need more capital to handle losses.

Subsequently, in this study, we are interested in the stability of the banking system, considering possible interdependencies among banks, and our focus is on the NPL measure.

4.4 Literature review

4.4.1 Studies of nonperforming loans

The studies conducted on NPLs can be separated into a few categories. In our study, we make a distinction based on the category the determinants examined belong to. Namely, the studies that identify the influence of macroeconomic factors only on NPLs, those studies that emphasized the impact of bank-specific factors only on NPLs and a last, vast category of studies in which researchers employ both macroeconomic and microeconomic factors as well.

4.4.1.1 Macroeconomic determinants of nonperforming loans

Studies using macroeconomic variables only have provided us with important insights as regards the determinants of non-performing loans (NPLs). Perotti (1996) suggests that

fiscal expenditures significantly influence households' and companies' future debt repayment capacities. He argues that high levels of debt can lead to austerity measures, which, in turn, may delay loan repayments due to reduced income and aggregate demand.

Reinhart and Rogoff (2011) use a large panel and find that an increasing NPL ratio can be a precursor to an upcoming financial crisis. They provide evidence for a causal relationship between debt and banking crises, running from debt crises to banking crises because of banks' difficulties raising funds as fiscal conditions deteriorate.

Nkusu (2011) further confirms this causal relationship, demonstrating an inverse relationship between macroeconomic variables and NPLs. As GDP and house prices decline, NPLs become overdue. Other studies, as well, have focused on households' debt management capabilities. For example, Bangia et al. (2002) assert the effect of business cycles on consumers' ability to pay off their debts and the corresponding influence on banks' capital and thus their ability to absorb potential losses, while Kauko (2015) identifies a relationship between credit growth, current account deficit, and NPLs.

Chortareas, Magkonis, and Zekente (2020) employ meta-regression techniques in their study to address the heterogeneities in studies on NPLs and the impact of GDP growth. They find that the inverse relationship between NPLs and GDP varies in magnitude as a result of factors such as geographic distribution, data characteristics, and the time range of the sample.

The business cycles are statistically significant in shaping NPLs. Quagliariello (2007) uses a large panel of data from Italian banks to study the effects of business cycles on NPLs. He finds a negative and long-lasting relationship between NPLs and business cycles. NPLs decrease during growth periods and increase during recessions.

However, this long-term relationship does not always manifest with a lag. Sometimes, macroeconomic conditions may have a contemporaneous impact on NPLs. Carey (2002) claims that governments and regulators should not delay addressing these issues, as they might pose serious risks to the soundness and stability of financial institutions. Anastasiou (2017) finds that credit cycles have a statistically significant and positive influence on NPLs in static models, while business cycles are negatively related

to NPLs in dynamic models, although the signs of the relationships align with theoretical expectations regardless of the model specification. A causal relationship running from business and credit cycles to NPLs emerges, underscoring the importance of macro-prudential policymaking.

Cifter, Yilmazer, and Cifter (2009) add to our knowledge on NPL determinants by examining the probability of default for each sector separately as affected by industrial production. They reach the conclusion that industrial production exerts an impact on default probabilities, but at different times, making it necessary to consider policies to minimize default rates.

Aysan et al. (2016) utilize monthly data from December 2002 to April 2011 for the Turkish banking sector to identify macroeconomic factors influencing NPLs within a VAR framework. Their findings suggest that macroeconomic conditions should be considered alongside microeconomic policies in the regulatory oversight of banking institutions.

Berge and Boye (2007) make a distinction between corporate and household loans in their investigation of NPL determinants, and they find that unemployment and real interest rates influence NPL.

Furthermore, financial markets can play a crucial role in influencing NPLs. This is the case, especially when the financial market size is disproportionately large compared to a country's GDP. Beck, De Jonghe, and Schepens (2013) suggest it in their study.

Different models and methods have been used to analyze NPLs' evolution other than the traditional approaches. For example, Rinaldi and Sanchis Arellano (2006) extend Lawrence's life-cycle model by using data from seven European countries and provide evidence that the probability of a household default is directly related to the wealth and unemployment characteristics of the respective country.

4.4.1.2 Microeconomic determinants of nonperforming loans

We can also recognize, as a strand of the literature about NPLs, that those studies employ microeconomic factors exclusively. As one of the first attempts in this strand of literature, Meeker and Gray (1987) find that it is of great importance for a financial institution to collect data about NPLs, especially the smaller ones.

Furthermore, Assarnow and Edwards (1995) collected data on NPLs, restructured loans from Citibank, and analyzed commercial loans to determine the importance of each microeconomic (bank-specific) factor in shaping NPLs.

With the use of provisions, Ahmed, Takeda, and Thomas (1999) used as a threshold point the switching regime of 1990 in capital adequacy regulations to confirm the hypothesis that provisions are used to achieve goals for capital needs. Further research on the income smoothing use of loan loss provision was conducted by Sood (2012), who used a sample of 800 banks and showed that banks are motivated to follow an income smoothing strategy. Additionally, the income smoothing effect is reinforced in more profitable periods when banks hit the regulatory target. In contrast, when in recession, the banks are highly motivated to delay provisioning to increase profitability. In their seminal study, Berger and De Young (1997) used bank-specific data to examine four hypotheses: a) the "bad luck" hypothesis, b) the "bad management" hypothesis, c) the "moral hazard" hypothesis, and d) the "skimping cost" hypothesis, to examine the relationship between the quality of loans and the effectiveness of equity. According to their arguments, cost efficiency is a major issue, which may result in increased NPLs and banks with problems. As an extension of the above study, Podpiera and Weill (2008) focused on bank-specific variables to investigate the effects of efficiency on NPLs on bank management for a sample of Czech banks for the period spanning 1994–2005. According to their results, there exists a negative relationship between cost efficiency and NPLs, meaning that a worsening of cost efficiency will induce an increase in NPLs.

In addition, Boyd and Gertler (1994) examine the "moral hazard" hypothesis and argue that the 1980s banking crisis in the USA was mainly a result of the US government's attitude toward helping big banks not to fail, confirming the "too big to fail" and the "moral hazard" hypothesis as well. Further to the investigation of the "Too-Big-to-Fail" hypothesis, Stern and Feldman (2004) find that the big banks, in terms of size, are exposed to more and more risk as they lean on government intervention in case of potential default. Because the results of the "too big-to-fail" hypothesis are still vague, Ennis and Malek (2005) conclude that further investigation is necessary on this issue so that we can obtain safer and more robust results.

An important bank-specific factor in shaping the NPL ratio of a banking institution is the quality of the management of the corresponding institution. By emphasizing bank-specific characteristics, Li et al. (2007) use data from banks in rural areas of China and reveal a direct relationship between NPLs and the management team's incentives.

Many studies have been dedicated to the impact of ownership status (government or private) on NPLs. For example, Saunders et al. (1990), Laeven and Levine (2009), and Azofra and Santamaria (2011), among others, [2] include in their analysis the way ownership is structured as regards the banking institution and find a positive relationship between ownership and risk-taking.

Finally, Pool, de Haan, and Jacobs (2015) and Vithessonthi (2016) find an alternating relationship in Japan, from positive to negative, between loan growth (LG) and non-performing loans. The turning point was the onset of the GFC in 2007.

4.4.1.3 Microeconomic and macroeconomic determinants of nonperforming loans

In recent years, many studies have utilized both macroeconomic and microeconomic variables in their analyses of non-performing loans (NPLs). Among the early studies, Clair (1992) establishes a positive relationship between loan growth (LG) and the worsening of non-performing loans (NPLs). He claims that this relationship is valid even after subtracting the effects of business cycles. Clair suggests that mergers between banks could be an effective solution to mitigate this issue. Similar findings were reported in their study by Festic, Kavkler, and Repina (2011). An additional contribution of the scholars lies in the direct relationship between business cycles and capital adequacy, emphasizing the importance of effective surveillance in preventing the economy from overheating. Institutions like central banks play an important role in stabilizing the economy through timely interventions and policy decisions. Additionally, Laeven and Magnoni (2003) discuss the importance of provisions in the context of regulations, particularly regarding capital adequacy during and before recessions, to ensure that banks will be able to handle potential financial distress.

Salas and Saurina (2002) highlight the well-known size effect on NPLs by decomposing Spanish banks into commercial and savings banks. They conclude that

different models may explain the behavior of commercial and savings banks. An opposite relationship is found between size and NPLs, as emphasis is given to the role of loan portfolio diversification in forming NPLs. From the macroeconomic variables, only GDP plays a negative role in shaping NPLs. To confirm these results, Tajik et al. (2015) find that the kind of loan and financial institution plays an important role in the effects of house prices on NPLs, with commercial banks and mortgage loans being more sensitive.

Shehzad, de Haan, and Scholtens (2010) find that the degree of ownership is inversely related to non-performing loans (NPLs). More specifically, a higher degree of ownership is associated with a decrease in NPLs, suggesting that tighter control improves management performance. Furthermore, Iannotta, Nocera, and Sironi (2007) use data from 15 European countries to identify an opposing relationship between the degree of ownership and a financial institution's loan quality, profitability, and risk. Us (2016) examines the ownership status of Turkish banks, differentiating between government-owned and private banks, to assess the effects of systemic (macroeconomic) and bank-specific (microeconomic) factors on NPLs. The results of this study suggest that the Global Financial Crisis (GFC) did not change the significance or direction of the relationship between ownership status and NPLs for private banks. But when public-owned banks are considered, this relationship is not statistically significant, no matter the period, before or after the Global Financial Crisis. Regarding foreign banks operating in Turkey, the GFC plays a crucial role in determining the statistical significance of ownership status: before the GFC, ownership status was statistically significant and directly related to NPLs, but this relationship becomes insignificant after the GFC.

Another interesting study is the one by Swamy (2012) that concludes, in contrast to what is believed, that interest rates do not affect NPLs. On the contrary, NPLs are affected by size and ownership status. When banks are private and large enough, their loan portfolio is characterized by a lower proportion of NPLs. This finding suggests the privatization of public-owned banks as the best solution.

As for the size of a bank institution, Rajan and Dhal (2003) find that the way this is measured plays an important role, as the impact on NPLs differs depending on this way of measurement. In this line, Louzis, Vouldis, and Metaxas (2012) deduce that bank size is

important up to a certain point, while the degree of influence of each determinant on NPLs depends on the loan category. [3] Additionally, bank management plays a significant role in the case of the Greek banking sector.

A study that is in favor of the bad management hypothesis is the one performed by Anastasiou, Louri, and Tsionas (2016), in which they investigate the determinants of European countries' bad loans from both microeconomic and macroeconomic perspectives. They also find the influence of risk preference, unemployment, tax, and the output gap on bad loans significant.

Ghosh (2015) introduces regional characteristics, such as regional GDP, real GDP per capita, and changes in housing market prices, into the study of non-performing loans (NPLs) using data from the United States. These factors are found to be statistically significant and should therefore be considered in the rating of banking institutions.

Additionally, the exchange rate may play a crucial role in the evolution of a bank's NPL ratio. Atanasijević and Božović (2016) use data from a Serbian bank's corporate loans over the period 2008–2012 to examine the factors that contribute to loans becoming non-performing. The results of their study suggest that the exchange rate is inversely related to NPLs; specifically, a depreciation of the local currency causes loans to become non-performing due to the reduced capacity of enterprises to manage their debts. A similar inverse relationship is observed between GDP growth rates and NPLs, while a positive relationship is found between loan size and the NPL ratio.

4.4.2 Studies of the role of corruption in banking

While there is some research on how corruption affects lending, including studies focused on Russia, there is no work, to the best of our knowledge, that explores how the relationships between macroeconomic and microeconomic factors and non-performing loans (NPLs) are shaped by changes in the corruption environment. The only study that directly examines the effect of corruption on NPLs is the one performed by Park (2012). The results support the positive and statistically significant relationship between corruption

and loan quality. However, it does not investigate how changes in corruption levels may influence the impact of macroeconomic and microeconomic factors on NPLs.

Furthermore, corruption has an equally important effect on the stability of the financial system. In their study, Chen et al. (2015) use data from 35 emerging economies over the period 2000–2012 to study the effects corruption incurs on the banking system's soundness along with the indirect influence of corruption on monetary policy. The results of their analysis confirm the direct relationship between NPLs and corruption, as the effect of corruption on risk through the implementation of monetary policy is underlined.

In an additional study, Farvaque, Alexandre, and Weill (2012) use data from 37 Russian banks over the period 2005–2007 to study the effects of the four dimensions of transparency, as they are estimated by Standard & Poor's, on the efficiency of the Russian banking system. They claim that transparency impacts efficiency positively through the increased ability of the banking system to raise deposits and provide loans. Among all the four dimensions of transparency, only the transparency of the board and the structure and process of management are statistically significant and exert a positive impact on efficiency.

Beck, Demirgüç-Kunt, and Levine (2006), in their pioneering study, explored firstly the relationship between bank supervision and bank corruption and secondly the validity of various theories surrounding bank supervision. Using the World Bank Enterprise Survey (WBES) and the Barth, Caprio, and Levine (BCL) datasets (Barth, Caprio, and Levine 2004), the authors identify the factors influencing bank lending and firms' access to external finance. Their findings also provide clear evidence that strong supervisory power is directly related to greater obstacles for firms seeking external finance, but this contradicts what traditional theories of bank supervision predict. Additionally, the results of their study reveal that when banks are strongly encouraged to disclose all necessary information, it becomes easier for firms to raise funds through the reduced barriers created by bank officials and the enhanced integrity of the banking system.

Houston, Lin, and Ma (2011) move a step forward by studying the degree to which the ownership status of media and the market concentration influence bank corruption and, therefore, bank lending practices. The results of their study support the view that both

media ownership status and market concentration amplify the direct relationship between supervisory power and lending corruption. Conversely, an opposite relationship is observed as regards private monitoring and bank corruption. These relations become more pronounced when the media are publicly owned.

The scarce capital resources can be allocated more effectively if corruption in bank lending is reduced. This could be achieved through enhanced information sharing, coupled with increased bank competition, as demonstrated by Barth, Lin, and Song (2009). The authors also suggest that the positive impact of heightened competition is further strengthened by improved information sharing.

However, an alternative presented by Weill (2011a) says that, in the presence of a high risk-aversion attitude on behalf of banks, corruption might be helpful for businesses to raise external finance by bribing banking officials. This view highlights that while corruption can enable firms to obtain funding, it does not necessarily lead to an increase in bank lending; on the contrary, it contributes to a rise in non-performing loans (NPLs). Halford and Li (2020), with their study, provide support for these findings. They indicate that businesses with politically connected leaders are more likely to restructure their loans, including through refinancing, rather than resorting to bankruptcy.

Braham, Peretti, and Belkacem (2020) analyzed intrinsic elements of corruption, such as political patronage, in the Middle East and North Africa (MENA) region for the period 2003–2015. They concluded that, when considered independently, patronage does not have a statistically significant impact on bank risk-taking. However, the situation changes when patronage is analyzed in conjunction with interactions involving capital and size. In such cases, these interactions appear to have a direct effect on bank credit risk.

Another strand of the literature also explores the impact of political connections, when combined with the ownership status of banking institutions, on non-performing loans (NPLs). Boateng, Liu, and Brahma (2019) studied 88 banks in China over the period 2003–2014 and found that the political connections of a bank's management team significantly and positively influence the NPL ratio. Additionally, ownership status plays a crucial role in this dynamic. Specifically, when banks are state-owned and their managers are politically connected, this interaction is positively associated with NPLs. In contrast, when

banks are privately owned and their board members have political connections, the interaction is inversely related to credit risk.

In another work, Weill (2011b) studies the effects of corruption on bank lending, using Russia as a reference country. He considers regional aspects and distinguishes between loan categories and whether the borrowers are households, private enterprises, or the government. The results indicate that corruption acts as an obstacle only for households and firms but not for the government. Of course, the results also show a direct relationship between lending, hampering, and corruption.

Akins, Dou, and Ng (2017) offer a very interesting alternative to the current corruption and bank lending literature. Using a sample of 44 countries and 3,600 firms, they find that timely loan loss recognition decreases corruption in bank lending. To put it another way, an increase in transparency can lead to the discovery of many bad loans.

4.5 Data and methodology

4.5.1 Determinants of Non-performing loans

4.5.1.1 Economic growth

In this study, we consider the interdependence among non-performing loans (NPLs), economic activity, and a set of bank-specific variables. The macroeconomic factor under consideration in this study is gross domestic product (GDP). The reason is that it plays an important role in measuring economic activity. We thus study the impact of GDP on the NPLs of Russian banks. According to the existing literature, the GDP and NPLs are inversely related. During a recession, the repayment capacity of households and businesses is adversely affected, leading to an increase in NPLs. Conversely, in periods of economic growth, the ability to meet loan obligations improves, resulting in a decrease in NPLs (Laeven and Majnoni, 2003; Biker and Metzemakers, 2005; Bangia et al., 2002; Carey, 2002).

4.5.1.2 Bank-specific factors and hypotheses tested

The bank-specific factors considered in this study are derived from the financial statements of individual financial institutions. These data offer valuable insights into the management practices of these institutions, particularly in relation to earnings management, risk-taking, and other relevant activities. This study tests the following hypotheses: a) the "Loan Growth" hypothesis; b) the "Bad Management" hypothesis; and c) the "Risk Aversion" hypothesis. **Table 4.1** provides a summary of the hypotheses examined within a Panel Vector Autoregression (PVAR) framework, taking into account the effects of changes in the level of corruption along with the corresponding expected outcomes.

Table 4. 1*. Hypotheses Tested-Expected Signs

Variable	Hypotheses	Expected Sign
EQUITY/LIABILITIES (EQTL)	Risk Aversion	-
LOANS GROWTH (ΔLOANS)	Loan Growth	-
RETURN ON AVERAGE ASSETS (ROAA)	Bad Management Procyclicality	- +

*In this table, the hypotheses tested are presented along with the expected signs according to the theory.

4.5.1.2.1 Loan growth hypothesis

When a bank increases its risk exposure by granting more loans to households and firms, the non-performing loans (NPL) ratio is likely to decline. This happens because the denominator (total loans) of the NPL ratio increases. The above is based on the premise that as a bank expands its loan portfolio, the proportion of NPLs to total loans will decrease. We thus expect an inverse relationship between NPLs and loan growth (LG) to be established. Moreover, since the increased lending activity results in increased interest income coming from loans that were granted to households and businesses, a negative correlation between NPLs and loan growth (LG) is expected.

4.5.1.2.2 Risk aversion hypothesis (equity-to-liabilities ratio)

According to Schepens (2018), shareholders and managers of well-capitalized banks have more at stake and are consequently less inclined to take excessive risks. Following this premise, we hypothesize a negative relationship between NPLs and the equity-to-liabilities ratio (EQTL). This implies that as shareholder equity in a bank increases, the institution becomes more risk-averse. If this hypothesis holds, it would contribute to a reduction in moral hazards and adverse selection issues.

4.5.1.2.3 Bad management–procyclicality hypothesis (return on average assets)

Within the framework of this hypothesis, both positive and negative relationships may be observed. A direct relationship will arise between return-on-assets and non-performing loans (NPLs) if banks exhibit procyclical behavior. In contrast, if bad management practices are implemented by the management team, this may make this relationship negative.

4.5.2 The corruption index

To assess corruption, we employ the methodology proposed by Park (2012) to construct an index where higher values indicate greater levels of corruption. The Corruption Perception Index (CPI) ranges from 0 to 100, with higher scores reflecting more transparent processes. Conversely, lower scores denote higher levels of corruption. Therefore, our corruption index is calculated as follows:

$$COR = 100 - CPI \qquad (3)$$

4.6 Preliminary analysis

For our analysis, we utilize annual data over the period 2008–2014 for Russian banks obtained from the Bankscope database, while the macroeconomic data (GDP) were extracted from the IMF and World Bank (WB) databases.[10] Our panel is unbalanced and consists of 779 cross units (banks).

[10] Data sources: www.imf.org and www.worldbank.org

In **Table 4.2**, we present the descriptive statistics of all variables of interest in our study. As we can see, the highest standard deviation is presented by GDP because the GFC occurred during this period. Additionally, NPLs, ΔLOAN, and rate of change in corruption present higher values of standard deviation than profitability (ROAA) or leverage (EQTL). The table gives us an initial picture of the highly volatile situation formed during the GFC within the Russian banking sector.[11]

Table 4. 2 Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
ΔNPLs	3514	.721	3.86	-4.51	8.901
GDP	3514	1.314	3.95	-7.821	4.504
ΔLOAN	3514	.585	3.002	-4.642	11.012
EQTL	3500	2.87	.955	-3.398	9.873
ROA	3514	.889	.736	-4.779	3.82
Δcor	3514	-1.268	2.543	-5.263	1.389

Notes: In this table the descriptive statistics are presented for the variables included in this study

Table 4. 3 Correlation Matrix

Variables	ΔNPLs	GDP	ΔLOAN	EQTL	Δcor	ROAA
ΔNPLs	1.000					
GDP	-0.265	1.000				
ΔLOAN	-0.209	0.367	1.000			
EQTL	0.011	-0.041	-0.149	1.000		
Δcor	0.108	-0.167	-0.348	0.019	1.000	
ROAA	-0.103	0.067	0.136	0.144	-0.077	1.000

Notes: In this table the correlations among the variables are presented to detect multicollinearity problems.

Table 4.3 presents the correlations among variables. As we can see, there is no problem of multicollinearity among the variables, since the highest value does not exceed 0.367.

[11] For the purposes of our analysis, we obtained the cubic root of the variables corresponding to bank-specific data, as did Miles et al. (2013). Thereafter, we deducted the extreme values below the 5th and above the 95th percentile.

As a first step in our analysis, to avoid the possibility of spurious regressions, we assume that all our variables of interest are stationary. For that reason, we applied the Fisher-Type Panel Unit Root Test (Dickey-Fuller), which best suits the nature of our data (small T, where T are the years, and very big N, where N is the number of cross units, for an unbalanced panel). To apply this test, we examined the null hypothesis that a unit root exists in our panels (non-stationarity) against the alternative that our panels are stationary and thus there is no unit root. From the results, we concluded that our variables do not contain a unit root, and thus the series are stationary.[12]

4.7 The econometric methodology

For the purposes of our econometric analysis, we were motivated by Papadamou, Sidiropoulos, and Spyromitros (2014) and PVAR is applied, as initially proposed by Holtz-Eakin, Newey, and Rosen (1988) and extended by Love and Zicchino (2006). In the first stage of our analysis, we estimated our model without including the rate of change of corruption.

The general form of the equation of a PVAR approach is as follows:

$$Y_{it} = B_1 Y_{i,t-1} + X_{it} Z + v_i + e_{it}\,, \quad (4)$$

where: Y_{it} is a (1 x k) vector of the dependent variables, v_i are the fixed (bank-specific) effects, and e_{it} is the error term. The variables examined are ΔNPLs (the rate of change in NPLS), ROAA (bank profitability), EQTL, and ΔLOAN (the rate of loan (credit) growth).

The impulse response functions plot the response of a variable after a positive shock to another variable of the system with all other factors remaining stable. The confidence intervals were generated using Monte Carlo simulations. In our case, we focus on the reactions of each bank-specific variable separately after a positive shock to ΔNPLs and the subsequent response of the ΔNPLs after a positive shock on each bank-specific variable. We additionally present the corresponding variance decomposition tables. They provide us

[12] The results of the Fisher-Type Panel Unit Root are not presented for economy of space reasons. They are available from the authors upon request.

with very useful information about how much the variation of a variable explains the variation of others across time.

In the second stage of our analysis, we include corruption in the form of a dummy variable called Δcor, which takes the value of one for every period, whereas the rate of change of the corruption index is positive (Δcor>0). This positive rate of change declares a situation of worsening corruption in the country. Consequently, a dummy variable defined as -Δcor takes the value of one for the periods of a negative rate of change of the corruption index (Δcor<0), which depicts an improved corruption level in Russia. In our analysis, the NPLs variable is decomposed into two new variables (+Δcor) x ΔNPLs and (-Δcor) x ΔNPLs. The introduction of these dummies helps us to study the responses of the bank-specific variables and the GDP as well as of a positive shock on ΔNPLs in periods of worsening and meliorating corruption correspondingly. It helps examine the effects of corruption on ΔNPLs. The variance decompositions of this stage are also presented, along with the impulse response functions.

4.8 Empirical analysis

The results of the first stage of our analysis are presented in **Figure 4.1**. In this stage, the positive shocks on NPLs, ROAA, EQTL, ΔLOAN, and GDP are examined with the corresponding responses of the variables included in the model to these shocks. In the first row of Fig. 1, a positive shock in profitability (ROAA) results in a significant reduction of nonperforming loans (ΔNPLs). This indicates that the more profitable a banking institution is, the better equipped it becomes to handle difficulties arising from nonperforming loans (NPLs). This result provides clear evidence of a causal relationship between NPLs and profitability.

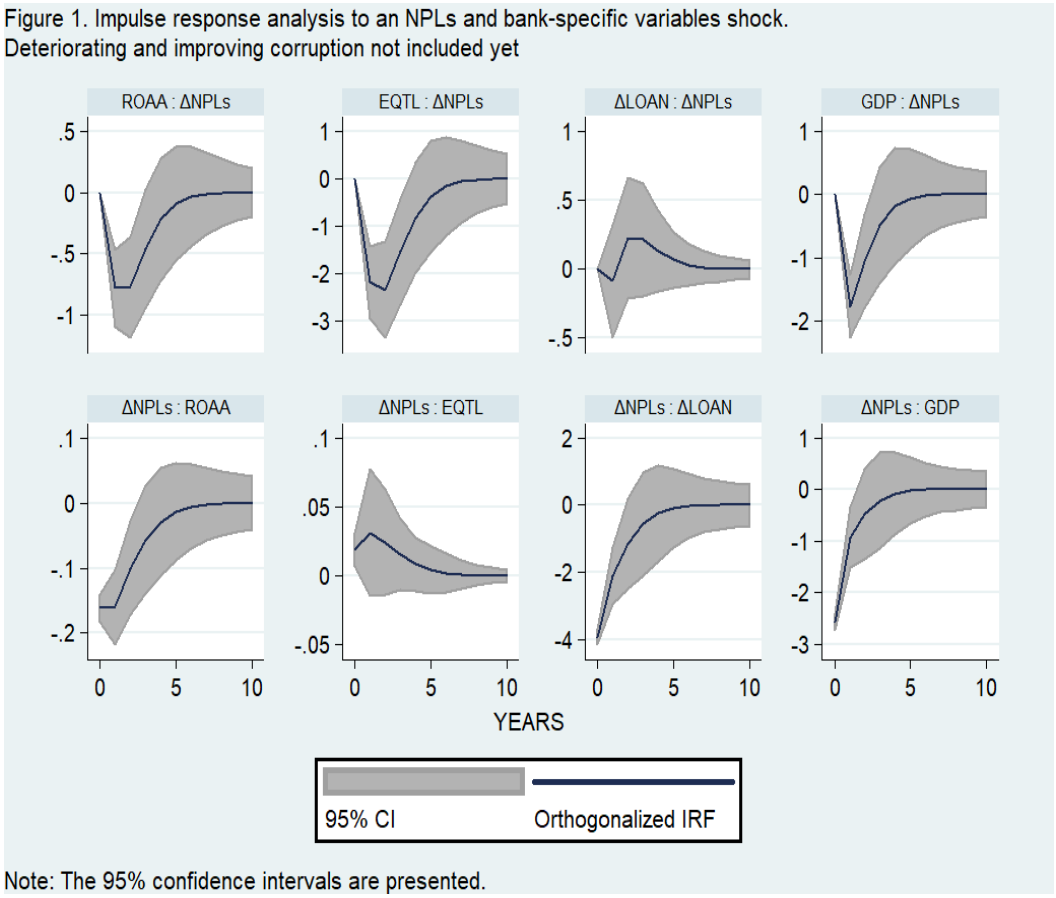
Apart from that, a positive shock in the equity-to-liabilities (EQTL) ratio results in a decline in the NPL ratio. This implies deleveraging and an improvement in the banking system's capital adequacy, suggesting that the ***Risk Aversion*** hypothesis is confirmed. It further implies that the higher participation of the shareholders in the equity of a bank forces the bank’s management to become more conservative towards risks and to

implement stricter lending criteria since, in case a project defaults, this implies higher losses. In other words, the bank's management becomes more risk-averse compared to the case where the shareholders participate less in the equity of the institution. In this manner, the ***Moral Hazard*** and ***Adverse Selection*** problems are mitigated. Moreover, the positive shock (increase) in GDP incurs a decline in nonperforming loans (NPLs) because of increased economic activity and the improved repayment capacity of households and businesses.

Looking at the second row of **Figure 4.1**, we can identify that a positive shock to nonperforming loans (ΔNPLs) leads to a reduction in profitability (ROAA), further supporting the ***Bad Management*** hypothesis. Loans previously granted that have now turned overdue exert downward pressure on profitability. Two main reasons are behind this: first, a greater portion of profits must be allocated to cover losses, and second, since the primary source of a bank's income is the interest paid on loans, the income diminishes when these loans become overdue. Due to the increase in the NPL ratio, the banks become less willing to grant new loans to businesses and households, and consequently, credit growth decreases. This finding provides evidence for the ***Loan Growth*** hypothesis. Furthermore, an increase in NPLs reflects a reduced capacity of households and businesses to repay their loans. As a result, the GDP declines.

In **Figure 4.2**, the results of the second stage of our analysis are presented, incorporating the effects of either a worsening or an improving environment of corruption into our model. The first row illustrates the response of NPLs in a context where corruption decreases, meaning the economy operates under a more transparent framework than before, following a positive shock (increase) in profitability (ROAA), the Equity-to-Liabilities (EQTL) ratio, loan growth (ΔLOAN), and GDP, with all other factors held constant. The second row of **Figure 4.2** shows the response of nonperforming loans (NPLs) in a deteriorating corruption environment (positive rate of change in corruption, +ΔCOR) when a positive shock occurs in profitability (ROAA), the Equity-to-Liabilities (EQTL) ratio, loan growth (LOAN), and GDP, again with all other variables held stable.

Figure 4. 1 Impulse response analysis to an NPLs and bank-specific variables shock. Deteriorating and improving corruption not included yet.



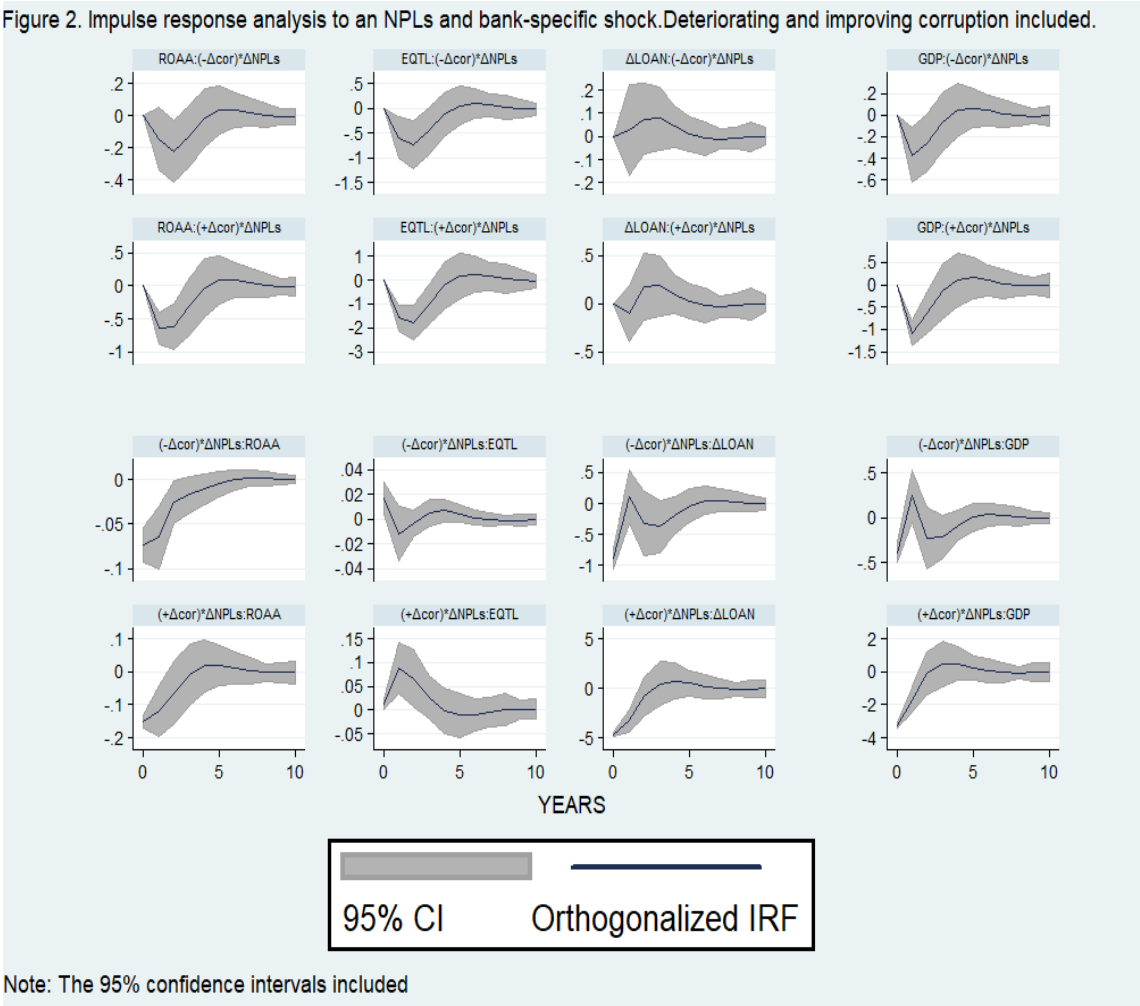
Note: The 95% confidence intervals are presented.

In the case of a positive shock to profitability (ROAA), NPLs decrease significantly within a worsening corruption environment (increasing corruption). This suggests that in a deteriorating corruption environment, profits must be utilized for a longer period to reduce the NPL ratio effectively. It is worth noting that the NPL ratio decreases as the corruption environment deteriorates, indicating the severity of corruption within the country. Consequently, NPLs return to equilibrium at a slower rate.

A positive shock to the Equity-to-Liabilities (EQTL) ratio leads to a reduction in the NPL ratio in both improving and worsening corruption scenarios. It arises as a result of the increased shareholder participation in a bank's equity, which in turn forces the management team to become more risk averse. The reduction in NPLs is more evident in a worsening corruption environment, with the problem of NPLs being more persistent over

time, as the magnitude of the reduction is nearly double, and it takes longer for NPLs to return to equilibrium.

Figure 4. 2 Impulse response analysis to an NPLs and bank-specific variables shock. Deteriorating and improving corruption included.



Note: The 95% confidence intervals included

Additionally, a positive shock to GDP results in a reduction in NPLs. This decrease is more intense and time-persistent in a worsening corruption environment. This response can be attributed to the increased economic activity that typically accompanies economic growth. In such a context, both businesses and households are better positioned to meet their debt obligations. Furthermore, as GDP rises, businesses—particularly those with

political connections in a deteriorating corruption environment—find it easier to secure funding. Consequently, even businesses with lower credit ratings may be granted loans.

Overall, we can conclude that in a corrupted environment, positive bank management practices and improved economic activity tend to reduce NPLs more significantly. This lies in the fact that in highly corrupted environments, NPLs are a substantial portion of total loans. Thus, any improvement in management practices or economic conditions has a stronger impact in reducing them.

The third and fourth rows of **Figure 4.2** illustrate the responses of profitability (ROAA), the equity-to-liabilities ratio (EQTL), loan growth (ΔLOAN), and GDP to a positive shock (increase) in NPLs under both improving and worsening corruption conditions. Similarly, the responses are more pronounced and persistent in a worsening corruption framework. More specifically, in the case of profitability (ROAA), the negative response to increased NPLs is almost double in magnitude under worsening corruption compared to improving corruption, and it takes longer for profitability to return to equilibrium. This can be attributed to the distorting effects of corruption: as the NPL problem intensifies, the misallocation of financial resources to non-creditworthy customers becomes more apparent. This results in a higher default rate among such customers, further eroding profitability. In contrast, if banks had allocated their resources more effectively—based on sound lending criteria rather than political connections- the impact on profitability would be less severe and should last less.

A similar explanation applies to the response of GDP to a positive shock in NPLs. As shown in **Figure 4.2**, the decline in GDP following an increase in NPLs, with all other factors held constant, is greater and more persistent in a worsening corruption environment than in an improving one. This reaction underlines the distorting effects of corruption on GDP. In a highly corrupted economy, economic agents with connections may be more willing to bribe officials to secure loans, gaining thus access to funding even when they do not meet the necessary risk management criteria. This leads to "zombie lending," where loans are extended to unviable businesses or households, a phenomenon corroborated by our empirical analysis.

A positive shock on NPLs causes an increase in the Equity-to-Liabilities ratio (EQTL). This is more pronounced and lasts longer in a deteriorating corruption environment. This happens because banks tend to accumulate capital as they become more cautious in their lending practices, building reserves to absorb potential losses.

Furthermore, in **Figure 4.2**, a positive shock to NPLs has an inverse impact on the loan growth rate in improving and deteriorating corruption environments. However, this decrease is significantly more intense and persistent when the shock to NPLs occurs within a worsening corruption context. This finding supports the view that in a corrupt economy, where nonperforming loans are on the rise, the banking sector becomes increasingly reluctant to issue new loans to businesses and households due to the borrowers' low credit ratings.

Figure 4.3a Impulse response analysis for an NPLs shock to itself. Deteriorating and improving corruption not included yet.

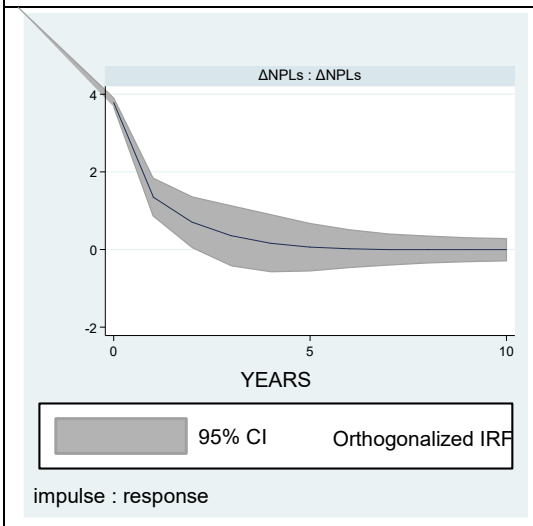
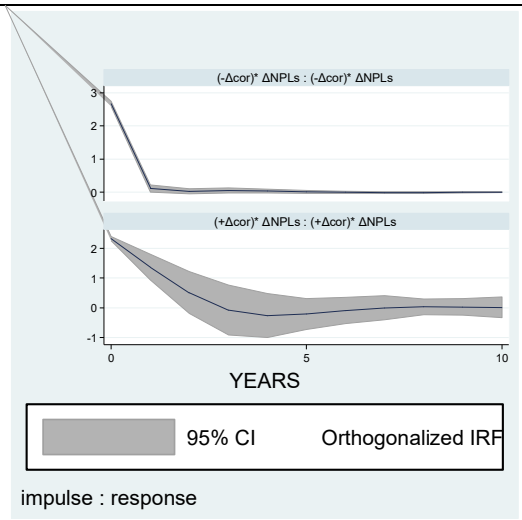


Figure 4.3b : Impulse response analysis for an NPLs shock to itself. Deteriorating and improving corruption now included



In **Figures 4.3a** and **4.3b**, the impact of a positive shock on NPLs and its self-response are presented for both cases where either corruption has been included in our model or not. It is observed that a positive shock to NPLs leads to an increase in NPLs. The NPLs ratio eventually returns to equilibrium after a certain period. Notably, **Figure 3b** shows that in a worsening corruption environment, it takes nearly twice as long for NPLs

to return to equilibrium compared to the case where corruption decreases, i.e., transparency improves (**Figure 3a**). These results reinforce earlier findings, indicating that higher levels of corruption cause the NPLs problem to be more severe and that more time is needed to return to equilibrium.

Table 4. 4 Variance Decomposition with no corruption distinction

Response Variable and Forecast Horizon	Impulse Variable				
	ΔNPLs	GDP	ΔLOAN	EQTL	ROAA
ΔNPLs					
1	1	0	0	0	0
3	0.515	0.131	0.002	0.315	0.040
5	0.466	0.124	0.003	0.365	0.041
7	0.464	0.124	0.003	0.368	0.041
9	0.464	0.124	0.004	0.368	0.041
GDP					
1	0.347	0.653	0	0	0
3	0.169	0.361	0.005	0.425	0.040
5	0.162	0.345	0.006	0.444	0.040
7	0.162	0.347	0.007	0.445	0.040
9	0.162	0.347	0.007	0.445	0.0402
ΔLOAN					
1	0.407	0.497	0.096	0	0
3	0.193	0.308	0.036	0.413	0.051
5	0.179	0.286	0.034	0.45	0.052
7	0.1791609	0.285	0.034	0.450	0.052
9	0.1791517	0.285	0.034	0.450	0.052
EQTL					
1	0.004	0.000	0.07	0.93	0
3	0.020	0.040	0.067	0.867	0.009
5	0.0219	0.042	0.065	0.859	0.013
7	0.022	0.042	0.065	0.859	0.013
9	0.022	0.042	0.065	0.858	0.013
ROAA					
1	0.107	0.048	0.004	0.028	0.813
3	0.147	0.129	0.004	0.165	0.555
5	0.136	0.127	0.004	0.238	0.495
7	0.135	0.126	0.005	0.245	0.489
9	0.135	0.126	0.005	0.246	0.489

Table 4. 5 Variance Decomposition with corruption distinction

Response Variable and Forecast Horizon	Impulse variable					
	(+Δcor)*ΔNPLs	(-Δcor)*ΔNPLs	GDP	ΔLOAN	EQTL	ROAA
(+Δcor)*ΔNPLs						
1	1	0	0	0	0	0
3	0.481	0.000	0.010	0.007	0.365	0.051
5	0.446	0.002	0.094	0.005	0.401	0.052
7	0.444	0.002	0.094	0.005	0.402	0.052
(-Δcor)*ΔNPLs						
1	0.0200	0.980	0	0	0	0
3	0.0629	0.805	0.023	0.001	0.010	0.008
5	0.0624777	0.7848	0.023	0.002	0.120	0.009
7	0.0632576	0.781	0.024	0.002	0.120	0.010
GDP						
1	0.555	0.008	0.437	0	0	0
3	0.285	0.006	0.234	0.006	0.429	0.040
5	0.285	0.006	0.228	0.008	0.432	0.040
7	0.283	0.006	0.227	0.008	0.436	0.041
ΔLOAN						
1	0.573	0.021	0.312	0.094	0	0
3	0.295	0.008	0.192	0.035	0.419	0.052
5	0.285	0.009	0.183	0.035	0.436	0.052
7	0.284	0.009	0.182	0.035	0.438 0249	0.0522 059
EQTL						
1	0.002	0.004	0.000	0.071	0.924	0
3	0.109	0.004	0.045	0.061	0.767	0.0146
5	0.103	0.004	0.048	0.056	0.765	0.023
7	0.104	0.004	0.049	0.056	0.764	0.023
ROAA						
1	0.096	0.023	0.040	0.003	0.028	0.815
3	0.115	0.029	0.079	0.004	0.144	0.633
5	0.110	0.028	0.074	0.005	0.176	0.607
7	0.111	0.028	0.075	0.005	0.176	0.601

Tables 4.4 and **4.5** present the variance decompositions, which provide us with information about the extent to which a variation of one variable explains the variation of

another. As can be easily seen, the variance decomposition appears to confirm what was claimed in our previous analysis. The inclusion of the improving or worsening corruption environment reveals significant information about NPLs and their role in the Russian economy.

The variability of variables of interest is much better explained by NPLs' variability in a highly corrupted environment than in an improved one. In other words, the variations of the variables are mainly explained by the positive rate of change of corruption, which means that the evolution of such variables is highly affected by the corruption level of a country.

4.9 Conclusion and discussion

This study examined the interdependence between NPLs, GDP growth, profitability, EQTL ratio, and Loan Growth. By going further, we investigated how these interdependencies were influenced in the context of ameliorating or worsening corruption. For our analysis, we employed a PVAR approach, using data from Russian banks from the period 2008–2014.

By focusing on Russia, a big country in transition after the collapse of socialism, which faces many challenges as regards the level of transparency, we examined the role of NPLs in the banking system and economic activity.

On the one hand, at the first stage of our analysis, a bidirectional relationship between NPLs and ROAA, EQTL, and GDP was found. On the other hand, when studying interdependencies between NPLs, ROAA, ΔLOAN, EQTL, and GDP by discriminating between a worsening and an improving corruption environment, significant findings were revealed. Most specifically, the negative effect on bank profitability, loan growth, and GDP of a positive shock to NPLs was much bigger in absolute terms, as well as more time-persistent, when the economy operates in a worsening corruption environment. Moreover, the positive response of bank equity to absorbing a positive shock to NPLs was much larger in such a corrupt environment. Another interesting finding was the time persistency found in the NPL dynamics.

We must mention at this point that the time persistence of these impacts provides pronounced evidence for the distorting effects of corruption on all aspects of financial systems and, thereby, the dysfunction it causes in the financing of businesses and households and the pace of economic growth.

All these conclusions provide useful information and can act as analytical tools for all stakeholders, such as the government, regulatory authorities, and bank administrators. Governments should aim to strengthen institutions, establish procedures, and adopt appropriate legislation to ensure the transparent operation of all aspects of the economy.

The supervisory authorities should carry out more intensive audits, imposing stricter criteria and making sure that credit is only provided under objective rules.

Finally, bank management should devote resources to the proper distribution of financial resources to the economy along with the implementation of advanced risk management techniques so that only sustainable investment projects are financed, and resources are not deprived of sound and transparent economic activities.

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Chapter 5

CONCLUSIONS

It was only after the onset of the Global Financial Crisis (GFC) of 2007–2009 that the necessary attention was directed—by regulatory and supervisory authorities, governments, and financial institutions—toward the quality of loan portfolios, as measured by the ratio of Non-Performing Loans (NPLs), and the overall health of financial systems. This shift in focus stemmed from the sharp rise in non-accrued loans during the crisis, which severely affected the balance sheets of many banking institutions, both at the individual and systemic levels. As a result, most banks were forced to allocate a significant portion of their capital reserves to absorb losses stemming from the accumulation of NPLs.

In light of this, several compelling research questions emerge from contemporary literature. Does the individual risk-taking behavior of banking institutions play a significant role in shaping their respective NPL ratios, or is this relationship consistent across all banks regardless of their internal risk management strategies? Furthermore, to what extent does the Economic Policy Uncertainty (EPU) Index—and its individual components—affect the long-term evolution of NPLs? If such a relationship exists, which components exert the strongest influence? Finally, do all subcategories of NPLs—such as consumer, business, and mortgage loans—adjust to long-run equilibrium at the same rate, or do they follow distinct adjustment paths?

As regards the first research question, it becomes obvious from the results of our study that banks' capital levels are statistically significantly related to NPLs, but this relationship varies across different banks in our sample. Specifically, while for the two of them the equity-to-assets ratio is negatively correlated with NPLs in the long run, suggesting that higher capitalization contributes to lower credit risk and thus providing evidence for the risk-averse attitude of the most capitalized banks, on the contrary, for the other two, the NPLs ratio is directly related to the capital, indicating that NPLs follow a

capital increase. The differences above clearly suggest that the Greek banks advocate distinct risk management strategies, which in turn exert influence on the NPLs ratio.

Furthermore, from the macroeconomic variable's perspective, the employment's evolution is directly related to the NPLs in the long run, underlining the distorting effects of reduced economic activity on the capability of households and businesses to meet their debts. Moreover, NPLs play a key role in explaining changes in both the liquidity and the capital, particularly in the cases of two of the four banks, as can be observed in the variance decomposition results. As a result, the interconnection of credit risk, liquidity, and capital adequacy in the Greek banking industry is highlighted.

With regard to the long-term relationship between economic policy uncertainty and non-performing loans (NPLs), our findings provide robust evidence of a negative impact of uncertainty on financial stability, even over extended periods. In addition to confirming classical theoretical assumptions, such as the Too-Big-to-Fail hypothesis, in the cases of Total, Mortgage, and Business NPLs, the results also support the risk aversion hypothesis in the case of Consumer NPLs. This latter finding may be attributed to the absence of collateral, which potentially makes borrowers more cautious in their credit behavior.

In the initial phase of our investigation, we discovered a reciprocal association between NPLs and GDP, ROAA, and EQTL. However, important findings emerged when examining the interdependencies between NPLs, ROAA, ΔLOAN, EQTL, and GDP while distinguishing between a worsening and an improving corruption environment. In particular, when the economy functions in an atmosphere of increasing corruption, the negative impact of a positive shock to non-performing loans (NPLs) on bank profitability, loan growth, and GDP was more significant in absolute terms and more durable over time. Furthermore, in such a corrupt atmosphere, bank equity responded more favorably to absorbing a positive shock to non-performing loans. The time persistence in the NPL dynamics was another intriguing discovery. We must note at this point that the long-term endurance of these effects offers clear proof of the distortions corruption has on all facets of financial systems and, consequently, the dysfunction it creates in the financing of individuals and enterprises and the rate of economic expansion.

From a policy-making perspective, banking regulators and government authorities must strengthen their control mechanisms concerning banks' risk-taking behaviors. This implies the implementation of strict supervisory frameworks, and the establishment of specific legislative measures designed to ensure financial system resilience. A key component of this oversight should involve the continuous and systematic monitoring of the composition and, thereby, the quality of banks' loan portfolios. This should provide the necessary guarantees for establishing a resilient financial system, particularly in times of heightened economic uncertainty.

In this context, policy efforts aimed at reducing uncertainty—particularly in the realms of fiscal, tax, and banking regulation—could play a critical role in enhancing the effectiveness of NPL management. Our findings demonstrate that economic policy uncertainty is positively associated with the accumulation of NPLs, not only in the short term but also over the long run. Therefore, political stability becomes a necessary condition for encouraging private sector investment and ensuring sound and effective lending practices.

These implications offer precious guidance for a range of stakeholders, including government bodies, regulatory institutions, and banking executives. Governments should focus on strengthening transparency and ensuring that all economic activities operate under clearly defined and consistently applied rules. Moreover, the supervisory authorities need to ensure a highly transparent environment to ensure the provision of loans based exclusively on objective financial criteria. Bank management teams should allocate their financial resources more effectively. Consequently, employing advanced risk assessment methodologies and ensuring that capital is channelled into projects that are economically viable and aligned with principles of sustainability. This would enable banks to contribute more effectively to economic growth while minimizing the vulnerabilities associated with non-performing assets.