Charles University in Prague

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Determinants of Non-Performing Loans in Eurozone and Non-Eurozone Countries

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Academic Year: **2019/2020**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, January 6, 2020

Signature

Acknowledgments

I am highly grateful to my supervisor prof. PhDr. Petr Teplý Ph.D. for his always support related to different topics and issues coming out during the thesis writing process. Despite all of this, I would like to also say him a big Thank You for all the positive attitude which was a great help for me to overcome all the difficult and stressful situations.

Meantime, I would like to express my deep gratitude for their patience and support to the most precious thing I have in life, my Family.

Abstract

This paper represents an empirical analysis of the determinants of Non- performing loans in Eurozone and Non- Eurozone countries. We contribute to the literature by including a comprehensive literature review and examining a large sample of annual data on 534 banks from both euro and non- euro member countries during the time period from 2012 to 2017. The timeline taken into study includes also the period of zero and negative rates in EU. By applying System GMM methodology, we find the empirical evidence to draw the conclusions regarding our four hypotheses as it follows. First, a better loan quality is found to be in Eurozone countries compared to the Non-Eurozone countries. We found out that both macroeconomic and bank related variables significantly impact the levels of NPLs. Second, the bank size resulted to have a non significant impact on loan quality during the studied period. Third, we considered also three industry related variables which also resulted to not have any impact in the fluctuations of bad loans. Finally, we show that the prolonged period of low interest rates has shaped the expectations for the future and has changed the slope of the yield curve thus significantly impacting the quality of loans.

JEL Classification	C33, E43, E52, E58, G21F12, F21, F23, H25, H71, H87
Keywords	banks, Eurozone, Non- Eurozone, credit risk, impaired loans, low interest rates, bank heterogeneity.

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Abstrakt

Tato diplomová práce představuje empirickou analýzu determinantů z nesplácených úvěrů v zemích eurozóny a mimo eurozónu. Přispíváme k literatuře zahrnutím komplexního výběrového přezkumu ročních údajů o 534 bankách jak od euro z členských, tak i z nečlenských zemí eurozóny v období 2012 až 2017. Časový plán, který je studován, zahrnuje také období nulových a záporných sazeb v EU. Použitím metodiky System GMM najdeme empirické důkazy k tomu, abychom mohli vyvodit závěry týkající se našich čtyř hypotéz, které zní takto: První, lepší kvalita úvěrů je zjištěna v zemích eurozóny ve srovnání se zeměmi mimo eurozónu. Zjistili jsme, že makroekonomické proměnné i proměnné závislé na bankách významně ovlivňují úroveň NPL. Za druhé, velikost banky má významný dopad na kvalitu úvěru během sledovaného období. Zatřetí uvažujeme také tři proměnné specifické pro dané odvětví, které rovněž nemají žádný dopad na výkyvy špatných úvěrů. Nakonec ukazujeme, že prodloužené období nízkých úrokových sazeb utvořilo očekávání do budoucnosti a změnilo sklon výnosové křivky, což významně ovlivnilo kvalitu úvěru.

JEL Klasifikace	C33, E43, E52, E58, G21F12, F21, F23, H25, H71, H87
Klíčová slova	Banky, členové Eurozóny, Nečelonové Eurozóny, úvěrové riziko, znehodnocení úvěru, nizké urokové sazby, heterogenita bank

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Acronyms

ECB European Central Bank

EU European Union

GDP Gross domestic product

GMM Generalized method of moments estimator

IAS International Auditing Standard

IFRS International Financial Reporting Standard

IMF International Monetary Fund

LSDV Least squares dummy variables estimator

NPL Non performing loans

OECD Organisation for Economic Co-operation and Development

OLS Ordinary least squares estimator

RWA risk weighted assets

UNCTAD United Nations Conference on Trade and Development

ZLB Zero lower bound

Master's Thesis Proposal

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Proposed Topic:

Determinants of Non- Performing Loans in Eurozone and Non- Eurozone Countries.

Motivation:

Following the financial crisis, non- performing loans (NPLs) average has increased sharply across different banking systems. NPLs are considered as bad news for banks. NPLs consume capital, distract the attention of the banks from the core activities, increase the operating costs, decrease profitability and they may even erode the sustainability of the bank. Therefore, the aim of my thesis will be to empirically examine the causes of non-performing loans in the European banking system for the 2012-2017 period. Moreover, a distinguish between the banks of the selected counties by bank type (bank holding companies, commercial banks, cooperative banks, real estate & mortgage banks or savings banks) will be provided.

One of the most recent and relevant to my study is the research done in 2017 by Jabra, Mighri, & Mansouri (2017), aiming to investigate the internal and external factors of European bank risk taking during the 2005- 2015 time period. The authors observed the relationship between credit risk and regulatory characteristics (Tier 1 ratio), institutional characteristics (Political Stability and Quality of Banking Regulation), bank-specific variables (Bank Capitalization, Bank Size, Insurance Coverage, Loan Loss Provisions Ratio and Herfindahl–Hirschman Index), institutional characteristics (Political Stability and Quality of Banking Regulation) and country- specific variables (annual GDP growth and annual inflation rate). They split the sample of 26 European countries into two subsamples, consisting in East and West European countries. Finally, using GMM model the authors found out those macroeconomic and regulatory variables to significantly impact the bank risk taking, meanwhile they pointed out a different correlation between credit risk and internal and external factors in each of the samples. A lack of bank heterogeneity is observed.

Makri, Tsagkanos, & Bellas (2014) studied the determining factors of the NPLs in the Eurozone€™s banking systems but he used NPL ratio as a dependent variable. The authors revealed strong correlations between NPL ratio and various macroeconomic factors such as public debt, unemployment, annual percentage growth rate of gross domestic product; and bank-specific factors such as capital adequacy ratio, rate of non-performing loans of the previous year and return on equity factors. Their study lacks the consideration of bank heterogeneity and industry- specific determinants as well. Such variables are somehow considered in Athanasoglou, Brissimis, & Delis (2008) who discuss the insignificance of bank concentration in explaining the profitability of the Greek banks. They find the ownership status to not have influence on bank profitability as well, stating that private banks do not make higher profits.

In my thesis, I will consider the impact of protracted period of low and even negative interest rates in the EU on the quality of the loans. The main sample will be split into two sub- samples, which will consist in Eurozone and Non- Eurozone countries respectively. Thus, a comparison between the samples will be provided.

Hypotheses:

1. Hypothesis #1: Macroeconomic and bank-specific variables influence loan quality, and that these effects vary between Eurozone and Non- Eurozone members' banking systems.

2. Hypothesis #2: Saving banks reported the lowest level of NPLs in both Eurozone and Non-Eurozone countries.

3. Hypothesis #3: Market specific variables are negatively correlated to the quality of loans.

4. Hypothesis #4: The prolonged environment of low interest rates increased all type of banks' NPLs level.

Methodology:

In order to test the hypothesis and provide a good assessment on the topic random effects, fixed effects or GMM methodology will be utilized. For writing the thesis, the Bank Scope database will be the primary data source. Additionally, available data from the database of Eurostat and ECB will be used. Due to lack of data, loan impairment charges to average gross loans will be used as a proxy for non- performing loan ratio, which will be the dependent variable in the model. The determinants of non- performing loans will include bank-specific characteristic, sector- specific variables as well as country- specific factors. Bank specific variables will cover possible effects of heterogeneity coming from bank size and other features of banking system. Sector- specific variables will cover the possible correlation between bank's business model and NPLs. Country specific variables will mainly cover macroeconomic factors which lead to bank heterogeneity across the countries. The final dataset will be a balanced panel covering the six- year period from 2012 to 2017.

Expected Contribution:

Even though the researchers have done several studies on this topic, there is still place for a deeper analysis. This study is expected to contribute to the literature by further examining the determinants of non- performing loans in the EU. A detailed comparison of differences in determinants of NPLs in Eurozone members and Non- Eurozone members will be provided as well. The financial institutions used will be categorized into five groups: commercial banks, cooperative banks, real estate& mortgage banks, saving banks, and bank holding& holding companies. In addition, heterogeneity coming from banks size and geographic location will be taken into consideration. Finally, my thesis will contribute by including explanatory variables which will be categorized into three main groups. For a large sample of European banks, a special dataset from Orbis Bank Focus will be used.

Outline:

The thesis is expected to be built in six chapters. The first chapter will mainly consist in introduction of the research topic where the core research questions, expectations and the organization of the study will be stated. The second chapter will be regarding the literature review framework. There will be a review of the previous studies conducted by different scholars on the main topic and of the variables used in the study. In the third chapter, the dataset and variables used for the analysis will be explained. During the fourth chapter, the implied methodology will be further explained in more details. Next chapter will be dedicated to the testing of the hypothesis and examination of the empirical findings. Lastly the study will be closed with a conclusion, which will provide a summary of the found results and the final answers to the research questions.

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Author **Supervisor**

1. Introduction

Banks are the key financial institutions of every economy which arrange a required level of finance to run a business effectively. Availability of finance and its appropriate usage brings numerous benefits towards banking, businesses and to the whole economy. Banks do their maximum efforts to provide loans against high potential project where the extent of returns is quite high with high performance as well. Performing loans cause more deposits towards banks and vast their operations, while Non-Performing Loans are treated as the night mare of the banking system. NPLs are those types of bank loans which are near to become due or they are already overdue. The time of default of the loan depends upon the terms of contract agreed in advance between the bank and debtor. In European Union, the scope of commercial banking operations is quite vast along with large trend of obtaining loans for business purpose as well. Due to this, the trend of NPLs in EU is increasing day by day. The financial year 2014 is considered most adverse era regarding default loans. In this year, the volume of bad debts became 6.5%, at the amount of €1.17 Trillion. Thus, the loss of banks increased sharply and adversely affected the performance of the banking system. Due to several legal and financial measures applied, this trend reached to 4.1% or € 814.5 billion during financial year 2017 (Guarascio, 2018).

However, NPLs are not considered as problematic events only in the Euro area but also in Non-Euro area. They hold an increasing trend among non-eurozone as well. The trend of NPLs in Bulgaria is quite high and has reached to 9.3% by end of financial year 2018. Bulgaria is ranked at fifth largest country in terms of NPL in entire European Union. Beside this, the trend of NPL is quite high in Poland as well. By August 2019, this level reached to 6.9% which was 6.3% by financial year 2018. This show an increase trend present in the NPL of Poland. The trend of NPL in Romania holds a drastic trend. The NPL trend of Romania was 2.59% only by year 2007 and reached to 21.31% by end of financial year 2013. Currently, the NPL level is 11.31% in Romania (John, 2018).

In general, the literature suggests that some of the main determinants for causing these levels of NPLs to flow are GDP Growth Rate, Inflation, Size of Deposit Liabilities, Number of Financial Institutions etc. Beside these mentioned factors, there are several other important macroeconomic, banking and industry related factors which can significantly change the amounts of bad debts in EU. They will be mentioned and empirically analyzed in the oncoming chapters of this thesis.

Through this research, a comparison between the determinants of NPLs in Euro and Noneuro area will be provided. The banks included in the analysis are operating in these two subsamples which are both located in Europe and under the policies of European Union, although currency they use is different. Moreover, the analysis considers the impact of protracted period of low and even negative interest rates in the EU on the quality of the loans. More specifically, the goal of this research is to prove the following hypothesis:

1. Macroeconomic and bank-specific variables influence loan quality, and that these effects vary between Eurozone and Non- Eurozone members' banking systems.
2. Large banks reported the lowest level of NPLs in both Eurozone and Non-Eurozone countries.
3. Market specific variables are negatively correlated to the quality of loans.
4. The prolonged environment of low interest rates increased all type of banks' NPLs level.

In total, the thesis will be organized in six chapters. Chapter 2 belongs to the detailed theoretical explanation of the main concepts mentioned in our analysis, which are closely related to the main topic. In order to provide the reader with some general and more global information regarding determinants of NPLs, Chapter 3 provides a global literature review of our topic, however the focus remains to the factors affecting bad loans in Euro and non-euro area. Chapter 4 represents a detailed descriptive analysis of the data used into the empirical analysis. Chapter 5 provides an overview of the empirical methodological applied. Then, Chapter 6 shows and explains the insights of the results of the whole empirical analysis of the thesis. Finally, Chapter 7 provides a brief summary of our findings.

2. Theoretical Background

This chapter is organized in the following subsections which explain in detail the theoretical concepts with a main importance to this thesis. Starting with the definition of credit risk and Basel Accord and ending up with the new accounting standard IFRS 9, it aims helping to fully understand the theoretical background of our topic and then moving forward into the empirical analysis.

2.1 Default risk

Financial institutions are categorized in diverse sections: commercial banks, saving banks, mortgage banks and many others. The backbone of every bank is deposit-taking and providing lending services to the customers. As previously mentioned, the largest portfolio of the bank's current assets is made up of loans, which are further categorized into performing loans and non-performing loans. As a result, credit risk set into play, and in turn, it might affect the operations of the financial institution positively or negatively. The theoretical background will attempt to provide fundamental theoretical concepts that form the cornerstone of this thesis. The factors are categorized in various sections like the macroeconomic factors, bank specific factors, industry specific factors and other ratios which are deemed to play a pivotal role in impacting the amount of non-performing loans. A key point to note is that when the ratio of non-performing loans to loan portfolios is high the credit risk goes high.

The financial institutions provide loans for both corporate and residential purposes. With an increase in the amount of loan issued, the liquidity risk, credit risk in times of default, and market risks increase. The goal of the banks is not to avoid risk but to measure and control it reliably in a way to maximize profit and minimize losses. However, the problem of information asymmetry arises when the borrower and the render fail to disclose full information relating to themselves (Barbosa & Marcal, 2011). The parties are highly likely to conceal some information that is considered important and thus leaving the other party on a losing end. The withholding of such information ends up raising the risk premium of credit facility provided. In 2013, Vallascas& Keasey argue that in an environment mired with opaque information,

banking institutions invest in risky assets, increasing the likelihood of default. Suh (2012) explains that the distress of one bank spreads easily to the others and this exposure to a common risk causes the multiple failures of banks. Therefore, banks should exercise due diligence a high sense of urgency to minimize risk emanating from the failure of the borrowers to honor the obligations.

The scrutiny of default risk is a critical part of gaining an understanding of Non-Performing Loans. It forms the preliminary steps to ascertain the ability of counterparties to honor their obligations as they remain relevant to terms of contract stated therein. It is a primary part of macroprudential analysis before issuance of a loan is qualified and assessment on the ability to pay justified with certainty (Brown & Moles, 2014). The failure to carry our due diligence lowers the quality of a bank's assets, increasing the probability of default by borrowers, and this leads to ballooning of the aggregate non-performing loan (Erdinç & Abazi, 2014). Therefore, it is pivotal for financial institutions to carry out their thorough research and obtain collateral before loans are issued. Therefore, it is pivotal for financial institutions to carry out their thorough research and obtain collateral before loans are issued.

Default risk refers to the likelihood that the borrower will fail to honor their obligations when they fall due, and as a result, the credit facility will not be repaid on time. High NPL ratios have serious impact on bank balance sheet and its overall profitability, and they hurt economic growth and the overall macroeconomic performance (Tanasković& Jandrić, 2015). The factors propelling the NPL ratio in EU countries have attracted greater attention. The increase in NPLs in countries such Italy, Portugal and Spain in recent times is alarming. However, countries such as Austria have taken a broad step in reducing their stocks in NPLs despite the escalating number of NPLs in other European Union Countries (Svitalkova, 2014). The EU has tried to develop strategies that will work in attempt to foster the reduction of bank risk and the NPLs (Haq& Heaney, 2012). However, it faces significant obstacles weighing it against reaching a consensus for a European Common Deposit Scheme as a subsequent pedestal for a fully-fledged Banking Union of Europe (Great Britain Parliament: House of Lords; European Union Committee, 2012). The greatest arguments remain that a sound banking system is destabilized, especially in EU periphery.

According to a research done by KPMG (2018), most banks across Europe suffer high levels of NPLs, and, Greece, Portugal, Cyprus, Ireland, and Italy at the forefront. The NPLs, for a universal bank, credit risk is at the core of every business, and it accounts for the biggest percentage of all forms of risks relating to banking sectors. A bank is highly likely to consider the age of the borrower or the going concern ability of an institution before advancing a credit facility. It follows that the bank assumes credit risk willingly by issuing loans to residential and corporate clients. Cerulli et al. (2017) states that since the start of the financial crisis, the credit quality of banks has deteriorated, and this positively influences the continued growth in non-performing loans, especially in the European Union. The bank's financial statement can provide an overview of the nature and the extent of NPLs from the receivable section. The higher the receivables, the higher the chances of having high amount of Non-Performing Loans. In 2007/2008 financial crisis, the NPLs played a very critical role, and this renews the emphasis on the significance of understanding and modeling default risk (Nagel & Purnanandam, 2019). Therefore, the minimization of stock of NPLs is critical for both the banking sectors and the economic growth at large. Financial institutions, especially banks should work both as individual banks and as a union to manage the level of default loans. The bank can employ use of joint venture agreements with other institutions in risk-sharing, securitize the NPLs and transfer them to a Special Purpose Vehicle (Aiyar, et al., 2015). Banking institutions can also establish internal independent workout units with or without external assistance to scale down their Non-Performing Loan while maintaining minimal interference with other bank operations.

2.2 Basel Capital Accords

The Basel Accords framework comprises three sections; minimum capital requirements, the supervisory review process, and market discipline (Shakdwipee & Mehta, 2017). All the three subsections play a pivotal role in determining how much a banking institution should issue in terms of loans to the borrowers and to what extent the firm wants to assume the credit risk (Drumond, 2009). Basel 1 which focuses on minimum capital requirements has attracted much attention compared to others. The Basel Accords outlines the regulations banks should adhere to, and it has serious impacts on the level of NPLs in the economy. Shakdwipee & Mehta (2017) explain that Basel 1 gives more focus to credit risks experienced by financial institutions, and

it proposes the risk weighting of assets by obtaining the product of nominal amount of assets owned by the bank by a factor known as the risk weight that denotes the risk perspective. According to Podpiera & Ötker (2010), the Weighted Risk Asset is used to compute capital ratios, which in turn determine the number of loans a firm can issue to the public. Its definition applies a simple principle: the higher the risk of an asset the higher the risk weighting. Such measures ensure the bank complies with 8% minimum capital requirement set out by the Basel I Accord (Dierick et al., 2005). The Basel Accord also translates to the capital that should be held by the bank, and the goal is to ensure that a banking institution can cover the losses arising from the loans issued. For example, when a creditor fails to honor their obligation, the bank can provide for loan losses in the future using the capital provided. Additionally, it is worth noting that banks with below 8% of capital requirements are at higher risk of experiencing huge losses in case the number of NPLs is high. Additionally, it makes the NPL to PL ratio to go high thus increasing risk of default and insolvency. It applies the concept of economic capital utilization model.

The penultimate pillar of Basel Accord dictates the amount of capital that a bank should hold for a given amount of risk weighted assets (RWA). In this case, capital is made up of accumulated reserves, gains on investments or assets, long term debt with a maturity of more than five years, and hidden reserves. The source of capital for banks includes customer deposits, equity, and debt.

2.3 Heterogeneity of banks

The concept of bank heterogeneity arises as a result of a multi-dimensional list of factors. The individual banks vary from each in many ways, and it might dictate the diversity in terms of shock experienced in the economy as a result of bank confirmation. Fernandez & Ausina (2015) points out that bank heterogeneity is observable by size whereby banks can be subdivided either in small, medium and large. Additionally, banks can be categorized based on the business model, and it means that we can distinguish banks into commercial banks, cooperative banks, real estate, and mortgage banks, saving bank, investment and savings banks, and bank holding banks. Hanzlík (2018) states that economies of scope and economies of scale are the two macroeconomic phenomena relating to bank heterogeneity.

Economies of Scale asserts that with a proportional growth in production factors that involves capital and labor, there is more than proportional growth of production, or earning assets in the specific case of banks (Mejstřík et al.,2014). Economies of scope, on the other hand, emphasize that the cost of production in separated processes exceeds a joint effort. From a banking point of view, it is more effective to offer diverse banking facilities in one single institution; for example, having a single banking organization to offer various services rather than separately. On the other hand, legal conditions may support bank specialization, for example by the US Glass-Steagal Act 1933 (Maivald, 2019).

The liquidity of commercial banks varies from one to another. Research done demonstrates that big multinational banks tend to have a higher share of large and institutional deposits. According to Laštůvková (2016), this allows such banks to maintain low liquidity levels. The regional and local banks have limited access to the financial markets, and they maintain liquidity through savings, liquid assets, and deposits. Therefore, it is more than reasonable to assume that there might be significant differences in the ways the small and large banks operate (Mejstřík et al.,2014).

Bank categories exist in different aspects; small banks, medium banks, and big banks. All three types of banks experience different levels of NPLs, determined by the liquidity levels. Also, the capital threshold is another way of distinguishing between banks, and this ultimately affects the exposure to risk. Banking is one of most regulated industries in Europe. Small banks in EU are deemed to have a capital amount below $1 billion, and as a result, they have fewer opportunities for diversification and have a higher probability of facing liquidity problems (Kimball, 1997).

Therefore, if small banks have high number of non-performing loans then there are chances that it will not be able to provide security for the loans perceived to be in default. It is therefore prudent to conclude that the higher the bank capital or tire, the higher the liquidity and the higher the number of loans it can issue. However, issues of NPLs can be limited since smalls banks are believed not to have a better strategy of managing risk arising from loan portfolios. Therefore, this demonstrates an inverse relationship between the NPLs and bank sizes, and this also applies to the medium-sized banks.

There are several types of banking institutions in the European Union like commercial banks, savings banks, investment banks, real estate banks and mortgage banks, holding banks and cooperative banks. Commercial banks make the largest chunk of all the banks in Europe, and they are involved in the business of accepting deposits from customers both institutional investors and individuals. Additionally, they do provide lending services to the client at a certain rate of interest above the bank lending rate to another bank. The higher the lending rate, the higher the NPLs since the borrower will not be able to honor the obligation of repaying the loans as per the terms outlined in the contract.

Mortgage and real estate banks provide loans to people who want to own houses and their business model is completely different from that of the commercial banks. They provide mortgage loans a certain interest rate to the customer or to the mortgagor who occupies the house (Boleat, 2012). There are few NPLs in this sector as the bank can auction the house in case the borrower is in default. A pre-determined plan of remitting payments is always pre-agreed between the bank and the customer. In case of default, collection procedures exist to ensure the loan does go not into default, for instance, putting up the house to auction.

Cooperative banks are another category defined as an autonomous association of people who voluntarily come together to meet their common economic, social, and cultural and aspirations through their jointly owned and democratically owned enterprise (Bülbül et al., 2013). According to International Cooperative Alliance website (2007), a cooperative provides loans to members based on agreed interest rates because they serve the purpose of improving the living standard of their members. The loan advanced to the member is contingent to amount of savings they possess with the cooperative. Additionally, the loan is never advanced to a random person but to a member who is well known by the group and whose savings are monitored either every month or quarterly basis. Ayad et al. (2010) employs one of the best strategies ensure the risk of default is low since the amount can be obtained through sale of collateral and redeeming the savings. Due to their high liquid nature and low credit risk, they do not have high numbers of Non-Performing Loans compared to other types of banking. The same case applies to saving banks.

2.4 The Zero Lower Bound

The concept relates to instances where the interest rates are approaching the negative side of the scale. Lopez et al. (2018) argue that as the interest rates approach the negative side, bank profitability declines because the low margins discourage lending. No banks would advance credit in an economy where the interest rates are so low (Altavilla et. al, 2019). According to Assenmacher & Krogstrup (2018) the effectiveness of monetary policy is limited when interest rates approach the zero-lower bound (ZLB). It also limits the power of the Central Banks in stimulating demand and borrowing through a reduction in short-term interest rates, and such a situation dooms the economy to a liquidity trap (Altavilla et. al, 2019). Banking institutions are hesitant to lower the interest on deposits since their primary source of income is accepting cash deposits and lending. As a result, most clients would rather hoard cash and wait until the market rate of interests becomes favorable. Bech & Malkhozov (2016) point out that negative interest rates were introduced in 2014 to counter deflation by the central banks of non-eurozone countries of Denmark and Sweden.

The zero lower bound rates are directly proportional to the amount of NPLs maintained by sound banks. Dell'Ariccia et al. (2014) argues that by hitting the ZLB, the deposit rate becomes negative, banks earn lower margins from its loan, and this is an incentive to invest risky assets. Basten & Mariathasan (2018) observe that in a negative interest rate environment, the weaker banks which face capital or liquidity constraints respond with increased risk-taking in the form of lowering requirements for collateral. Altavilla et al. (2019) point out that sound banks can offer negative rates on deposits, mostly on enterprises, because of the rise in the demand for safe investments, and this has a positive effect on deposits amount. According to the authors, in Germany, a core Eurozone member, the deposits earning negative rates accounted for 15% of total deposits, and around 50% of enterprises deposits indicating that the effects are economically quite significant.

Moreover, the introduction of the negative interest rate policy (NIRP) has the effect of stimulating bank's appetite for risk by expanding the supply of credit to previously unqualified borrowers (Hong & Kandarac, 2018). Hong & Kandarac (2018) further document that banks sensitive to NIRP will experience a higher probability of default, and this increases exposure to failure. The financial institutions from the euro area are

less affected by the ultimate crisis, and they in a better position to provide a negative interest on deposits. With the negative nature of interest rates, sound banks are affected by such rates as they have enough deposits and can facilitate lending to their clients. Altavilla et al. (2019) emphasize that this case is not always the same since there is no correlation between the non-Performing loans and hitting the ZLB in European Union. In conclusion, the ZLB rates of interest arise when the confidence level in the banking sector diminishes all drops significantly. ZLB was introduced to increase lending and deposits in the European Union. Banking institutions that offer zero lower bound interest rates focus on long term investments than short term investment ventures.

2.5 Non- Performing Loans

Non-Performing Loans are financial assets that are no longer operational and are considered impaired. They arise as a result of harsh economic conditions and the inability of creditors to honor the agreements leading to default in repayment of the loan. Additionally, the non-symmetrical nature of the economy versus the banking sector has increased the number of non-performing loans in the European Union (Cucinelli, Gai, Ielasi, & Patarnello, 2018). The high number of NPLs poses an enormous risk to the financial soundness of an institution, and as a result, they significantly grew in the aftermath of the global financial crisis (Ozili, 2019).

The non-performing loans have been piling up over the years, and a study done by IMF asserts that the NPLs amounted to 1 trillion in the year 2014, more than twice in 2009. Various issues have been pointed out as obstacles that have impeded the reduction of Non-Performing Loans in the European Union. Ozili (2019) suggests that such issues relate to prudential supervision issues, legal obstacles, distressed or constrained debt markets, informational hindrances, and other tax obstacles. The credit risk in banking sectors requires sound financial management. When the level of NPLs is so high, a higher amount of losses will be charged against profits and can end consuming bank capital and reserves and ultimately leading to the closure of the financial institution (The International Monetary Fund, 2019). Often, the banks have serious issues with the Non-Performing Loans always seek forbearance from the regulatory authorities, which provides them with enough time to deal with their current state of NPLs and improve their financial position (European Central Bank, 2017).

Non-Performing Loans can send the unappealing signals to the investors and can ultimately cause the bank to shut down its operation if the capital of the company is wiped out (Ozili, 2019). Therefore, banks should learn how to manage their Non-Performing Loans for them to remain relevant in the market. Gaining a better understanding of NPLs requires an analysis of the causal factors, and such determinants include the fluctuation of the business cycle, regulatory capital ratios, and loan growth. Additionally, one must understand the implication of these on the economy and subsequently to the banking sector (Ozili, 2019).

The Banking Act of Europe considers it prudent for banks to classify loans and advances to baskets, which demands banks to classify loans based on days past due and or the creditworthiness of the facility. Hence, such systems are useful in the provisioning and classification of NPLs, problem loans, non-accruals as well as handling loans, which are likely to result in losses. The implementation of systems for classifying the loans is a primary and valuable tool for supervisors to provide a wide understanding of the overall quality of the assets and categorically deteriorating loans as well as benchmark banks against their competitors (D'Hulster et al., 2014).

Ghosh (2012) points out that credit risk is the driver of NPLs for banks, and its components include the perceived loss, likelihood of default, and the exposure to default. Barisitz, 2013 points out that classification of loans using days past due comprises five categories; “pass/standard, watch/special attention, substandard, doubtful, and loss.” The banking guidelines require an institution to recognize a loan as non-performing when it is due for more than ninety days (Bank for International Settlements, 2016). However, they emphasize the importance of carrying out a final assessment to consider local banking practices and characteristics, such as internal strengths to recover debt and the operating environment (European Central Bank, 2017).

Impaired loans refer to those bank assets where the chance of collection of future interest and principal payments is low (Comptroller of the Currency Administrator of National Banks, 2012). It arises when the borrower is willing to repay and honor the obligations, but due to deteriorating financial conditions, the borrower ends up not remitting the payment. Ultimately, such a loan becomes uncollectible. A non-performing loan is defined as a situation when the borrower fails to honor their obligation of making payments, whether that of interest (Barisitz, 2013). For this

research, the ratio of impairment loan charges to gross loans is the dependent variable, and it is a precedent of the NPL ratio. Ferreira (2017) conceptualizes the impaired loans to gross loans as a measure of a bank's asset quality that shows the doubtful amounts of loans. According to Beccalli & Poli (2015), the ratio is high during times of financial crisis and therefore, a bank aims to have a low impairment charge to gross loans because this demonstrates a higher quality of its assets. However, there are other instances where NPLs arise due to the client's decision not to submit data, especially when they decide to use the money for the unintended purpose.

2.6 New Accounting Standard IFRS 9

IFRS 9 is an abbreviation of the International Financial Reporting Standard that was brought in place to replace the International Auditing Standard (IAS 39). It primarily focuses on the impairment of financial instruments and has caused a significant impact on the banking industry (Volarević & Varovi, 2018). The commercial banking sector contains a lot of financial assets in their balance sheet, and as such, amortization should be applied to these assets since they are subject to credit risk and impairment (PwC, 2019). Kund & Rugilo (2018) point out that IFRS 9 addresses the flaws inherent in IAS 39 by changing the way banking institutions recognise credit losses.

IFRS 9 requires banks to start providing for future credit losses when the creditors fail to honor their obligation as they fall due, and this reduces the profit for the period unless the bank can recover the amount fully and reverse the provision (Gaffney & McCann, 2019). Additionally, new systems will be required to facilitate collection of data and information that will be deemed paramount for accounting purposes and creating IFRS Models that will be of great use in the banking sector. Bholat, Lastra, Markose, Miglionico, & Sen (2016) point out that IFRS 9 proposes a three-stage model to determine the expected loss provision. The first stage comprises of loans with low credit risk, and the loss provision anticipates default in twelve months. Stage two comprises loans which have undergone a considerable rise in credit risk, and it requires the recognition of a provision over the loan's lifetime (Bholat, Lastra, Markose, Miglionico, & Sen, 2016). Stage three comprises loans which are impaired and the payment of future cash flows is at serious risk (United Nations Conference on Trade and Development (UNCTAD), 2019).

The introduction of IFRS 9 is expected to boost efficiency in reporting and contribute to cost-saving. However, it can also lead to some unappealing surprises to the investors and the banking operators. IFRS 9 was introduced to respond to the criticism against the IAS 39. The criticism resonates around the complexity of IAS 39 and the inconsistencies in its model. The inconsistencies also relate to the manner of risk management; the model also defers the recognition of credit losses on loans and receivables until it is too late in the credit cycle (PwC, 2019). As a result, the International Auditing Standard Board decided to introduce IFRS 9, and it did so in three phases (Cohen & Edwards, 2017). First, it decided to handle the classification and measurement of financial assets, impairment, and hedging. However, the new IFRS did not implement entirely new ideas since it incorporated some concepts and aspects of IAS 39. Banking institutions implemented the standards in those different phases until it was fully adopted and released in May 2014. The introduction of IFRS 9 models in 2018 has caused banks to struggle in terms of providing impairment of loans over a stipulated maturity period (Da-Rochas-Lopes, 2019). The standards have taken prevention measures on classification and measurement of financial assets immediately after the initial recognition with one model, which has few close to no exceptions. The new concept appreciates the fact that financial assets should be measured and recognized at fair value with changes in fair value recognized as income or expense through profit and loss account. The standard is considered simple but complex due to variations in profits, for instance, derivatives embedded in financial assets can influence a bank's net profit.

The new standard allows for the measurement of account receivables that lack enormous financial components at non-discounted cost rather than the fair value. However, there are no more exemptions that allow the measurement of investments in some of the non-traded investments in equity instruments. Restriction of optional fair value through profit and loss designation and has set out new criteria for reclassifying of financial liabilities and assets. Some of faced by banks in the adoption of IFRS 9 include a sudden increase in credit losses impacting bank profits and credit losses provision, jerking an enormous decrease in common equity tier 1 capital and ratios for many EU banks. The main consequence it deemed to be a result of an increased estimate of a lifetime for stage 2 exposures. There have been several benefits though around; there is an incentive to improve the credit appraisal method, provisions for underperforming exposures and credit impairments, as well as capital planning and

business processes can be evaluated reviewed and improved during the audit processes. There is also an aspect of full disclosures that encourage transparency, and enhancement of markets to the shareholders to a large extent compared to the period of IAS 39 applicability. Banking institutions require sound systems for processing data, analyzing information, and models to provide a sound estimation of perceived credit losses (Da-Rochas-Lopes, 2019). IFRS 9 also requires tenets such as data quality, availability of historical data quality and assessment of significant increase in credit risks. Sánchez Serrano & Suárez (2018) argue that the adoption of IFRS 9 will address the prevalent problem of high levels of NPLs in the EU by drawing attention to the level of credit quality of bank loan portfolios. This form the basis of the most significant challenges the banking industry will face going forward. However, there are still some assertions that IFRS 9 might not be sustainable as the debate between recognition and classification of financial assets still subsists among the stakeholders and its consequences.

In the EU, IFRS 9 introduced in 3 stages to avoid any controversies around its operations. As a result, this saw the amendment and the implementation of the Capital Requirement Regulation in all bank operations (Chalkiadis, 2019). IFRS 9 came with some disadvantages that affected the profit and loss account of the banking sector. Bholat et al. (2016) point out that there has been increased provisioning of NPLs loans, which make banks report high losses causing a bank's capital to fall below the required Basel Accord levels Banking institutions can reduce the impact above by increasing their share capital. An increase in loan provision results to decline in bank reserves and retained earnings, which affect the banks negatively. Such a scenario compels banks to issue few loans to protect themselves from providing for loans, which might default in payment.

3. Literature review

Recently, the issues concerning to non- performing loans (NPLs) level and their causes have been of the main importance for the global banking sector, especially after the financial crises of 2007- 2009, years which will be long remembered due to the threatens caused to the banking system. Many authors, like Barseghyan (2010) and Zeng (2011) refer to NPLs as a "financial pollution" which considerably harms both the financial and economic health. Therefore, the aim of this thesis is to determine the external and internal effects influencing the non- performing loans level in Euro-zone and Non-Euro-zone countries during the period of time from 2012 to 2017.

Starting from the early 1980s, when several banking sector crises were appearing because of the uncontrolled disorientation in loan losses, several studies were conducted regarding the factors causing the undesirable situation for banking systems stability. However, due to different regions, estimation techniques, time and variable scope used during the empirical analysis, different results have been pointed out. The literature generally suggests that integration among three main variables sets brings out a significant impact in the number of non- performing loans. More precisely, these variable sets are categorized as country- specific, industry- specific and bank- specific variables.

Therefore, this chapter will consist in three main parts. Firstly, we will present some previous years papers which empirically studied the impact that macroeconomic conditions have on the problem loans, in different areas and different time lines. Furthermore, in the end of each sub- section there will be provided a summary table which will contain the authors' names, region, a short description, methodology and data used in each of the working papers.

3.1 Country- Specific Determinants of NPLs

King and Plosser (1984) were among the first authors who studied the impact of business cycle phases on the stability of the banks. Based on their theoretical model, the authors find out a negative correlation between the stage of business cycle and the

loan defaults. The outcomes suggest that, during recession, some important country-based factors like low GDP growth and income level additionally with high unemployment rate increase the barriers of households to pay back loans. In contrary, during expansion, the borrowers already possess the needed income to repay the debt within the maturity date, thus contributing to a lower NPLs level for banks.

Lawrance (1995) attempted to explain the probability of default concept by using the life-cycle consumption model. Based on the baseline model, the author claims that due to factors like unemployment, the borrowers with lower incomes provide a higher probability to default in paying back their debts. Furthermore, this category of borrowers is charged with higher rates from the banks, raising in this way a new source to a higher NPL rate. He also suggested the GDP growth, unemployment rate and interest rate as the main macroeconomic indicators with a significant impact in the amount of NPLs. However, the Lawrence's model was further extended by Rinaldi and Sanchis-Arellano (2006). According to the authors the household arrears on payment obligations is more depended on the actual level of income and actual percentage of unemployment. Moreover, they claim that both macroeconomic features are closely related to the insecurity of the future level of income and rates for lending.

Similarly, Nkusu (2011) looked about the macroeconomic factors which are able to explain the fluctuations in NPLs ratio. In order to achieve the final results, the author used two approaches in his study and both was based on a panel data of 26 advanced economies (Australia, US, specific countries from Euro area and Switzerland) for the period of time from 1998 to 2009. In the first approach, Nkusu used all three OLS, PCSE and GMM methodology, to point out what would have a significant impact on the NPL ratio from the macroeconomic perspective. The results describe a negative relationship between the dependent and independent variables. Accordingly, a worse performance of macroeconomic indicators, such as GDP growth, unemployment and asset price rates derive to a higher level of bad debts. In the second approach, after running a panel vector autoregressive (PVar) model he arrived in the results coming from the impulse response functions, which suggested a significant connection between credit risk and macroeconomic issues. To conclude, the author claimed that asset quality contributes to a stronger business cycle and deterioration in the macroeconomic environment is considered as one of the main sources for higher NPLs.

De Bock and Demyanets (2012) looked for the internal and external factors affecting the asset and credit quality of the commercial banks in 26 emerging countries from 1996 to 2010 period. Using a panel regression, the authors realized a strong correlation between the quality of banks' assets, credit and macroeconomic indicator suggesting that a fall in GDP growth, a depreciated exchange rate, weaker terms of trade and a decline in capital inflows coming from debt-creation have a significant negative impact causing the credit growth to fall and credit risk to rise. Moreover, feedback effects are shown to perform a high level of significance confirming that financial sector state also influences the real economy to fluctuate. Applying the structural panel Vector Auto Regressions (VAR) model, the authors found evidence to say that deterioration in the level of NPLs cause a shrink in economic growth.

Similarly, Beck et al. (2013) tried to construct the macroeconomic indicators of credit risk for 75 globally selected countries. Using non- performing loans rate as a proxy for credit risk, the authors modeled a novel panel data for the past decade, where they considered only country- level indicators. Applying Fixed Effect model, the estimation outputs confirmed that real GDP growth rate, exchange rate, interest rate of lending and share price significantly impact the level of NPLs. Based on the estimations, the results suggest that a decline in the global economy would derive to a higher level of bad loans, while other variables are shown to have influence level in a group of countries within the sample. More precisely, the depreciation in the exchange rate is found to have a higher significance level in arising the NPLs for countries which provide higher amounts of foreign currency lending to the unhedged borrowers compared to the others; while a drop in stock price has a larger negative impact upon credit risk of banks in countries which have large stock amounts relative to the market. As for the significant impact that is caught regarding the lending interest rate on the bank asset quality, the authors concluded that it is relevant to central banks for two main reasons: firstly because it is negatively related to the financial stability in general and secondly because of the systemic banking crises leading to unfavorable economic situations through the feedback effect between the sectors of economy and finance.

Table 3. 1: Overview of key empirical works dealing with country- specific determinants of NPLs

Author(s)	Region	Short Description	Methodology& data	Results
King & Plosser (1984)	U.S.A	Studies the impact of business cycle phases on the stability of banks.	Theory based model.	Negative correlation between the business cycle phases and NPLs level.
Lawrance (1995)	U.S.A	Analyzing probability of default by using life- cycle consumption model.	Theory based model.	Significant impact of GDP growth, unemployment and interest rate on NPL rate.
Rinaldi & Sanchis-Arellano (2006)	6 Eurozone Countries	Developed the life-cycle consumption concept. Analyzing household financial fragility due to the large debt increase.	Panel Group FMOLS cointegration estimation for the period of time from 1999 to 2004.	The rise of income in slow rates has put the household sector in a riskier financial position.
Nkusu (2011)	26 Developed Countries	Examination of macroeconomic determinants affecting NPL ratio using two different approaches.	Panel data over the period of 1998-2009. The approaches are verified through OLS, PCSE and GMM methodology; Panel VAR methodology respectively.	Negative relationship between GDP growth, unemployment and asset price rates and NPL ratio. Significant connection between credit risk and

				macroeconomic conditions.
De Bock & Demyanets (2012)	26 Developing Countries	Investigates the internal and external variables determining the asset and credit quality of the selected baking systems.	Panel regression for the period of time from 1996 to 2010 through the application of structural VAR.	Negative relationship between GDP growth rate, exchange rate, export to import price ratio, capital inflows and credit risk and positive relationship with credit growth.

Source: Table created by author based on previous literature.

Many studies support the hypothesis that the amount of doubtful accounts in banking sectors around the world is conditioned only by the stage of the economy and the major macroeconomic forces; however, the literature suggests that a large part of the NPLs' fluctuations is also related to the bank- specific factors like bank's profitability, solvency, size etc. In the second section of this chapter, there will be provided working papers which diachronically have contributed to the literature by explaining the bank's asset quality based on country- specific, industry- specific and bank- specific factors. Specifically, the following subsection will have as focus the explanation of the effect of industry- related variables in the change of NPLs level.

3.2 Industry- Specific Determinants of NPLs

Keeton and Morris (1987) were the first who improved the studies done until those years by inducing to the analysis criteria also the set of sector specific variables. The authors took under study the years from 1979 to 1985 with a large sample of 2470 commercial banks from US banking system. They attempted to detect a possible

relationship between the two sets of explanatory variables, consisting in macroeconomic and industry specific variables and the dependent variable that is credit risk of banks measured by NPLs unit. Based on the findings, the authors suggest that the combination of both, unfavorable economic conditions of the region and industry-specific circumstances significantly impact the level of loan losses.

Athanasoglou et al. (2008) also used sector- specific variables like ownership and market concentration in their working paper but they used it to understand how these variables effect on the profitability of the Greek banks. Applying GMM methodology, the authors estimated the model under a dynamic panel data of the largest banks from Greek banking sector for the 1985 to 2001 period of time. Trying to find what impacts the profits of banks to change, together with industry- specific variables they also used macro variables (inflation expectations and cyclical output) and bank- related variables (bank capital, credit risk and productivity growth) in their analysis. The empirical outcomes showed a strong correlation between profitability persistence and real economy conditions in Greece, suggesting the inflation expectations to significantly impact the banks' profitability, while business cycle to be significant only in the upper part with a strong positive impact on the dependent variable. Similarly, the cost of capital and productivity growth are shown to be of a great importance in Greek banking' economy of scale, while a decline in credit risk level would impact in raising the profits. Coming to industry- specific variables, the final estimations showed them to not have any influences on the dependent variable. The market concentration does not appear to have any relation with banks profitability, also the results suggested that a private owned bank in Greece does not experience any larger economy of scale compared to the others.

In their working paper, Fišerová et al. (2014) considered industry- related determinants, along with country and bank- related determinants to test whether economic conditions of the host country impact the profitability of domestic foreign-owned banks in the host country. The authors used ROA, ROE and NIM as a proxy for profitability of the selected banks. Estimated through System GMM methodology and Fixed Effect modeling, the final sample consisted of 140 foreign- owned banks operating in seventeen selected countries from the Central and Eastern European region and New Zeeland for 2005 to 2011 periods of time. Seemly, all those countries, have

in common the large number of foreign banks operating within them where most of them share a large concentration in the market. The final estimations suggested a more favorable performance of the foreign banks during favorable times of the host country real economy. But, the significance coefficients of macro variables clearly supported the fact that performance of these banks is not affected only by macro conditions but also by bank specific factors, suggesting the operating efficiency as crucial indicator for performance stability of foreign- owned banks. Market concentration is found to be insignificant in explaining all three dependent variables, with a coefficient value near to zero. Additionally, a very slight influence of the number of banks within the industry is found to be in the case of NIM dependent variable, although the value of the coefficient is again very low. Similarly, banking assets as percentage of GDP are found to slightly affect only the level of ROA ratio. Similarly, as in our paper, this study also considers bank heterogeneity.

One of the most recent and relevant to my study is the research by Jabra et al. (2017), which aimed to investigate the internal and external factors of European bank risk taking from 2005 to 2015 time period. The authors observed the relationship between credit risk and regulatory characteristics (Tier 1 ratio), institutional characteristics (Political Stability and Quality of Banking Regulation), bank-specific variables (Bank Capitalization, Bank Size, Insurance Coverage, Loan Loss Provisions Ratio and Herfindahl–Hirschman Index), institutional characteristics (Political Stability and Quality of Banking Regulation) and country- specific variables (annual GDP growth and annual inflation rate). They split the sample of 26 European countries into two subsamples, consisting in East and West European countries. Finally, using GMM model the authors found out those macroeconomic and regulatory variables to significantly impact the bank risk taking, meanwhile they pointed out a different correlation between credit risk and internal and external factors in each of the samples. However, a lack of bank heterogeneity is observed.

Table 3. 2: Overview of key empirical works dealing with industry- specific determinants of NPLs

Author(s)	**Region**	**Short Description**	**Methodology& data used**	**Results**

Keeton & Morris (1987)	U.S.A	Examining the macroeconomic and industry-specific determinants of bad loans level.	Theory based model with data for 2470 commercial banks from US banking system from 1979 to 1985.	Significant relationship between both macro and industry-specific factors and the level of NPLs.
Athanasoglou et al. (2008)	Greece	Analyzing whether macroeconomic conditions, industry- related and bank-related determinants affect the profitability of banks.	A panel regression with data from Greece banking system for the period of time from 1985 to 2001, verified through application of GMM methodology.	Significant impact of inflation rate, the upper part of the business cycle, cost of capital and productivity growth. No impact resulting from Industry-related variables.
Fišerová et al. (2014)	17 Countries from Central and Eastern Europe and New Zeeland	Investigating whether the economic conditions of host countries has any influences in the domestic foreign owned banks profitability. A variable such as ROA, ROE and NIM was used as proxy for the	Dynamic panel data of 140 foreign owned banks operating in the selected countries during 2005 to 2011 period of time, which is estimated by System GMM and Fixed Effect methodology.	The macroeconomic variables and operating efficiently have explanatory power on ROA, ROE and NIM. Number of banks is significant only for NIM while banking assets as

		dependent variable.		percentage of GDP only for ROA.
Jabra et al. (2017)	26 European countries	Examining the internal and external factors of European bank risk taking, considering regulatory and institutional characteristics; bank-specific and country-specific variables.	Panel data created by data from 2005 to 2015 time period, verified through GMM modeling. The sample of 26 European countries was split into two main subsamples such as East and West European countries.	Only macroeconomic (annual GDP growth and annual inflation rate) and regulatory variables (Tier 1 ratio) have equal explanatory power on the bank risk taking for two subsamples.

Source: Table created by author based on previous literature.

Turning to the internal factors affect, the last section of this chapter refers to the explanatory power of bank- specific variables on the level of bad debts.

3.3 Bank- Specific Determinants of NPLs

Espinoza and Prasad (2010) attempted to construct the determinants of bad loans for approximately 80 banks in Gulf Cooperation Council (GCC) region from 1995 to 2008. Applying Fixed Effects for panel data, difference GMM and System GMM methodologies, the empirical outcomes indicate country- based and bank- based variables as factors that significantly affect the level of NPLs. As expected, economic growth was found to be negatively correlated to the banks' credit risk while among bank- specific variables, bank efficiency and past expansion of the balance sheet are the ones which resulted significant in explaining the NPLs deterioration. Using a panel VAR, the authors also studied the feedback effect of an increase in bad loans amounts in the real economy. Based on the empirical results, they confirmed a strong short-term effect of NPLs in the economy growth of the GCC countries; however, the authors

concluded that no systemic banking crises were happening during the period that is taken under study.

Louzis et al. (2012) presented an empirical study whose aim was to determine the macro- based and bank- based determinants of non- performing loans in the euro-zone country, Greece. The base line model was estimated through difference GMM methodology, based on a dynamic panel data of nine largest country's commercial banks from 2003 to 2009 time period. Regarding the studied timeframe, due to involvement of the favorable economy phase and the very first stages when the financial crises were smelled across the Europe, it provided important insights for the factors affecting NPL ratio in different states of Greek economy. The authors provided three empirical examinations in their study. They categorized NPLs in three levels: NPLs coming from business loans, consumer loans and mortgages. The final outcomes suggested that despite the loan category, the level of bed debts was mainly dependent on macroeconomic factors, such as: GDP growth rate, unemployment rate, interest rates and public debt. However, differences in the coefficients among three types of loans cannot be neglected, where consumer loans were the most sensitive to changes in interest rates, business loans to the real GDP growth rate, while the non- performing mortgages where considered as the least sensitive ones regarding the macro changes. Furthermore, "Too Big to Fail" (TBTF) effect was seemed to be present especially in case of mortgage and business loans. On the other hand, the results suggested a large influence on Greek NPLs level coming from bank specific determinants, mostly related to bank management. To conclude, the authors said that these results should serve to the regulators to understand that the linkage between loan quality and management quality is highly significant, thus reconsidering the measurements for the board performance, is of great importance.

Furthermore, Ćurak et al. (2013) studied the key drivers causing the fluctuations in the level of non- performing loans in the Southeastern European banking industries. The author found the motivation in the increasing amounts of credit risk and its negative impact in the overall financial and economic stability in the above-mentioned area, especially after the recent financial crises. The dynamic panel data consisted in 69 banks from 10 selected Southeastern European countries for the 2003 to 2010 period. The final model was again estimated by difference GMM estimator. Taking in

consideration country- level variables and bank- level variables, they found out that the major macroeconomic measures like GDP growth rate, interest rate and inflation rate significantly influence the quality of loans' portfolio in the selected countries. As for the banking industry- level variables, ROA, solvency ratio and bank size are found out to determine the fluctuation of NPLs ratio.

Messai & Jouini (2013) tried to detect the micro and macro factors which influence the level of bed loans in Greece, Italy and Spain. These countries have always been problematic in terms of NPLs levels; however, the beginning of the financial crises caused deeper unfavorable loans' portfolio health. The sample consisted of a panel data organized by 85 selected banks from the banking system of the three countries for the time period of 2004- 2008 and it was estimated by Fixed Effect estimator. The authors used two variables sets, that are macroeconomic variables (GDP growth rate, unemployment rate and real interest rate) and banking sector- specific variables (ROA ratio, loan loss reserves to total loans ratio). The results obtained after the empirical analysis suggested that a decline in GDP growth rate and an increase in unemployment and lending rates would cause the doubtful accounts in banks' balance sheets to increase, while an increase in loan loss reserves to total loans ratio and lower levels of banks profitability (ROA ratio) would directly cause unfavorable levels of NPLs ratio. The authors concluded that these results should make the macro policy makers aware of the huge importance of major macroeconomic determinants like GDP to be included in achieving stability of financial and economic system in general.

Moreover, Klein (2013) scrutinized the macro and micro factor affecting the credit risk in the banking systems of the Central, Eastern and South Eastern Europe (CESEE) region during the 1998- 2011 period. The sample used for estimation was created by ten largest banks in each of the sixteen selected CESEE countries. The baseline model consisted in country-specific factors and bank- specific factors and it was estimated under System- GMM methodology for balanced panel data. The first variable set mainly consisted in macro factors such as GDP growth rate of EU, unemployment, inflation and exchange rate and volatility of S&P500 index, while the second set consisted in bank- related variables like ROE ratio, equity to assets ratio, loan to assets ratio and loans growth rate. After the econometric model estimation, the final outcomes suggested that both sets of variables had explanatory power on the dependent

variable (NPL ratio), however the impact was slightly lower in the case of the second group. Moreover, the authors add to their empirical study the analysis of the feedback effect between the NPLs and the above-mentioned sets of variables. The results confirm a strong relationship between macroeconomic and financial stability in the CESEE region. The credit risk level is found to be closely associated with the major macroeconomic indicators such as GDP growth, while the significant impact of banking system on the state of economy is unavoidable as well. Based on the study results, the author claims that there is a strong existing correlation between the financial stability and real economy, which means that the high level of doubtful accounts of CESEE's banking systems directly impact in the slowing of economy growth.

Makri et al. (2014) contributed to the literature by introducing their study which was concerned on finding out what drives the NPL-s level to grow in the Euro zone countries during the pre- recession period of time, concretely from 2000 to 2008. This was the first study which empirically examined the possible macro and bank- specific which have a significant effect in the changes of non- performing loans ratio by using aggregate level data for the area taken into analysis. The sample consists in an unbalanced panel of 120 observations which includes data for 14-euro zone countries and difference GMM method is applied. This study is different from ours because of excluding countries of non- euro area from the sample and not considering the possible sector- specific factors effect as well. However, the econometric model is built by several major macro indicators, such as public debt as percentage of GDP, government budget deficit or surplus as percentage of GDP, annual percentage growth rate of GDP, annual average inflation rate and percentage of unemployment; and bank- specific ones such as NPL ratio of the previous year, bank capital and reserves to total assets ratio, loans to deposit ratio, ROA and ROE. The findings show a strong correlation between the level of bad loans and bank-specific variables like the rate of non-performing loans of the previous year, the capital ratio and ROE, which appear to have a strong influence on the non-performing loans rate. Furthermore, the outputs from the analysis suggest an existing relationship between NPLs rate and macro indicators as well where public debt, GDP and unemployment are considered as the additional factors causing fluctuations in the NPL ratio. Due to the final outcomes of their study, the authors finally say that the quality of loan portfolio is essential for the economical state of the euro area.

Similarly, Škarica (2014) investigated several factors with have a significant influence in the level of bed loans in selected Central and Eastern European (CEE) countries, that are Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia. He was the first who came out with an empirical analysis done for the above-mentioned countries by using aggregate country- level data on the non- performing loans. The analysis was done for the time period from the third quarter of 2007 to the third quarter of 2012, using a model which consists on a panel data being estimated through the fixed effects estimator. The author included in his examination two sets of variables, such as country specific variables (GDP, Unemployment, Nominal Effective Exchange Rate, Share Prices Index, 3-month Interest Rate and Index of Consumer Prices) and bank- specific variables (Loans growth). The results indicate the state of the economy as the main factor influencing the NPLs level to change. This statement is based on the significance and large coefficients of GDP growth rate, unemployment rate and inflation rate.

Chaibi and Ftiti (2015) presented an empirical comperative analysysis regarding determinants of NPLs in one market- based economy country as France and a bank-based economy country as Germany from 2005 to 2011 period of time. Motivated by the hypothesis that different indicators of banks' credit risk will vary between these two economies, the authors disscused the main internal and external factors affecting NPLs flactuations in both countries respectively. To have a more efficient result Chaibi and Ftiti estimated the base line model by utizing difference GMM model. As for the macroeconomic variables set, all (GDP growth rate, unemployment rate, interest rate and exchange rate) with expection of inflation rate in France, were found to have large explanatory power on the dependent variable for both France and Germany. The authors explained this result based on the fact that both countries are part of euro zone. On the other hand, size and profitability of the banks were found to be the only bank-specific variables which have a significant impact on the NPLs of both banking systems, while the results suggests loan loss provisions and inefficiency; and banks' leverage as the main credit risk drivers for market- based economy and bank- based economy respectively. Based on the estimations' outputs, the authors finally conclude that credit risk is more persistant in banking systems from market- based economies compared to those coming from bank- based economies.

Anastasiou et al. (2016) contributed to the literature regarding non-performing loans with a comparative empirical study regarding the determinants of non-performing loans level in core (Austria, Belgium, France, Germany, Finland, Lithuania, Luxemburg, Netherlands and Slovakia) and periphery (Greece, Italy, Ireland, Portugal and Spain) euro area countries. The model is estimated based on a panel data for the period of time from 2003 to 2016 and the methods used were both the Fully Modified OLS (FMOLS) and the Panel Co- integrated VAR. In order to explain the fluctuations of non- performing loans to total loans ratio, which is the dependent variable, the authors have used two sets of variables, that are macroeconomic (GDP growth rate, unemployment rate, inflation rate, tax on personal income, government budget deficit or surplus, output gap, interest rate margin and credit to private non-financial sector) and bank-specific factors (ROE, ROA, loans-to- deposits ratio and bank size). With a stronger significance and larger coefficients in case of Greece, Ireland, Italy, Portugal, and Spain (GIPSI) countries, both methodologies applied; suggest the same macro and bank- specific determinants influencing the level of bad loans. The fragile economic conditions and financial system stability during 2008, especially in periphery eurozone countries, seems to be positively correlated to the level of NPLs. The analysis suggests the higher unemployment rate, taxes and lower GDP growth, as three main indicators of bad loans growth in both groups of countries. As for the differences, variables like fiscal consolidation, interest rate margins and those like quality of management and loans to deposits are found to be significant only for the core and periphery countries respectively. Furthermore, bank size is found to be significant but negatively correlated to the level of NPLs only in the case of the periphery. To conclude, the authors stress out the importance of such findings in helping the responsible institutions to undertake the needed policies regarding the NPLs and distinguish between the needs of banks coming from one group of countries compared to the other.

Furthermore, Balgova et al. (2016) examined the problematic issue of NPLs and how they impact the economy in a sample of 100 countries from 1997 to 2014 period of time. The authors put their analysis on comparative bases, where three different scenarios following a rise in bad loans level are used. First, they used dynamic measures in order to reduce the NPLs stock and realized that such an action would have a medium- term positive impact in the economy. Second, they considered the declining of NPLs through a significant increase of influx of the new credit, revealing a larger

positive impact in the countries with higher amounts of new credit. Third, the authors examined how neglecting NPLs would impact the economy performance and the results showed that in such a case the economy wouldn't be efficient anymore suggesting a growth of two percentage points until the problem is due.

Umar and Sun (2016) showed that considering only macroeconomic or banking-industry specific factors in explaining the level of non- performing loans would definetely result in non accurate outcomes. The authors investigated the determinants of chinese non performing loans for the periodof time from 2005 to 2014. In oder to obtain more accurate and relevant outcomes, they estimated three different base line models. Umar and Sun started by using only macroeconomic variables as explanatory variables, then continued by using only banking- industry specific variables and in the third and last model they explained the NPLs flactuations by the attribution of both macro and banking- industry specific factors. Same as in our paper, the authors also estimated their base line models by utilizing System GMM methodology. Based on the estimations outcomes, country- specific factors such as GDP growth rate, effective interest rate, inflation rate and exchange rate are found to significantly impact the level of bad loans, meanwhile bank type, bank risk-taking behavior, ownership concentration, leverage and credit quality are found to be the bank- specific factors which have explanatory power in explaining the chinese banking sector's credit risk.Moreover, the study provided a distinguish among listed and unlisted banks suggesting the economic growth, bank risk- taking behavior, levarage and credit quality as common determinants of both listed and unlisted banks' NPLs, while inflation rate and exchange rate are found to be significant only for the unlisted chinese banks.

Gila-Gourgoura and Nikolaidou (2017) looked over the macroeconomic and bank-specific determinants of Spanish NPLs. The final sample covered aggregate data observed from the fourth quarter of 1997 to the third quarter of 2015, covering both expansion stage of spanish economy and post- crises period of time. The authors attempted to realize an exisitng long- run or short- run relationship among the dependent variable (NPL ratio) and the two sets of explanatory variables, thus they utilized the autoregressive distributed lag (ARDL) model. The final results showed that both in long and short run the real GDP gwoth, the long-term government bond yield,

ROE ratio, total capital and capital to assets ratio have a singnificant impactin the credit risk of Spanish banking system, suggesting both sets of variables as important factors to explain the flactuations of NPLs. However, the authors conclude that if they would have found data in non- agregated level, other important bank- specific indicators like bank type, bank ownership, etc would have been employed so the study would have been provide even more accurate and helpful results to the Spanish monetary policy.

Similarly, Khan and Ahmad (2017) investigated about the factors which determine the increasing level of NPLs in the banking system of Pakistan for the 2006 to 2016 period of time. The empirical study uses only bank- specific variables like ROA, EPS, CAD ratio, cash to total asset, investment to total asset ratio, breakup value per share and bank size, in order to explain the fluctuates of NPLs level. The model is estimated based on a panel data of 20 commercial banks by applying descriptive statistics, correlation analysis and the random effect panel least square estimator. The final outcomes from the analysis suggest the Return on Asset, earning per share, Capital adequacy ratio and Breakup value per share as the main factors which explain the changes of bad debts with a higher significance and larger coefficient showing their strong correlation with the dependent variable.

Furthermore, Kjosevski and Petkovski (2017) investigated the correlation between macro- specific and bank- specific indicators of NPLs and their impact on the economic performance in the three Baltic States. Using two approaches, the authors firstly tried to detect the macro and micro causes of bad loans on annual basis. The empirical model was estimated by using GMM difference estimator and the sample consisted in a panel data of 27 banks from the Baltic countries for the 2005 to 2014 period of time. The final results of the first approach suggested the macroeconomic variables such as GDP growth, inflation and domestic credit to the private sector to significantly determine the level of NPLs in the above-mentioned region. As for the bank- specific determinants, the empirical analysis suggests them to be ROA, ROE, equity to total assets ratio and the growth of gross loans. Furthermore, the dummy variable (DUM 2009) which was included in the model to cover financial crises period, resulted to have the highest explanatory power on the NPLs' fluctuations in the Baltic banking sector. The second approach was related to the indication of an existing feedback effect of NPLs and macro variables. The significance and large coefficients showed a strong

feedback of bad loans on the macro activities performance, more precisely suggesting that an increase of NPLs level would directly cause a disorientation of macro variables like private credit (as a share of GDP), GDP growth, inflation and unemployment rate. Finally, the authors claim that a healthy banking system would derive a better-performing economy.

As it is seen, the literature regarding the macroeconomic and bank- specific indicators of NPLs is vast, however some authors considers them as not enough, including firm-specific variables. Even though our study does not consider the latest mentioned variable sets, this section provides a recent working paper which shows its significance in explaining the fluctuations of Indian non-performing loans (Mohanty, Das, & Kumar, 2018).

Mohanty et al. (2018) looked over Indian NPLs and the macroeconomic, bank- specific and firm- specific factors affected them from 2000 to 2016 period. The final sample was estimated through system GMM estimator, by regressing NPLs on its own legs and changes and instrumenting the explanatory variables by their lagged levels. Macroeconomic variables such as GDP growth, stock market and market capitalization were found to have a negative correlation to the Gross NPL ratio, while expansionary fiscal policy indicates favorable rate of Gross NPL ratio. Among the firm- specific variables included in the base line model, only net sales growth and net profit margins were found to have a significant impact on the dependent variable. On the other hand, bank- specific variables like credit growth deposit ratio, number of bank branches, ROA and CAR have a negative correlation to Gross NPL ratio, and while a higher operating expense ratio derives to higher levels of NPLs. Authors underlined the importance of a healthy private corporate sectors' balance sheet relative to banks' balance sheet by lowering the non- performing loans levels.

Table 3. 3: Overview of key empirical works dealing with bank- specific determinants of NPLs

Author(s)	**Region**	**Short Description**	**Methodology& data used**	**Results**

Espinoza & Prasad (2010)	GCC Countries	Examining the macroeconomic and bank-specific determinants of bad loans level.	A panel data verified through applying Fixed Effect, Difference GMM and System GMM methodology for 80 commercial banks over 1995- 2008.	Significant relationship between economic growth, bank efficiency, past expansion of the balance sheet and the deterioration of the NPLs level.
Louzis et al. (2012)	Greece	Analyzing whether macro conditions and bank- related determinants affect the credit risk of Greek banks. Three categories of NPLs were included: mortgages, business and consumer loans.	A dynamic panel data of 9 largest Greek banks for the period of time from 2003 to 2009, verified through application of GMM methodology.	Significant impact of GDP growth, unemployment rate, interest rate, and public debt and bank management related variables on the three types of bed loans.
Ćurak et al. (2013)	10 Southeastern European Countries	Examining the main macroeconomic and bank related drivers of NPLs in the banking systems of the selected Southeastern countries.	A dynamic panel data of 69commercial banks from 10 selected countries from 2003 to 2010 time period. Methodology applied was difference GMM.	Significant variables were found to be GDP growth, interest rate, inflation rate, ROA, solvency ratio, bank size.

Messai & Jouini (2013)	Greece, Italy, Spain	Investigates the macro and micro determinants of the selected countries NPLs amounts.	Panel data considered by data from 2004 to 2008 for 85 selected banks. Methodology applied was Fixed Effect model.	GDP growth, unemployment rate, lending rates, ROA and loan loss reserves to total loan ratio directly impact the level of bad loans.
Klein (2013)	CSEE Countries	Analyzing the macroeconomic and bank related variables which determine the changes in NPLs level of the selected countries.	A balanced panel data verified by System GMM methodology over 1998- 2011.	GDP growth rate of EU, unemployment rate, inflation rate, exchange rate, volatility of S&P 500 index, ROE, equity to assets ratio, loan to assets ratio, loan growth ratio tends to impact NPL ratio. Feedback effect realized.
Makri et al. (2014)	14 Eurozone Countries	Investigates the macro and bank- specific determinants of NPLs level in Eurozone countries.	Panel data regression considered by aggregate-level data for 14 selected eurozone countries over 2000- 2008 period of time. Methodology applied was Difference GMM model.	Strong relationship between rate of NPL of previous year, capital ratio, ROE, GDP growth rate, unemployment rate and public debt and the dependent variable, which is NPL ratio.

Škarica (2014)	7 CEE countries	Analyzing the macroeconomic and bank related factors which significantly affect the NPLs level to change.	Panel data created by aggregate- level data for the period of time from 2007 to 2012. Methodology applied was Fixed Effect model.	Large significance level of GDP growth rate, unemployment and inflation rate.
Chaibi & Ftiti (2015)	France, Germany	Analyzing weather country- level and bank- level determinants of NPLs between one market- based economy country as France and a bank- based economy country as Germany vary among them.	Data collected for the 2005 to 2001 period of time and base line model was estimated through difference GMM methodology.	Different NPL determinants between two countries. Higher level of credit risk in bank- based economy countries such as Germany.
Anastasioue t al. (2016)	Eurozone Countries	Examination of macroeconomic and bank- specific determinants of NPLs in core and periphery eurozone countries.	A balanced panel data verified by both FMOLS and Panel Co- Integrated VAR methodologies over 2003- 2013.	GDP growth, unemployment rate and taxes are significant for both core and periphery countries. Fiscal consolidation and interest rate margin impact only NPLs from core countries,

				while quality of management, loans to deposits ratio and bank size affect only NPLs from periphery countries.
Balgova et al. (2016)	100 Diversified Countries	Examining the problematic issue of NPLs and how they impact the economy of the selected countries by using three different scenarios.	Using dynamic measures for a data set of 100 countries for the period of time from 1997 to 2014.	Reducing NPLs stock has a medium- term positive impact on the economy. Declining the level of NPLs through raise of new credit influx give a larger positive impact on the countries with higher level of new credit. Neglecting NPLs results in two percentage point increase until the problem is due.
Umar & Sun (2016)	China	Analyzing the country and bank- level determinants of Chinese NPLs by three different approaches in order to verify that only the attribution of both variable sets derive in	In order to estimate the base line models which consisted in data obtained from 2005 to 2014 time period, System GMM methodology was utilized.	GDP growth rate, effective interest rate, inflation rate, exchange rate, bank type, bank-risk taking behavior, ownership concentration, leverage and credit quality significantly

		accurate results.		impact the NPLs ratio.
Gila-Gourgoura & Nikolaidou (2017)	Spain	Examining the macroeconomic and bank-specific factors affecting the level of NPLs in both short and long run.	A panel regression estimated through ARDL model, consisting in data from 1997 to 2015 time period.	Explanatory variables such as GDP growth, long- term government bond yield, ROE, total capital and capital to asset ratio have significant impact on NPLs ratio, both in short and long run.
Khan & Ahmad (2017)	Pakistan	Investigating only bank-level factors which determine an increasing level of NPLs in banking system of Pakistan.	A panel data of 20 commercial banks over 2006- 2016 time period. Methodology applied was Random Effect Panel Least Square model.	Bank- specific factors such as ROA, EPS, CAR, BPS have a huge influence on the level of Pakistan NPLs.
Kjosevski & Petkovski (2017)	Baltic States	Examining the impact of macroeconomic and bank-	A panel data of 27 commercial banks over 2005- 2014 period of time. Methodology	Significant relationship between GDP growth, inflation

		level determinants of NPLs in the economy of the selected states.	applied was difference GMM.	rate, domestic credit to the private sector, ROA, ROE, equity to total assets ratio and growth of gross loans and the dependent variable, which is NPLs ratio, especially during the financial crises. Furthermore, feedback effect was realized.
Mohanty et al. (2018)	India	Investigating the country-specific, bank-specific and firm- specific determinants of NPLs in India banking sector.	A panel regression estimated through System GMM methodology. The study includes data for the period from 2000 to 2016.	GDP growth, stock market, market capitalization, expansionary fiscal policy, net sales growth, net profit margin, credit growth deposit ratio, number of bank branches, ROA, CAR and operating expense ratio have a significant impact on the Gross NPLs ratio.

Source: Table created by author based on previous literature.

In the view of the above literature, a strong existing relationship is captured between the level of non-performing loans and macroeconomic determinants such as GDP growth, unemployment, interest rate, public debt and others. Moreover, several bank-

specific determinants like ROA, ROE, Capital Adequacy ratio, bank size and so on, are shown to have a huge influence on the credit risk level. Beside these two main variable categories, changing level of bad loans is also shown to come from industry-related determinants such as market concentration and others. Similarly, to this study, the literature suggests that attribution of these three categories of variables result in more accurate outcomes regarding the explanation power of banking system credit risk over different times and areas.

4. Data

The objective of this study is to empirically examine the causes of non-performing loans in the European banking system for 2012 to 2017 period. The thesis employs a dummy variable in order to distinguish between two main regions taken into analysis, which are Eurozone and Non- Eurozone. In total, the empirical examination considers 534 banks operating across EU. After filtering the dataset, countries like Croatia, Bulgaria and Romania are excluded from the analysis due to the lack of data from the reliable sources. In order to detect heterogeneity, the banks are categorized based on the specialization and the size of the total assets they possess. Beside bank heterogeneity, the determination of non-performing loans is done by employing three different explanatory variable sets viz, country- specific variables, industry- specific variables and bank- specific variables.

The selection of the independent variables is done based on the previous literature who empirically studied the factors of credit risk, but in different regions and period (De Bock, 2012), (Fišerová& Teplý, 2014), (Jabra et al., 2017), (Mohanty et al., 2018). Due to lack of data, the depended variable of the main model in this thesis will be loan-impairment charges to average gross loans, which is considered as a proxy for non-performing loan ratio. The selection of the proxy for the non- performing rate ratio is based on the previous literature, e.g. Ahmad & Ariff, in 2007, studied the determinants of credit risk in emerging (India, Korea, Malaysia, Mexico, Thailand) and developed economies (Australia, France, Japan, US) by using impaired loans to gross loans ratio as the depended variable for credit risk measurement. Another example would be Bussoli et al., who studied the determinants of impaired loans to gross loans of Italy in 2016. Moreover, impaired loans are commonly used as a proxy of non- performing loans also in practical banking.

All the variables are sourced from three different official sources. More precisely, the data for country- specific variables are obtained from Eurostat, the data for industry-specific variables from ECB and the data for bank- specific variables are sourced from

the Orbis Bank Focus Database. As for all explanatory variables included in the empirical analysis, a detailed description will be provided as follows in this chapter.

4.1 Bank Specific variables

The below table 4.1 represents a list of all non-dummy bank specific variables which are used in our baseline model to empirically test the raised hypothesis.

Table 4. 1: Non dummy bank- specific variables

Logarithm (Total assets) of the bank	Represents the size of the bank.	lta
Loan loss reserves to gross loans ratio	Represents the healthiness of the bank assets by evaluating the part of the debt which tend to be not collected until due time.	llr_gl
Equity to total assets ratio	Represents the financial leverage of the bank.	eq_ta
Return on average equity	A determinant of bank profitability based on the average equity of the shareholder.	roae
Cost to income ratio	Represents the operational efficiency of the bank.	c_ir
Interbank ratio	Represents the interest rate at which banks provide loans between each other in the banking market.	intr
Net loans to total assets ratio	Indicates the percentage of total assets shared by loans.	nl_ta
Liquid assets to deposits and short-term funding ratio	Provides insights for the bank liquidity and its balance sheet structure.	la_dstf

Source: Compiled by the author, the selection of the variables is based on (Hanzlík & Teplý, 2019)

As mentioned, this thesis considers also the heterogeneity of the banks. Heterogeneity detection is done based on two criteria, that are specialization and size of the bank. Therefore, two groups of dummy bank specific variables will be used. An overview of the bank specific dummy variables is provided in the table 4.2.

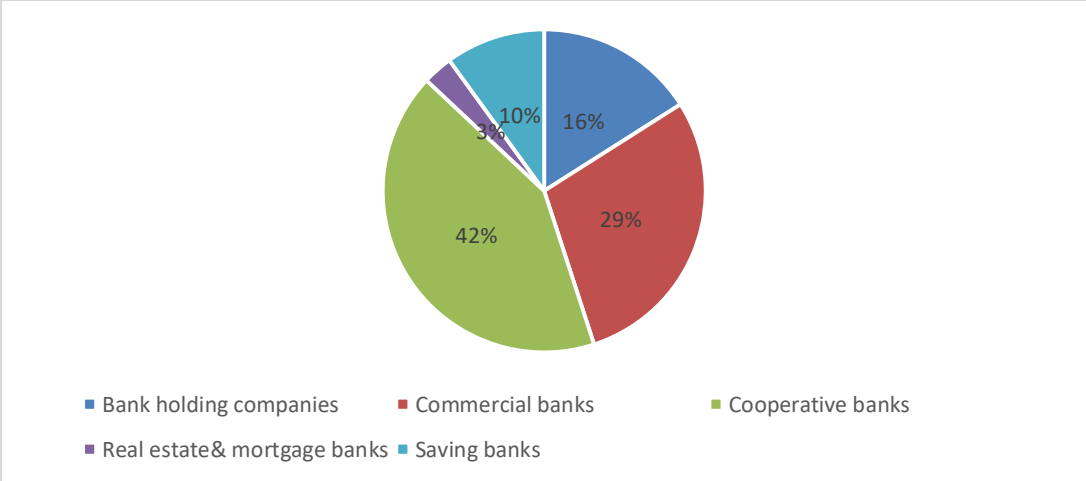
Table 4. 2: Dummy bank- specific variables

Dummy Bank- Specific Variables		
Bank holdings& holding companies	Equals 1 if specialization of the bank is Bank holdings& holding companies; 0 if other.	bhhc
Cooperative banks	Equals 1 if specialization of the bank is Cooperative banks; 0 if other.	coob
Real estate& mortgage banks	Equals 1 if specialization of the bank is Real estate& mortgage banks; 0 if other.	remb
Saving banks	Equals 1 if specialization of the bank is Saving banks; 0 if other.	savb
Large banks	Equals 1 if bank's assets are higher than USD 30 billion until 2017; 0 if other.	large
Small banks	Equals 1 if bank's assets are lower than USD 1 billion until 2017; 0 if other.	small

Source: Compiled by the author, the selection of the variables is based on (Hanzlík & Teplý, 2019)

Firstly, according to the business model, overall banks are distinguished between 88 bank holding companies, 204 commercial banks, 223 cooperative banks, 14 real estate& mortgage banks and 5 saving banks. Therefore, we can say that the business model which possess the total dataset of the banks are cooperative banks which counts almost 42%. On the other hand, saving banks has the lowest % share in the total dataset, counting only 10%. The following figure 4.1 shows the share of each business model during year 2017.

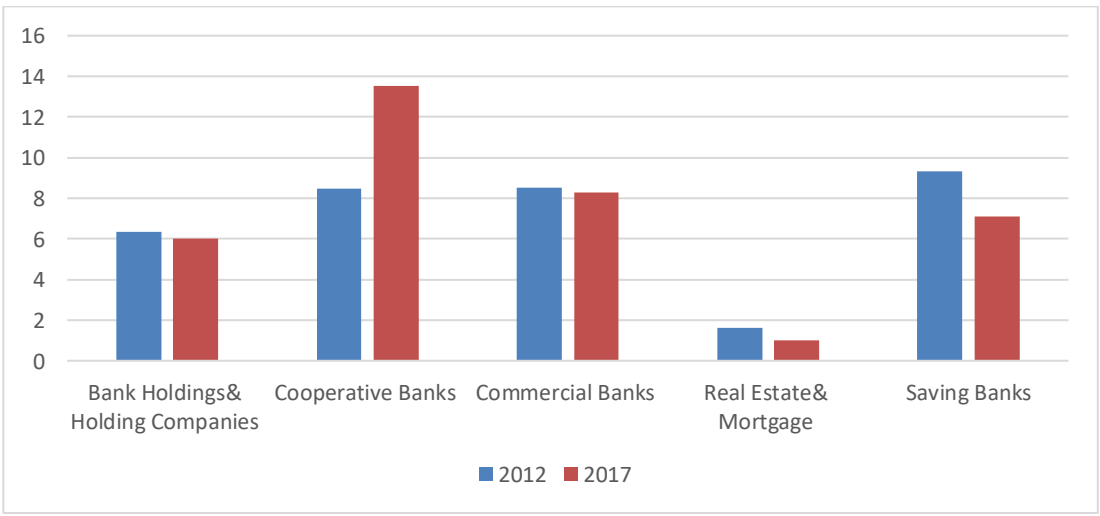
Figure 4. 1: % Share of total banks based on bank specialization (2017)



Source: Compiled by the author, data from the Orbis Bank Focus Database.

As mentioned, this thesis aims to detect any possible relationship between non-performing loans (impaired) and specialization category of the bank. Therefore, the below figure 4.2 shows impairment loans fluctuations in EU during 2012 and 2017, two extreme periods in our study.

Figure 4. 2: Share of impaired loans/ gross loans in EU based on specialization (2012, 2017)



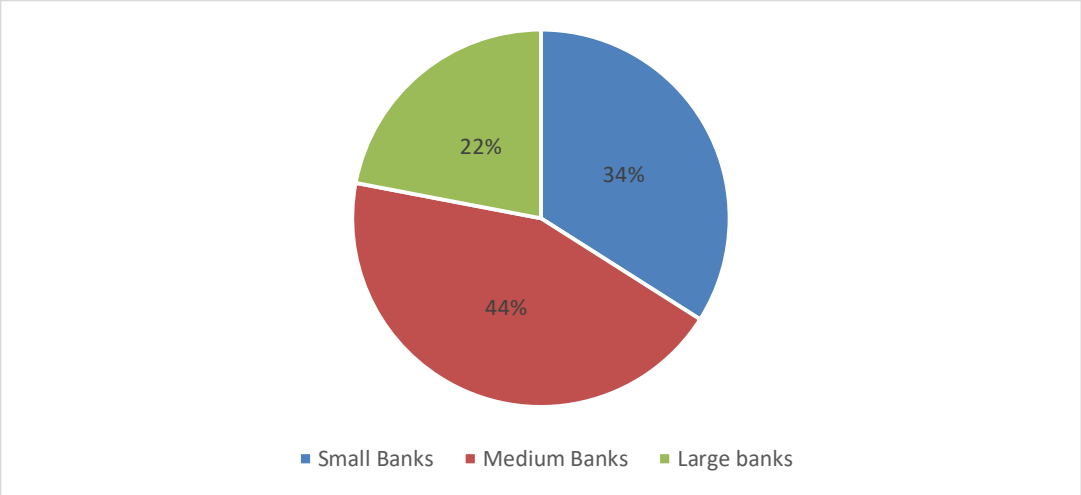
Source: Compiled by the author, data from the Orbis Bank Focus Database.

Based on the graph, the highest levels of impaired loans are found to belong to cooperative banks, especially in 2017. The lowest levels correspond with Real estate & mortgage banks. However, this graph does not necessarily show the aggregate level

of whole EU because the dataset is limited in time and bank numbers length, so it is biased.

Secondly, we study the impact of the bank size on the level of NPLs. In order to detect the impact of the size we employ dummy variables, which categorize our dataset into 180 small banks, 237 medium banks and 117 large banks. The share of each category is shown in the figure 4.3 below.

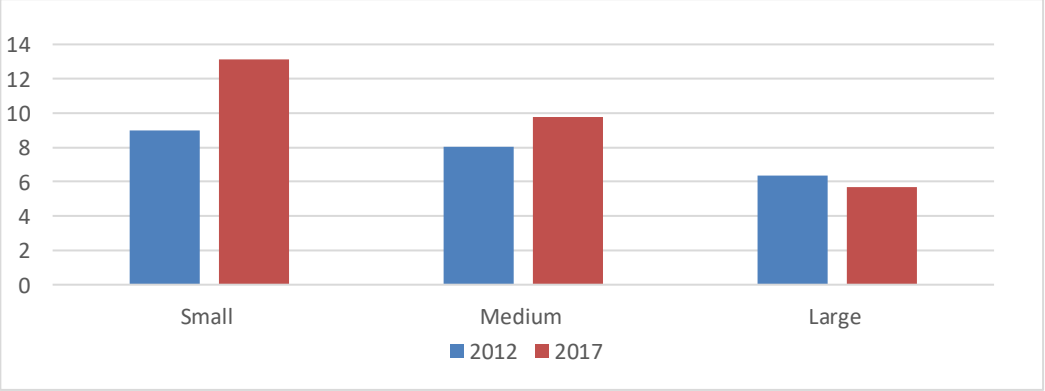
Figure 4. 3: Share of total banks based on bank size (2017)



Source: Compiled by the author, data from the Orbis Bank Focus Database.

As shown, most of the banks which are considered for the analysis are medium banks, counting 44% of the total share, followed by 34% small banks and 22% large banks. In order to provide with a clearer view of how impaired loans are connected to each size of the banks included in our dataset, the below figure 4.4 is provided for two extreme periods 2012 and 2017.

Figure 4. 4: Share of impaired loans/ gross loans in EU based on size (2012, 2017)



Source: Compiled by the author, data from the Orbis Bank Focus Database.

The graph summarizes that the highest levels of impaired loans belongs to small banks in 2017 and the lowest in large banks again in 2017. However, the real impact of bank size will be empirically tested in Chapter 6. The table 4.3 below represents the descriptive analysis of all bank specific variables. The description is done for the whole dataset including both Eurozone and Non-Eurozone countries.

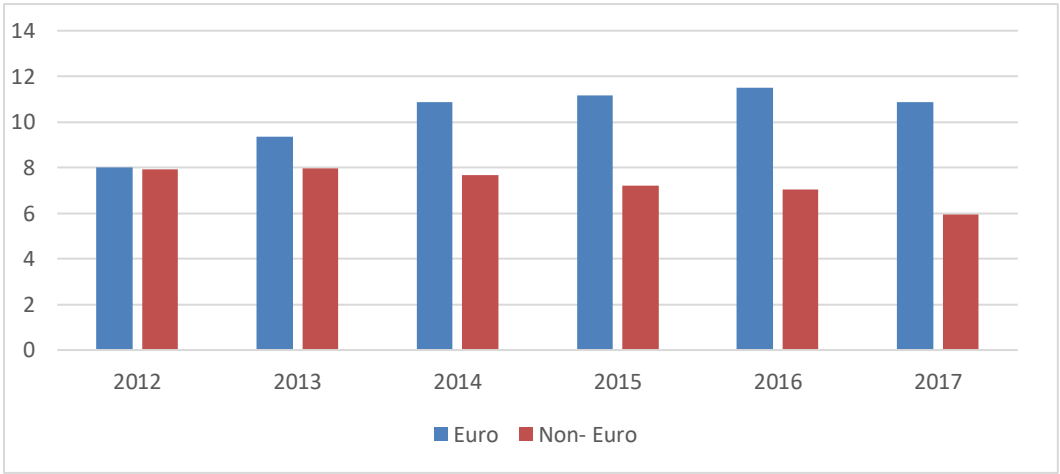
Table 4. 3: Descriptive analysis for bank specific variables in EU (2012-2017)

	N	**Mean**	**SD**	**p25**	**Med**	**p75**
il_gl	509	10.02	9.36	2.62	7.16	15.29
lta	533	6.66	1.08	5.77	6.54	7.43
llr_gl	526	5.25	4.97	1.4	3.79	7.95
eq_ta	533	9.87	5.25	6.91	8.78	12.21
roae	533	4.21	8.4	1.78	4.07	8.01
cir	533	67.61	20.4	58.38	66.67	76.31
nl_ta	533	58.13	17.33	48	59.59	70.11
la_dstf	533	22.34	27.28	8.09	14.44	27.78

Source: Compiled by the author in R.

As we can see, the dataset is unbalanced with some missing observations generally in all bank- specific variables, especially Interbank ratio, where only 490 observations are included. Impaired loans to gross loans variable are shown to have a mean of 10.02 and a median of 7.16. This result suggests that 10,2% of the total loans in EU are classified as impaired loans. These values are expected to have been boosted because as mentioned, the table 4.3 provides the descriptive analysis including the data both areas. Also, the net loans to total assets ratio seems to have quite a huge impact on credit risk, showing a mean of 58.13 and median of 59.59. Descriptive analysis for total assets in EU during the period of 2017 is provided in the Appendix part, in the table A.1. A separate graph for eurozone and non-eurozone regarding the levels of il_gr in each region for 2012-2017, is shown in the figure 4.5.

Figure 4. 5: Average impaired loans by region (2012-2017)



Source: Compiled by the author, data from the Orbis Bank Focus Database.

Based on the above graph, Eurozone countries are shown to have a higher share of impaired loans to gross loans, which means that they seem to have a lower loan quality compared to Non- Eurozone countries. The years which are considered on these analyses are after the euro financial crises, so this may be a good explanation regarding the values we obtain. However, figure 4.5 not necessarily explains the real aggregate level of impaired loans in these areas, since the dataset is limited in time and in the number of the banks included as well. Moreover, in this case we have considered the impaired loans only, without any other effect from other determinants which would split somehow the significance.

4.2 Country Specific Variables

The second group of explanatory variables which is used in the empirical examination is macroeconomic variables. The data regarding the country specific variables were collected from Eurostat database. Table 4.4 provides with country- specific variables description and expectations regarding the signs of the coefficients.

Table 4. 4: Overview on country- specific variables.

Real annual GDP growth rate (%)	High likelihood for the coefficient to be negative.	gdp
Annual inflation rate (%)	Represents annual increase of consumer prices. The	infl

	coefficient is expected to be positive.	
Annual unemployment rate (%)	The relation between unemployment and credit risk should be positive.	unemp
Spread (%)	Difference between the ten-year government bond yield and 3M interest rate. The coefficient is expected to be positive.	spread

Source: Compiled by the author, the selection of the variables is based on (Hanzlík & Teplý, 2019)

Table 4.5 below, provides with the descriptive analysis of all macroeconomic variables used to explain the changes of non-performing loans (impaired loans).

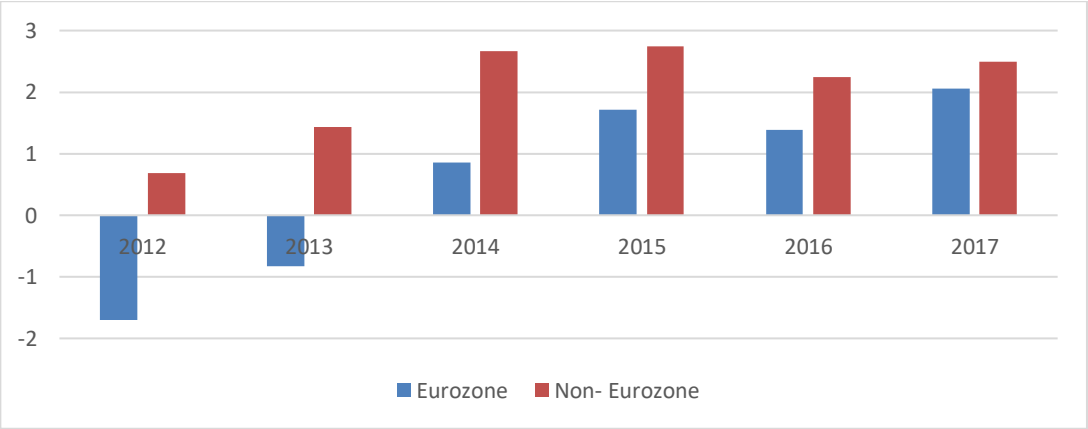
Table 4. 5: Descriptive analysis for country specific variables in EU, 2012-2017.

	N	Mean	SD	p25	Med	p75
gdp	534.00	2.15	1.01	1.50	1.70	2.30
infl	534.00	1.54	0.52	1.30	1.30	1.70
unem	534.00	8.78	3.42	5.50	9.40	11.20
spread	534.00	1.64	1.00	0.82	1.89	2.44

Source: Compiled by the author in R.

The GDP rate seems to be at a mean of 2.15 and a median of 1.7. The unemployment rate is shown to be relatively high in EU, with a mean of 8.78, a rate which is closely related to the financial crises of 2009, especially for Eurozone. In order to detect the effect of low interest rates on the NPLs of these areas, the spread variable is used as a proxy. The descriptive analysis table shows it to be with a mean value of 1.64. In the below figure 4.6, the level of GDP rate is provided by considering both areas of EU separately, during 2012-2017 period.

Figure 4. 6: Average GDP rate by region (2012- 2017)

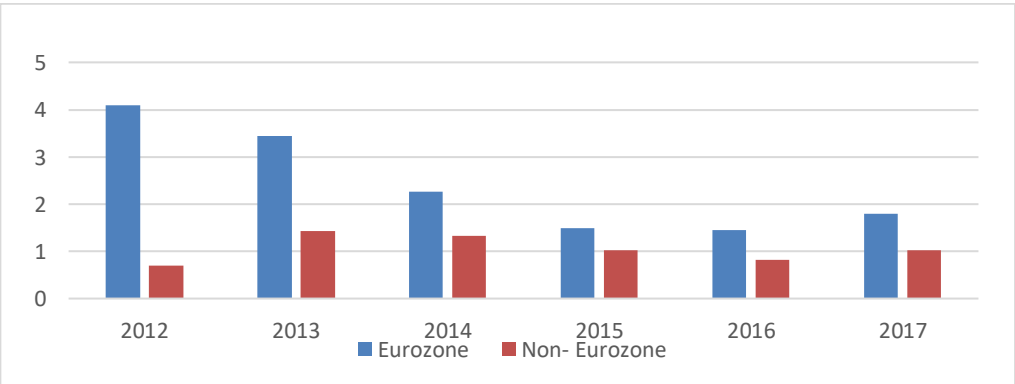


Source: Compiled by the author, data from Eurostat.

Based on the graph, Euro area is associated with lower levels of the growth rate compared to Non- Euro area. As seen, right after the sovereign debt crises, during the years of 2012-2013, eurozone countries experienced even negative GDP rates. This may be explained due to the huge impact the crises had on the region and the fact that these are has a centralized monetary policy, while non-Eurozone countries are more independent in this aspect. Furthermore, the previous literature also suggests that the countries which did not achieve yet the peaks of development, have the tendency to have higher rates of growth rates. The highest levels of GDP growth rate for Non-euro zone is shown to be during 2014-2015.

Our study aims also to check the relationship between the interest rate and the non-performing loans. Therefore, as earlier mentioned, the explanatory variable which will be used as proxy for the non-performing loans is spread. The figure 4.7 below provides us with the mean values of spread for euro and non-euro area from 2012 to 2017.

Figure 4. 7: Average interest rate by region (2012-2017)



Source: Compiled by the author, data from Eurostat and OECD.

The closest years after the sovereign debt crisis in our data sample is 2012, and it is exactly that year when the euro area shows to have been experiencing the highest levels of interest rates (spread). After the financial crisis, the government decreased sharply the short-term interest rates in order to boost the investments. On the other side, the long-term interest rate which is mainly based on expectations, remained high. This is the reason why Eurozone is provided with the highest levels of spread, which is the difference between the long term and short-term interest rate. As seen from the graph, the level of spread in Eurozone dropped year to year. This may be as a result of the ECB, which started to slowly decrease its expectations also for long term interest rate, thus lowering the spread. Unsurprisingly, the Non-Eurozone countries are provided with more stable levels of spread, reaching mainly the values of 1.2 to 1.3 percentage points. This may be an outcome of the fact that this area was less impacted from the euro financial crises of the years 2008-2009.

4.3 Industry- Specific Variables

Together with bank- specific and macroeconomic variables, the third group involved in the thesis is industry specific variables group. Data for these explanatory variables category are gathered from ECB database. The description for each industry specific variable is provided in the table 4.6 below.

Table 4. 6: Overview on industry- specific variables

Number of financial institutions	Represents the number of financial institutions for each of the selected countries.	nobanks
Herfindahl- Hirschman index	Represents the market concentration of a specific banking sector, also determining the competitiveness in the market.	hhi
Banking assets to GDP ratio	Total assets held by deposit money banks as a share of GDP. Usually referred as banking sector penetration.	bas

Source: Compiled by the author, the selection of the variables is based on Fišerová, Teplý, & Tripe (2014)

Table 4.7 below provides with the overview of the descriptive analysis for industry specific variables. The dataset is taken as one, without split based on region. It will provide us with a general overview of the whole dataset, for whole EU during 2012 to 2017.

Table 4. 7: Descriptive analysis for industry- specific variables in EU (2012- 2017)

	N	Mean	SD	p25	Med	p75
Herfindahl Index	534.00	0.07	0.04	0.05	0.05	0.06
Number of financial inst.	534.00	533.00	385.26	355.00	590.00	590.00
Banking assets to GDP ratio	534.00	179.71	74.55	140.22	140.22	265.51

Source: Compiled by the author in R.

With a mean value of 0.07 and median of 0.05, Herfindahl index basically suggests a low market concentration. However, we should again emphasize that the table does not necessarily show the real market concentration in EU on aggregate level due to limitations in dataset. Moreover, this thesis provides a a cross- correlation analysis including all variables considered for the study. The output can be found in appendix part, table A.2.

5. Methodology

As mentioned in the previous chapters, the stated hypothesis of this study will be empirically tested by using a panel dataset. The most common estimation methods regarding panel datasets are Pooled Ols, Random Effect model and Fixed effect model. Like other techniques, they have their own pros and cons to be considered before deciding the best estimation technique for a specific study. If the independent variables of our model would be uncorrelated with the error term, then we could employ Pooled Ols. But our model contains group specific fixed effects, therefore this assumption is impossible for us to get fulfilled. Random effects model would be used if we assume that the group specific constant term is not correlated to the regressors and that these effects are similar to the exogeneous shocks effects but time invariant (Maivald, 2019). On the other hand, in case of an unobserved constant term and correlated to explanatory variabliables, then fixed effects model could have been implemented. However, one of the biggest deficiencies of the fixed effects model regarding our analysis is that it drops the time invariant variables, which in our case are the dummies to distinguish between two regions in EU and specialization and size, which are crucial for the study. Therefore, fixed effects would not provide us with the most efficient results as well. Greene (2012) has explained the advantages, deficiencies and the assumptions to be fulfilled for each of the models mentioned above. Therefore, for more details one can refer to his working paper.

However, these methods can at least estimate static panel data models. These models are build up by the constant *a,* the explained variable y_{it}; the explanatory variables' matrix $x_{i,t}$, where $i=(1,...,N)$ stands for individual groups and t=(1,…,T) stands for time periods; the fixed or random group specific effect μ_i and the error term e_{it}. A basic panel data framework is static and would look as following:

$$y_{it} = \beta_0 + \beta_1 ' x_{it} + \mu_i + \epsilon_{it} \qquad (5.1)$$

On the other side, these techniques are not able to properly eastimate a dynamic panel data model, where the lagged dependent variable $\gamma' y_{i,t-1}$ is included in the analysis as

well. In such a case, the lagged dependent variable is expected to be correlated with the error term, thus indicating that both the variable's coefficients and the standard errors values are biased. So, they would produce inefficient results.

Fortunately, Arellano& Bond (1991) developed the Difference GMM methodology. It was the first approach which was able to overcome the previously mentioned deficiencies. By applying this approach, one would use the lags of the explained variable as instruments and endodeneity would be allowed in some of the explanatory variables as well. On the other hand, this approach has also few disadvantages coming as a result of diferencing. In case of an unbalanced dataset regarding explained variable, the model would produce inefficient results because of losing observations due to lagged $y_{i,t}$ (Rodman, 2009). Moreover, difference GMM is not able to estimate a model including group dummy variables because they are canceled out due to differencing.

Blundell & Bond (1998) proposed a version of GMM which overcomes this issue. Named as System GMM, this technique gets the model estimated jointly in levels and differences. Such model allows the estimation with the usage of dummy variables. Therefore, the model of this thesis will have the following structure and will be empirically analysed by using sytem GMM.

$$ilgl_{i,t} = \beta_0 + \gamma' ilgl_{i,t-1} + \beta_1' x_{it} + \theta' Dummy_{i,t} + \beta_2' z_{it} + \beta_3' I_{it} + \mu_i + \epsilon_{it} \qquad (5.2)$$

where, $\gamma' ilgl_{i,t-1}$ is the lagged dependent variable, $\beta_1' x_{it}$ stands for the group of bank specific variables, $\theta' Dummy_{i,t}$ stands for the bank related dummy variables that are specialization and size, $\beta_2' z_{it}$ stands for the group of macroeconomic variables and $\beta_3' I_{it}$ represents the group of industry specific variables. All the group of the explanatory variables which are considered in this thesis are explained respectivally in table 4.1, table 4.2, table 4.4 and table 4.6 in chapter 4.

Overall, system GMM is the best model to be applied in this thesis. First, it can overcome the endogeneity issue characterizing our model. As mentioned, the lagged dependent variable is suspected to be correlated with the error term. Second, it can estimate models incuding time invariant variables like the dummies for the business model and size included in our research. Third, the system GMM is very suitable in datasets where the number of periods is smaller than the number of observations, as it

is in our case. Similar to Hanzlík & Teplý (2019), this thesis has used the "xtabond2" command in Stata to perform this model, developed by Roodman (2009). In order to provide with all needed evidences regarding the choice of the best methodology to be applied, the outputs of the static panel data methods as Pooled Ols and Fixed effects model will be also included in chapter 6. Tests for the robustness check will be also performed. This methodology is well known in the literature of NPLs. Some previous studies which applied system GMM as the best methodology to empirically study the determinants of NPLs are Klein (2013), Jabra et al. (2017), Maivald (2019) etc. Also, our choosen methodology is implemented and explained also in the research done by Hanzlík & Teplý (2019), but they test for the determinants of bank profitability.

6. Empirical estimation

This chapter is concerned with the empirical estimation and testing of the hypothesis raised in this thesis. As explained in the methodology section, there will be applied different panel data techniques like Pooled OLS, Fixed Effects and GMM methodologies in order to appropriately test the hypothesis. This chapter will be structured into multiple subsections, initially starting with the discussion of the raised hypothesis. It will be followed by the estimation of multiple models using Pooled OLS and Fixed Effects, which will also be subject to further testing and coefficient interpretation. Moreover, further estimations and discussion will be conducted by making use of the GMM technique, which based on the economic theory would provide more robust results. Lastly, the chapter will be concluded with the main outcomes and the final answers to the raised hypothesis.

6.1 Hypotheses

The first hypothesis that this study aims to test and provide an answer for is the following:

Hypothesis #1: Macroeconomic and bank-specific variables influence loan quality, and that these effects vary between Eurozone and Non- Eurozone members' banking systems.

Macroeconomic factors such as GDP growth rate, inflation, unemployment rate and interest rate, have been widely assessed and discussed in the literature. Their importance and significance have been confirmed in multiple studies and various samples. We can easily refer to the studies conducted by King & Plosser (1984), Rinaldi & Sanchis- Arellano (2006), Nkusu (2011), De Bock & Demyanets (2012), Beck et al. (2013) etc., to understand the relevance of these variables and the consistent significance that they attain in different samples.

Another important group of variables whose relevance has been assessed in many studies in literature are the bank-specific variables. As mentioned in the papers written by Ćurak et al. (2013), Klein (2013), and Makri, Tsagkanos, & Bellas (2014),

profitability ratios are among the most important and significant variables impacting NPL. Moreover, Chaibi & Ftiti (2015), highlights the difference between bank-based and market-based financial systems, by claiming a higher impact of bank- specific variables on the former category. In addition, Anastasiou, Louri, & Tsionas (2016) provide an important assessment to the bank size. Acknowledging the findings of the literature, the dataset used in this thesis uses multiple bank-specific variables as explained in the data chapter.

The second hypothesis that will be assessed is as follows:

Hypothesis #2: Large banks reported the lowest level of NPLs in both Eurozone and Non- Eurozone countries.

It is generally believed that large banks have better credit risk management and better screening techniques compared to the small banks. This contributes to a more stable portfolio and better credit risk management, thus a lower NPL level. This thesis aims to test this claim by making use of a dummy variable, which will reveal the indication of large banks on credit risk levels.

The third hypothesis to be tested is as follows:

Hypothesis #3: Market specific variables are negatively correlated to the quality of loans.

The market-specific variables in our case are the number of banks *(nobanks),* Herfindahl- Hirschman index *(HHI),* and bank assets helps as deposits as a share of GDP *(bas)*. It is expected that a high number of banks will contribute into a less concentrated market, thus fueling the competition and lowering the loan quality in order to surpass the competitors. A highly concentrated market on the other hand is translated into more rigorous lending and a better screening. Unfortunately, this leaves a lot of room for abuse as the big banks are known to run under the *"Too Big to Fail"* concept. Lastly, the share of bank assets held as deposits as a percentage of GDP is expected to be negatively correlated to the quality of loans. This means that if the money is kept as deposits, the credit risk will be smaller.

And the last hypothesis to be tested in this thesis is as follows:

Hypothesis #4: The prolonged environment of low interest rates increased all type of banks' NPLs level.

It has been clearly evidenced that the world economy has been stuck to a low interest rate environment. Ever since the global financial crises, the monetary authorities used the low interest rate policy to provide monetary easing. Although this strategy aims to boost the economy, it is often associated with an increase in the credit risk. The low interest rate environment stimulates more borrowing, thus causing a higher level of moral hazard and adverse selection. This will be tested by making use of the slope of the yield curve coefficient.

6.2 Results and Findings

The analyses initiate with the estimations of basic panel data models such as pooled and fixed effects, which have been summarized in table 6.1 below. In addition, further testing and estimation has been conducted in order to determine the best models, identify for heteroskedasticity, cross-dependence and autocorrelation issues. Moreover, the models have been re-estimated by using HAC robust errors.

Table 6. 1: Panel estimations results.

	Pooled OLS	Fixed Effects	Pooled OLS Robust Errors	Fixed Effects Robust Errors
	1	2	3	4
Eurozone	-0.7589***		-0.7589**	
	(1.684e-05)		(0.0032)	
Lag(ilgl,1)	0.6670***	0.2052***	0.6670***	0.2052***
	(2.2e-16)	(2.2e-16)	(2.2e-16)	(9.324e-07)
e_tas	-0.1013***	0.0319	-0.1013***	0.0319
	(3.744e-12)	(0.3598)	(1.285e-06)	(0.3726)
llr_glr	0.5392***	1.0825***	0.5392***	1.0825***
	(2.2e-16)	(2.2e-16)	(3.571e-07)	(2.2e-16)
nl_tas	0.00039	4.0009e-04	0.00039	4.0009e-04
	(0.7299)	(0.6639)	(0.7890)	(0.6560)
la_dstf	0.0025	4.1095e-05	0.0025	4.1095e-05
	(0.2726)	(0.9846)	(0.4257)	(0.9850)
Roae	-0.0375***	-0.0366***	-0.0375***	-0.0366***
	(4.692e-16)	(2.2e-16)	(0.0001)	(5.320e-07)
c_inc	-0.0076***	4.9607e-04	-0.0076.	4.9607e-04
	(5.756e-05)	(0.7649)	(0.0548)	(0.8470)
log(totas)	-0.1394**	-0.2661	-01394*	-0.2661
	(0.0082)	(0.3409)	(0.0326)	(0.2716)
Coob	1.1615***		1.1615***	
	(4.277e-15)		(9.971e-08)	
Remb	0.2946		0.2946	
	(0.3560)		(0.2176)	
Savb	0.6536		0.6536	
	(0.1535)		(0.1301)	
Bhhc	0.5736***		0.5736**	
	(0.00031)		(0.0070)	
Small	0.0948		0.0948	
	(0.5941)		(0.6937)	
Large	-0.2152		-0.2152	
	(0.3375)		(0.4369)	
Spread	-0.3121*	-0.1792	-0.3121.	-0.1792
	(0.0197)	(0.2329)	(0.0669)	(0.3869)
$spread^2$	0.0886***	0.01068	0.0886***	0.01068
	(1.628e-08)	(0.5648)	(0.00027)	(0.7329)

Gdp	-0.2269*** (4.052e-11)	-0.0730* (0.0403)	-0.2269*** (0.0010)	-0.0730. (0.0978)
Infl	-0.2177** (0.0066)	-0.09771 (0.1799)	-0.2177** (0.0027)	-0.09771. (0.0989)
Unemp	0.0907*** (0.00035)	0.2003*** (4.548e-05)	0.0907** (0.0054)	0.2003*** (0.0001)
Nobanks	0.00023 (0.2281)	4.5128e-03*** (8.737e-05)	0.00023 (0.3099)	4.5128e-03*** (2.362e-05)
Hhi	-2.3436 (0.1360)	-7.1575* (0.0262)	-2.3436 (0.2148)	-7.1575* (0.0105)
Bas	-0.0011 (0.1282)	-3.1538e-03 (0.3845)	-0.0011 (0.2495)	-3.1538e-03 (0.3625)
Intercept	4.3447*** (7.262e-06)		4.3447*** (0.0005)	
No. of observations	2000	2000	2000	2000
R-Squared	0.9412	0.75294	N/A	N/A
Adj. R-Squared	0.94051	0.68822	N/A	N/A
F-statistic	1375.17 on 23 and 1976 DF, p-value: < 2.22e-16	301.719 on 16 and 1584 DF, p-value: < 2.22e-16	N/A	N/A

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Compiled by the author, R.

Starting with the pooled OLS model, we can initially identify the relevance of the lagged impaired loans to gross loans value in explaining the current situation. As expected, the previous period value of this ratio positively impacts the current period value and it is statistically significant at 5% significance level. Moving forward with the other bank-specific variables such as *e_tas, nl_tas, llr_glr, log(totas), la_dstf, roae*, and *c_inc*, we can indicate the significance for most of these variables. The values of *e_tas* provide quite an ambiguous result as the sign is not consistent across the pooled and fixed effects models. There are two main explanations for these results. Firstly, there is a high possibility that there might be a collinearity issue impacting our pooled OLS model. Secondly, based on financial and economic theory the increase in the value of equity and liquidity is associated with two main interpretations. One is the possibility that the bank is operating in highly risky environment where the lending has been extremely reduced in order to prevent further losses and continuous increase in credit risk, thus explaining the positive sign. Second scenario includes the probability that the bank is operating in a healthy environment and is experiencing increases in deposits and good profits, thus explaining the negative sign. Jumping to the profitability ratio, *roae*, we indicate the negative sign of the coefficient and its high significance on the 5% significance level. Similar indication is being provided for *c_inc*, thus supporting the reasoning that a more efficient bank will decrease the amount of non-collectable loans. This variable has been found significant at 5% significance level in pooled OLS models. The remaining variables of *llr_glr* and *nl_tas* positively impact the dependent variable, but only the former one is found to be significant at 5% significance level. Their signs make sense as a higher loan loss reserve ratio and a higher amount of net loans to total assets would only contribute to an increase in credit risk.

In addition to the former bank-specific variables we have the group of dummies, which check if the bank specialization and size are somehow relevant in explaining some part of credit risk. Based on the pooled OLS results, all our dummies indicating the bank specialization positively impact the dependent variable. These results go against the rationale that the banks specialized in only some certain channel of lending are more secure. In addition, it has been acknowledged that only the dummies for *bank holding & holding companies* and *cooperative banks* are significant at 5% significance level, while the other two are found to be insignificant.

The results generated from the fixed effects model reveal similar conclusions to the pooled OLS model, but with some small differences and improvements. Starting with the bank specific variables, it is noticeable that the lagged dependent variable has dropped significantly in size, even though it has been able to maintain its significance. Other variables, such as *llr_glr, nl_tas, la_dstf*, and *roae*, have remained in similar levels, thus preserving the sign and their respective significance. On the other hand, *c_inc* has switched the sign to positive and has lost the significance together with the variable of the *e_tas* and *log(totas)*.

Moreover, the group of country-specific variables yields interesting results which seem to be in the same line with the literature. As expected, *GDP, inf, unemp*, and the *spread*, are all significant at 5% significance level. The results indicate that the GDP growth rate and inflation are negatively influencing the dependent variable, thus agreeing with the main findings in the papers by Ćurak, Pepur, & Poposki (2013) and Messai & Jouini (2013). Unemployment rate on the other hand is positively related to the dependent variable. Again, this is in the same line with the literature and the rationale behind these outcomes is quite clear as higher unemployment rate decreases the chances to repay the loan. Moreover, the variable of *spread* indicates a negative impact on the dependent variable and it is found to be significant at 5% level. The negative sign is explained with the fact that a bigger *spread* means more profitability. Banks pay short-term rates on deposits and earn long-term rates on loans, thus explaining why a bigger band would positively impact bank profitability, thus improving the credit quality indicators. The squared value on the other hand seems to change sign to positive. This might be due to the shift in expectations for the future.

In addition, under the fixed effects model, all these variables maintain the exact same impact as in the former OLS model, but only unemployment rate and GDP are found to be significant at 5% significance level. Also, the coefficients for the first two variables have changed in size, thus indicating a lower impact on the dependent variable. On the other hand, the variable of *spread* is found to be insignificant at 5% significance level in both linear and quadratic form. As expected, the impact is negative in levels and positive when we use the quadratic term.

All in all, from the pooled OLS results we can confirm the relevance of the first hypothesis, thus agreeing that the bank and country-specific variables are relevant in explaining the loan quality. In addition, we confirm that there is a significant difference between the Eurozone and non-Eurozone countries. Our dummy variable indicates that the Eurozone countries tend to have a lower credit risk in comparison to the non-Eurozone countries. The variable has been found to be statistically significant at 5% significance level. This result concludes our first hypothesis. The second hypothesis, which claims, that the large banks tend to have lower NPL ratio for both Eurozone and non-Eurozone countries has been rejected. Unfortunately, even though the sign of our dummy is negative as expected, it was proven not to be significant at 5% significance level, thus not being able to confirm our claim. Regarding the fixed effects model, the outcomes for the bank and country-specific variables suggest that the relevance of both groups is significant in explaining credit quality. As a result, we can fully support our claim that both bank and country-specific variables are relevant in explaining the quality of loans. It seems like there are individual components within the group which can cause the main impact, while others influencing at a smaller rate. In addition, it is not possible to test if there is a difference between the Eurozone and non-Eurozone countries due to the model's limitation in allowing the usage of dummy variables. The third hypothesis about the positive indication of the prolonged period of low interest rates on the NPL level seems to hold only under the pooled OLS model. The rationale behind this conclusion lies on the fact that short-term rates have been tied mostly to the zero lower bound and as a result have shifted the long-term expectations. Such developments have caused the spread to narrow, thus decreasing the bank profitability and deteriorating the credit quality factors as well. Unfortunately, this conclusion is dropped under the fixed effects model as the variables became insignificant.

Furthermore, the last variables in our model are the industry-specific ones. The results indicate a positive indication of number of banks, while the amount of bank assets held as deposits exerts a negative impact to the dependent variable. In addition, the *HHI* is also negatively related to the dependent variable, suggesting that a highly concentrated environment would decrease the credit risk. None of these variables were found to be significant at 5% significance level. From these results it is not possible to confirm the claim that the industry-specific variables are negatively correlated to the quality of loans. The lack of significance of all three variables does not support our hypothesis.

Similarly, to the former model, under the fixed effects it is indicated that the *HHI* and *BAS* negatively influence the dependent variable, even though only the former one is found to be significant at 5% significance level. The only difference with the pooled OLS, is the fact that now *HHI* follows our claim that the impact should be negative and it is significant. The result suggests that a highly concentrated market is more secured compared to a market characterized with numerous banks and smaller market concentration. On the other hand, the variable of *nobanks* has maintained the sign and significance similarly like in the former model. Regardless, of the insignificance of the latter variable, we get enough evidence supporting the relevance of industry specific measures in explaining a portion of loans quality under the fixed effects model.

To sum up, it is possible to conclude that the pooled OLS model can explain over 94% of the variation in the dependent variable. In addition, the adjusted R-squared yields similar result, thus indicating that all the explanatory variables somehow contribute in explaining the dependent variable. The unusually high R-squared can be explained with the model deficiencies, such as the presence of heteroskedasticity, autocorrelation, and endogeneity. All these issues yield biased coefficients and biased standard errors, thus having a clear impact on the R-squared. On the other hand, the fixed effects model explains over 75% of the variation in the dependent variable, associated with an adjusted R-squared of 68%. Lastly, both models are found to be statistically significant based on the F-statistic results. Furthermore, Random effects model is also estimated and the results can be found in appendix part, table A.3. The results reconfirm that Random effects method is not able to significantly explain our model.

6.3 Robustness Check

The analyses will continue with models' tastings and robustness checking. In the table 6.2 below, we have presented the results from the F-test indicating the best performing model.

Table 6. 2: F- Test results

F	DF1	DF2	F-test: Testing for Fixed effects
6.0539	192	1584	p-value < 2.2e-16

Source: Compiled by the author in R.

Based on the result of the F test we have enough evidence to reject the null hypotheses of pooled OLS. So, the best performing model is found to be the fixed effects. In table 6.3 below, we have summarized the test results for autocorrelation, heteroskedasticity, and cross-sectional dependence.

Table 6. 3: Test performance for autocorrelation, heteroskedasticity and cross-sectional dependence.

Autocorrelation Breusch-Godfrei/Wooldridge Test		H_0: No serial correlation
Pooled OLS	p-value < 2.2e-16	
Fixed Effects	p-value < 2.2e-16	
Heteroskedasticity Breusch Pagan Test		H_0: Homoscedastic errors
Pooled OLS	p-value < 2.2e-16	
Fixed Effects	p-value < 2.2e-16	
Cross-sectional dependence Pasaran CD Test		H_0: Cross-sectional dependence
Pooled OLS	p-value < 2.2e-16	
Fixed Effects	p-value = 1.361e-10	

Source: Compiled by the author in R.

From the p-values presented in the table we can conclude that the pooled OLS model suffers from the presence of all these issues. In all cases, it is possible to reject the null hypothesis of no autocorrelation, homoscedasticity and cross-sectional dependence. The fixed effects model on the other hand, seems to have no autocorrelation issue, but unfortunately the results suggest the presence of heteroskedasticity and autocorrelation. These tests indicate that the results from our models are contaminated. As such, it is necessary to apply HAC robust errors in order to get the correct values of the standard errors.

We have re-estimated the initial models by making use of HAC robust errors in order to correct for the issues of autocorrelation, heteroskedasticity and cross-sectional dependence. The results have been summarized in table 6.1 above.

The first indication that we get by simply looking at the results is the fact that the standard errors values have significantly changed. Firstly, this is quite visible for the pooled model where all the variables now are associated with higher values of standard errors. The only variable who lost its significance is the *c_inc*, belonging to the bank–specific group. This variable is also insignificant under the fixed effects model. Regarding the fixed effects, we notice a slightly different pattern. There are cases where the standard errors have been increased and cases where they have decreased in value. The moves have been quite small and it has resulted in preservance of the significance for the ones which were already significant, except for the GDP which now turned insignificant. Compared to the former model, the current one has improved and it is far more reliable now that we have applied the HAC robust errors.

6.4 GMM

Due to multiple issues and deficiencies encountered with the previous models, we have applied the system GMM, which is believed to overcome the formerly encountered issues. To sum up the main reasons why the system GMM is the best model, it is important to initially admit the endogeneity issue characterizing our former models. The lagged dependent variable is suspected to be correlated with the error term, thus indicating that both the variable's coefficients and the standard errors values are biased. Moreover, the system GMM is very suitable in datasets where the number of periods is smaller than the number of observations, like in our case. In addition, the pooled OLS model is the only one to take into consideration our dummy variables, as the fixed effects model is unable to include them, since it uses the within group differences. GMM model can overcome both issues and is also able to control for omitted variable bias, measurement bias and unobserved panel heterogeneity. Unfortunately, the standard panel GMM, developed by Arellano & Bond (1991), does not allow using the group of dummy variables intended to study in this thesis, as they would be eliminated through differencing. Thankfully, Arellano & Bover (1995) and Blundell & Bond (1998) proposed a version of GMM which overcomes this issue by estimating the model jointly in levels and differences. Such model allows the estimation with the

usage of dummy variables. This thesis has used the "*xtabond2*" command in Stata to perform this model.

In table 6.4 below we have presented the results of One-Step GMM and Two-Step GMM, by making use of both normal and heteroskedasticity and autocorrelation robust errors.

Table 6. 4: Two- Step GMM results.

	One-Step GMM	One-Step GMM Robust	Two-Step GMM	Two-Step GMM Robust
	1	2	3	4
Eurozone	-0.9729***	-0.9729**	-0.8947**	-0.8947**
	(0.1228)	(0.3154)	(0.2689)	(0.3420)
Lag(ilgl,1)	0.4014***	0.4014***	0.4098***	0.4098***
	(0.0100)	(0.0595)	(0.0399)	(0.0603)
e_tas	-0.0823***	-0.0823**	-0.1158***	-0.1158**
	(0.0088)	(0.0294)	(0.0257)	(0.0413)
llr_glr	1.0023***	1.0023***	1.0295***	1.0295***
	(0.0185)	(0.1004)	(0.0717)	(0.1087)
nl_tas	3.31e-06	3.31e-06	0.0001	0.0001
	(0.0006)	(0.0007)	(0.0006)	(0.0007)
la_dstf	0.0061*	0.0061*	0.0020	0.0020
	(0.0016)	(0.0028)	(0.0023)	(0.0031)
Roae	-0.0344***	-0.0344**	-0.0264***	-0.0264*
	(0.0034)	(0.0103)	(0.0062)	(0.0119)
c_inc	-0.0033*	-0.0033	-0.0033*.	-0.0033.
	(0.0014)	(0.0029)	(0.0016)	(0.0026)
log(totas)	-0.3972***	-0.3972*	-0.4060*	-0.4060.
	(0.0835)	(0.1885)	(0.1762)	(0.2263)
Coob	1.3556***	1.3556***	1.1473***	1.1473***
	(0.0979)	(0.2702)	(0.2471)	(0.3101)
Remb	0.4860*	0.4860	0.3409	0.3409
	(0.2286)	(0.3504)	(0.3420)	(0.3811)
Savb	0.9755**	0.9755*	1.0453*	1.0453*
	(0.3404)	(0.4354)	(0.4194)	(0.5252)
Bhhc	0.6531***	0.6531*	0.5508*	0.5508.
	(0.1069)	(0.2709)	(0.2529)	(0.3177)
Small	0.1208	0.1208	0.1268	0.1268
	(0.1564)	(0.3190)	(0.3131)	(0.4038)
Large	-0.1947	-0.1947	-0.1421	-0.1421
	(0.1225)	(0.3654)	(0.3409)	(0.4190)
Spread	0.8428***	0.8428**	0.4245*	0.4245.
	(0.1559)	(0.2753)	(0.2118)	(0.2545)
$spread^2$	-2.2212***	-2.2212**	-1.3282*	-1.3282.
	(0.4933)	(0.7955)	(0.6563)	(0.7948)
Gdp	-0.1767***	-0.1767**	-0.2638***	-0.2638.
	(0.0286)	(0.0671)	(0.0613)	(0.1543)
Infl	-0.1932**	-0.1932**	-0.0880	-0.0880
	(0.0574)	(0.0677)	(0.0566)	(0.0757)
Unemp	0.1449***	0.1449***	0.1067***	0.1067**
	(0.0188)	(0.0393)	(0.0285)	(0.0398)
Nobanks	0.00044**	0.00044	0.0003	0.0003
	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Hhi	0.2270	0.2270	1.2064	1.2064
	(1.0959)	(2.3151)	(1.9713)	(2.4287)
Bas	-0.0019	-0.0019	-0.0014	-0.0014
	(0.0005)	(0.0012)	(0.0011)	(0.0014)
Intercept	5.1186***	5.1186**	5.2155***	5.2155*
	(0.7673)	(1.7030)	(1.4448)	(2.0537)
No. of observations	2475	2475	2475	2475
No. of groups	521	521	521	521
No. of instruments	38	38	38	38
Wald Statistic	63971.41***	9978.36***	12389.97***	2475
Arellano-Bond AR(1)	-13.82***	-6.12***	-4.69***	-4.27***
Arellano-Bond AR(2)	-1.18	-1.19	-1.05	-1.04
Sargan/Hansen test	173.67***	16.72	16.72	16.72

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Compiled by the author in R.

At first glance, it is noticeable that the coefficient of the lagged dependent variable is quite consistent across the models. In addition, it is statistically significant, thus confirming that the previous values of the dependent variable can explain its future values. Another important point that these results reveal, is the fact that the GMM coefficient is smaller than the Pooled OLS and greater than the Fixed Effects ones. This has been considered as a rule of thumb in choosing between differenced GMM and system GMM in the paper by Roodman (2009).

Moving onwards to the group of bank-specific variables, it is revealed that the variables of *e_tas, roae, log(totas), and c_inc*, negatively impact the dependent variable. In addition, they are all significant under all types of models, except for the *c_inc*, which becomes insignificant when applying the robust errors. Such results are quite consistent through different models in this thesis and are in the same line with the economic theory. The other variables of *llr_glr, nl_tas, and la_dstf*, all follow similar logic and sign like in the pooled OLS and fixed effects models. Unfortunately, only the *llr_glr* is significant across all models and *la_dstf* is significant under One-Step GMM, while *nl_tas* is completely insignificant.

Moreover, the dummies indicating the bank specialization are found to positively impact the dependent variable. The variables of *coob, savb, and bhhc*, are found to be statistically significant across all models, except for the latter variable which loses its significance when applying the robust errors in the Two-Step GMM model. Unfortunately, the variable of *remb* is found to be significant only on the standard One-Step GMM. These results conclude that the bank specialization in only one sector fuels the credit risk and deteriorates the loan quality.

Furthermore, the group of macroeconomic variables reveals quite consistent results. Starting with the real GDP growth rate, we notice a clear negative impact on the dependent variable. Such impact is found to be consistent and statistically significant across all models, except for the robust Two-Step GMM. The variable of inflation as well is found to exert a negative effect in all models but preserves its significance only under the One-Step GMM model. On the other hand, unemployment rate indicates that an increase on this value would positively impact the credit risk, thus decreasing the possibility to repay the loan. In all cases this variable has been found to be statistically significant.

The discussion of these two groups of variables helps to conclude the first hypothesis of this thesis. It has been statistically proven that both bank and macroeconomic variables are relevant in explaining a considerable portion in the variation of our loan quality indicator. In addition, while taking into consideration the dummy variable of Eurozone, we can confirm that the Eurozone countries have better loan quality compared to the non-Eurozone countries. Such variable is statistically significant and with such information we can confirm our first hypothesis.

Furthermore, the variable of *spread* in its linear and quadratic form, indicate interesting results. Unlike the former models results, under the GMM the *spread* coefficient is positive on its linear form and its square is negative. Earlier in this chapter it has been argued that the bank pays short-term interest and receives long-term interest. Such argument suggests that the prolonged period of low short-term interest rates would preserve the profit in the present but would ruin the future as it would shift people's expectations. That argument is still valid, but the discussion of interest rates in our case is restricted in a period of only five years, while it is suggested that such behavior should be observed on a longer time frame. Moreover, the behavior and the interpretation can be quite ambiguous. Our GMM results suggest that lower interest rates positively impact credit risk in the short term. But while it may lower the costs that the bank has to pay, it may also increase the adverse selection and moral hazard as people are more encouraged to borrow when the rates are so low. This reasoning helps to explain the negative impact in the short-run, but on the other hand it is quite difficult to explain the behavior in the long term. Our model predicts that the effect will transform after some point in time, and again this is connected to the shift in expectations. As the short-term rates keep being low for way to long, then the long-term rate will decrease as well, thus deteriorating the bank profits. But under this period the banks would take measures to keep their margins up and such thing has been mainly done through higher commissions and very low interest rates for the saving accounts. Such tactic clouds our results in a way of showing that the long-term slope decreases credit risk, while it might be due to alternative precautions taken by banks. All in all, this variable is significant and our hypothesis is concerned with the short-term rate. By looking at the positive sign and its significance across all models we can confirm the hypothesis.

Shifting the analyses to the discussion of the last two dummy variables, which check if the size of the bank matters in explaining the loan quality, the results are in the same line with the former models. Unfortunately, even though we have a consistent sign, we do not have statistically significant coefficients. Such results suggest that we do not have enough evidences to support the claim that large banks reported lower levels of NPL. Such assumption might be invalid, but it could be interesting to check in a larger sample across a larger number of periods.

The last group of variables is the industry-specific ones. While checking if there is a negative relation between these variables, we notice that only *nobanks* is significant under One-Step GMM model with normal errors. In all the other cases all variables are found to be statistically insignificant. Such outcome helps to conclude that the industry-specific variables are somehow irrelevant in our case, and as a result we have enough evidence to reject the hypothesis.

All in all, the models are found to be statistically significant based on the Wald statistic reported on table 6.4. In addition, the reported values from the tests Arellano-Bond AR (1) and AR (2) indicate that the best model to be specified is the one with one lag of the dependent variable. The last tests performed on our GMM models are the ones checking for overidentifying restrictions. For the basic One-Step GMM only the Sargan test has been reported, being the only values produced by Stata. Based on this value the instruments are not exogenous. Shifting to the three other models, we have reported the Hansen statistic, which is robust and in all three cases is unable to reject the hypothesis of exogenous instruments. The GMM models are the best performing ones in this thesis. Their results are in the same line with the expectations and with the literature.

6.5 Summary of Results

The contribution of this thesis strives in the ability to investigate the impact of bank-specific, country-specific, and industry-specific groups of variables on the quality of loans. With a unique dataset and a wide range of variables, we have provided various estimations by making use of different panel data techniques. Our study has significantly contributed the literature by considering the distinction between Eurozone and non-Eurozone countries.

Hypothesis #1- not rejected: It has been shown and proven that Eurozone countries have better loan quality in comparison to the non-Eurozone countries. In addition, it has been indicated and reconfirmed the relevance of bank-specific and macroeconomic variables. The draw conclusions are in the same line with the literature findings in Espinoza & Prasad (2010), Louzis, Vouldis, & Metaxas (2012), Ćurak, Pepur, & Poposki (2013), Messai & Jouini (2013), Klein (2013), Makri, Tsagkanos, & Bellas (2014), and Škarica (2014). Moreover, the significance of bank-specific and macroeconomic variables, while being used together with the dummy of Eurozone indicates the uniformity of the impact for all these countries similarly to Anastasiou, Louri, & Tsionas (2016). This indication is supported also in studies which have considered other samples, such as in Umar & Sun (2016), Khan & Ahmad (2017), and Mohanty, Das, & Kumar (2018).

Hypothesis #2- rejected: Moreover, this thesis considered bank size by creating a dummy for large banks with over 30 billion in assets and small banks with less than 1 billion in assets. The results indicated no significant impact of size and similar conclusions have been presented in the studies like Ćurak, Pepur, & Poposki (2013).

Hypothesis #3- rejected: Furthermore, the group of industry-specific variables have been found insignificant. As a result, we are unable to confirm the hypothesis of a negative impact of these variables to the dependent variables. Such result is in the same line with the outcome in the study by Borio et al. (2015). Similar conclusions have been presented in the studies by Athanasoglou, Brissimis, & Delis (2008) and Jabra, Mighri, & Mansouri (2017). Table 6.5 represents a comparison between the findings between this and previous similar studies. However, the included papers differ from each other in the size of the dataset, time and geographical scope and applied methodology.

Hypothesis #4- not rejected: Lastly, this thesis presented a significant impact of the spread in explaining loan quality. The outcome was quite ambiguous and the interpretation is tightly connected to the expectations. So, we conclude that the prolonged period of low interest rates has shaped the expectations for the future and has changed the slope of the yield curve, thus significantly impacting the quality of loans. In 2019, Hanzlík & Teplý found out an insignificant relationship between spread

and NIM. However, based on our sesults, we can say that this relationship becomes significant when it comes specifically to the quality of the loans.

As seen in the table below, we can find similar conclusions for specific variables like roae, log(tassets), interest rate (spread), gdp, inflation, unemployment etc. On the other side, the results differ among the different studies included in the table 6.5 especially during the study of interest rate impact, which in our paper is stated as the difference between the yield of the 10-year government bond and 3-month interest interbank rate, named spread. Regarding the impact of the bank size on the loans quality, the authors of the previous studies mainly tried to detect it by including total assets variable or logarithm of total assets, while our study employes specific dummies for each category, that is small, medium and large. Same logic stands also for bank categories based on specialization where our study contributes by including 5 dummy variables to detect the impact of each category specifically.

Table 6. 5: Overview of ours and previous findings regarding the determinants of NPLs.

Author/s	Data	Methodology	eurozone	ll/gr.$_{-1}$	e_ta	llr/gl	nl/tas	la/dstf	roae	c/inc	Log(tas)	specialization	size	spread	spread^2	gdp	infl	unempl	nobanks	hhi	bas
(Anastasiou et al. ,2016)	Bank Scope Data-base, ECB, OECD, IMF; 226 banks; 2003-2016	Panel data verified by FMOLS; Panel Co- integrated VAR	+*	/	/	/	/	+	-	/	-	/	-	/	/	-	0	+	/	/	/
(Maivald, 2019)	Bankscope, 1610 banks; 2011-2017.	2-Step System GMM	+*	+*	-	/	/	+	/	/	0	-*	0	-*	/	-	0	+	/	/	/
(Louzis et al. 2012)	Bankscope, Bank of Greece; 9 banks, 2003-2009.	GMM	+*	+*	/	/	/	/	-	-	/	+*	/		/	-	/	+	/	/	/
(Kjosevski& Petrovski, 2017)	Bankscope database of Bureau van Dijk, WDI; 27 banks; 2005-2014	Panel VAR, Difference GMM	/	/	-	/	/	/	-	-	+*	/	/	/	/	-	-*	+	/	/	/
(Mohanty et al., 2018)	Reserve bank data of India, 95 banks; 2000-2016	System GMM	/	+*	/	/	/	/	-	/	/	+*	/	0	/	-	/	/	-	/	/
Our Thesis/ Chapter 6	Bankscope, Eurostat, ECB, OECD; 534 banks, 2012-2017.	Pooled Ols, FE, 2-step system GMM	-	+	-	+	0	0	-	-	-	+*	0	+	-	-	0	+	0	0	0

Notes: + indicates positive significant impact, - indicates negative significant positive impact, 0 indicates non-significant impact, +* or -* indicates positive or negative significant impact with some specifications, / indicates that the variable is not included in the empirical analysis.

Source: Author based on previous studies and own research.

Finally, the main contribution of the empirical analysis provided in this chapter is the consideration of three different explanatory group variables in order to explain the fluctuations of the NPLs in both Eurozone and Non-Eurozone. Moreover, this analysis studies for any significant relationship between loan quality and bank heterogeneity by employing dummy variables for both size and the business model of the bank. Also, the comparison between euro and non-euro area is done by including a specific dummy variable which helps to distinguish between these two zones inside EU.

6.6 Further Research Opportunities

Despite all the valuable contribution to the previous literature, this study has also some limitations which would be worthy to be considered for a future development of the topic. Therefore, we will briefly conclude the future study opportunities. The main points can be summarized as following: further analysis of the yield curve; extended geographical scope e.g. US; extended time span.

1) Further analysis of the yield curve:

In their study, Hanzlík & Teplý (2019), found out a negative linear relationship between the yield curve and the NIM ratio. However, they stated that this finding is not exactly in the same line with the previous literature and with the common theoretical sense. On the other hand, Borio et al. 2015, states that if the yield which reach at a specific level, it may happen that it may cause the bank profitability to decrease. As NPLs are a part of the main importance regarding the performance of a bank, it would be interesting if we would further develop this thesis with respect to yield curve impact analysis.

2) Extended geographical scope e.g. in US:

Another scope of developemnt would be that of the reagion taken into analysis. This study would better develope by taking into consideration areas like US. Definitely, this research would be better completed if data for such an area with a different location, economical model, different political and social background would be included. It is not easy to collect the data for such a big and diversivied region, however it would

definitely contribute in a better explanation regarding the factors which cause the level of NPLs to flactuate, especially by contrasting them with the EU.

3) Extended time span:

Due to the unavailability of the data, this study is limited only with the period from 2012 to 2017. However, it would be more preferable if longer time length would be included. If data from previous years would have been included, this study would have higher siginificance in loan quality description. Moreover, a longer time span would make able to include longer time when the interest rates in Eurozone was reaching zero or even negative levels, thus providing a more robusted results regarding the relationship between NPLs and interest rates.

7. Conclusions

Non performing loans level is one of the most sensitive topics when it comes to the European banking system, especially after the impact of the financial crises. Due to its main importance and close relation to the performance of the banks, the previous literature is very rich in studies regarding the determinants of the credit risk. Different authors studied NPLs in different regions and time span, however there are still many open questions which are not answered yet. For instance, Athanasoglou et al. (2008) studied the determinants of NPLs in Greece, Anastasiou et al. (2016) analyzed the NPLs factors in Eurozone countries, Jabra et al. (2017) studied factors of bad loans in 26 specific European countries, Mohanty et al. (2018) studied indian NPLs and so on. As seen, previous literature is mainly concerned in what causes the credit risk level to flactuate in a specific area, but our thesis provides an empirical examination based on a comperative approach in two areas which are found within the same region but operates with different currency and under different economial and social policy. Differently from the previous literature, we also consider the bank heterogeneity based on the specialization and size of the bank. Furthermore, the time span taken into study, 2012-2017, takes into consideration also the impact of low or even negative interest rates across EU, which was found to be significant in explaining the level of NPLs.

Based on a dataset with a considerable number of 534 banks operating either in euro or non euro area, we found out that the loan quality during the tested period is better in euro area. This can be explained due to the reason that all banks which provides services in these area are operating under common rules and politics which are settled and controlled by one main institution, which is European Central Bank (ECB). This may result in a better organised banking system as a whole. Using the System GMM methodology as the main and best panel data method to examine our dataset, it has been indicated and reconfirmed the relevance of bank-specific and macroeconomic variables. Moreover, the significance of bank-specific and macroeconomic variables, while being used together with the dummy of Eurozone indicates the uniformity of the

impact for all these countries. Therefore, we have no evidences to reject Hypothesis #1.

As mentioned, this thesis considered bank size by creating a dummy for large banks with over 30 billion in assets and small banks with less than 1 billion in assets. The examination results revealed a non significant impact of bank size on the loan quality. Therefore, we have enough evidences to reject Hypothesis #2 that large banks reported the lowest level of NPLs in both Eurozone and non-Eurozone countries. Similar conclusions have been presented in the study done by Ćurak, Pepur, & Poposki (2013).

In addition, this thesis employs three groups of explanatory variables. Hypothesis #3 says that industry specific variables, which is the third group of independent variables, is negatively related to the quality of loans. However, we found out that the group of industry-specific variables to be insignificant to explain NPLs fluctuations in either euro or non euro area. As a result, we are unable to confirm the hypothesis of a negative impact of these variables to the dependent variables. Thus, we reject Hypothesis #3. Such result is in the same line with the outcome in the study by Borio et al. (2015).

Lastly, our study aspires to examine for any existing relationship between the low interest rates environment and the level of NPLs. Our findings showed a significant impact of the spread in explaining loan quality. The outcome was quite ambiguous and the interpretation is tightly connected to the expectations. So, we conclude that the prolonged period of low interest rates has shaped the expectations for the future and has changed the slope of the yield curve, thus significantly impacting the quality of loans. So, we found no evidences to reject Hypothesis #4.

To conclude, the main contribution of this thesis consists as following: the evolvment of a comprehensive literature; the testing of a relatively large dataset of 534 banks operating either in euro or non euro area which are also distinguished between them based in their size and specialization; the time spanning from 2012 to 2017, covering also the period of low or negative interest rates especially in eurozone countries. Similar studies like Athanasoglou et al. (2008), Jabra et al. (2017), Mohanty et al. (2018) studied the determinants of NPLs by using similar methodology as ours, however none of them included both areas existing within EU and treating the analysis

on comperative basis and either consider all three groups of explanatory variables as this study does in order to increase the significance of the results.

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Appendix

Chapter 4

Table A. 1: Descriptive analysis of total assets in each country, 2017

	N	Mean	SD	p25	Med	p75	Total
AT	22	36.30	64.93	3.64	13.48	27.81	798.69
BE	5	147.92	137.49	20.03	182.08	201.43	739.61
CY	2	14.30	19.80	7.30	14.30	21.30	28.60
CZ	5	35.91	29.74	6.72	47.16	61.79	179.55
DE	40	58.53	136.55	2.78	6.43	36.06	2341.31
DK	28	21.24	52.96	0.98	2.10	5.02	594.68
ES	11	365.23	511.00	65.62	155.93	362.51	4017.49
FI	4	64.94	73.87	10.19	44.37	99.12	259.76
FR	46	320.19	598.97	12.98	28.55	258.44	14728.61
GB	39	320.72	543.91	3.99	38.84	476.63	12508.04
GR	5	61.54	32.22	71.99	72.93	77.68	307.72
HU	4	19.25	21.25	7.55	9.77	21.47	77.01
IE	5	53.23	53.69	22.14	27.32	49.28	266.14
IT	246	13.11	89.50	0.23	0.62	2.01	3226.27
LT	5	4.16	4.28	0.53	2.44	8.22	20.78
LU	8	22.50	23.15	4.07	14.73	35.01	180.00
MT	4	6.19	6.25	1.28	4.75	9.66	24.74
NL	12	196.74	346.07	5.01	14.73	172.65	2360.90
PL	12	26.72	23.53	11.30	20.20	36.59	320.61
PT	6	63.73	32.20	41.84	62.25	80.65	382.40
SE	13	91.92	112.78	14.15	50.78	123.42	1194.94
SI	6	5.43	4.79	2.63	4.09	5.53	32.56
SK	5	7.85	8.07	1.75	4.26	14.99	39.26

Source: Compiled by the author, R.

Chapter 4

Table A. 2: Cross- correlation analysis

	ILGL	LA_DSTF	LLR_GLR	NL_TAS	E_TAS	C_INC	GDP	GOVBOND	INFL	ST_IR	ROAE	UNEMP	TOTAS	BAS	HHI
ILGL	1	-0.04237	0.897892	-0.07002	0.10671	-0.00535	-0.10339	0.254145	-0.1903	-0.07537	-0.24898	0.417723	-0.14603	-0.28906	0.086397
LA_DSTF	-0.04237	1	-0.02211	-0.05729	0.138877	-0.30791	0.102686	-0.12591	-0.07514	0.049444	0.042986	-0.12468	0.170739	0.235689	0.022001
LLR_GLR	0.897892	-0.02211	1	-0.08312	0.112615	0.002795	-0.00448	0.187124	-0.20486	-0.05568	-0.25204	0.357953	-0.11552	-0.23253	0.151183
NL_TAS	-0.07002	-0.05729	-0.08312	1	-0.03076	-0.17493	0.022482	0.011874	-0.01399	0.035262	0.007376	-0.0481	-0.04359	0.041814	0.04055
E_TAS	0.10671	0.138877	0.112615	-0.03076	1	0.068901	-0.04959	0.026606	-0.01624	-0.01298	0.04555	0.030776	-0.23738	-0.17218	-0.05182
C_INC	-0.00535	-0.30791	0.002795	-0.17493	0.068901	1	-0.08879	0.025014	0.241666	-0.06	-0.13001	-0.09837	0.005634	-0.03337	-0.05183
GDP	-0.10339	0.102686	-0.00448	0.022482	-0.04959	-0.08879	1	-0.64973	-0.38901	-0.12588	0.093803	-0.3517	0.081924	0.057446	0.162334
GOVBOND	0.254145	-0.12591	0.187124	0.011874	0.026606	0.025014	-0.64973	1	0.392426	0.378797	-0.09085	0.531954	-0.085	-0.26358	0.021063
INFL	-0.1903	-0.07514	-0.20486	-0.01399	-0.01624	0.241666	-0.38901	0.392426	1	0.373117	-0.03541	-0.19176	0.049526	0.069123	-0.06663
ST_IR	-0.07537	0.049444	-0.05568	0.035262	-0.01298	-0.06	-0.12588	0.378797	0.373117	1	-0.04346	-0.0841	0.04261	-0.09989	-0.01124
ROAE	-0.24898	0.042986	-0.25204	0.007376	0.04555	-0.13001	0.093803	-0.09085	-0.03541	-0.04346	1	-0.14064	0.001686	0.019001	-0.00922
UNEMP	0.417723	-0.12468	0.357953	-0.0481	0.030776	-0.09837	-0.3517	0.531954	-0.19176	-0.0841	-0.14064	1	-0.03987	-0.19951	0.053789
TOTAS	-0.14603	0.170739	-0.11552	-0.04359	-0.23738	0.005634	0.081924	-0.085	0.049526	0.04261	0.001686	-0.03987	1	0.310123	0.027497
BAS	-0.28906	0.235689	-0.23253	0.041814	-0.17218	-0.03337	0.057446	-0.26358	0.069123	-0.09989	0.019001	-0.19951	0.310123	1	0.090432
HHI	0.086397	0.022001	0.151183	0.04055	-0.05182	-0.05183	0.162334	0.021063	-0.06663	-0.01124	-0.00922	0.053789	0.027497	0.090432	1

Source: Compiled by the author in R.

Chapter 6

Table A. 3: Random effects model

	Random Effects
	1
eurozone	-0.2010
	(0.3347)
Lag(ilgl,1)	0.9690***
	(2.2e-16)
e_tas	-0.0611***
	(0.0005)
llr_glr	0.0925*
	(0.0135)
nl_tas	0.0017
	(0.5315)
la_dstf	0.0037
	(0.4603)
Roae	-0.0019
	(0.8403)
c_inc	-0.0221***
	(1.034e-05)
log(totas)	-0.0759
	(0.2188)
Coob	0.6642***
	(0.0001)
Remb	-0.1571
	(0.6729)
Savb	-0.0641
	(0.9014)
Bhhc	0.2221
	(0.2232)
Small	-0.1965
	(0.3264)
Large	-0.1552
	(0.5475)
spread	0.0327
	(0.8980)
$spread^2$	0.0521.
	(0.0528)
Gdp	-0.2458***
	(3.302e-05)
Infl	-0.5090*
	(0.0418)
Unemp	-0.0053
	(0.8899)
Nobanks	0.00027
	(0.3019)
Hhi	-4.1731.
	(0.0546)
Bas	-0.00072
	(0.4539)
Intercept	3.1731*
	(0.0192)
No. of observations	2000
R-Squared	0.98472
Adj. R-Squared	0.98379
F-statistic	1053.87 on 23 and 376 DF, p-value: < 2.22e-16
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1	

Source: Compiled by the author in R.