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FACULTY OF ECONOMICS

MASTER'S THESIS

**DETERMINANTS OF NON-PERFORMING LOANS IN  
THE CENTRAL AND EASTERN EUROPEAN  
COUNTRIES**

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## **AUTHORSHIP STATEMENT**

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## INTRODUCTION

The last two decades were generally characterized by a widespread credit growth supplied by the financial institutions in regards of the development of the banking industry. This extensive credit boom can be considered as a consequence of the deregulation process of the financial market and also, the expansion of the information technologies in the banking industry. The deregulation process of the financial industry actually removed the restrictions on the financial industry risk-taking which were imposed after the Great Depression in the 1930s. Thus, this progression led to significant growth in the size of the overall financial industry to levels not seen since the late 1920s (Korinek & Kreamer, 2014).

However, the benefit of the strong deregulation process was the enhanced financial intermediation and the improved competition across the financial institutions. On the other hand, the bigger banks' competition was also accompanied by the increased credit risk of the banks which impacted their loan portfolios in terms of less restrictive borrowing criteria and bad loans screening procedures. Additionally, this deregulation process also caused more volatile financial system in which the real economy was exposed to growing risk of credit crunches as the global crisis in 2008 clearly revealed (Makri, Tsagkanos, & Bellas, 2014).

Moreover, the credit risk of the banks is very often linked with the ratio of the non-performing loans (hereinafter: NPLs) which can be generally defined as loans in default or close to being in default. So, the quality of the banks' loan portfolios and the levels of NPLs remained relatively stable until the emergence of the financial crisis in 2008. Subsequently, the loan portfolios were sharply deteriorated impacting the banks' profitability and liquidity and consequently the stability of the financial system. Hence, high levels of NPLs place strong pressure on the balance sheets of the banks and adversely influence their lending capabilities and operations. Also, the rising levels of NPLs could be closely related with the problems of economic stagnation in terms of holding resources in unprofitable areas and consequently affecting the economic growth and efficiency. In this sense, it is of great importance to maintain the NPLs levels at minimum as possible which can be also considered as a necessary condition for improving economic growth (Messai & Jouini, 2014).

Moreover, the financial crisis left a legacy of especially high volume of NPLs in the Central and Eastern Europe (hereinafter: CEE). The recession had strong influence on the economic conditions and performance of the CEE region and the recovery following the crisis has been very weak as well. Therefore, the level of NPLs remained very high in the specific countries regardless of the attempt from the regulatory bodies and banking sector to minimize them. Also, if compared with the more advanced economies in Western Europe, the non-performing loans in the CEE countries were more widespread (Skarica, 2013).

Finally, the evidence from the past financial crisis suggests that the lasting recovery from the crisis requires bringing down and eliminating the NPLs from the financial sector. So, in spite of the valuable efforts that were performed in order to control and reduce the NPLs, the levels of these loans are still at persistent levels in some countries. Therefore, the theme of non-performing loans has drawn increasing attention in the past few years and it is still in the spotlight for both banks and regulators (European Banking Coordination "Vienna" Initiative

[hereinafter: EBCI], 2012). This establishes the main motivation in this master thesis for analyzing the NPLs and their potential determinants which would provide major feedback for the financial stability.

More specifically, due to the high volume of NPLs in the CEE region and also the specific situation of their strong persistence after the global crisis, the main focus in this master thesis is the research of the determinants of the non-performing loans in the Central and Eastern European countries regarding the post-crisis period from 2008-2015.

Therefore, the main purpose of this thesis is to analyze the dynamics of the non-performing loans in the Central and Eastern European countries and to observe the factors that contribute to the growth of NPLs. So, the main research question is whether these non-performing loans are mostly shaped by the macroeconomic factors such as growth of the gross domestic product (hereinafter: GDP), inflation, debt, unemployment and government budget balance or by the bank-specific factors including profitability, capital adequacy, liquidity and inefficiency. Moreover, **the general objective** of this thesis is to acquire broader knowledge of the non-performing loans, their emergence, and their impact on the banks' performance and success and on the countries' economic and financial conditions. The better understanding of NPLs will help me to explore the opportunities and solutions for decreasing the non-performing loans generally and give some recommendations about preventing them.

In addition, the more **specific objectives** include extending the perception of the functioning of the banking industry in the CEE region, its problems with NPLs, to deepen the understanding of the global crisis's effect on these non-performing loans and the measures undertaken following the crisis and finally, to examine whether the large extend of the banks' foreign ownership in this region have some influence on the high levels of non-performing loans.

Also, my master thesis research goals are:

- To gain better understanding of the NPLs, their appearance and their general impact;
- To explore the factors which contribute to the existence of NPLs, whether those factors are bank-specific or macroeconomic and which of them have the greatest influence on NPLs;
- To examine already existing case studies and research analysis about NPLs in order to classify the key contributors of non-performing loans;
- To analyze the banking industry of the CEE region and obtain greater knowledge of its performance;
- To observe the changes that were made in the banking sector of this region after the global crisis and how they have affected the volume of the NPLs;
- To research more solutions for diminishing the level of NPLs and to give some propositions for future improvement of banks' performance;
- To integrate theory and practice while deeply analyzing the banking sector of CEE region.

In addition, the research questions that are examined in this thesis are the following:

1. Are the non-performing loans in CEE region mostly shaped by bank-specific factors of macroeconomic factors?
2. Which of the factors demonstrate significant and positive correlation with the NPL ratio?
3. Which of the factors demonstrate significant and negative correlation with the NPL ratio?
4. Is there any significant relationship between the bank's ownership, whether it is under domestic or foreign ownership, and the level of NPLs in the CEE region?
5. Is there a strong persistence level of non-performing loans in the Central and Eastern European region?

Moreover, based on these research questions, the following alternative research hypotheses are developed:

H<sub>1</sub>: The NPLs in the CEE region are mostly shaped by bank-specific factors.

H<sub>2</sub>: The capital adequacy ratio has positive impact on the NPLs level.

H<sub>3</sub>: The return on assets ratio has negative impact on the NPLs level.

H<sub>4</sub>: The loans to deposits ratio has positive impact on the NPLs level.

H<sub>5</sub>: The inefficiency ratio has positive impact on the NPLs level.

H<sub>6</sub>: The annual GDP is in negative correlation with the NPLs level.

H<sub>7</sub>: The inflation rate is in negative correlation with the NPLs level.

H<sub>8</sub>: The public finances factors, public debt and government budget are positively correlated with the NPLs level.

H<sub>9</sub>: The unemployment rate has positive impact on the NPLs level.

H<sub>10</sub>: Foreign banks have less non-performing loans than domestic banks.

However, the findings of this study might be useful and beneficial for various stakeholders such as the individual Central Banks and Regulatory Bodies of the countries, the commercial banks and also, the study can be used as a guideline for other studies in this area or for some related topics. Firstly, the Central Banks and the Regulatory Bodies can find the results of this research practical in the further setting of standards and regulations related with the lending policies of the commercial banks and with the overall banking operations as crucial part of the economy as a whole. Secondly, the outcome of this research paper will come in handy to support the individual commercial banks in their decision-making process and in their development of policies. In particular, the banks can exploit the results as indication for which things should be more taken into consideration and improved in order to minimize the

level of non-performing loans and consequently enhance the banks' performance. Finally, this study contributes to enriching the existing literature in a way that is the first study that examines the determinants of NPLs in this CEE region and exactly in the period of 2008-2015 employing bank-level data. This means that there is no research paper conducted in this time period and for this region exactly. Also, it provides directions and ideas for further research and it can be used as a reference by other academics from various areas.

What is more, this study is adjusted to fulfill the previously mentioned objectives of exploring the determinants of NPLs within limited time period and scope of banks included. More specifically, this thesis is limited to 98 banks all in all from 15 countries from the Central and Eastern European region. The majority of the included banks are larger banks that play key role in the financial markets of the individual countries and contribute to their financial and economic soundness. Moreover, the study is also constrained to specific number of possible determinants of NPLs divided in two groups. Namely, the first group of bank-specific determinants incorporates: capital adequacy, return on assets (hereinafter: ROA), loans to deposit ratio and inefficiency ratio. Additionally, macroeconomic determinants, the second group of determinants, encompass the GDP, inflation rate, unemployment rate, government budget and lastly, the public debt. To this end, the thesis covers panel data from the period from 2008 to 2015. In addition, the data is based on bank-level data instead of aggregate data. On the whole, the scope of this study is limited to bank-specific and macroeconomic determinants of NPLs in the CEE region in the aforementioned time period.

Finally, when it comes to the structural definition, this master thesis is organized into four chapters. The first chapter represents the theoretical part of the thesis or the review of related literature including the analysis of the banking sector in the CEE region. In addition, it also includes the theoretical description of the banks' credit activity relating it with the non-performing loans and the factors impacting them in general. Next, the second chapter involves the review of empirical literature, separating the single country and cross-country empirical studies. Moreover, the third chapter deals with detailed clarification of the research methodology including the thorough explanation of the variables used and the estimation techniques. Finally, the fourth chapter focuses on the model estimation, obtaining the results and their interpretation. The thesis finishes with concluding remarks and recommendations for possible topics for further research.

## **1 THEORETICAL LITERATURE REVIEW**

The theoretical review in this thesis is focused on the analysis of the banking sector in the CEE region and the impact of the global crisis in this region, and on the general explanation of the non-performing loans and its determinants.

## **1.1 Overview of the Banking Sector in the CEE Region**

First of all, the region investigated in this paper is the CEE region including 15 countries as following: Bulgaria, Bosnia and Herzegovina, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia. The majority of them hold the membership of the European Union except for Bosnia, Macedonia, Serbia and Montenegro. Also, Estonia, Latvia, Lithuania, Slovakia and Slovenia are the EU's countries which use the same currency or in other words are part of the Eurozone. Additionally, Montenegro has also adapted the euro as official currency even though it is a non-EU member.

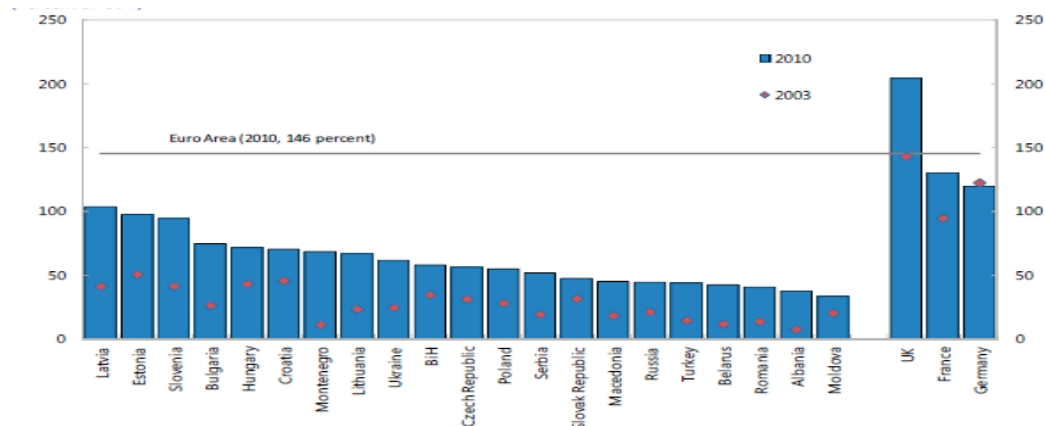
Secondly, another important characteristic of this region is the fragmented market structure. This kind of structure is a consequence of the obvious fragmented structure of the countries included in the region and also the different financial, fiscal and monetary policies on a country level. As mentioned before, some of them adopted the euro currency, some of them are planning to do that (Bulgaria and Romania) and some of them try to preserve their national currency such as Poland, Hungary and Czech Republic. Also, all of the countries have their monetary autonomy which signals different and modified policies which resulted in distinctive loans and deposits structure. In other words, those countries which chose high interest rates and lending in foreign currency in the pre-crisis period ended up deeply indebted especially in euro, Swiss franc and other foreign currencies due to the depreciation of the emerging market currencies caused by the global panic. On the other side, the countries in the Eurozone and with low interest rates had insignificant exposure to foreign exchange risk (Kutasi, 2014).

Moreover, the banking sector of the CEE region has encountered a long process of transition characterized by privatization, liberalization of licensing, capitalization by foreign investors and deregulation in the last two decades. As the banking sector of this region entered the process of transition, it became the most attractive market for foreign investors, especially for German, Austrian and Italian banks which were the first foreign players to enter the CEE banking sector and dominate as owners of the banks in this region. The high degree of foreign ownership and investment in this region is visible through the comparison of foreign owned banking assets as percentage of the total bank assets (Psilaki & Mamatzakis, 2017). The detailed ownership of the banks included in the analysis in this paper can be found in Appendix C.

Furthermore, this transition process also affected the vulnerability and stability of this region. In particular, the CEE markets are featured by small scale and low levels of product diversification and financial penetration. Also, there is still impact of the past command economy in which the CEE banking sector operated until 1990s even though the sector is now controlled by the market economies. Additionally, the foreign bank participation was especially expressed in the undercapitalized transition region as previously mentioned. Although, some of these things positively influenced the CEE region such as the positive impact of the foreign entry on the technical efficiency through introducing better technologies or business practices, other things have shaken up the stability of the banking sector. More

specifically, the aforementioned characteristics led to dynamic expansion of the credit and the debt exposures of the banks which exceeded the capacities of the risk management systems and supervisory institutions (Kutasi, 2014).

Figure 1. Selected European Countries: Private Sector Credit



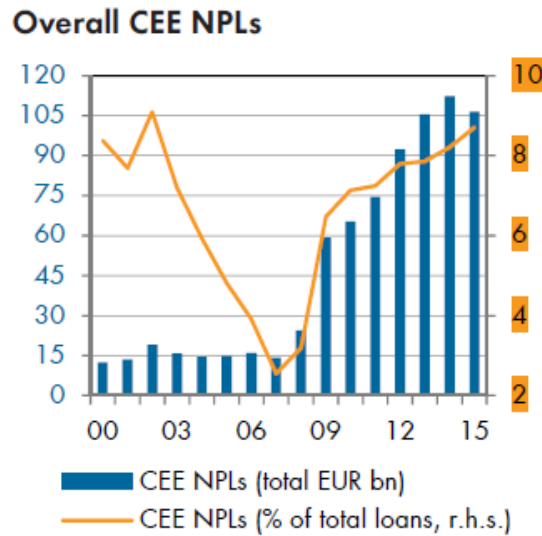
Source: European Banking Coordination “Vienna” Initiative, *Working Groups on NPLs in Central, Eastern and Southeastern Europe*, 2012, p. 20.

Therefore, the region faced the challenge of trying to balance the extensive lending and maintain the overall financial stability. Subsequently, many of the CEE countries applied a risky model based on cheap funds in order to support the increased credit growth (Benczes, 2008). The CEE countries’ credit boom can be observed in Figure 1 and it can be noticed how it even outperformed the economic activity in some countries. The private sector credit to GDP ratio reached 60% in 2010 compared to 27% in 2003 (EBCI, 2012). In addition, high foreign funding before the crisis in this region led to high share of loans denominated in foreign currencies and to increased exposure to the foreign currency risk. Then, in the period of 2008-2012, the CEE countries were characterized by considerable deleveraging process which involved substantial outflows mainly due to the reduction in loans to banks (Skarica, 2013).

What is more, the banking sector of the CEE region is also highlighted by high levels of non-performing loans. The unsuitable boom in the credit growth from 2003-2008 was disrupted by the global crisis and the deep recession afterwards. Those countries with particularly pronounced lending activity were worse off. The NPL ratio now is around 11% in this region, yet due to data deficiencies and underreporting of the non-performing loans, it is possible that the problem is even bigger than the official statistics data suggests (EBCI, 2012).

The major problem in this is region is that the persistence of the NPLs could become obstacle for the economic activity and therefore, the banks and the official authorities put considerable effort in the NPLs resolution although at a very slow pace. There is a long list of barriers of legal, judicial, tax, regulatory and coordination nature that hold up the faster resolution of the NPLs in the CEE region (EBCI, 2012). The movement of the general NPL ratio in the CEE region can be seen in Figure 2 on the next page.

Figure 2. Overall NPLs in CEE Region



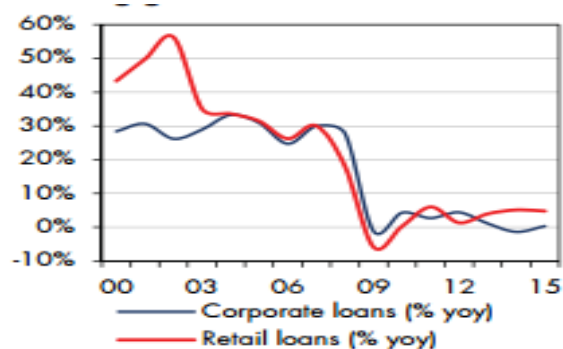
Source: Raiffeisen Bank Research,  
*CEE Banking Sector Report*, 2016, p.19.

However, a brief overview of the banking sector for each of the analyzed countries is presented further in this paper.

First, the **Bosnian banking sector** is characterized by moderately concentrated banking sector incorporating 27 banks from which the majority belongs to foreign subsidiaries, the Austrian and Italian banks dominating the market. So, exactly 82% of the banking sector assets are in foreign ownership. Moreover, in the pre-crisis period from 2003-2007, the level of issuing loans in Bosnia to the private sector recorded significant increase at an average annual rate of around 25% although the expansion of the credit represented the lowest in this region. From Figure 3 on the next page can be seen the lending growth in Bosnia until 2015. Then in 2009, the global crisis weakened the asset quality and the profitability of the Bosnian banking sector (Raiffeisen Bank Research, 2016).

The negligent lending before the crisis hit the banking sector, led to high levels of NPLs, more specifically the ratio increased from 3% at the beginning of the crisis increasing to 15.5% in the mid-2014. However, in 2015 slight improvement was noted in the levels of non-performing loans to 13.7% due to improvement in the retail loans' quality (International Monetary Fund [hereinafter: IMF], 2015a). Also, at the end of the analyzed time period, the Bosnian banks were capitalized at 15% well above the legal requirements even though the capital adequacy ratio was still on deteriorating path and also, depositors showed quite solid faith in the banks for the period ending (Raiffeisen Bank Research, 2016). All in all, the main risks threatening the financial sector of Bosnia at the end of 2015 were the slow resolution of the non-performing loans, weak demand and high level of dependence on the parent banks of the foreign subsidiaries (IMF, 2015a).

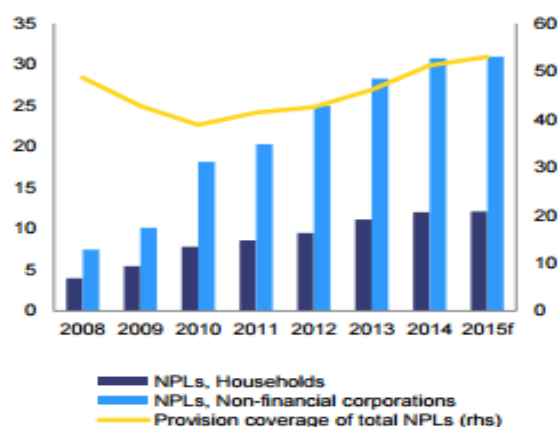
Figure 3. Lending Growth in Bosnia



Source: Raiffeisen Bank Research,  
*CEE Banking Sector Report*, 2016, p.44.

Second, in 2015, the Croatian Central Bank was a regulator of 28 banks which are mostly in foreign ownership dominated by Austrian and Italian banks. More than a half or exactly 16 were foreign subsidiaries while the rest of the banks were in domestic private or state ownership. However, at the end of the time period analyzed in this paper, the Croatian economy finally exited the six years long recession caused by the global crisis that shrunk the GDP by more than 12% until 2014. Hence, the asset quality of the banking sector in 2015 was enhanced and some weaknesses have been spotted only in some small banks (European Commission [hereinafter: EC], 2016). Yet, the volume of non-performing loans still represents a weight on the functioning of the **Croatian banking sector**.

Figure 4. NPLs in Croatia



Source: European Commission, *Country Report Croatia*, 2016, p.28.

Although the NPL total ratio has somehow stabilized, it still signals high levels of NPLs in Croatia, more specifically around 17% in 2015. The movement of the households and non-financial corporations' NPLs can be observed from Figure 4 above. The steady growth of the NPLs can be mainly attributed to the corporate loan portfolio's deterioration, especially in the loans to the construction sector (Skarica, 2013).



Moreover, the Croatian banking sector was characterized in 2015 also by slow resolution of NPLs and currency risk representing serious issue for the Croatian banks since high portion of the loans are denominated in foreign currency. For instance, potential risk is the possible negative impact of the conversion of CHF to EUR loans which can eventually hit the banks' profitability and capital base (EC, 2016).

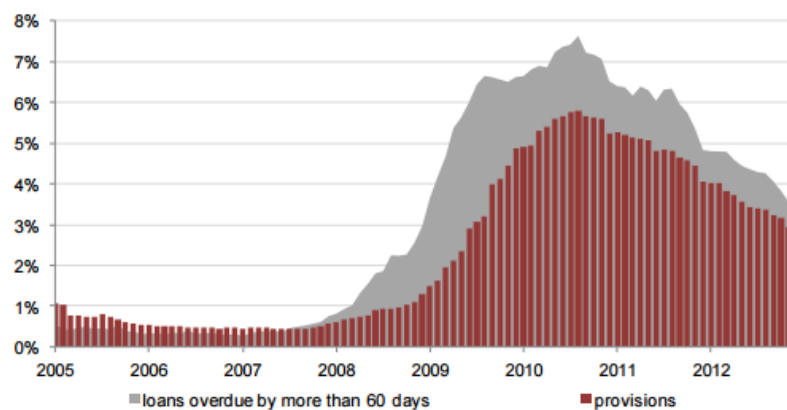
Furthermore, the **Bulgarian banking sector** is predominantly host to the EU banks which means that by 2014 around 73% of the total banks were in foreign ownership. Also, 24% of the market share belongs to the Greek subsidiaries which dominate the Bulgarian banking sector. In total there were 27 banks in Bulgaria until 2015 of which six were branches. However, the Bulgarian banking sector somehow handled the global crisis, but in 2014 two bank failures emerged. Additionally, the levels of NPLs have increased by 15 % as a consequence of the crisis and until 2015 it rose to around 18%. On the other hand, the liquidity indicators and the capital base of the Bulgarian banks have shown resilience in 2014 which were results of the regulatory measures taken in the previous years (IMF, 2015b). More specifically, the liquidity ratio improved to around 37% in 2015 compared to 30% in 2014 and the decent capitalization of the banks was indicated by the capital ratio increase to around 20%. Also, significant enhancement in the amount of the deposits was also recorded due to the restored trust in the banking system. Therefore, major obstacle for the banking sector in Bulgaria in 2015 remained the inferior asset quality and the resolution of the NPLs would be the major concern to the Bulgarian regulators similarly as in the previous two cases of Bosnia and Croatia (Raiffeisen Bank Research, 2016).

Moreover, the **Czech banking sector** is quite different from the previously analyzed banking sectors. So, it is similar in a way that is also characterized by concentrated banking sector dominated by the five largest banks controlling 70% of the total banks' assets. Unlike the other countries in the CEE region, the Czech banking sector is dominated by conservative balance sheet implying that high share of the loans and deposits is denominated in the local currency and only one fifth of the loans is denominated in foreign currency. This also means that the extensive credit growth, which distinguishes the CEE region, was supported by domestic deposits in Czech Republic and therefore, this country is one of the few in this region that did not need any exceptional measure to be undertaken by the regulators during the crisis. However, although the liquidity, profitability and capitalization were quickly improved after the crisis, the credit growth and the resolution of the NPLs is still slow. Nevertheless, the NPL ratio stayed around 5% which is comparable to the advanced economies and the asset quality remained decent as well (Skarica, 2013).

What is more, the financial sector of Estonia is mostly based on commercial banks. Thus, the small **Estonian banking sector** incorporates eight banks in total from which six are considered as small-size banks and the sector is dominated by the other two medium-size banks. In addition, the major banks in Estonia are owned by Nordic investors from Sweden, Norway and Denmark with Sweden being the main owner. Also, the Estonian banking sector is highly concentrated in a way that 87% of the banks' assets are possessed by the four largest banks. During the crisis, some of the major banks did not focus on the market share as much as on the portfolio quality and as a result some of the domestic banks gained some market

share during this period. The crisis also adversely influenced the general profitability of the banks increasing the net loan losses to 5.3% for the period from 2008-2012. Subsequently, the ratio of non-performing loans started to rise from 2007 and it peaked in 2010 valuing 7.6% which was smaller than predicted but relatively high compared to the previous years. Then, when the Estonian economy started to recover, the NPL ratio started to recover as well valuing 3.2% in 2012. The enhancement partly resulted from to the improved loan repayment due to better macroeconomic conditions and low interest rates and partly from large amount of write-offs. See Figure 5 for the movement of the NPL ratio in Estonia (The Bank of Estonia, 2013).

Figure 5. NPL Ratio's Movement in Estonia



Source: The Bank of Estonia, *Review of the Estonian Financial System*, 2013, p.19.

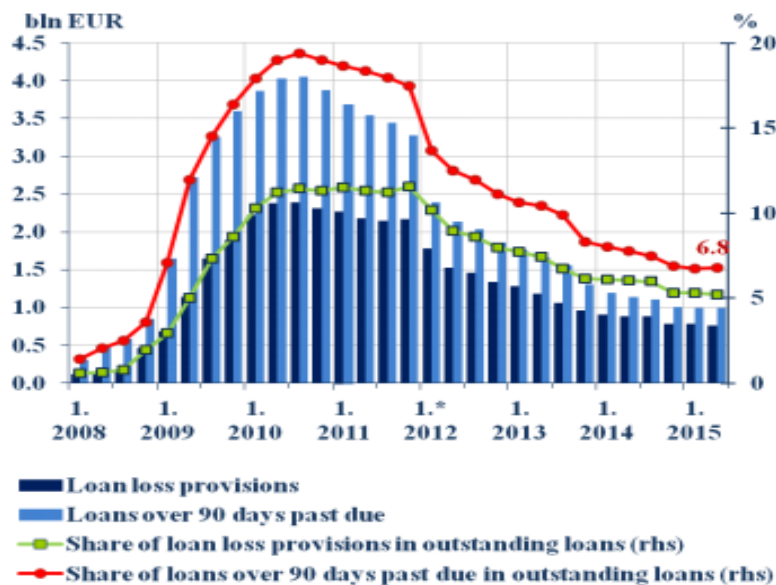
Furthermore, the banking sector that was heavily affected by the global crisis is the **Hungarian banking sector**. The negative influence of the crisis resulted even in banking tax adopted by the government, one of the non-standard measures in order to balance the budget. Additionally, the global crisis also left legacy of high portion of Swiss-denominated loans and weakening of the local currency forint. The adverse effect led to “unorthodox” measures adopted by the regulatory institutions which included a plan for replacing the foreign denominated loans with low-interest domestic loans and temporary exchange-rate limit program. Based on this limit, debtors could cap their repayments up to five years. Hence, the difference between the capped exchange rate and the actual exchange rate in that period was continually added in a special account which will be repaid later. Another consequence of the crisis was the high level of NPLs in Hungary reaching over 16% in 2012 (Skarica, 2013). Nevertheless, after year of losses, in 2015 the economic activity returned back on track indicating improved profitability of the banks, abundance of banks’ liquidity and increased capital adequacy ratio to 20% compared to in 11% in 2008 (Raiffeisen Bank Research, 2016).

The next relatively small economy is the Latvian economy whose banking sector is divided into two segments: domestically orientated banks which are characterized by Scandinavian ownership, and banks orientated on servicing non-residents of Latvia and these banks are mainly domestic banks but have no close association with the domestic economy. Moreover, the banking sector has rapidly been enlarging and dominating the financial system of Latvia with 90% of total assets especially since Latvia joined the EU in 2004. However, this country suffered considerable losses in the period of 2008-2012 during the global financial crisis

(Organisation for Economic Co-operation and Development [OECD], 2016). Despite the recorded economic growth in Latvia in 2012, the banks' NPLs continued to deteriorate reaching more than 19% in 2010 and afterwards it began to decline (Figure 6).

The enhancement was more noticed in the corporate loans compared to the household loans, which is a consequence of the housing bubble (Skarica, 2013). From 2014 onward, **the Latvian banking sector** started to show higher profitability and the non-performing loans fell to around 6% in 2015. Finally, the capital adequacy and liquidity of the banking sector displayed significant improvement in 2015 with ratios of around 18% and 65% respectively (OECD, 2016).

Figure 6. Non-performing Loans in Latvia



Source: Organisation for Economic Co-operation and Development, *Latvia: Review of the Financial System*, 2016, p.8.

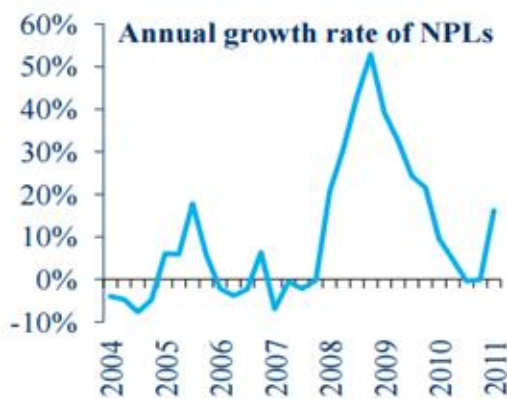
Next, another banking sector important for this analysis is the **Lithuanian banking sector**. Also, it is a small banking sector consisting of six banks<sup>1</sup> and seven foreign bank branches at the end of 2015. Not surprisingly, the Scandinavian banks also dominate this market. As of January 1st 2015, Lithuania adopted the euro as its official currency and consequently, the total banking assets were slightly lower at the end of this year. However, all the banks met the minimum capital requirements required and improvement in lending activities and growth of deposits has also been recorded. The ratio of non-performing loans has also been enhancing after the crisis and it reached in general 5.5% in 2015. In addition, the global financial crisis was felt in Lithuania in the same way as in the other countries and in 2013, the economy started to reactivate (Bank of Lithuania, 2015).

Another relatively small economy included in this paper is the Macedonian economy. Again, the financial sector of Macedonia is dominated by the banking industry which incorporates 14 private banks and one state-owned bank. The **Macedonian banking system** is also highly

<sup>1</sup> Failure of two banks has been recorded after the crisis.

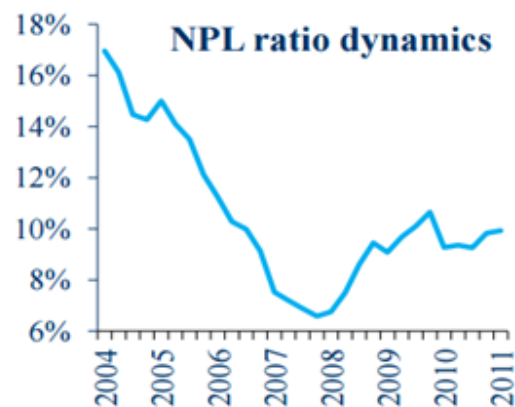
concentrated with three largest banks holding 60% of the total banking assets. The foreign ownership characteristic of the CEE region is common in Macedonia as well. At the end of 2015, foreign capital was present in 11 of total 14 Macedonian banks. Until the mid-2000s, the credit markets can be considered as underdeveloped and the loan supply was on a very low level. Afterwards, the credit growth started to climb together with the change of the ownership in the domestic banking. However, with transmission of the effects of global crisis and worsening of the macroeconomic conditions, the indicators of the banks' performance including the NPL ratio began to deteriorate (National Bank of the Republic of Macedonia Report [NBRM], 2012). The increase of the ratio after the crisis can be observed in Figure 7 and Figure 8 below.

Figure 7. Annual Growth Rate of NPLs in Macedonia



Source: NBRM, *National Bank of the Republic of Macedonia Report*, 2012, p.5.

Figure 8. NPL Ratio Dynamics in Macedonia

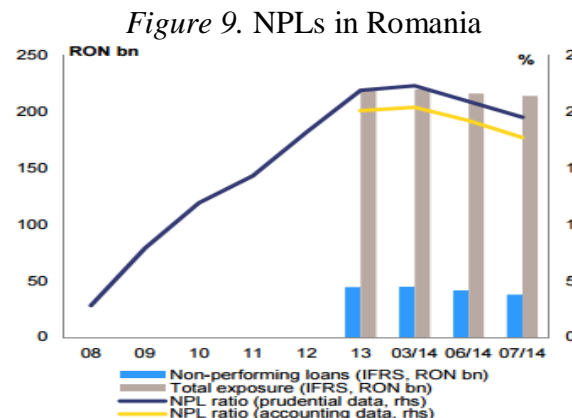


Source: NBRM, *National Bank of the Republic of Macedonia Report*, 2012, p.5.

Furthermore, the financial system of Montenegro is fully dominated by the banks possessing 90% of the total assets that belong to the financial system. More specifically, **Montenegro's banking sector** is consisted of 14 banks operating in the market in 2015 and the number of banks increased from 11 banks in total in 2013. Around 79% of the total banking assets is part of foreign subsidiaries which is not unusual for this region. Also, the lending activity is mostly present in the trading sector and to the households, especially mortgages. In addition, even though Montenegro is not part of the Eurozone, it has adopted the euro as its official currency. Moreover, the consequences of the global crisis were the deteriorated asset quality of the banks reflected through high levels of NPLs, then low profitability and high indebtedness of the private sector and these indicators still continue to adversely affect the banks' functioning. Still in 2015, the profitability of banks was weak, then, their capitalization appeared adequate, yet with some variations and the lending activity was sluggish despite the decreasing lending rates. Lastly, the levels of NPLs were still high in 2015 although they decreased to around 14% from 25% in mid-2011. The range of the NPL ratio for different banks was from around 5% to 35% in 2015 (IMF, 2016).

Similarly, Poland has also financial system dominated by the banking sector which incorporates 80% privately owned banks and several state owned banks. Also, the foreign capital is a common thing in **Poland's banking sector** with 60% of the total banking assets. At the end of 2015, Poland's banks activity performed strongly with sound profitability ratios, loans growth and loan to deposit ratio strongly above 100%. Also, the loan portfolio of the banks was enhanced with the NPL ratio declining to around 7% in 2015 (Raiffeisen Bank Research, 2016).

Moreover, Romania's financial system is also based on the banking sector incorporating 80% of the assets. Again, the majority of the banks are owned by foreign investors dominated by the Austrian capital since 2000 and followed by French and Greek capital. However, in 2012, there were 31 banks in the **Romanian banking system** and eight foreign bank branches. Only two banks were owned by the state while 26 of them were owned by foreign investors as mentioned earlier. The emergence of the global financial crisis did not bring any need for non-standard measures for the banking system in Romania (Skarica, 2013).

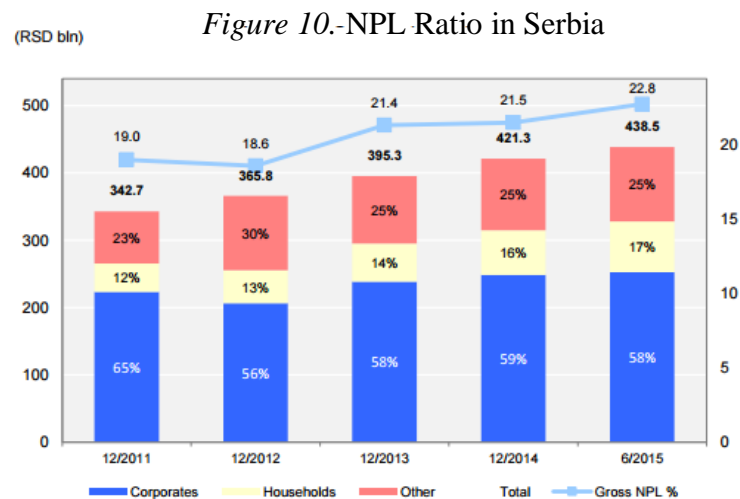


Source: European Commission, *Country Report Romania*, 2015a, p.50.

The crisis was weathered well and the capitalization of the banks remained strong. Also, the risk associated with the large volume of non-performing loans was alleviated with the cautious policy for loan loss provisions imposed by the regulatory institutions and the banks' balance sheet cleaning process incorporating write-offs and sales of impaired loans (EC, 2015a). Hence, in the end of 2014 the NPL ratio drastically fell to 14% from around 22% in March in the same year when it reached its peak (See Figure 9). On the other hand, due to these policies, the banks' profitability was adversely affected and it suffered loss for three years until 2013 and then again in 2014 as a result of the plan of the National Bank of Romania for cleaning the balance sheet of the banks as a resolution for the non-performing loans. Additionally, the loan growth contracted in 2014 due to both supply and demand factors in line with the trend in this region and the deleveraging process of the foreign banks since 2011 is another feature of the Romanian banking sector. So, the main risks that threatened the banking sector in 2015 were the high levels of non-performing loans, significant portion of foreign currency denominated loans and the deleveraging process which are all characteristic for the CEE region generally (EC, 2015a).

Likewise, regarding the **Slovakian banking sector**, it could be said that is very similar to the previously analyzed banking sector of the Czech Republic. In particular, its banking sector is also highly concentrated and dominated by foreign subsidiaries, but the lending activity is financed mostly through deposits denominated in the domestic currency alluding to the banking sector's limited dependence on the external funding. Besides, the general NPL ratio in Slovakia reached its peak of 5.25% in 2010 as a result of the effect of the global crisis and afterwards started to decline. For instance, it was relatively low in 2012 valuing around 4% (Skarica, 2013).

Furthermore, the **Serbian banking sector** numbered 30 banks in 2015, also it is characterized with high concentration and presence of foreign bank subsidiaries, especially Italian, Austrian and Greek subsidiaries holding 54.2% of the total banking assets. Again, the global crisis negatively impacted the banks' performance in Serbia. The ratio of the non-performing loans started to increase after the crisis, and then started to recover slightly until 2012 when again an increase in the ratio was recorded which can be observed in Figure 10 (National Bank of Serbia, 2015).



Source: National Bank of Serbia, *Banking Sector in Serbia: Second Quarter Report 2015*, p.16.

However, despite the high level of NPLs in 2015, more specifically around 22%, the credit growth actually rebounded in this year due to more favorable economic conditions and falling interest rates (Raiffeisen Bank Research, 2016).

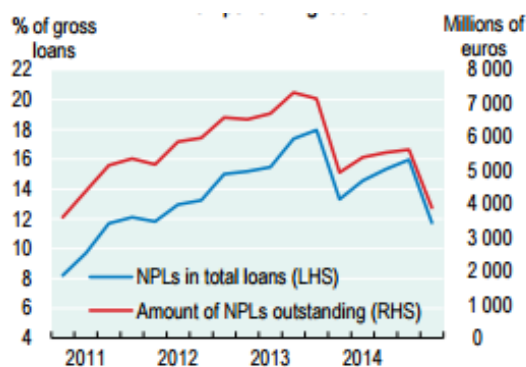
Last but not least, the **Slovenian banking sector** is also relatively small and dominated by foreign capital. Before the crisis, the sector was featured by extensive credit growth, loose credit standards and poor risk assessment which led to unsustainable debt in banks and corporate sector. Subsequently, the crisis deteriorated the economic activity and drastically increased the levels of NPLs especially in those banks owned by the state which left the banks poorly capitalized and incapable to provide further credit to the private sector affecting also the investment and overall consumption. The evolution of the capital adequacy and the NPL ratio can be observed in Figure 11 and Figure 12 respectively. Thus, the banking sector needed recapitalization and restructuring. So, two small private banks and the three largest



banks owned by the state (NLB<sup>2</sup>, Abanka and NKBM<sup>3</sup>) were recapitalized and also, the authorities committed to fully privatizing the last two banks. Consequently, NKBM was privatized and the bad assets of all the state-owned banks were transferred to Bank Asset Management Company (hereinafter: BAMC) in 2013 and 2014 (OECD, 2015).

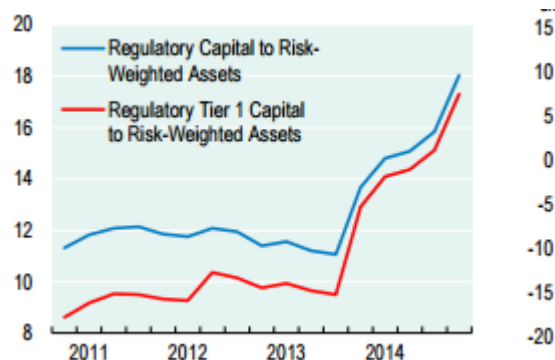
However, the restructuring stabilized the Slovenian banking sector and increased the level of provisioning and in 2015, the banks returned on the profitability track, adequate liquidity and increasing capital ratios. Although the NPL ratio started to decrease, it still remained at high levels in 2015 of around 16% compared to 17% and 20% in 2014 and 2013 accordingly. Still, the levels of NPLs were higher in the state-owned banks relative to the foreign-owned banks despite the sale of the bad assets to BAMC which is mainly due to new lending and poor quality loans outside Slovenia, mainly in the Balkan countries (EC, 2015b).

Figure 12. NPL Ratio in Slovenia



Source: OECD, *Economic Surveys Slovenia*, 2015, p.15.

Figure 11. Capital Requirements Ratio in Slovenia



Source: OECD, *Economic Surveys Slovenia*, 2015, p.15.

To sum up, each of the analyzed countries have similar features in general including the high foreign ownership, high share of loans denominated in foreign currency, deleveraging process and high levels of NPLs. Hence, the Czech Republic and Slovakia are the countries with lowest levels of NPLs and also, lowest share of foreign currency loans and Czech Republic demonstrated lowest general indebtedness as well. On the other hand, Latvia, Lithuania, Romania, Serbia and Montenegro recorded higher levels of non-performing loans and in the same time highest portion of loans issued in foreign currency (Skarica, 2013). Additionally, even after more than three years of the height of the financial crisis, the credit growth was still subdued in most of the CEE countries with exception of Poland which is the only country that avoided recession in 2009 (EBCI, 2012).

<sup>2</sup> NLB stands for *Nova Ljubljanska Banka* (New Bank of Ljubljana).

<sup>3</sup> NKBM stands for *Nova Kreditna Banka Maribor* (New Credit Bank of Maribor).

## **1.2 Credit Activity of Banks and NPLs' role**

This section includes the explanation of the way of functioning of the banking industry in general. More specifically, it focuses on describing the banks' main activities, especially on its credit activity, then mainly on the non-performing loans and its determinants.

### **1.2.1 Credit Activity of Banks**

First of all, a common definition of a bank indicates that bank is an institution that operates as a financial intermediary between borrowers and savers. In this sense, a bank represents a financial intermediary whose fundamental activity is to grant loans to borrowers and collect deposits from savers. Actually, their key role is to provide mechanism by which surplus funds are channeled to those people with deficit funds. In addition, the banking business can be generally classified into commercial and investment banking and non-interest Islamic banking practices (Casu, Girardone, & Molyneux, 2006).

Moreover, the core financial activity of the banks is of great essence in ensuring the smooth and efficient functioning of the financial system and the economy since banking plays such a crucial role in transferring and allocating funds to borrowers with productive investment opportunities and that is done through deposits which are sources of funds (Mishkin, 2007).

Furthermore, over the last 30 years banks have undergone to substantial change which transformed them to banks with full financial services. More specifically, banks have enlarged their narrow activities of lending and deposits' gathering to incorporating all aspects of financial services such as insurance, securities operations, pensions, leasing and so on. This extension of the banks' activities was a consequence of establishing and implementing new banking directives and regulations (Casu et al., 2006).

However, the main focus in this study is the credit activity of the commercial banks as their primary profit making activity. The income is generated through the credit activity in a way that this service is generally provided at a cost known as interest rate of the loan. Besides being the main source of income for the banks, loans also represent a way of increasing the money supply in the economy (Felix & Claudine, 2008). What is more, the banks typically issue loans to individuals, non-financial and financial companies. Furthermore, loans are the main part of the assets side of the banks' balance sheet. This means that a loan constitutes an asset for a bank since it provides earnings for the banks. On the other side, a loan represents a liability for the individual or corporation receiving the funds. Another thing about loans that make them so special is that they provide the highest return which the banks earn. The reason behind this is that the loans are typically less liquid than the other assets since their immediate conversion to cash is constrained by the maturity date of the loans. Additionally, loans imply the highest default risk due to the higher probability of default compared to the other assets of the banks. Moreover, in order to maximize their profits, banks must simultaneously obtain the highest return on the loans and securities, also reduce the risk as



much as possible and hold liquid assets to maintain the liquidity. What is of great importance, it is the decision of the bank officers for the good candidates who will made the interest and principal payment punctually. This means that all the banks must engage in screening activity in order to minimize the adverse selection of the candidates and in the same to not miss out the attractive lending opportunities that will lead to the highest profits. This screening process and other factors play the main role in the emergence of the non-performing loans which are in the center of this thesis and exactly those factors are being examined (Mishkin, 2007).

In addition, the major categories of loans are commercial loans (short-term loans to business), consumer loans, mortgage lending and real estate loans. Thus, the largest categories of loans for the commercial banks belong to the commercial loans and real-estate loans (Casu et al., 2006).

### **1.2.2 Non-performing Loans (NPLs)**

In general, non-performing loans are loans on which borrowers have failed to provide contractual payments for a pre-determined time. It should be noted that not all loans denoted as non-performing unavoidably lead to potential losses. In a case when there is adequate collateral in place, losses might be avoided and might not occur. So, non-performing loans do not signal necessarily loss for the banks. On the other hand, some loans might be lost even though they were not categorized as non-performing loans in the first place. Also, one limitation in relation with this special category of loans is that there is no universal definition for them meaning that not all the countries consider the same definition of non-performing loans. The precise standards and definitions can vary across countries depending on the sector involved as well. So, accordingly the IMF's report, a NPL is defined as:

“A loan is nonperforming when payments of interest and/or principal are past due by 90 days or more, or interest payments equal to 90 days or more have been capitalized, refinanced, or delayed by agreement, or payments are less than 90 days overdue, but there are other good reasons such as a debtor filing for bankruptcy to doubt that payments will be made in full" (IMF, 2005).

So, the non-performing loans negatively affect the capacity of the banks to provide new loans in a way that the banks lose their interest income from the NPLs which otherwise will be used for making profit and broaden the loan portfolio, in other words the resources are trapped in unproductive use. It is also clear that the NPLs induce greater uncertainty and influence the banks' willingness and capability of lending which will impact the aggregate demand and investments. So, these non-performing loans are of significant importance since they are one of the major causes of banks performance's difficulties and economic stagnation problems. Therefore, the banks have to maintain the level of non-performing loans as minimum as possible in order to be successful and profitable in the long run (EBCI, 2012).

Similarly, the European Banking Authority (hereinafter: EBA) has defined the non-performing exposures as following:

“Non-performing exposures are those that satisfy either or both of the following criteria:

- a) Material exposures which are more than 90 days past-due;
- b) the debtor is assessed as unlikely to pay its credit obligations in full without realization of collateral, regardless of the existence of any past-due amount or of the number of days past due”(EBA, 2014).

Also, the European Banking Authority indicates the NPLs as a problem at multiple levels: at a micro prudential level linked with lower profitability and efficiency, at a macro level associated with tied capital and at a households and corporations’ level. Besides, another cause for concern associated with the NPLs is the quality of their data. NPL data is difficult to interpret and compare across countries as a consequence of non-existing international accepted standards for NPLs measurement and supervisors’ difficulties to enforce NPLs reporting by banks in line with national rules (EBCI, 2012). Moreover, the scope of NPLs is expected to vary across countries as well. In accordance with EBA, each country’s economic, financial and legal conditions are likely to impact the banks’ credit quality to a great extent. Additionally, the structural characteristics of the local markets can be possible driver of the credit quality since the significant difference in the legal systems, duration of court proceedings and tax regimes can affect the bank’s capacity to handle the NPLs (EBA, 2016). In addition, the separate definitions of NPLs in some of the CEE countries according to a survey conducted in the past can be seen in Appendix B.

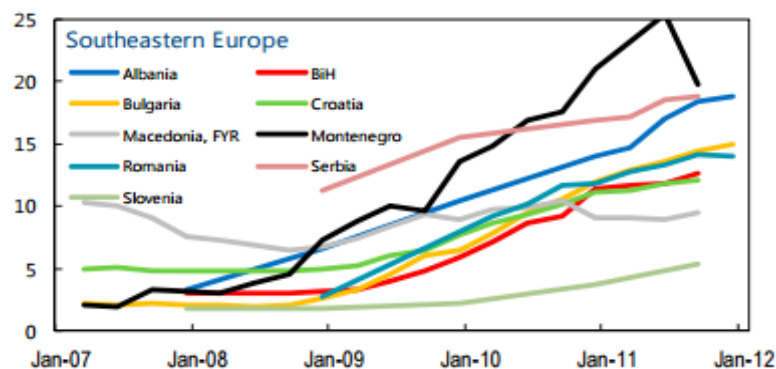
Furthermore, it is of general importance to outgrow the NPLs problem since unresolved NPLs can influence various parts of the macro economy and **financial stability**. Regarding the latter, non-performing loans can seriously threaten it in a way that robust levels of NPLs can lead to transparent losses which will disrupt the banks’ capital base and liquidity and subsequently the overall financial stability. Second, high and persistent NPL ratio could also reflect substantial economic issue of either general **over-indebtedness** of a country or either of individual overextended borrowers. This is actually associated with the issue whether the accelerated credit supply will hinder or support the economic recovery. More specifically, in a case of general debt overhang, further credit growth will only compound the debt and it will adversely influence the economic recovery. On the other hand, if the indebtedness is only light and the problem is in overextended borrowers, then the rising credit growth is more desirable. In the specific case of the CEE region which is focus in this paper, the over-indebtedness is not much of a problem when compared to the Western European Countries and therefore, the credit growth does not have necessarily to present a problem for the economic growth. However, there are some exceptions in this region (EBCI, 2012).

Third, the high NPL levels also represent a concern for the **economic recovery** in a way that banks burdened with NPLs could not be capable of issuing fresh credit or the overextended borrowers could not be able to invest, so the assets will be caught in unproductive uses as mentioned before. Moreover, the non-performing loans can also influence the credit supply due to the psychological effects of the lenders to be unwilling to issue new loans when they

are saddled with old loans and also, it can be impacted through several mechanisms. First, there is empirical positive relationship between the NPLs and the banks' **funding costs**. The justification behind this relationship is that as the NPLs increase in the loan portfolio they increase the uncertainty about the capitalization of the banks and whether the provisions will be adequate for the loan loss. Therefore, the risk premium on the funding increases which is reflected through the lending rates and consequently the credit supply falls. Second, the NPLs can also affect the credit supply through banks' **efficiency**. More specifically, as proxy for the efficiency of the banks is used the interest margin and there is clearly positive relationship between the interest margins and levels of NPLs. There are two possible reasons behind this, the first one involves that the increasing interest margins might signal the banks' efforts to manage with the NPLs or on the other hand, banks might increase interest margins in order to recover some of the loan losses. Either way, the increasing interest margins negatively affect the credit supply. Lastly, the rising NPLs could also impact the credit supply through the **capital** in a way when NPLs increase, the provisions should also be increased and consequently the banks' income and capital would be lower. The lower capital in return reduces the ability of the banks to issue more loans and the final consequence would be the lower credit supply (EBCI, 2012).

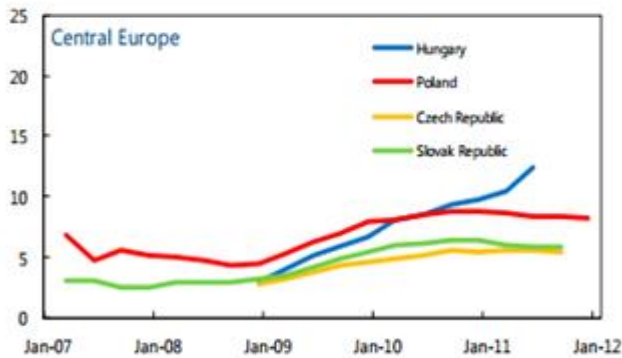
However, the general credit quality of the loan portfolios remained relatively stable until the financial crisis hit the global economy in 2008. The predictable part of financial crisis and times of financial distress is the growth of non-performing loans. So, the Central and Eastern European Region, the region of main interest in this paper, represents a special case in terms of the non-performing loans. More specifically, after the global financial crisis hit this region, the ratio of NPLs increased from around 3% before the crisis and remained above 11% at the end of 2011 on average. In some countries as Latvia, Montenegro and Lithuania, the NPLs ratio reached even 20% after the crisis. Predictably, more sensitive to the increase of non-performing loans were those countries with the largest economic drop (EBCI, 2012). According to World Bank data, the NPL ratio more than doubled in the period between 2009 and 2014. Yet, the high level of NPLs is not the problematic part, but the concern is the strong persistence of NPLs which makes this situation unusual (Balgova & Plekhanov, 2016). The levels of NPLs in all the countries combined together can be observed in Figure 13, Figure 14 and Figure 15 below.

Figure 13. NPL Ratio (%) in SEE



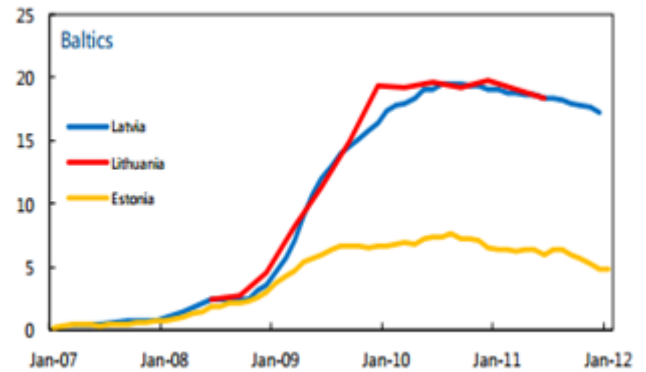
Source: EBCI, *Working Groups on NPLs in Central, Eastern and Southeastern Europe*, 2012, p. 12.

Figure 15. NPL Ratio (%) in Central Europe



Source: EBCI, *Working Groups on NPLs in Central, Eastern and Southeastern Europe*, 2012, p. 12.

Figure 14. NPL Ratio (%) in the Baltics



Source: EBCI, *Working Groups on NPLs in Central, Eastern and Southeastern Europe*, 2012, p. 12.

### 1.2.3 Determinants of NPLs

#### 1.2.3.1 Bank-specific Factors

The effects of the bank-specific factors in the performance of NPLs are being increasingly studied by the academics nowadays. The bank-specific factors are the factors that make every bank unique and these factors actually differentiate the banks from one another indicating the performance and success of the individual banks. They include the bank's profitability, solvency, liquidity, capital adequacy, risk management, efficiency, bank size, ownership and so forth.

Thus, numerous bank-specific factors have been examined as determinants of NPLs in the past few years. To begin with, the **profitability ratios**, return on assets and return on equity (hereinafter: ROE), are the most common factors whose effect on the NPLs has been explored. The vast majority of the literature has observed negative impact of the profitability ratios and the NPLs meaning that highly profitable banks have less incentive to engage in riskier activities which could lead to decline of non-performing loans and vice versa (Makri et al., 2014). Such studies include Makri et al. (2014) and Messai and Jouini (2014), Selma and Jouini (2013), Cotugno, Stefanelli, and Torluccio (2013), Louzis, Vouldis, and Metaxas (2010) and so on.

Moreover, the **solvency ratio** defined as the ratio of total equity to total assets can also influence the NPLs positively or negatively. In most of studies there is negative relationship such as in the studies of Berger and DeYoung (1997) and Salas and Saurina (2002). Similarly, Makri et al. (2014) and Espinoza and Prasad (2010) have also found negative correlation between the **capital adequacy** and the NPLs. The explanation behind these findings can be that less capitalized banks response to moral hazard incentives by increasing

the riskiness of their loan portfolio and consequently that can influence the rise of the NPLs (Salas & Saurina, 2002). This “**moral hazard**” hypothesis about negative relationship between capital and NPLs was suggested by Keeton and Morris (1987). However, there are also studies that found positive relationship between the aforementioned factors with the rationale that highly capitalized banks can have more incentives to engage in high-risk activities (Constant & Ngomsi, 2012).

Furthermore, the results of Berger and DeYoung (1997) have shown two-way causality between NPLs and the bank-specific factor cost efficiency. So, they suggest the hypothesis “**bad luck**” for the causality from the NPLs to cost efficiency and the “**bad management**” hypothesis for the effect of the cost efficiency on NPLs. In particular, the first hypothesis is explained mainly by the weaker macroeconomic conditions while the second hypothesis indicates that low cost efficiency signals poor management practices and inadequate monitoring and underwriting process which lead to rise of NPLs. This negative correlation is also confirmed by Williams (2004), Podpiera and Weil (2008) and Louzis et al. (2010). Alternatively, high cost efficiency might indicate lower resources allocated to the monitoring, underwriting and controlling process and again, it will lead to increase in NPLs. This rationalization is packed in the “**skimping**” hypothesis (Berger & DeYoung, 1997). Such findings are also observed in the study of Rossi, Schwaiger, and Winkler (2005).

Another bank-specific factor that has proven to influence the volume of NPLs is the **excess lending** that will eventually absorb high loan losses. This was argued in the studies of Keeton and Morris (1987), Salas and Saurina (2002) and Jimenez and Saurina (2005). Finally, the **bank size** also can play important role in the shaping of the NPLs in a way that large-size banks are capable of extending their loan portfolio and take on more risky activities signaling positive correlation with the NPLs. Stern and Feldman (2004) also found the same result for bank size. On the other hand, Salas and Saurina (2002) found negative relationship between the aforementioned factors arguing that larger banks can exploit the diversification of the loan portfolio and subsequently lower the risk.

However, besides the many possible scenarios for bank-specific factors impacting the NPLs, I have decided to proceed with the research with the capital adequacy, ROA, loans to deposits ratio, inefficiency ratio and bank’s ownership as potential determinants of the NPLs.

#### 1.2.3.2 Macroeconomic Factors

The performance of NPLs cannot be solely determined by bank-specific factors. Therefore, there is significant evidence of the macroeconomic factors’ impact especially signaling the **anti-cyclical behavior of NPLs**. This actually implies that when the economy is booming, the GDP is higher and the unemployment decreases, then the NPLs fall due to enhancement of the debt-servicing capacity of the borrowers. On the contrary, economic slowdown cause higher unemployment and lower cash flows to timely repay the outstanding debt. These

arguments have been confirmed with the studies of Salas and Saurina (2002), Rajan and Dhal (2003), Fofack (2005) and Jimenez and Saurina (2005).

Another crucial macroeconomic factor affecting the levels of NPLs can be the **exchange rate**, its appreciation and depreciation. In other words, the depreciation of the exchange rate might have negative impact on banks' assets, especially in countries where a very common thing is issuing loans in foreign currencies to debtors that do not practice hedging strategies to lower the risk. Also, the **interest rate** plays major role in the shaping of the NPLs in a way that increase in interest rate automatically make the outstanding loans more difficult for repayments especially for those loans with floating instead of fixed interest rate. This negative relationship between the exchange rate and NPLs and positive relationship between the interest rate and NPLs have also been found in the study of Louzis et al. (2010).

What is more, the **inflation** is another common macroeconomic factor that has been investigated, particularly because of the unclear and ambiguous evidence generated. Thus, hike in the inflation rate can mean decrease of the real value of the outstanding loans and hence make them easier for servicing. On the other hand, higher inflation can also allude to decrease in the real income in the long-run and therefore, leaving the debtors with smaller amount of funds for repaying the debt. So, it is really important to determine whether you are researching for the short or long-run. Additionally, higher inflation can also cause higher interest rates as a result of the monetary policies of the Central Banks in order to tackle the inflation (Klein, 2015). Accordingly, Skarica (2013), Us (2016), Fofack (2005), Klein (2015) and Rinati and Sanchis-Arellano (2006) suggest positive correlation between inflation and NPLs while Shu (2002) has proven negative impact of the inflation rate.

Lastly, the **share price indices** have also been examined as factors influencing the NPLs but it actually depends to a large extend on the size of the stock market capitalization of the countries. In this sense, in countries with large stock market capitalization, drop in the share price indices can significantly contribute to rise in NPLs. This was also confirmed by Beck, Jakubik, and Pilou (2013) who studied relatively large markets. Conversely, countries with small stock market capitalization do not show significant relationship between the macroeconomic and financial indicators and the stock market indices. This is the case of the countries of the CEE region and statistically insignificant results were also observed in the study of Skarica (2013).

Nevertheless, this master thesis focuses on the following macroeconomic factors as possible determinants of NPLs: GDP, inflation rate, unemployment rate, public debt and government budget surplus or deficit.

## **2 EMPIRICAL LITERATURE REVIEW**

There is rich literature associated with this subject for the determinants of the non-performing loans for different time periods, pre-crisis and post-crisis, and also for different regions

varying from single country studies to various regions studies. Firstly, the review of the single country studies is presented further in this chapter and later, the cross-country studies.

## **2.1 Single Country Studies**

First, one of the earliest empirical studies regarding the causes of loan loss variation was done by Keaton and Morris (1987) on a sample of 2,500 USA banks. The results of this study indicated that the majority of the diversity in the loan losses belonged to macroeconomic factors or more specifically due to diverse economic conditions and different performance of different industries, particularly agriculture and energy. On the other hand, only small part of loan loss variation was a consequence of the bank-specific factors such as the tendency for the banks to issue loans even though they are aware of the high-probability default rate and therefore, purposely engaging in high-risk activities.

Also, Gambera (2000) observed that good predictors of problem loans ratios can often be represented by specific national and regional macroeconomic variables. The objective of this study was the link between the asset quality of banks and macroeconomic dynamics analyzed through quarterly US data and utilizing the Vector Autoregression (hereinafter: VAR) methodology.

Similarly, quarterly data and VAR methodology was also used by Hoggarth, Logan, and Zicchino (2005) who conducted a study for United Kingdom in order to examine the relationship between some specific macroeconomic variables and the write-offs to loans ratio. They enriched the existing literature with evidence signaling to the inflation rate and interest rate as having significant impact on the loan portfolios in the UK. Next, the levels of NPLs in Spain were researched by Saurina (2002) through examining the Spanish commercial and savings banks and considering both bank-specific and macroeconomic factors as determinants of NPLs. The results suggest that the credit risk in Spain is mostly explained by the following factors: market power, capital adequacy, portfolio composition, net interest margin, size, inefficiency, rapid past credit expansion, GDP growth rate and indebtedness. In addition, Saurina together with Jimenez presented extended version of the previously mentioned research paper in 2006. They discovered that economic boom in Spain and decline in the interest rates can eventually lead to improvement in the non-performing loans.

Furthermore, Louzis et al. (2011) conducted a study for the determinants of the NPLs in Greece taking into account both macroeconomic and bank-level factors. What should be also noted is that they examined the determinants separately for three loans categories: consumer, business and mortgage loans. These findings clearly indicated that the non-performing loans were in the examined period mostly shaped by macroeconomic factors including GDP growth, unemployment rate, interest rate and public debt, and additionally the management quality of the bank-level factors. Another European country investigated in 2001 was Austria by Arpa et al. (2001) observing the risk provisions in the loans of the Austrian banking sector

as a whole. The regression analysis in this study suggested that the NPLs in Austria depend on the GDP growth, inflation, real interest rate and real estate inflation.

Another single country study is carried out by Shu (2002) regarding the NPL ratio in Hong Kong. The outcome of the regression analysis implied that the number of bankruptcies and increase of the nominal interest rates positively influence the NPL ratio while the acceleration of economic growth, higher inflation and property price inflation negatively affect the NPL ratio. Likewise, Quagliariello (2003) has researched the NPL ratio as dependent variable and various variables as independent and explanatory variables including different macroeconomic factors such as real GDP growth rate, inflation rate, change in unemployment, M2 growth rate, real exchange rate and growth change in gross fixed investment and consumption. However, the analysis was conducted for the Italian economy and the results signaled that in a case of slowdown in the economy meaning falling GDP and increasing unemployment, the NPL ratio increases.

What is more, Ahmed and Bashir (2013) conducted two studies, one regarding the macroeconomic factors and one associated with bank-specific factors as determinants of NPLs. In the first study, they included 34 banks from Pakistan from 1990 to 2011. The results of the first study showed statistically significant and negative relationship between the lending rate and GDP growth with the NPL ratio. In the same way, they also analyzed the bank-specific factors only for the period from 2006 to 2011 and they observed significant positive impact of ROA on the NPLs, but on the other hand insignificant impact of ROE on NPLs. Another attractive result was obtained by Louzis et al. (2010) who evaluated the factors impacting the NPL ratio in the Greek banking sector. This study actually observed negative statistically significant effect of both ROA and ROE on the NPL ratio while it showed positive correlation between the inflation and lending rate with the NPL ratio.

Lastly, a more recent study was conducted for the determinants of the non-performing loans in the Turkish Banking Sector by Us (2016). He actually covered quarterly data for 21 deposit banks from Turkey and the analysis was conducted two times, for the pre crisis period from 2002-2008 and for the post-crisis period from 2008 to 2015. Due to the dynamic nature of the data, Generalized Method of Moments (hereinafter: GMM) was utilized in order to obtain the estimation results. So, it was found that some of the results were changed after the Turkish economy was hit by the global crisis. In particular, the GDP growth is only significant after the crisis whereas the capital adequacy ratio, bank size and inefficiency show statistical significance only in the pre crisis period. Meanwhile, the exchange, inflation and lending rate indicate statistical significance in both periods, while the policy rate did not imply statistical significance at all. The conclusion according to Us (2016) involves that the non-performing loans before the crisis are mostly affected by the banking reform in the Turkish banking sector, whereas the NPL dynamics in the post-crisis period seems to be mostly shaped by the factors influencing the macroeconomic conditions.



## 2.2 Cross-Country Studies

Secondly, there is also a vast literature of cross-country studies which include examining the shaping the non-performing loans in a specific region or specific countries. So to begin with the studies containing the region which is also examined in this paper and that is the Central and Eastern European region. First, one substantial study for the determinants of the NPLs in the CEE region is conducted by Skarica (2013). The study included only 7 countries from this region and that for the period from 2007 to 2011. However, the researcher utilized the fixed effects regression model which gave the similar result as the other studies. More specifically, the study observed significant negative relationship between the GDP growth and the NPL ratio while positive significant relationship between the inflation rate and unemployment with the non-performing loans.

Moreover, Klein (2013) also researched this region, but including South Eastern Europe as well. So, this study covers data for 10 banks from 16 countries from the CESEE region and for the period 1998-2011. Thus, the panel data covered in the study was analyzed with the dynamic panel model and fixed effects regression model using the macroeconomic factors GDP growth, inflation rate, unemployment and loan growth rate as explanatory variables. Subsequently, the analysis demonstrated again positive impact of the inflation rate on NPL ratio and also, for the loan growth rate, and negative influence of the GDP growth rate. Nevertheless, no significant effect was found for the unemployment rate.

Furthermore, the Eurozone region was also examined exclusively for the pre-crisis period from 2000-2008 and for 14 countries out of sample of 17 Eurozone countries. The study was performed by Makri et al. (2014) incorporating both macroeconomic and bank-specific factors. For the estimation of the results, the Difference GMM was utilized. The findings of this study implied that the profitability ratios, ROA and ROE, and the GDP growth have negative impact on the NPL ratio whereas unemployment, lending and inflation rate have positive significant influence on the shaping of non-performing loans.

Also, Italy, Greece and Spain were analyzed separately regarding the levels of NPLs in the study carried out by Selma and Jouini (2013). Namely, the study is focused on the determinants of NPLs throughout the period from of 2004-2008 and for a sample of 85 banks. The factors investigated in this study are also divided into macroeconomic factors including the GDP growth rate, unemployment rate and real interest rate, and bank-specific factors incorporating the return on assets, loan loss reserves to total loans ratio and loan growth. The fixed effects regression model suggested that there is positive relationship of the unemployment rate, real interest rate and the loan loss reserves ratio with the NPLs. On the other hand, the results indicated significant negative impact of the GDP growth rate and ROA on the shaping of the non-performing loans.

Additionally, another study is the study of Boudriga, Taktak, and Jellouli (2010) with the title “Bank specific, business and institutional environment determinants of banks nonperforming loans: evidence from MENA<sup>4</sup> countries”. The authors investigated the problem loans in 46

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<sup>4</sup> MENA stands for Middle East and North Africa region.

countries across the period from 2002-2006. The fixed effects panel regression model presented results which indicate that capital adequacy and ROA have statistically significant influence on the problem loans in this region.

Also, the Espinoza and Prasad (2010) is another empirical regional research on this topic in the Gulf Cooperation Council (GCC). This study involves panel data analyzed with three alternative estimation methods: fixed effects, Difference and System GMM model. The study found strong significant inverse relationship between the GDP growth rate and NPL ratio. In addition, the study also implied strong, but short-lived feedback effect on the real economy which was estimated employing VAR methodology.

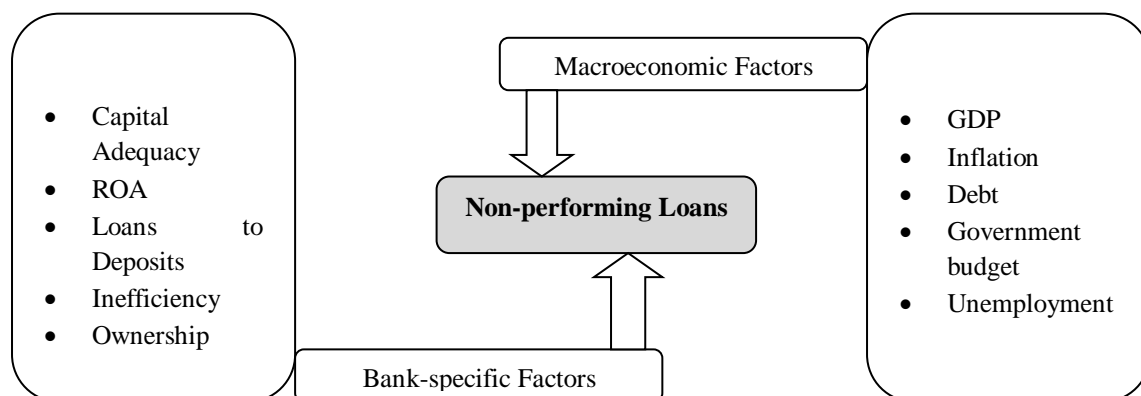
Last but not least, Constant and Ngomsi (2012) investigated the determinants of non-performing loans in the Central African Economic and Monetary Community (CEMAC). They used panel data for sample of 35 commercial banks from six African countries over the period from 2001-2010. The study actually focused on several bank-specific and macroeconomic factors' effect on the NPLs. It was found that capital adequacy ratio negatively impacts the non-performing loans whereas the inflation rate did not prove any significant influence on the non-performing loans.

### 3 EMPIRICAL ANALYSIS

#### 3.1 Conceptual Framework

As it was pointed out several times before, the purpose of this paper is to determine to factors mostly shaping the non-performing loans in the Central and Eastern Europe. Accordingly, it can be summarized a conceptual framework consisting of the dependant variable or the focus of this paper which is the non-performing loans ratio and both the bank-specific and macroeconomic factors. The first group of factors include: capital adequacy, ROA, loans to deposit ratio, inefficiency and banks' ownership. Secondly, macroeconomic factors incorporate: GDP, inflation rate, public debt, government budget and unemployment rate. The summarized conceptual framework can be seen in the Figure 16 below.

Figure 16. Conceptual Framework



### **3.2 Research Design and Approach**

The main purpose of every research is to obtain knowledge and extend the understanding, to collect facts and evidence and interpret them in order to build a picture of the research problem to the world. So, the master plan identifying the research methods and gathering procedure is called a research design (Creswell, 2007). There are numerous types of research designs and their choice depends on the nature of the researchers' objectives which they aim to achieve.

One type of research design included in the Walliman's proposed list of common research designs is the correlation type which is used to examine the relationship between two concepts. Actually, that association can be influential with some kind of influence of one on the other and causal relationship or the "cause and effect" relationship as noted by Walliman (2010). In fact, the cause is called "independent variable" and the affected variable is referred to as the "dependent variable". Therefore, since the aim of this research is to examine the cause and effect relationship between the non-performing loans and their determinants, it belongs to the group of studies with correlation design.

Moreover, another thing that has to be specified is the research approach or the specific research methods with which the data will be efficiently gathered and analyzed and produce the outcomes aimed at. In this case, the research approach is quantitative which means that the factors being examined affect the outcome through numeric values, in this case the factors impact the non-performing loans positively or negatively (Creswell, 2003).

### **3.3 Scope of Sample Data and Data Analysis**

Firstly, as a type of data for empirical analysis in this study is used panel data in which the cross-section units are surveyed over time. In other words, it contains space as well as time dimensions. More specifically, this panel covers appropriate data for 98 banks from 15 countries from the period from 2008 to 2015. Moreover, the choice of panel data is due to its ability to enrich the empirical analysis in a way that might not be possible with only cross-section or time series data. Thus, panel data is better suited to study the dynamics of change and it gives "more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency." One advantage of using panel data is the considerable increase of sample size. And it also enables us to study more complicated behavioral models (Gujarati, 2009).

Secondly, this research utilizes secondary data which was obtained from various sources. Actually, secondary data means that it has been collected and analyzed by someone else and it can be published or unpublished (Kothari, 2004). So, the dataset used in this study consists of bank-specific data obtained from Bankscope database and the audited financial statements of the concerned banks from the Central and Eastern European countries. Also, it includes macroeconomic data acquired from the Central Banks of each CEE country, World Bank and each state's statistical agencies. The specific countries involved into this research are the

following: Bulgaria, Bosnia and Herzegovina, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia. For the complete list of the 98 banks included in the analysis see Appendix C.

Subsequently, the collected data was divided into subcategories individually for every bank included across the time period from 2008-2015, then it was classified, checked and entered into excel program's spreadsheet in order to prepare it for data analysis. Finally, the data is processed and analyzed using the program STATA 13 through descriptive analysis including the descriptive statistics<sup>5</sup> of the variables under investigation and through employing three alternative estimation techniques. First, the fixed effects (hereinafter: FE) model is taken into account which considers the heterogeneity across banks by allowing variables intercepts, then random effects model and also two tests are applied in order to determine the choice of these two techniques. Next, the Difference GMM with instrumental variables for dynamic panel data is utilized and additionally, the lagged version of the dependent variable is taken into the estimation in order to examine the persistence of the NPLs. Finally, the System GMM is also implemented into STATA, so we can compare the coefficients of the variables obtained from the different methods. The last two methods are applied in order to also investigate the persistence of the NPLs, otherwise with the lagged dependant variables included in the FE model might lead to biased and inconsistent results. However, all the estimation techniques mentioned above are more thoroughly clarified in the next chapter.

### 3.4 Model Specification

As mentioned before, the main objective of this study is to examine the bank-specific and macroeconomic factors on the volume of non-performing loans. For that reason, a precise econometric model is developed incorporating all the widely recognized variables mentioned above. Also, the model is summarized in accordance with the existing models in the vast literature and the variables involved are also supported by substantial empirical evidence.

In general, the following econometric model is developed:

$$NPL_{i,t} = \alpha_0 + \gamma_0 NPL_{i,t-1} + \beta_1 CAR_{i,t} + \beta_2 ROA_{i,t} + \beta_3 LTD_{i,t} + \beta_4 INEF_{i,t} + \beta_5 OWN + \beta_6 GDP_{i,t} + \beta_7 INF_{i,t} + \beta_8 DEBT_{i,t} + \beta_9 FISCAL_{i,t} + \beta_{10} UNEM_{i,t} + \varepsilon_{i,t} \quad (1)$$

To be more specific:

- $NPL_{i,t}$  is the dependent variable for bank  $i$  in year  $t$ ;
- $i$  takes the values from 1 to 98 and  $t$  from 2008 to 2015
- $\alpha_0$  is the intercept;
- $\gamma_0$  is the coefficient of the lagged dependent variable which was incorporated into the model in order to examine the persistence of non-performing loans;

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<sup>5</sup> Mean, standard deviation, minimum and maximum values of the concerned variables.

- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$ , are the coefficients of the Capital Adequacy Ratio, Return on Assets, Loans to Deposit Ratio, Inefficiency Ratio, Dummy Variable for ownership, GDP, Inflation, Public Debt, Fiscal and Unemployment Rate respectively;
- These coefficients and their significance and signs imply their effect and its extent on the dependent variable;
- $\varepsilon_{i,t}$  denotes the error term (disturbance term) for unintentionally or intentionally omitted and added variables with zero mean and constant variance;
- In order to obtain deeper insight into the relevance of the explanatory variables, their coefficients are estimated by employing three estimation techniques: **Fixed Effects Model** (without the variable  $NPL_{t-1}$  from equation (1), since it can lead to inconsistent results), **Difference GMM** and **System GMM**, also the necessary relevant tests which will be explained more specifically further in the paper.

### 3.5 Description of Variables

The key variable in this analysis is the non-performing loans ratio calculated as the percentage of non-performing loans of the gross loans. It is essentially considered as the dependent variable which is possibly affected by the explanatory study variables. Hence, the independent variables are divided into two subcategories: bank-specific variables and macroeconomic variables. So, the first subcategory incorporates the following variables: Capital Adequacy Ratio, ROA, Loans to Deposit Ratios and the Inefficiency Ratio, while the macroeconomic group contains the Annual GDP Growth, Inflation, Public Debt, Unemployment Rate and Government Budget surplus/deficit. Additionally, a dummy variable is integrated into the model in order to capture the effect of the bank's ownership on the NPLs.

#### 3.5.1 Dependent Variable

The dependent variable is the ratio of NPLs to total (gross) loans. At the most general level, a non-performing loan is a loan for which the borrower is not making the repayments according to the contractual commitments. So, any loan that is outstanding in terms of paying principal and interest contrary to the obligations indicated in the loan agreement is commonly considered as NPL (Bholat, Lastra, & Markose, 2016). Also, the level of NPLs in the banks' balance sheet reflects the quality of the banks' assets and it is one of the most common indicators of identifying credit risk (Makri et al., 2014).

However, no precise and internationally accepted definition of NPLs exists. This implies that the precise classifications of the NPLs vary across different countries. Yet, the most commonly used definition which was outlined by the Basel Committee on Banking Supervision, specifies that these non-performing loans should include all loans that are 90 days overdue. In spite of that, countries report their statistics differently in a way that some include all the loans which are 31 days past due, some countries take into account 61 days

past due and some do not meet the terms of the international standards at all. Furthermore, besides the overdue days of the NPLs, there are other features that might distinct the definitions of NPLs across countries. For instance, one feature is whether the banks report these loans in gross terms or as net of provisions. Moreover, some countries as Romania for example, might include other elements in the NPLs' definition such as the financial performance of the borrower and the existence of judicial procedure. Also, the collaterals and guarantees represent another important difference amongst definitions since in some countries they are not taken into consideration in the classification processes. Therefore, taking into account all the previously mentioned disparities, the comparison of the volume of NPLs across different countries and regions should be cautiously interpreted (Beck et al., 2013).

Besides, the NPLs ratio is measured by the amount of NPLs to the gross loans. The majority of the data for the dependent variable in this study was obtained from Bankscope database. Additionally, the missing data was carefully extracted by each bank's financial statements and annual reports whether already included as computed ratio or manually calculating it considering all gross loans 90 days overdue.

### **3.5.2 Independent Variables**

As mentioned before, the independent variables are the explanatory variables that impact the dependents variables and they are classified into two subcategories. In addition, the concise calculation of the independent variables can be found in Appendix E.

#### **3.5.2.1 Bank-Specific Variables**

- ***Capital Adequacy Ratio***

One of the examined bank-specific factors is the capital adequacy ratio (hereinafter: CAR). In general, all banks are legally obliged to uphold adequate capital funds in order to maintain resources for cases of possible future losses on assets. It is actually a measure of the amount of bank's capital expressed as a percentage of its risk-weighted assets and it captures the risk that the bank can undertake (Us, 2016).

However, despite their extensive usage in similar studies, there is ambiguous evidence about their impact on the non-performing loans, whether they affect them positively or negatively (Makri et al., 2014). The point is that banks with lower capital adequacy ratios have higher risk exposure which might lead to increase in these loans (Salas & Saurina, 2002). This negative relationship was confirmed by Makri et al. (2014) and Espinoza and Prasad (2010) as well. On the other hand, the banks with higher levels of NPLs might enlarge their capital as a result of mitigating their credit risk. Another thing is that higher capital can encourage banks to engage in riskier activities and consequently deteriorate their credit portfolio

(Ahmad & Ariff, 2007; Us, 2016). For instance, Constant and Ngomsi (2012) found positive association between CAR and NPLs in line with the previously mentioned argument.

- ***Profitability Ratio - ROA***

The effect of profitability ratio on NPLs is also investigated including the Return on Assets. The vast majority of the literature demonstrates negative correlation between the aforementioned ratio and the banks' non-performing loans. The main argument behind this evidence is that the profitability is linked to the risk-taking behavior of banks. This essentially means that highly profitable banks have less incentive to generate income and to engage in risky activities such as issuing risky loans. Alternatively, bad management can also play a role in the negative relationship since it could lead to higher-risk activities and weaker performance (Makri et al., 2014).

So, **ROA** is linked to the extent of efficient utilization of banks' assets to generate higher profits. In fact, it is measured as the ratio of the net profit and banks' average total assets. Various research papers illustrate distinctive results of this correlation. However, the majority of studies show negative relationship between NPLs and ROA justifying that deterioration of the profitability leads to greater risk-taking activities and higher level of NPLs. Such studies include Makri et al. (2014) and Messai and Jouini (2014). Selma and Jouini (2013), Cotugno et al. (2013) and Louzis et al. (2010) also identified negative correlation. Therefore, we expect negative sign of this explanatory variable.

- ***Loans to Deposit Ratio (LTD)***

This study also includes the Loans to Deposits Ratio (hereinafter: LTD) and its influence on NPLs. Thus, this index is the ratio between banks' total loans and total deposits and it points out the liquidity of the banks. More specifically, it indicates how efficiently the bank has utilized the customer deposits into credit loans (Makri et al., 2014). A high LTD ratio might imply nonsufficient liquidity for covering unexpected claims in the future and on the other hand, the bank generates more income. Conversely, a low LTD ratio might mean that the bank could be earning much more that it does since it does not utilize its assets enough to generate income and also, the bank is at lower risk (Rengasamy, 2014). However, some empirical evidence suggests that this ratio might influence the NPLs and according to Louzis et al. (2010) and Misra and Dhal (2010), there is positive relationship between LTD Ratio and Non-Performing Loans. The possible clarification for this kind of relationship is that as the number of issued loans increases, the probability for the default of those loans increases as well. Therefore, we predict positive sign of the abovementioned independent variable.

- ***Inefficiency***

The impact of inefficiency on NPLs is included in this research paper as well and the inefficiency of banks is captured through other operating expenses to banks' average total assets. Generally, the research papers investigating the inefficiency discovered significant and positive impact on the credit portfolio especially on the non-performing loans. Nonetheless, the rationalization behind this relationship might be that NPLs may arise due to poor credit underwriting, inadequate monitoring and cost control which on the other hand are consequence of higher inefficiency. Therefore, higher inefficiency may result in higher NPL ratio indicating their positive relationship. This justification is in line with the findings of Williams (2004) and Espinoza and Prasad (2010). Conversely, another possible case is when lower inefficiency may mean higher cost efficiency which indicates fewer resources distributed to risk monitoring and consequently, rise in NPLs may appear (Us, 2016).

### 3.5.2.2 Macroeconomic Variables

- ***Annual GDP Growth***

In this study, also the connection between country's macroeconomic conditions and the NPLs is examined and one of those macroeconomic factors is the annual growth of GDP. The macroeconomic factors are increasingly linked with the soundness of the banking system especially since the global crisis. However, as a common finding of the vast majority of the studies on this subject is that when there is slowdown in the economy, a rise in the non-performing loans can be noticed (Skarica, 2013). Therefore, we anticipate strong negative relationship between the GDP growth and the non-performing loans. The reasonable explanation behind this relationship is that when the economy is growing and the income of the borrowers is increasing, the debt servicing capacity improves and the overall financial stability as well (Us, 2016). Accordingly, all the empirical evidence related with this correlation suggests strong significant and adverse relationship between these two variables. Such examples are: Makri et al. (2014), Skarica (2013), Us (2016), Fofack (2005) and Salas and Saurina (2002). In addition, the data for this variable was extracted from each country's Central Bank.

- ***Inflation Rate***

Moreover, another macroeconomic factor of great essence is the inflation and as its proxy is used the change in Consumer Price Index (hereinafter: CPI) on annual basis. Accordingly, the data was obtained from the Central Banks. However, there is strong evidence that the inflation might impact the level of NPLs, yet the results of the exact relationship are ambiguous since there is evidence for positive as much for negative relationship. Firstly, increasing inflation might spread the non-performing loans in the loan portfolios since it



could shrink the real income and hence affecting the debt-servicing capacity of the borrowers. Also, high inflation can also have an effect on the nominal interest rates and again weaken the servicing of debt. In addition, it is worth mentioning the short-run relationship between inflation and NPLs. More specifically, higher inflation can reduce the available funds for paying back the outstanding loans if the income does not move in line with the inflation, yet the costs would be higher leading to the positive correlation between NPLs and inflation (Skarica, 2013). This kind of reasoning is aligned with Skarica (2013), Us (2016), Fofack (2005), Klein (2015) and Rinati and Sanchis-Arellano (2006), who suggest the inflation's positive impact on NPLs. On the other hand, there is also evidence of reverse relation when higher inflation influences the real value of the outstanding debt facilitating their repayment and thus diminishing the levels of NPLs (Us, 2016). So, this kind of negative relationship between these two variables is observed by Shu (2002). All in all, we do not expect precisely clear results for this relationship.

- ***Public Finance Variables***

Recently, since the crisis firstly affected the economy in general, afterwards the fiscal indices and finally extended to the banking system, it is of great interest to also investigate the effect of the public finance indicators on the loan portfolio quality. Therefore, in the model are also added the public debt variable and the fiscal variable.

Firstly, **public debt** or in other words the government debt is the debt owed by the central government. It is actually a form of financial obligation incurred by the government or the borrowings and repayments. Also, it is usually in negative correlation with the government budget since in the most cases the public debt is increased by the government in order to meet up the government budget deficit. In the data collected, it is expressed as percentage of the GDP and collected by each country's Central Bank and World Bank database. However, in terms of the relationship between the level of NPLs and the public debt we anticipate positive relationship since deterioration in the public finances or additional increase in the public debt can influence the credit ratings of the government and consequently the banks' liquidity. More specifically, the banks tend to invest their liquidity reserves in government securities and with the deterioration of the government credit rating, the rating of the government securities is also affected and in that way, banks continue their operation under the liquidity pressure. So, the need of dealing with the liquidity pressure limits the banks' placement of loans and subsequently, the debtors cannot renew their loans which can cause an increasing trend in the level of NPLs (Reinhart & Rogoff, 2010). Therefore, we anticipate positive sign of the variable public debt in accordance with the study Makri et al. (2014) as well.

Secondly, in the research is also considered the **fiscal variable** which actually represents the government budget surplus or government budget deficit exhibited as percentage of GDP. In general, a country has surplus in its budget in a case when government revenues exceed government expenditures and vice versa for the government budget deficit. Thus, surplus can indicate increase in taxes or decrease in government expenditures or both at the same time

while deficit implies decrease in taxes and rise of government expenditures or both in the same time (Hyde, 2002). Hence, the relationship between the government's fiscal position and the level of non-performing loans is not quite clear due to two reasons. First, higher government surplus can be positively correlated with the level of NPLs since it signals restrictive fiscal position which involves increasing taxes or decreasing government spending. On the other hand, higher government surplus can also be negatively related with the level of NPLs due to the reason that it can indicate better fiscal position of the country, reduced risk, cheaper financing and also, the people's expectations about a sustainable fiscal position are improved (Makri et al., 2014). However, this kind of reasoning is in line with the studies of Makri et al. (2014) and Dimitrios, Helen, and Mike (2016). In addition, the data for this variable is extracted from each country's Central Bank.

- ***Unemployment Rate***

Last but not least, the model also incorporates the variable unemployment which represents the control variable for the health of the economic environment and also the influence of the business cycle on the overall loan portfolio. As mentioned before, it is widely recognized that a healthy and sound economic environment can direct the increase of the overall economic income and decrease of the unemployed people. As a result, we should expect positive connection between the unemployment rate and the level of non-performing loans (Makri et al., 2014).

In fact, when the borrowers are unemployed, they are constrained in repaying their commitments due to absence of regular earnings. So, rise in the unemployment rate actually limits the current and future purchasing power of the households and enterprises, also adversely affects their cash flows and therefore, increasing debt burden appears with the increasing unemployment rate (Messai & Jouini, 2014). Makri et al. (2014) and Messai and Jouini (2014) represent evidence of the unemployment rate significantly and positively related to the NPLs. In addition, Louzis et al. (2010) and Bofondi and Ropele (2011) demonstrate comparable results. Hence, we forecast positive sign of the unemployment variable.

### **3.5.3 Ownership Variable**

In addition, the model also considers a dummy variable for the ownership of the banks, whether the majority of the shareholders who hold most of the banks' stocks, are domestic or foreign investors<sup>6</sup>. Actually, a dummy variable is a variable incorporated into a regression model which assumes value of 0 and 1. Hence, such variables can be essentially seen as a device to categorize data into mutually exclusive categories (Gujarati, 2009).

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<sup>6</sup> If domestic investors hold 51% stake in the bank, then the bank will be considered under domestic ownership and the same applies for foreign ownership.

In that way, the value of 0 of the dummy variable indicates that the bank is under domestic ownership and the value of 1 designates foreign ownership of the bank. So, if the dummy variable validates statistically significant result then it means that the type of ownership of the banks has also impact on the non-performing loans' ratio. However, in this dataset of 98 banks, exactly 33 banks are under domestic ownership and the rest of the banks or 65 banks are foreign banks from which most prevailing are the Italian and Austrian banks. The detailed ownership of the banks can be observed in Appendix C.

Table 1. Summary - Presentation of Variables

	<b>Symbol</b>	<b>Explanation</b>	<b>Expected sign</b>
<b>Bank-specific Variable</b>	NPL	Non-Performing Loans to Gross Loans	(+)
	CAR	Banks' capital and reserves to risk-weighted assets	(+)/(-)
	ROA	Return on Assets	(-)
	LTD	Loans to deposits ratio	(+)
	INEF	Other operating expenses to total assets	(+)
<b>Macroeconomic Variables</b>	GDP	Annual growth rate of GDP (%)	(-)
	INF	Annual Inflation Rate	(+)/(-)
	DEBT	Public Debt as % of GDP	(+)
	UNEM	% of unemployment	(+)
	FISCAL	Government budget surplus/deficit as % of GDP	(+)/(-)
	OWN	Dummy variable for the ownership of the banks: 0 for domestic ownership and 1 for foreign ownership of the banks	

## 4 RESULTS AND DISCUSSION

### 4.1 Model Estimation

Firstly, the model is estimated through two techniques used for analyzing panel data: fixed effects and random effects (hereinafter: RE) techniques, and one of them, is selected for the estimation of the predetermined equation. The choice of selection of one technique is based

on the results of the appropriate tests that are being employed. Afterwards, the GMM method is applied as more fitting method for this kind of panel data and type of variables.

#### 4.1.1 Fixed effects versus random effects model

To begin with, the fixed effects model is also known as the Least-Squares Dummy Variable Model (LSDV) in the broad literature. This model focuses on the heterogeneity among the individual subjects incorporated in the panel data meaning that it allows for heterogeneity by permitting each entity to have its own intercept value. Also, the term “*fixed effect*” emerges from each entity’s intercept in our case each bank’s intercept in a way that every intercept does not vary across time even though it may differ across the individual banks. Thus, the intercept is time-invariant (Gujarati, 2009).

Simply put, in our case each banks has its own individual characteristics that may or may not influence the independent variables and subsequently, the independent variables may be biased and therefore, they have to be controlled. Hence, the correlation between entity’s error term and the error term is the first assumption of this model. For this reason, the fixed effects model removes the time-invariant characteristics mentioned above by allowing individual intercept values. Additionally, another assumption of the model includes that it is of great importance that the time-invariant characteristics should not be correlated with each other or in other words, they have to be unique to the individual banks in our case (Baltagi, 2008).

Moreover, the suitable equation for estimation through fixed effects model becomes:

$$NPL_{i,t} = \alpha_i + \beta_1 CAR_{i,t} + \beta_2 ROA_{i,t} + \beta_3 LTD_{i,t} + \beta_4 INEF_{i,t} + \beta_5 GDP_{i,t} + \beta_6 INF_{i,t} + \beta_7 DEBT_{i,t} + \beta_8 FISCAL_{i,t} + \beta_9 UNEM_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where:

- $\alpha_i$  ( $i=1, \dots, 98$ ) is the each bank’s individual time-invariant intercept;
- $\beta_1 - \beta_9$  are the coefficients of the independent variables which show their impact on the dependent variable;
- $\varepsilon_{i,t}$  is the error term;
- As can be noted from the equation, it excludes the lagged dependent variable due to the possibility that it may give rise to potential “dynamic panel bias” which is a consequence of the possible endogeneity of the lagged dependent variable and the fixed effects in the error term. In addition, the dummy variable for the ownership is also excluded since these variables are absorbed by the intercept in this model and the ownership’s impact on the non-performing loans is investigated later in this chapter (Klein, 2013).

Secondly, the RE model should be utilized in cases when it is expected that the discrepancies across entities somehow influence the dependant variable. So, the main assumption behind the random effects technique is that contrary to the fixed effects model, the differences across entities are presumed as random and uncorrelated with the independent variables incorporated in the model (Greene, 2008).

Furthermore, another advantage of the random effects model is that time invariant variables can also be added into the model and the intercept will not absorb these kinds of variables such as in fixed effects estimation. In particular, the rationale of RE is that the entity's error term is not correlated with the independent variables and thus, RE allows for time invariant variables to take part as independent variables (Baum, 2006). On the other hand, the characteristics of the individual subjects that are expected to have some effect on the dependent variable or not, need to be specified. So, a major caveat here is that some of those variables might not be available which will lead to omitted variable bias in the model (Baltagi, 2008).

Moreover, Breusch-Pagan Lagrange Multiplier (hereinafter: LM) is a test that helps in the selection of the Random Effect Model and a simple Ordinary Least Squares (hereinafter: OLS) Regression. The null hypothesis of the test is structured around the assumption that there are no significant differences across units meaning no panel effect and that simple OLS regression should be applied. More specifically, the null hypothesis of the LM test is that the variance across units equals zero (Kohler & Kreuter, 2009). From Figure 6 in Appendix H the Stata results for this test can be analyzed. In line with the Figure 6, since the probability is lower than 0.05, we can reject the null hypothesis that there is no panel effects. This means that we have significant differences across banks and subsequently, we should follow the random effects model.

What is more, as mentioned before, it also should be decided between one of the previously discussed estimation techniques for panel data. The well-known test for deciding between random and fixed effects model is the Hausman test that should be run in Stata. In fact, it fundamentally tests whether the entities' unique errors are correlated with the regressors, so the null hypothesis is that they are not in correlations. As a result, the null hypothesis is actually that the RE is preferred while the alternative hypothesis include that the fixed effects should be selected.

Thus, from the Table 2 on the next page, the results from the Hausman test can be observed. Hence, aligned with the results from Figure 13, the probability is lower than 0.05, so we can reject the null hypothesis that the RE is preferred and proceed the estimation with employing the fixed effects model. So, the Hausman test indicates us that fixed effects model should be used during the estimation. However, despite the Hausman test, in the selection of the model we should also ensure that our assumptions for the data set are aligned with the elected model's assumptions. Thus, the first obvious difference between FE and RE is the correlation between the entity's error term and the independent variables or in other words FE assumes the correlation is present and RE otherwise. Consequently, relating the variables in our model, we assume that some of the explanatory variables are not strictly exogenous meaning

that they are possibly correlated with the entity's error term. As a result, one of our assumptions again implies to utilizing the fixed effects model.

Table 2. Hausman Test

```

hausman fixed random

----- Coefficients -----
      (b)      (B)      (b-B)      sqrt(diag(V_b-V_B))
      fixed    random    Difference    S.E.
-----+-----+-----+-----+-----
car      .1587921    .127093    .0316991    .0196519
roa     -1.208133    -1.19913    -.0090021    .0495498
ltd      .0050232     .0006905    .0043328    .006036
inef    -1.1470985    -1.1262684    -.0208301    .0146666
gdp      .0853711     .084662    .0007091    .0080389
inf     -1.408662    -1.3904214    -.0182406    .027404
debt     .0659047     .0913442    -.0254395    .0187823
fiscal   .3653652     .2628045    .1025607    .0227994
unem     .6479466     .3353078    .3126388    .0946145
-----+-----+-----+-----+-----
b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

      chi2(9) = (b-B)' [(V_b-V_B)^(-1)] (b-B)
              = 99.95
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

```

Source: Own calculations via STATA 13

Additionally, in a short panel<sup>7</sup>, the estimates obtained can differ considerably and therefore the fixed effects should be employed when we strongly believe that the units in the model are not random drawings from a larger sample, in that case the RE is preferred (Judge et al., 1988). But in our short panel we believe that the units are not just a random selection and therefore, once again the assumptions reinforce the results from the Hausman test. Subsequently, the fixed effects model is further brought into play. The complete table with results from the fixed effects model estimation will be presented later in the chapter and it will be discussed and compared with the results from the alternative estimation techniques. In addition, the entire collection of results from the random effects estimation can be seen in Appendix I.

#### 4.1.2 Generalized Method of Moments (GMM)

First of all, the Generalized Method of Moments which is a generic method for estimating parameters in statistical model was developed by Hansen in 1982. Using this framework, Arellano and Bond developed the Difference GMM, by transforming all the regressors, typically by differencing (Arellano & Bond, 1991). Afterwards, the development of the System GMM dramatically increased the efficiency. In fact, these Arellano-Bover (1995)/Blundell-Bond (1998) estimators enhanced the Difference GMM by making additional assumptions that the fixed effects are uncorrelated with the first differences of the

<sup>7</sup> Large N, Small T.

instrument variables which lead to the possibility of employing more instruments (Roodman, 2006).

Moreover, according to Roodman (2006):

“The Arellano-Bond and the Arellano-Bover /Blundell-Bond estimators are both general dynamic panel estimators designed for: 1) “small T, large N” panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) a single left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; 5) Fixed individual effects; and 6) Heteroskedasticity and autocorrelation within individuals but not across them”.

However, the equation that we aim to estimate in this research paper in order to observe the impact of the bank-specific and macroeconomic variables on the non-performing loans is the following:

$$NPL_{i,t} = \alpha_0 + \gamma_0 NPL_{t-1} + \beta_1 CAR_{i,t} + \beta_2 ROA_{i,t} + \beta_3 LTD_{i,t} + \beta_4 INEF_{i,t} + \beta_5 OWN + \beta_6 GDP_{i,t} + \beta_7 INF_{i,t} + \beta_8 DEBT_{i,t} + \beta_9 FISCAL_{i,t} + \beta_{10} UNEM_{i,t} + \varepsilon_{i,t} \quad (1)$$

As mentioned before, this equation also incorporates the lagged dependant variable and the dummy variable for banks’ ownership which were earlier excluded in the fixed effects estimation since the first one can result in “dynamic panel bias” and the latter will be absorbed by the model’s intercept. Nevertheless, the reasons behind the choice of Arellano-Bond GMM Estimator are elaborated subsequently.

So, numerous econometric problems may appear while estimating equation (1) with simple OLS or alternative estimation techniques. To start with, there might be potential endogenous variables in the specified model when the causality runs in both directions. In our model we assume that the bank-specific variables might be potentially endogenous since they can be affected by the dependent variable NPL and vice versa they can impact it. Secondly, time invariant characteristics might be correlated with the independent variables, such as the unique characteristics of the banks or the characteristics of the individual countries such as the demographics and geography. Third, the lagged dependant variable incorporated into the model might give rise to autocorrelation. Last but not least, the data is characterized with smaller number of time periods (t=8) and significantly greater number of the bank dimension (n=98). This means that the data is a short panel data with “small T, large N” (Gujarati, 2009).

Hence, as discussed earlier, the first two potential problems can be potentially managed with the fixed effects instrumental variables estimation. However, there are also other econometric problems mentioned which together with the first two problems can be fixed with the GMM estimators. Moreover, if we relate and compare the potential econometrics problems with the conditions designed for the GMM estimators we can notice a correspondence to a great extent. In particular, the panel data prepared for this study is a linear functional relationship, a dynamic left-handed variable, small T, large N, not strictly exogenous some of the variables

and fixed effects that were observed with the first estimation technique. Accordingly, the structured model for the determinants of the NPLs is a perfect match for GMM estimation and therefore, I decided to proceed with the aforementioned technique to obtain more relevant and unbiased results. Additionally, following the past papers with dynamic panel data, there is also empirical evidence indicating the practice of these estimators. Mostly of the research papers that are similar to this one, that are focused on the objectives alike and that are handling equivalent panel data set, utilized the Difference and System GMM. Such examples include: Makri et al., (2014), Us (2016), Klein (2015), Beck and Levine (2004), Cheng and Kwan (2000) and many others.

Accordingly, three alternative techniques are considered for the estimation of the results. The first has already been explained and the reasons behind its choice were elaborated earlier. The other two techniques that are taken into account are the Difference GMM and the System GMM.

Moreover, worth mentioning is that the estimation starts with naive attempt of estimating with OLS method and then the FE model is applied. However, the model estimated now also includes the lagged dependent variable which was previously excluded due to leading to “dynamic panel bias”. Additionally, the dummy variable for investigating the banks’ ownership on the NPLs is also entered. This inclusion of the lagged dependent variable is done intentionally due to the need to obtain the coefficients of the lagged variable from the OLS and FE methods. The value of those coefficients actually shape a range in which the good estimates of a true parameter should therefore lie in or near that range (Roodman, 2006). Actually, these bounds of the lagged dependant variable’s coefficients estimated with OLS and FE provide a practical check on the results acquired from the theoretically superior estimators or in other words the GMM estimators (Bond, 2002).

Furthermore, as was discussed before, even though the fixed effects model is rather simple and intuitive, it might give rise to the “dynamic panel bias” and the results will be potentially biased. Therefore, Difference GMM is next applied in order to avoid this in a way that this estimator transforms the data to first differences to remove the fixed effects and uses the lagged levels of the right-handed independent variables as instruments. Still, in panel datasets with limited time dimension or lower T, this estimation can have lower precision (Blundell & Bond, 1998). As a result, the System GMM is applied in order to avoid this concern. This approach actually involves two equations: one in levels in which the instruments are presented by the lagged first differences, and the other in the first differences with lagged levels as instruments (Arellano & Bover, 1995).

Moreover, according to Roodman (2006), we should point out all the specification during the utilization of the GMM estimators. Firstly and most importantly, we have a short panel with large N and small T, instruments tend to explode with large T and with small N, and the standard errors and the autocorrelation tests might be unreliable.

Secondly, we should report the type and number of instruments used during the estimation. Since the variables that should be instrumented are the variables that are not strictly



exogenous, we should determine the endogenous variables in our initial model. The sources of endogeneity can be omitted variables included in the error term and simultaneity as well, when causality may run in both directions. This means when the dependent variable impacts the independent variable and vice versa. As a consequence, we assume in our model that the bank-specific explanatory variables can indicate simultaneity meaning that they can influence the non-performing loans and on the other hand the non-performing loans can influence them, for example the profitability, the loans to deposit ratio, the capital adequacy of the bank and its inefficiency. Also, they can be correlated with some omitted variables such as other bank-specific characteristics that influence the shape of the non-performing loans but are not incorporated into the model. Therefore, we use the bank-specific variables as endogenous variables and the country-specific variables and the dummy variable for ownership will be treated as strictly exogenous. This is also in line with the empirical evidence presented in the past (Klein, 2015).

Additionally, as these GMM estimators are designed for general use, another assumption is that the good instruments of the endogenous variables are not strictly outside the immediate dataset. In fact, they assume that the only good instruments of the endogenous variables are internal or in the other words the lagged levels of the instrumented variables (Roodman, 2006). Although, the GMM estimators allow the inclusion of external instruments we use instruments based on the lags of the endogenous variables during the estimation.

Moreover, the rule of thumb relating the instruments is to keep the number of instruments less than or equal to the number of groups. However, the second lags of the instrumented variables are required since they are not correlated with the error term, while the first lag shows some correlation. In fact, it is accepted to experiment with the second or deeper lags in order to find decent instruments but the drawback is that as the number of lags increases, the sample size reduces. Subsequently, in our estimation we use the second lags of the endogenous variable to obtain good instruments. Additionally, for the exogenous variables, Stata is instructed to use the variables themselves as their own instruments (Mileva, 2007).

To sum up, we firstly estimate the initial model using:

- One-step **Difference GMM estimation** with the bank-specific variables assumed as endogenous variables and their second lags used as instruments and the country-specific variables and dummy as exogenous variables.
- Secondly, the lagged levels of the regressors can sometimes be poor instruments of the first-differenced regressors and therefore, secondly we apply the one-step **System GMM** which can potentially increase the efficiency through using a system of two equations as was explained before and through the second equation, additional instruments can be obtained (Mileva, 2007). Similarly, the bank-specific variables are treated as endogenous and their second lags used as their instruments and the macroeconomic and dummy variables treated as exogenous.

Finally, we now turn to the ultimate estimation of the structured model with the techniques that were explained and discussed earlier. First, we run the simple Ordinary Least Squares

and the Fixed Effects estimation in order to get the range in which the coefficient of the lagged dependent variable should belong eventually. Afterwards, we apply the commands for the Difference GMM and the System GMM.

Correspondingly, from the first two estimations of OLS and FE we obtain lagged non-performing loans variable's coefficients of 0.817 and 0.532 respectively. This means that with the next estimations we should expect coefficients that are between this boundaries or near them to get the opportunity to check the values of true parameters. The complete set of results from these two estimations can be found in Appendix J.

Moreover, the GMM estimation techniques are applied into Stata. In addition, the entire Stata output and the analysis of the results estimated with Difference GMM and System GMM is presented in the next section. However, some remarkable features that can be observed from the results are worth mentioning here:

- The coefficients of the lagged dependent variable gained from the last two techniques are in line with the aforementioned check test. This means that the coefficients are within the OLS-FE bracketing range and indicate the straightforwardness of the estimates.
- Besides, the Stata output reports the number of instruments used during the Difference GMM and System GMM of 40 and 72 respectively which is lower than the number of groups valuing 98.
- Another appealing thing that can be noticed from the results is that the Difference GMM drops the dummy variable for the ownership and states it as omitted variables. So, that coefficient would disappear in a Difference GMM while in a System GMM, time-invariant regressors could be included and they will not affect the coefficients of the other regressors (Roodman, 2006). This is another motivation for exploiting System GMM in order to investigate whether the ownership of the banks have influence to some extent on the volume of NPLs in CEE region.
- Also, after reporting the estimated results, Stata by default reports three tests by defaults as well. The first one is the **Sargan test**<sup>8</sup> which is testing the joint validity of the instruments used during the procedure. However, the null hypothesis of the test involves that the instruments as a group are endogenous (Roodman, 2006). Therefore, we anticipate higher value of the Sargan statistic as a proof of the validity of the instruments. Consequently, our results show p-values for the Sargan statistics of the Difference GMM and System GMM of 0.539 and 0.461 correspondingly as can be seen from Table 3 below. The results indicate that we used decent valid instruments during the estimation.
- Finally, the other two tests are the Arellano-Bond tests for testing autocorrelation and it involves the subsequent null hypothesis of no autocorrelation and it is applied to differenced residuals. The results from Table 3 indicate that there is no serial correlation of second order. On the other hand, the estimates imply that autocorrelation of first order is present but yet it does not signal inconsistency of the results. In practice, the first test **AR (1)** in first differences is typically rejected indicating signs of autocorrelation. More

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<sup>8</sup> In robust estimation such in our case, STATA reports the Hansen statistic instead of the Sargan statistic with the same null hypothesis (Mileva, 2007).

importantly, the second **AR (2)** test should not be rejected because otherwise it detects second-order autocorrelation and inconsistency would be assumed consequently.

Table 3. GMM Estimation Tests

	Difference GMM		System GMM	
	Test statistic	p-value	Test statistic	p-value
<b>Sargan Test</b>	25.64	0.539	28.07	0.461
<b>AR (1)</b>	-7.34	0.000	-7.94	0.000
<b>AR (2)</b>	-0.35	0.725	-0.96	0.339

Source: *Own calculations via STATA 13*

## 4.2 Estimation Results and Discussion

This section starts first with the descriptive statistics or more deeply analyzing the data used in the estimation. Then, the results estimated with the fixed effects technique are presented and their interpretation and discussion is also illustrated. Afterward, this section demonstrates the results from the GMM estimators and their analysis and interpretation. Finally, this section concludes with the comparison of the results obtained from the three alternative estimation techniques.

### 4.2.1 Descriptive Statistics

As it was said before, the present study inspects the determinants of the non-performing loans with a panel data. In fact, the analysis covers 98 banks from 15 countries from the CEE region throughout the period beginning from 2008 to 2015. Overall, the data includes 784 observations and the distribution of the observations per country can be seen in Appendix D. The descriptive statistics of the variables used in the empirical analysis is presented in Table 4 below and the STATA output for the descriptive summary is presented in Appendix H.

Table 4. Descriptive Statistics of the Variables

Variables	Mean	SD	Min	Max
<b>NPL</b>	13.70021	10.95546	0.02	58.27
<b>CAR</b>	17.58256	6.78640	6.65	70.00
<b>ROA</b>	0.36002	2.32705	-15.65	17.59
<b>LTD</b>	107.00460	40.85391	8.37	295.49
<b>INEF</b>	3.81062	5.62993	1.10	86.19
<b>GDP</b>	0.62335	3.90949	-14.81	8.46
<b>INF</b>	2.97542	3.47146	-1.40	15.43

table continues

continued

<b>Variables</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
<b>DEBT</b>	41.76383	22.01175	4.50	97.00
<b>FISCAL</b>	-3.69260	2.68896	-15.02	1.60
<b>UNEM</b>	15.61939	8.06043	4.40	33.80

Source: *Own calculations via STATA 13*

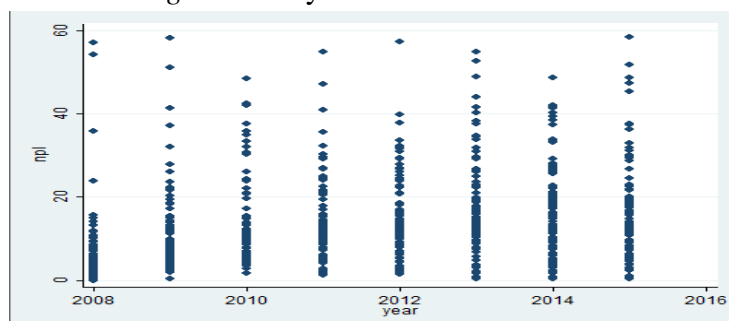
Firstly, the data for non-performing loans ranges from 0.02% to 58.27% and the banks with the highest levels of NPLs included in this dataset are from Latvia, Serbia and Bulgaria. Then, the CAR ratio present minimum and maximum values of 6.65% and 70% respectively which signals that some of the banks throughout this period did not meet the minimum capital requirements posed by the regulatory institutions. As far as the profitability ratio is concerned, ROA demonstrates high disparity from -15.65% to 17.59% which also implies negative earnings of some of the banks during the selected period. The variable LTD also displays a high disparity since its minimum value is 8.37 and its maximum value is 295.49. The reasoning behind such high values of the LTD ratio of some banks can be that it is not rare for the foreign banks or banks owned by foreign investors to have higher LTD ratios since they can easily borrow funds from their parent banks and do not have liquidity problem related with the huge LTD ratios. As mentioned before, the degree of foreign capital in this region is very significant and therefore, this might be the reason for the high values of LTD ratios as can be seen from Table 4. The last variable from the banks specific data, the inefficiency ratio extends from 1.1 to 86.19 as can be observed from the Table 4.

Next, the annual growth in the GDP of the countries displays minimum and maximum value of -14.81% and 8.46% which indicates that some countries marked negative growth as a consequence of the global crisis. The variables inflation and debt present ranges of -1.4% to 15.43% and 4.5% to 97% respectively. Additionally, the average public debt in this data takes value of 41.76%. Furthermore, the fiscal variables represent the government budget deficit with negative values and government budget surplus of the countries with positive values. However, it records range from -15.02 to 1.6. It should also be underlined that the mean recorded negative sign. Finally, the last variables included into the data presents minimum and maximum value of 4.4% to 33.8% which points out the levels of unemployment in the selected countries and also, signaling generally high level of unemployment in this region. Additionally, the histograms of the distributions of the data for every variable can be found in Appendix G.

Also, the movement of the NPL ratio from the concerned data during the selected years 2008-2015 can be seen in Figure 17 below. If we observe the lower area of the graph in which the dots are more densely allocated, the NPL ratio started to increase after the crisis until 2010 and then started to slowly diminish afterwards. However, in 2013 and 2014, the ratio went back to increasing its levels and again, the ratio started to fall in 2015. On the other hand, if we observe the upper area of the graph in which the dots are more lightly distributed, we can notice many ups and downs from year to year. Still, these dots represent only a small number of banks with more extreme data which separate out from the majority of the banks included

in the dataset. In general, the levels of NPLs significantly increased after the crisis in this region and after that, those levels were closely maintained from year to year. Additionally, the movement of the NPL ratio across the individual countries can be observed in Appendix F.

Figure 17. Dynamics of NPL Ratio



Source: Own calculations via STATA 13

Moreover, as can be observed from the correlation matrix of the independent variables presented in Table 5, the correlation coefficients between the independent variables are relatively low. The highest correlation is between the variable for the government budget and public debt of 0.4315. Nonetheless, the multivariate multicollinearity test is also applied before the estimation in order to test the introduction of these variables together. According to Gujarati, 2009, if the Variance Inflation Factor (hereinafter: VIF) is lower than 10, then there is no multicollinearity problem and the independent variables can be brought together in the estimation of the model. Subsequently, the results of the multicollinearity test demonstrate VIF values lower than 10 indicating that all the variables can be included together further in the estimation. The results from this test can be seen in Appendix H (Table 5).

Table 5. Correlation Matrix

	NPL	CAR	ROA	LTD	INEF	GDP	INF	DEBT	FISCAL	UNEM
NPL	1.0000									
CAR	0.0404	1.0000								
ROA	-0.2528	0.0594	1.0000							
LTD	-0.1360	0.0049	-0.0543	1.0000						
INEF	-0.0521	0.1823	-0.0118	0.0460	1.000					
GDP	0.0192	0.0111	0.1522	-0.1032	-0.0467	1.0000				
INF	-0.1817	0.0830	0.1613	0.2085	0.2379	0.0672	1.0000			
DEBT	0.1768	-0.0277	-0.1925	0.0219	-0.0653	-0.0871	-0.2873	1.0000		
FISCAL	-0.0567	0.0855	0.2385	-0.1444	0.0164	0.5082	0.0523	-0.4315	1.0000	
UNEM	0.0573	0.0904	0.0752	-0.0220	0.1419	0.0815	-0.1106	-0.0975	0.1102	1.0000

Source: Own calculations via STATA 13

#### 4.2.2 Results from the Fixed Effects Regression Model

Before starting the discussion of the results, it should be mentioned that the STATA output and results from the simplest estimation technique OLS can be found in Appendix M. So, as mentioned previously, the investigation starts with estimating the model with fixed effects method while the lagged dependent variable is excluded due to potentially leading to biased and inconsistent estimation results. The decision for the utilization of this model is made based on the Hausman test for choosing between the fixed effects or random effects model. Also, this model is designed for panel data like the dataset used in this study and this model allows for heterogeneity among the individual subjects incorporated in the panel data such as the different characteristic of our individual banks. However, the results are presented in Table 6, containing the estimated values of the coefficients, the standard errors and the p-values indicating the statistical significance. Additionally, the entire output set from STATA can be found in Appendix I.

Table 6. Results from the Fixed Effects Regression Model

<b>Independent Variables</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>P&gt; t </b>
Capital Adequacy (car)	0.158792	0.0573389	***0.006
Return on Assets (roa)	-1.208133	0.1651551	***0.000
Loans to Deposits (ltd)	0.005023	0.0050232	0.710
Inefficiency (inef)	-0.147098	0.0627678	***0.019
GDP (gdp)	0.085371	0.0857483	0.320
Inflation Rate (inf)	-0.408662	0.1059815	***0.000
Public Debt (debt)	0.065905	0.0299975	**0.028
Government budget (fiscal)	0.365365	0.1422614	***0.010
Unemployment Rate (unem)	0.647947	0.1213773	***0.000
Constant	1.005130	2.6552550	0.705
<b>R<sup>2</sup> = 0.2602</b> <b>Prob &gt; chi2 = 0.0000</b> <b>Rho = .61966466</b>			

Note. \*Denote significance at 10% respectively.

\*\*Denote significance at 5% respectively.

\*\*\*Denote significance at 1% respectively.

Source: *Own calculations via STATA 13*

Firstly, as shown in Table 6, the coefficient of determination is 26.02% exposing that the 26.02% of the variation in the dependent variable NPL is explained by the explanatory variables incorporated into the model. Also, the value of Rho reveals that 61.97% of the variation in the non-performing loans variables is due to the individual characteristics of the cross-sectional units included, in our case the specific banks from the CEE region. Finally, the very low p-value of the F-statistic of this model indicates that the null hypothesis can be rejected meaning that all the independent variables in the model jointly impact the dependent variable.

Moreover, taking into consideration that the basic aim of this research is to investigate the factors shaping the non-performing loans in the specific region, we obtain quite interesting results. To begin with, both the macroeconomic variables and the bank-specific variables demonstrate statistical significance.

However, from the bank-specific variables group, the capital adequacy and loans to deposits ratios show positive correlation with the NPL ratio while the return on assets and the inefficiency ratio prove to be in reverse relationship with the variable in focus in this study. Firstly, regarding the capital adequacy variable we were not quite sure of the expected sign since the evidence have shown ambiguous results. Thus, in this study, a positive sign of the CAR variable is found supporting the argument that the higher capital of banks can encourage them to engage in riskier activities and possibly lead them to weakening the loan portfolio. Secondly, the estimated sign of the variable return on assets confirms our expectations for a negative correlation between this variable and the NPLs. Finally, our predictions of positive relationship between loans to deposits ratio and the dependent variable, once again are verified with the estimation. Although, the sign of the loans to deposit ratio fulfills our anticipations, it does not illustrate statistical significance and therefore, it is not taken into consideration.

First, the capital adequacy ratio shows statistically significant and strong relationship with the NPL ratio at a level of 1%. As mentioned earlier, we were not quite sure about the sign of this variable due to different evidence from different papers. However, the estimation shows positive correlation which might mean two things. The first things is that the highly capitalized banks engage in more riskier activities and deteriorate their asset quality and the second thing is that the banks slammed with non-performing loans might increase their capital base on purpose in order to avoid loan losses (Ahmad & Ariff, 2007). The obtained result is also corroborated by the literature through the study of Constant and Ngomsu (2012) and also we reject the null hypothesis in favor of the second alternative hypothesis  $H_2$ . So, one unit increase in the capital base of the banks will lead to 0.16 units increase in the NPL ratio under all else equal.

Second, concerning the variable return on assets, which is one of the banks' profitability ratios, we observe negative impact on the dependant variable and it displays statistical significance of 1% as well. As a result, we reject the null hypothesis and accept the alternative hypothesis  $H_3$ . This result is also in line with past empirical evidence such as the studies of Louzis et al. (2010), Makri et al. (2014), Shigjerji (2013), Abid, Ouertani, and Zouari-Ghorbel (2014) which all observed negative statistically significant sign of ROA. This could be justified as a support for the bad management hypothesis, meaning that the quality of management has an impact of the procedures' efficiency for granting loans to borrowers. Actually, the coefficient denotes value of 1.21 which means that one unit change in ROA will lead to 1.21 units change in the level of non-performing loans in the opposite direction, all else equal. In addition, the negative sign of ROA reinforces our assumptions.

The last variable from the bank-specific variables that also expresses statistical significance is the inefficiency ratio representing the other operating expenses to total assets. The estimation

of this coefficient illustrates quite interesting result since it produces sign contrary to our beliefs. More specifically, it was expected positive sign of the inefficiency ratio aligned with most of the evidence of the vast literature. However, in the fixed effects estimation, it is found a negative correlation of the variable and the NPLs and a p-value of 0.019 revealing the statistical significance. Consequently, we fail to reject the null hypothesis and we do not accept the alternative hypothesis  $H_5$  which involves positive relationship between the inefficiency ratio and the NPLs level. The rationalization behind the reverse relationship is that when banks have lower inefficiency, that could mean that they are more cost-efficient and devote less effort to ensuring high-quality loans and that could eventually lead to higher number of NPLs in the long-run. This result of negative influence of the banks' inefficiency is also illustrated in study of Us, (2016). Nonetheless, the coefficient takes value of -0.147 meaning that under all else equal, the volume of non-performing loans will fall by 0.147 units if there is increase of one unit in the inefficiency.

As regards to the group of macroeconomic variables, the majority of the variables is statistically significant and confirms our initial expectations about the coefficients' signs. So, the inflation rate, the public debt, the government budget and the unemployment rate are estimated as having statistically significant influence on the shape of the non-performing loans in the selected countries from 2008 to 2015. As a consequence of these results, we reject the null hypotheses in favor of the previously mentioned research hypothesis  $H_7$ ,  $H_8$ ,  $H_9$  and  $H_{10}$ . Firstly, about the inflation rate, we did not expect specific signs of its coefficient due to ambiguous past literature evidence. Hence, it is revealed that the inflation rate adversely affects the non-performing loans with statistical significance of 1% as shown in the table above. More precisely, all else equal, one unit increase in the inflation rate results in decrease of 0.41 units in the level of the non-performing loans in the portfolio. The justification behind this indication could be that when the inflation rate rises, it affects the real value of the outstanding loans making the repayment of loans easier. Likewise, Shu (2002) also demonstrated results that support these findings.

Secondly, the estimates of the macroeconomic variable for the public debt of the country also confirms the predictions for positive relationship with the non-performing loans corroborated by many research studies such as Makri et al. (2014) and Reinhart and Rogoff (2010). In particular, the fixed effects model estimates coefficient with value of 0.066 which implies that if the government debt increases by one unit, under all else equal the non-performing loans will be positively affected by 0.066 units. Besides, it demonstrates statistical significance at a level of 5%. Thus, the justification of this relationship is that increase in the public debt can deteriorate the rating of the government securities and subsequently, it can influence banks' liquidity since they are usually inclined to invest their liquidity reserves in government securities. Consequently, the banks limit the issuing of new loans and since borrowers cannot renew their loans, the non-performing loans might increase (Reinhart & Rogoff, 2010).

Moreover, the results from the fixed effects model suggest strong and positive statistical significant relationship between the NPL ratio and the government budget. So, this can be justified by the rationalization that the government budget surplus increase can be supported



by a contractionary fiscal policy which incorporates increased taxation and reduced government spending. As a result, this government policy can influence the repayment ability of the borrowers and therefore, the level of NPLs might increase in line with the increase in government budget surplus. According to the results in the table above, one unit increase in the government budget deficit leads to 0.36 units increase in the level of NPLs under all else equal. However, these results are supported by the empirical evidence provided by Makri et al. (2014) and Dimitrios et al. (2016).

Last but not least, the unemployment rate displays not very surprising result as can be noticed from the table above. As it was anticipated, it is found a strong positive relationship between the unemployment rate and the non-performing loans in the Central and Eastern European Countries. This sign alludes to the assumption that when unemployment between people increase, it limits their cash flows and resources since they are not working and consequently constraints their ability to repay the outstanding loans and therefore, that increase contributes to the raising of the NPLs in the loan portfolios. This justification and the obtained results are aligned with Makri et al. (2014), Messai and Jouini (2014), Louzis et al. (2010) and Bofondi and Ropele (2011) who represented evidence of the unemployment rate significantly and positively related to the NPLs. Thus, the estimated value of the coefficient suggests enlargement of the non-performing loans of 0.65 units in a case when the unemployment rate will go up by one unit, all else equal. Also, the p-value of the t-statistic reveals statistical significance of at a level of 1%.

Additionally, it is quite interesting that GDP variable displays positive sign of its coefficient which is contrary to the initial expectations in this study (see Table 1) and the past similar research papers. Either way, the p-value does not indicate statistical significance of this macroeconomic variable's coefficient and subsequently, it is not taken into account for discussion and interpretation in this section.

All in all, bearing in mind all the things previously discussed, it can be concluded that in the period from 2008 to 2015, the non-performing loans in the country have been determined to a great extent by the macroeconomic variables such as the inflation and unemployment rate in the country and the public debt and the government budget as well. This could possibly make sense in a way that the period under investigation is the period of the beginning of the crisis and the post-crisis period. It could mean that the economic conditions deteriorated substantially to such extent, especially in the countries of this region and therefore, they seemed to play major role in the shape of the non-performing loans. Then again, the capital adequacy ratio, the return on assets and the inefficiency ratio as bank-specific factors, turned out to have some influence of the non-performing loans in this region. On top, all of them have positive correlation with the volume of NPLs, except the profitability ratio-return on assets, inefficiency ratio and the inflation rate. Also, only the inefficiency variable shows sign opposite from our expectations from the statistically significant variables while the GDP variable also, shows opposite sign from anticipated but it does not show statistical significance and therefore, it is not interpreted. Yet, it should be mentioned that these are the results from the fixed effects model in which is not included the lagged dependant variable

examining the persistence of the NPLs and also, the dummy variable for the ownership's effect on those loans due to biased and inconsistent results. Since these things are one of the main objectives in the center of this study, the study proceeds with GMM estimators including the main research questions.

#### 4.2.3 Results from the Difference GMM Estimation

So, the next estimation technique which is discussed is the Arellano-Bond Difference GMM whose regression outcome is placed in Table 7 below. Plus, the full output produced by STATA is presented in Appendix K. Nevertheless, this estimation technique is employed in order to investigate the persistence of the NPLs through the variable lagged non-performing loans ratio which is excluded from the fixed effects model due to the possibility of yielding biased results.

Table 7. Results from the Difference GMM Estimation

<b>Independent Variables</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>P&gt; t </b>
Lagged NPL	0.656574	0.0787791	***0.000
Capital Adequacy (car)	0.534100	0.1486351	***0.000
Return on Assets (roa)	-1.010250	0.4179535	***0.016
Loans to Deposits (ltd)	0.057774	0.0319548	*0.071
Inefficiency (inef)	-0.296487	0.0985738	***0.003
GDP (gdp)	-0.044968	0.0933253	0.630
Inflation Rate (inf)	-0.161101	0.1837535	0.381
Public Debt (debt)	-0.076006	0.0481100	0.115
Government budget (fiscal)	0.213013	0.1907945	0.265
Unemployment Rate (unem)	0.477437	0.1924126	***0.013
<b>Number of Groups: 98</b> <b>Number of Instruments: 40</b> <b>Prob &gt; chi2 = 0.000</b>			

*Note.* \*Denote significance at 10% respectively.

\*\*Denote significance at 5% respectively.

\*\*\*Denote significance at 1% respectively.

Source: *Own calculations via STATA 13*

As presented in the table above, the estimation is consistent with the aforementioned rule of thumb for the allowed number of instruments to be lower than the number of groups. In this sense, we have 40 instruments used during the regression and 98 groups in total.

Moreover, if we analyze the table negligently, we can observe that the results of the Difference GMM estimation signal that the levels of non-performing loans in the 15 countries of the CEE region are generally characterized by the bank-specific factors against the macroeconomic factors of the individual countries. More accurately, five or all of the bank-

specific factors reveal statistical significance while only one of the macroeconomic factors is statistically significant.

Along these lines, bank-specific factors that significantly impact the shape of the non-performing loans in this region according to this estimation technique are the lagged independent variable, capital adequacy, return on assets, loans to deposits ratio and lastly, the inefficiency ratio of the banks. Firstly, the lagged version of the dependent variable is incorporated into the model with purpose of examining the dynamic persistence of the NPLs loans. More specifically, as it was argued previously, it is not shocking the revelation of the extensive emergence of the non-performing loans during crisis, what is surprising is the continuous perseverance of the volume of the NPLs in this region. Therefore, we also investigate the impact of the lagged variable of NPL. In this sense, the concerned variable shows strong statistical significance of 1% and positive correlation with dependant variable. Similarly, such findings were recorded in the studies of Jimenez and Saurina (2006), Dash and Kabra (2010), and Misra and Dhal (2010), revealing the persistence of non-performing loans. The high positive and statistical significance of the lagged variable confirms the dynamics nature of this model and also, the values suggest that a shock in the NPLs may have prolonged effect on the banking system in this region (Dash & Kabra, 2010). In addition, the lagged NPL expresses value of 0.66 which imply 0.66 units increase in the NPLs if under all else equal, the NPLs in the previous year increased by one unit.

Secondly, a further interesting result gained with the estimation is the capital adequacy of the bank which signals strong statistical significance of 1%. It actually captures the risk that the bank can undertake in their activities. Besides, it implies positive influence on the shape of the non-performing long. However, we were not quite determined about the exact sign of this variable's coefficient due to different results from different research papers. Consequently, it is found strong positive relationship which signals the incentive of banks to engage in riskier activities when they are largely capitalized and potentially leading them to disruption of the loans portfolio. On the other hand, another option is that bank with high levels of non-performing loans in their portfolios employ more capital in their balance sheet with purpose of alleviating the volume of NPLs (Ahmad & Ariff, 2007). So, as shown in Table 6, one unit of change in the capital ratio of the banks will lead to 0.53 units of change in the NPLs in the same direction. Also, this result is corroborated by literature, as similar findings were recorded in the studies of Constant and Ngomsi (2012).

Similarly, the return on assets demonstrates statistical significance like in the results from the fixed effects model estimation. More specifically, from the Table 6 above, it can be observed unsurprisingly negative correlation between the ROA and NPL ratio as it was expected. This means that one unit change in this independent variable when everything else is equal, the NPL ratio will change in the opposite direction by 1.01 units. This result is in line with the majority of evidence presented by the literature, more specifically, the studies of Makri et al. (2014) and Messai and Jouini (2014). So, the results are compatible with the economic intuition and the theoretical arguments discussed previously in this study. Again, the result

reinforces the theoretical argument of bad management in the bank which will eventually lead to weakening of the efficiency in the procedure for underwriting bank loans.

Furthermore, as it was anticipated, the results for the loans to deposits ratio indicate positive statistically significant relationship with the non-performing loans despite the fact that it does not quietly illustrate strong statistical significance but significance at a level of 10%. This suggests that high loans to deposits ratio could mean that the bank has boosted its credit lending and there are more loans than deposits. Subsequently, that could expose the bank to higher risk of some loans to become non-performing loans. In other words, the possibility of converting the outstanding loans to non-performing loans is higher when the total loan portfolio is considerably large. Nonetheless, the results imply that one change increase in the loans to deposits ratio will lead to 0.058 increase in the levels of non-performing loans under all else equal. Similar results were presented by the studies of Louzis et al. (2010) and Misra and Dhal (2010).

Last but not least, the inefficiency ratio is the remaining variable of the bank-specific internal factors that could possibly shape the design of the non-performing loans in the CEE region. This factor illustrates strong statistical significant level or specifically p-value of 0.003 at 1% significance and it shows a negative correlation with the dependant variable opposing to our earlier predictions. This negative influence of the banks' inefficiency is consistent with the evidence that Us (2016) provided with his study. However, the sign can be justified regarding the cost efficiency of the banks which will increase significantly when the inefficiency will fall on the other side and possibly alluding that the banks will allocate fewer resources to risk monitoring which will result in deteriorating the loan portfolio. More specifically, when the inefficiency ratio diminishes by one unit, 0.296 units of non-performing loans will be added to the credit portfolio.

Regarding the macroeconomic factors as possible determinants of the NPLs, only one is found as strongly impacting the non-performing loans which actually is the unemployment rate. The rest of the variables included into the model GDP growth, inflation rate, the public debt and the fiscal variable do not signal statistical significance and thus, they will not be taken into consideration.

Finally, the results for the unemployment rate do not turn out very surprising with the Difference GMM estimation. As we predicted, they are in a positive relationship indicating that rise of one unit in the unemployment rate, will lead to ascending the level of NPLs by 0.57 units under all else equal. More to the point, it reveals strong statistical significance at 1% with p-value denotation of 0.48. It is worth signaling that these results are compatible with the findings contributed by the studies of Makri et al. (2014), Messai and Jouini (2014), Louzis et al. (2010) and Bofondi and Ropele (2011). In this sense, the valid rationalization of the common results is that when the number of unemployed people increases and also, the number of people constrained with cash flows and income increases and therefore, the number of people incapable of repaying the loans increases as well.

On the whole, when all the results considered, we can argue that in the period 2008-2015 the volume of the NPLs in the CEE countries, was generally influenced by the quality of management of the banks through their decisions made relating the capital, credit lending and cost efficiency of the banks. Also, the recent crisis impacted the non-performing loans in a way that left many people with no job and unable to repay their loans. It is also worth mentioning that the Difference GMM omits the invariant variables such as the dummy variable for ownership in our case and therefore, it cannot be interpreted. Additionally, the positive sign of the lagged dependant variables also points out the dynamic persistence of the NPLs in this region. Nonetheless, the results from this estimation technique allow us to reject the null hypotheses in favor of the alternative hypotheses H<sub>2</sub>, H<sub>3</sub>, H<sub>4</sub>, and H<sub>9</sub>. On the other hand, we fail to reject the null hypothesis and we do not accept the H<sub>5</sub> alternative hypothesis since the estimation produced opposite sign of the inefficiency variable.

#### 4.2.4 Results of the System GMM Estimation

Lastly, the final estimation technique utilized in STATA is the System GMM method and the outcome it produces is displayed in Table 8 below. Besides, the full set of findings in STATA can be found in Appendix J. In addition, as can be noticed from the table, the number of instruments is consistent with abovementioned rule. Thus, 72 instruments were used during the estimation with 98 groups. Besides, this estimation technique is utilized in this study since it increases the efficiency compared to the Difference GMM technique. Also, it does not absorb the dummy variables such as in the previous estimation technique and it allows us to investigate the relationship between the ownership of the banks and the level of NPLs.

Table 8. Results from the System GMM Estimation

Independent Variables	Coefficient	Standard Error	P> t
Lagged NPL	0.819164	0.0427349	***0.000
Capital Adequacy (car)	0.023647	0.0770790	0.759
Return on Assets (roa)	-0.460652	0.2714956	*0.090
Loans to Deposits (ltd)	0.018158	0.0172169	0.292
Inefficiency (inef)	-0.002369	0.0670731	0.972
Ownership	-1.153808	0.9439584	0.222
GDP (gdp)	-0.213818	0.0838195	***0.011
Inflation Rate (inf)	0.066855	0.1280145	0.602
Public Debt (debt)	-0.013275	0.0134147	0.323
Government budget (fiscal)	-0.020918	0.1416145	0.883
Unemployment Rate (unem)	0.009222	0.0333164	0.782
<b>Number of Groups: 98</b> <b>Number of Instruments: 72</b> <b>Prob &gt; chi2 = 0.000</b>			

Note. \* Denote significance at 10% respectively.

\*\*Denote significance at 5% respectively.

\*\*\*Denote significance at 1% respectively.

Source: Own calculations via STATA 13

As the results in Table 8 indicate, it is notable that the System GMM method produces fewer variables as statistically significant and potentially shaping the intensity of the non-performing loans compared to the previous two estimation techniques. More specifically, statistical significance is discovered only for the lagged version of the dependent variable, the ROA ratio and the GDP annual growth rate of the countries.

To begin with, the lagged version of the NPL once again examines strong positive impact on the dependent variable and also statistical significance at 1%. This finding is consistent with the results from the studies of Jimenez and Saurina (2006), Dash and Kabra (2010), and Misra and Dhal (2010) as they all observed positive correlation. Besides, the coefficient implies the dynamic persistence of the non-performing loans in the CEE region and the values in both estimation techniques imply the possibility of prolonged effect on the CEE banking system in a case of shock in the NPL, as was argued in the previous section. In addition, the coefficient estimated denotes value of 0.82 indicating that one unit increase in the non-performing loans in the previous year will cause increase in the non-performing loans of 0.82 units.

Furthermore, with this estimation it is also provided another support of the reverse and statistically significant influence of the level of the ROA profitability ratio of the banks on the shape of the non-performing loans in their portfolios. Once again, this variable reveals negative relationship with the non-performing loans as it was expected. More specifically, one unit change in this ratio will cause a change of 0.5 units in the NPL ratio in the opposite direction. Additionally, the estimation reveals statistical significance at 10% for this independent variable. Moreover, the arguments supporting this outcome might include that with the deterioration in this profitability ratio, the banks might engage in riskier activities with aim to enhance the bank's profitability and to return the ROA ratio back on its increasing track. Consequently, it is very likely that these riskier activities will lead to increase in the NPLs. In addition, this result reinforces the bad management hypothesis once again. However, this rationalization is also corroborated by Louzis et al. (2010), Makri et al. (2014), Messai and Jouini (2014) and Selma and Jouini (2013).

Next, the System GMM is the only estimation technique in this study that does not omit the dummy variable for ownership. Actually, the result for this variable offers answer to one of the main research question in this master thesis. In particular, one of the objectives is to investigate whether the type of ownership of banks influence the emergence of non-performing loans in the CEE region. Since the dummy variable does not reveal statistical significance in the estimation, it indicates that whether the banks are under domestic or foreign ownership, it is not related with the levels of NPLs in this region. This is very important since one of the main characteristics of the CEE region is the high level of foreign ownership meaning that a large number of the banks are subsidiaries of foreign banks, especially the Austrian and Italian banks. The foreign ownership started to expand in the period of the transition of the CEE countries in the last two decades. Actually, the common undercapitalized banks were supported by the foreign banks which entered the CEE market and subsequently, the banks started to extensively issue loans. Then the region was considerably hit by the crisis and as a result a lot of non-performing loans emerged (Kutasi,

2014). However, our estimation does not show statistically significant correlation between the ownership of the banks affecting the rise of the NPLs of the banks. But, the foreign ownership could possibly help the banks in regards with their liquidity since their foreign parent bank can easily lend them funds in case of emergency. Also, it is worth mentioning that one drawback is that the ownership variable is taken as time invariant or time constant variable. This indicates that the ownership is not observed for every year of the period included in a chance the ownership has been changed. However, that is beyond the scope of this study.

As a final point, the last statistical significant variable from the System GMM estimation is the GDP annual growth which displays significance at a level of 1% with 0.011 of p-value. Also, it once again supports the negative correlation with the non-performing loans in the CEE region aligned with the results from Makri et al. (2014), Skarica (2013), Us (2016), Fofack (2005) and Salas and Saurina (2002). The sign of these variables fulfill our expectations as well and one unit change in the GDP will lead to 0.214 units change in the opposite direction in the NPL ratio. This means that when the economy is booming, the income of the people is also increasing and they have more cash flows to repay their outstanding debts. Conversely, in time of economic recession, when the GDP falls, the wages are as well disrupted and the people are left with less income needed for meeting their loan obligations. Consequently, it influences the level of the non-performing loans and they increase substantially (Makri et al., 2014).

Moreover, with reference to the Table 8 above, the rest of the variables show signs of the coefficients in accordance with the earlier expectations and predictions presented in Table, with some exceptions. However, all these variables do not verify statistical significance and for that reason, they do not take place in the discussion and interpretation of the estimation results.

To sum up, the final results from the System GMM estimation point out that the non-performing loans in the CEE region from 2008 to 2015 were determined by some bank-specific variables included into the model and also by macroeconomic variables. This probably means that there is still need of improving the structure of the banking sector in these 15 countries and also, need of enhancing the quality of the banks' management which can be crucial in the determination of the non-performing loans, as it is observed through the results interpreted previously. Additionally, the deteriorated macroeconomic conditions in the CEE region from the crisis also influence the high levels of NPLs in this region which is reflected through the statistical significance of the GDP variables. Lastly, the considerable level of foreign investors in this region does not impact the shaping of the non-performing loans. Subsequently, we fail to reject the null hypothesis and we do not accept the last hypothesis  $H_{10}$  that the foreign banks have fewer NPLs than domestic banks since the results show that the ownership of the bank does not matter for the level of NPLs. Finally, we reject the null hypotheses in favor of the alternative hypotheses  $H_3$  and  $H_6$  according to the results and the signs of the return on assets and GDP respectively.

#### 4.2.5 Comparison of the Results

Table 9. Comparison of the Results

	Fixed Effects		Difference GMM		System GMM	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
<b>NPL<sub>t-1</sub></b>			0.656574	***0.000	0.819164	***0.000
<b>CAR</b>	0.158792	***0.006	0.534100	***0.000		
<b>ROA</b>	-1.208133	***0.000	-1.010250	***0.016	-0.460652	*0.090
<b>LTD</b>			0.057774	*0.071		
<b>INEFF</b>	-0.147098	***0.019	-0.296487	***0.003		
<b>OWN</b>						
<b>GDP</b>					-0.213818	***0.011
<b>INFL</b>	-0.408662	***0.000				
<b>DEBT</b>	0.065905	**0.028				
<b>FISCAL</b>	0.365365	***0.010				
<b>UNEMPL</b>	0.647947	***0.000	0.477437	*0.013		

Note. \* Denote significance at 10% respectively.

\*\*Denote significance at 5% respectively.

\*\*\*Denote significance at 1% respectively.

Source: *Own calculations via STATA 13*

In Table 9, all the results obtained from the three different estimation techniques: fixed effects, Difference GMM and System GMM, are combined together with the value of the coefficients and the p-values indicating the statistical significance of the variables. The estimations for the overall period suggest that the selection of the independent variables is plausible and most of the regressors yield statistically significant coefficients, which also have the expected signs. Additionally, the first two estimation techniques produce quite similar results while the third estimation technique demonstrates quite different results. Also, the first two estimations produce larger number of significant variables compared with the last estimation technique.

Firstly, from the table above, it can be observed that the profitability ratio ROA yields statistical significance in all three estimation techniques although the level of significance is weakening from the first estimation technique until the last one in which shows significance at 10% level. The interpretation of this ratio is that it is in a negative correlation with the NPL ratio due to the reason that highly profitable banks might have less incentive to engage in riskier activities such as issuing risky loans in order to generate more income which can lead to increase in the non-performing loans. Besides, this outcome once again supports the bad management hypothesis for the banks and the argument that the banks' profitability and decision making process significantly impacts the volume of NPLs in the CEE region. Additionally, the result is in line with the evidence provided from past studies discussed previously.



Secondly, from the Table 9 above can be noticed that the variables capital adequacy, inefficiency and the unemployment are statistically significant in the first two estimations. In fact, in the both models, the coefficients of these variables impact the shape of the NPLs in significance level of 1% which indicates a strong statistical significance of these three variables.

So, the capital adequacy ratio is considered as a significant factor with the fixed effects estimation and also the difference GMM estimations positively impacting the NPLs. In that sense, the unemployment factor also shows strong statistical significance at 1% and the correlation with the dependant variable in the same direction, yet the significance is displayed with the fixed effects and difference GMM methods. It also signals that the considerably high levels of unemployed people in this region impact the high levels of non-performing loans.

What is more, another variable that signals statistical significance from the first two alternative techniques is the inefficiency ratio. Despite the fact that it does not confirm our expectations, the sign remains in negative correlation during the both estimations. However, the results for this variable reinforce the assumption for the cost efficiency of the banks influencing the NPLs and over again, this point out the quality of the bank's management as crucial factor for their loan's portfolio quality and subsequently for the level of non-performing loans in the CEE region.

Moreover, the results for the lagged version of the dependent variable also present positive correlation with the NPL ratio and shows strong statistical significance in both of the models that estimated its coefficient. The high positive and statistical significances of the lagged dependent variable in both models also confirm the dynamic character of the models' specification. The values of lagged NPLs between 0.66 and 0.82 suggest that a shock to NPLs would be likely to have a prolonged effect on the banking system of the CEE region. Again, it supports the evidence from the vast literature and it indicates the dynamic persistence of the NPLs in the CEE region from 2008 to 2015.

Furthermore, it is quite interesting that some of the macroeconomic variables show statistical significance only within the first estimation. Such variables are the inflation, the public debt and the government budget variable signaling strong statistical significance. While some of the bank-specific variables reveal statistical significance only within the second estimation technique or the difference GMM. For instance, the loans to deposits ratio demonstrates positive relationship in line with our initial beliefs. Moreover, the third system GMM estimation illustrates strong reverse and statistically significant relationship between the GDP and the NPL ratio. This variable demonstrates some influence on the non-performing loans only during this estimation. Lastly, the third estimation also discloses the effect of the type of ownership of the banks on the shaping of the non-performing loans, but still it does not yield statistical significance of the dummy variable for the ownership of the banks' capital.

Besides, the main research questions imposed in this master thesis need to be answered once again shortly and concisely. First, regarding the first question, the answer is that in this period the non-performing loans in the CEE region are generally shaped by the bank-specific

factors. Second, the factors that demonstrate statistically significant and positive correlation with the NPLs ratio are the following: the lagged non-performing loans ratio, capital adequacy and loans to deposits ratio from the group of bank-specific factors, and the public debt, government budget and unemployment rate from the group of macroeconomic factors. Also, the signs of these variables are in line with the initial expectations. Third, negative and statistically significant correlation demonstrate the following factors: return on assets and inefficiency from the first group of factors and GDP annual growth and inflation from the second group of factors. In addition, the signs of these variables are aligned with the initial anticipations, except for the inefficiency. Moreover, the answer to the fourth question is that the results do not show any relationship between the type of ownership of the banks and the NPLs level. This means that it does not matter whether the bank has domestic or foreign owners, it does not impact its level of NPL ratio. Finally, there is also a solid persistence level of NPLs in the Central and Eastern European region, which is actually the answer to the fifth and last research question of the master thesis.

Further, in terms of the research hypotheses imposed in the introduction of this study, most of the hypotheses can be accepted. More specifically, the hypotheses that involve the kind of the relationship between the factors and the NPL ratio are all accepted except for the H<sub>5</sub> due to the obtained result of negative impacts instead of positive impact as structured in the hypothesis. This means that we reject the null hypotheses in favor of the alternative hypotheses H<sub>2</sub>, H<sub>3</sub>, H<sub>4</sub>, H<sub>6</sub>, H<sub>7</sub>, H<sub>8</sub> and H<sub>9</sub>. Also, the first null hypothesis is rejected in favor of the alternative hypothesis since more of the bank-specific factors demonstrate statistical significance compared to the macroeconomic factors as was mentioned previously. Lastly, once again we fail to reject the last null hypothesis since the dummy variable does not yield statistical significance and does not indicate a relationship between the bank's ownership and level of NPLs.

In summary, it can be argued that in the period of 2008 to 2015 the design of the non-performing loans was mostly shaped by the bank-specific factors. Even though the global crisis left a legacy of severe consequences in these 15 countries and to some extent impacted the non-performing loans, still the bank industry in this specific region needs advanced development and further enhancement of the quality of the management and their decision-making process which could eventually affect the level of the non-performing loans. In addition, although less macroeconomic variables demonstrate statistical significance during the estimation, it still implies that some macroeconomic factors of this region influence the level of non-performing loans to some levels, especially the unemployment rate which is relatively high in this region. Supplementary elaboration of this rationalization and merger of the theoretical analysis of the CEE region's banking industry and the obtained empirical results is presented further in the conclusion.

## CONCLUSION

So, the main objective in this master thesis is the investigation of the key determinants of the non-performing loans in the Central and Eastern European countries. The research is conducted through three different estimation techniques in order to obtain broader group of results across which a substantial comparison can be included and also, to check the robustness of our results. In addition, the diversity of the main research questions of the thesis also requires different estimation techniques since not all research questions can be answered through only one estimation technique.

However, the general conclusion for the banking industry of the Central and Eastern European region can comprise the sluggish development of this industry due to the transition process that symbolized these countries in the past two decades and to some extent the banking industry is still progressing in some of the countries. Moreover, the banking industry is generally characterized by high concentration reflected through the small number of larger banks holding the majority of banking assets and also, high presence of foreign ownership in the banks in these countries. What is more, another common feature of these countries is the noteworthy effect that the global crisis of 2008 left on their overall economies. The economic recovery was slow and weak with subdued credit growth and high extent of unemployment and some of the countries went back on the economic growth track in the past three years. The high levels of non-performing loans and their persistence is another common characteristic that shapes the banking industry in the CEE region. From the analysis of the CEE banking sector, it can be concluded that high share of loans denominated in foreign currency is also present in this region and that those countries with such lowest shares demonstrate the lowest levels of NPLs such in the cases of Czech Republic and Slovakia since they were less exposed to the foreign exchange risk. Nonetheless, it should be considered that even though these specific countries belong to one region, there are considerable dissimilarities between them. For instance, not all of them are EU-member countries and not all of them are part of the Eurozone. This means that some of them differ in terms of different currency adoption, different monetary policies and different regulations and standards in the overall financial industry. In addition, the definition and the reporting of the non-performing loans can also vary across these CEE countries. Therefore, all these discrepancies should be taken into account when considering the interpretation of the results obtained from the empirical part.

Furthermore, from the empirical part of the thesis we can see that relatively different results are shown through the three alternative estimation techniques. The general conclusion that can be drawn is that in this specified period the non-performing loans in this specified region were mostly shaped by bank-specific factors and also, the presence of high unemployment in this region affected the NPLs to a large degree. Additionally, the remaining high levels of NPLs and their persistence in this region are also confirmed with the analysis.

To sum up, the levels of non-performing loans in this region are largely affected by the characteristics of the banking sector which means that the slow transition process has left certain legacy in the banking sector and also the still on-going development process of the

financial markets to certain extent impacts the shaping of the non-performing loans. Consequently, this implies that there is still need of further improvement of the performance and operation of the banks in this region including the enhancement of the quality of the management and their decision-making process. Finally, the GDP and the unemployment rate also demonstrate evident impact on the levels of NPLs implying that besides the specific nature of the CEE region's banking industry, the global crisis also plays a role and has left legacy of high NPLs across the region. And as the economic recovery came in relatively late in this region and yet considered as weak, the persistent non-performing loans still represent an attractive issue that symbolizes the region.

Based on these findings, a recommendation that can be given for diminishing the levels of NPLs in this region is a comprehensive approach which indicates a proactive and cooperative approach of the lenders, borrowers and regulatory bodies combined together. This approach can be one solution for the non-performing loans whether it will include restructuring of the banks, constraining the borrowing criteria or stricter monitoring and screening processes imposed on the borrowers and on the banks by the regulatory bodies as well. In addition, a stimulus to the economic growth and the employment rate is another different approach that should be taken into consideration in this region. To conclude, the banks in general should broaden their credit risk assessments, enhance the evaluation of the existing processes and outstanding loans and also, reconsider the modern loan repayment practices.

Finally, a recommendation for future researches can be investigating the determinants of the non-performing loans with inclusion of broader choice of variables such as the exchange rate which might show great importance in this region, also the lending rate and the size of the banks. Another direction for further research can be extending the time period and analyzing the NPLs separately in the pre-crisis and post-crisis period and comparing the results subsequently to investigate whether the crisis changed some determinants of the NPLs. This could give more vivid picture to the policymakers of the changes caused from the aftermath of the crisis and focus on improving those things and as a result promoting financial stability. Finally, further work may include this same analysis but for separate loan categories and the results might point out the different incentives for repayment of different loan categories due to structural factors. In this sense, such findings could help the policymakers to identify the loan categories that are mostly generating non-performing loans and consequently, to concentrate on those categories in order to influence the levels of non-performing loans and achieve enhanced financial stability.

## REFERENCE LIST

1. Abid, L., Ouertani, M. N., & Zouari-Ghorbel, S. (2014). Macroeconomic and bank-specific determinants of household's non-performing loans in Tunisia: A dynamic panel data. *Procedia Economics and Finance*, 13, 58-68.
2. Ahmad, N. H., & Ariff, M. (2007). Multi-country study of bank credit risk determinants. *International Journal of Banking and Finance*, 5(1), 6.
3. Andries, A. M., & Nistor Mutu, S. (2016). Systemic Risk and Foreign Currency Positions of Banks: Evidence from Emerging Europe. Retrieved April 15, 2017, from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2892230](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2892230)
4. Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277-297.
5. Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1), 29-51.
6. Arpa, M., Giulini, I., Ittner, A., & Pauer, F. (2001). The influence of macroeconomic developments on Austrian banks: implications for banking supervision. *Bank for International Settlements Papers*, 1, 91-116.
7. Aver, B. (2008). An empirical analysis of credit risk factors of the Slovenian banking system. *Managing Global Transitions*, 6(3), 317.
8. Balgova, M., Nies, M., & Plekhanov, A. (2016). The economic impact of reducing non-performing loans. *European Bank for Reconstruction and Development Working Paper*, 193.
9. Baltagi, B.H. (2003). *A Companion to Theoretical Econometrics*. Oxford: Blackwell Publishing Ltd.
10. Baltagi, B.H. (2008). *Econometric analysis of panel data (Vol. 1)*. England: John Wiley & Sons.
11. Bank of Estonia. (2013). *Review of the Estonian Financial System*. Tallinn: Bank of Estonia.
12. Bank of Lithuania. (2016). *Banking Activity Review 2015*. Vilnius: Bank of Lithuania.
13. Baum, C. F. (2006). *An introduction to modern econometrics using Stata*. College Station, TX: Stata press.
14. Beck, R., Jakubik, P., & Piloju, A. (2013). Non-performing loans: What matters in addition to the economic cycle? *ECB Working Paper Series*, 1515.
15. Beck, T., & Levine, R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking & Finance*, 28(3), 423-442.
16. Benczes, I. (2008). *Trimming the Sails: The Comparative Political Economy of Expansionary Fiscal Consolidations: a Hungarian Perspective*. Budapest: Central European University Press.
17. Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, 21(6), 849-870.

18. Bholat, D. M., Lastra, R. M., Markose, S. M., Miglionico, A., & Sen, K. (2016). Non-performing loans: regulatory and accounting treatments of assets. *Bank of England Working Paper*, 594.
19. Blundell, R., Bond, S., Devereux, M., & Schiantarelli, F. (1992). Investment and Tobin's Q: Evidence from company panel data. *Journal of Econometrics*, 51(1/2), 233-257.
20. Bofondi, M., & Ropele, T. (2011). Macroeconomic determinants of bad loans: evidence from Italian banks. *Bank of Italy Occasional Paper*, 89.
21. Bond, S. R. (2002). Dynamic panel data models: a guide to micro data methods and practice. *Portuguese economic journal*, 1(2), 141-162.
22. Bonin, J. P. (2004). Banking in the Balkans: the structure of banking sectors in Southeast Europe. *Economic systems*, 28(2), 141-153.
23. Boshkoska, M. (2013). The profitability of banking sector in Republic of Macedonia. *International Journal of Economics and Finance*, 5(3), 143.
24. Bottazzi, G., De Sanctis, A., & Vanni, F. (2016). Non-performing loans, systemic risk and resilience in financial networks (2016/08). *Laboratory of Economics and Management (LEM)*. Pisa: Sant'Anna School of Advanced Studies.
25. Boudriga, A., Taktak, N. B., & Jellouli, S. (2010, September). Bank specific, business and institutional environment determinants of banks nonperforming loans: evidence from MENA countries. *Economic Research Forum, Working Paper*, 547, 1-28.
26. Casu, B., Girardone, C., & Molyneux, P. (2006). *Introduction to Banking*. Essex: Pearson Education Limited.
27. Cetorelli, N., & Goldberg, L. S. (2011). Global banks and international shock transmission: Evidence from the crisis. *IMF Economic Review*, 59(1), 41-76.
28. Cevik, N. K., Dibooglu, S., & Kutun, A. M. (2016). Real and financial sector studies in Central and Eastern Europe: A Review. *Finance a Uver*, 66(1), 2.
29. Cheng, L. K., & Kwan, Y. K. (2000). What are the determinants of the location of foreign direct investment? The Chinese experience. *Journal of international economics*, 51(2), 379-400.
30. Constant, F. D., & Ngomsa, A. (2012). Determinants of bank long-term lending behavior in the Central African Economic and Monetary Community (CEMAC). *Review of Economics & Finance*, 2, 107-114.
31. Cotugno, M., Stefanelli, V., & Torluccio, G. (2013). Relationship lending, default rate and loan portfolio quality. *Applied Financial Economics*, 23(7), 573-587.
32. Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. *Handbook of mixed methods in social and behavioral research*, 209-240.
33. Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: SAGE Publications, Inc.
34. Dash, M. K., & Kabra, G. (2010). The determinants of non-performing assets in Indian commercial bank: An econometric study. *Middle Eastern Finance and Economics*, 7(94), 106.

35. Dimitrios, A., Helen, L., & Mike, T. G. (2016). Non-performing loans in the euro area: are core-periphery banking markets fragmented? *Bank of Greece Working Paper*, 219.
36. European Banking Authority. (2014). *EBA Final draft Implementing Technical Standards*. Retrieved March 23, 2017, from <https://www.eba.europa.eu/documents/10180/449824/EBA-ITS-2013-03+Final+draft+ITS+on+Forbearance+and+Non-performing+exposures.pdf>
37. European Banking Authority. (2016). *EBA Report on the Dynamics and Drivers of Non-performing Exposures in the EU Banking Sector*. Retrieved March 25, 2017, from <https://www.eba.europa.eu/documents/10180/1360107/EBA+Report+on+NPLs.pdf>
38. Erdinç, D., & Gurov, A. (2016). The Effect of Regulatory and Risk Management Advancement on Non-Performing Loans in European Banking, 2000–2011. *International Advances in Economic Research*, 22(3), 249-262.
39. Espinoza, R. A., & Prasad, A. (2010). Nonperforming loans in the GCC banking system and their macroeconomic effects. *IMF Working Papers*, 1-24.
40. European Banking Coordination “Vienna” Initiative. (2012). *Working Groups on NPLs in Central, Eastern and Southeastern Europe*. Retrieved February 13, 2017, from <https://www.imf.org/external/region/eur/pdf/2012/030112.pdf>
41. European Commission. (2015a, February 26). *Country Report Romania 2015*. Brussels: European Commission.
42. European Commission. (2015b, February 26). *Country Report Slovenia 2015*. Brussels: European Commission.
43. European Commission. (2016, March 3). *Country Report Croatia 2016*. Brussels: European Commission.
44. Fiala, T., & Havranek, T. (2017). The sources of contagion risk in a banking sector with foreign ownership. *Economic Modelling*, 60, 108-121.
45. Fofack, H. (2005). Nonperforming loans in Sub-Saharan Africa: causal analysis and macroeconomic implications. *World Bank Policy Research Working Paper*, 3769.
46. Greene, W. H. (2008). The econometric approach to efficiency analysis. *The measurement of productive efficiency and productivity growth*, 1, 92-250.
47. Gujarati, D.N. & Porter, D. C. (2009). *Basic Econometrics* (5th Ed.). Boston, MA: McGraw-Hill/Irwin.
48. Hall, A. R. (2005). *Generalized Method of Moments*. New York, NY: Oxford University Press Inc.
49. Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica: Journal of the Econometric Society*, 1029-1054.
50. Hyde, A. C. (2002). *Government budgeting: theory, process, and politics*. Toronto: Wadsworth Publishing Company.
51. International Monetary Fund. (2015a). *Bosnia and Herzegovina: Financial Sector Assessment Program (IMF Country Report No. 15/124)*. Washington, D.C.: International Monetary Fund.

52. International Monetary Fund. (2015b). *Bulgaria: Financial Sector Assessment Program (IMF Country Report No. 15/29)*. Washington, D.C.: International Monetary Fund.
53. International Monetary Fund. (2016). *Montenegro: Financial Sector Assessment Program (IMF Country Report No. 16/88)*. Washington, D.C.: International Monetary Fund.
54. Islam, M., & Nishiyama, S. I. (2016). The determinants of non-performing loans: dynamic panel evidence from South Asian countries. *DSSR Discussion Papers*, 64, 1-34.
55. Jimenez, G., Salas, V., & Saurina, J. (2006). Determinants of collateral. *Journal of financial economics*, 81(2), 255-281.
56. Judge, G. G., Hill, R. C., Griffiths, W., Lutkepohl, H., & Lee, T. C. (1988). *Introduction to the Theory and Practice of Econometrics*. New York, NY: John Wiley and Sons.
57. Kjosevski, J., & Petkovski, M. (2016). Non-performing loans in Baltic States: determinants and macroeconomic effects. *Baltic Journal of Economics*, 1-20.
58. Klein, N. (2013). Non-performing loans in CESEE: Determinants and impact on macroeconomic performance. *IMF Working Paper 13/72*.
59. Kohler, U., & Kreuter, F. (2016). *Data Analysis Using Stata*. Berlin: Walter de Gruyter GmbH & Co KG.
60. Korinek, A., & Kreamer, J. (2014). The redistributive effects of financial deregulation. *Journal of Monetary Economics*, 68, S55-S67.
61. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Delhi: New Age International (P) Ltd., Publishers.
62. Kutasi, G. (2014). Financial Integration of the CEE banking sector. *ISES Working Papers 2014(15)*.
63. Lapteacru, I. (2014). Do more competitive banks have less market power? The evidence from Central and Eastern Europe. *Journal of International Money and Finance*, 46, 41-60.
64. Lapteacru, I. (2017). Market power and risk of Central and Eastern European banks: Does more powerful mean safer? *Economic Modelling*, 63, 46-59.
65. Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance*, 36(4), 1012-1027.
66. MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate behavioral research*, 39(1), 99-128.
67. Makri, V., Tsagkanos, A., & Bellas, A. (2014). Determinants of non-performing loans: The case of Eurozone. *Panoeconomicus*, 61(2), 193.
68. Messai, A. S., & Jouini, F. (2013). Micro and macro determinants of non-performing loans. *International Journal of Economics and Financial Issues*, 3(4), 852.
69. Mileva, E. (2007). Using Arellano-Bond dynamic panel GMM estimators in Stata. *Economics Department, Fordham University*, 1-10.



70. Mishkin, F. S. (2007). *The Economics of Money, Banking and Financial Markets* (8th ed.). Boston, MA: Pearson Education.
71. Misra, B. M., & Dhal, S. (2010). Pro-cyclical management of banks' non-performing loans by the Indian public sector banks. *BIS Asian Research Papers*.
72. National Bank of the Republic of Macedonia. (2012). *Macroeconomic Determinants of Non-Performing Loans in Macedonian Banking System – Panel Data Analysis*. Skopje: National Bank of the Republic of Macedonia.
73. National Bank of Serbia. (2015). *Banking Sector in Serbia: Second Quarter Report 2015*. Belgrade: National Bank of Serbia.
74. Organisation for Economic Co-operation and Development [OECD]. (2015). *Economic Surveys Slovenia*. Paris: OECD.
75. OECD. (2016). *Latvia: Review of the Financial System*. Paris: OECD.
76. Pindyck, R.S. & Rubinfeld D. L. (1998). *Econometric Models and Economic Forecasts*: Fourth Edition. Boston: Irwin/McGraw-Hill.
77. Psillaki, M., & Mamatzakis, E. (2017). What drives bank performance in transitions economies? The impact of reforms and regulations. *Research in International Business and Finance*, 39, 578-594.
78. Raiffeisen Bank Research. (2016). *CEE Banking Sector Report*. Vienna: Raiffeisen Bank International AG.
79. Reinhart, C., & Rogoff, K. (2010). Debt and growth revisited. *MPRA Paper*, 24376.
80. Rengasamy, D. (2014). Impact of Loan Deposit Ratio (LDR) on Profitability: Panel Evidence from Commercial Banks in Malaysia. *Third International Conference on Global Business, Economics, Finance and Social Sciences* (pp. 19-21). Mumbai: GB14 Mumbai Conference.
81. Rinaldi, L., & Sanchis-Arellano, A. (2006). Household debt sustainability: what explains household non-performing loans? An empirical analysis. *ECB Working Paper*, 570.
82. Roodman, D. (2006). How to do xtabond2: An introduction to difference and system GMM in Stata. *Center for Global Development Working Paper*, 103.
83. Salas, V., & Saurina, J. (2002). Credit risk in two institutional regimes: Spanish commercial and savings banks. *Journal of Financial Services Research*, 22(3), 203-224.
84. Skarica, B. (2013). Determinants of Non-Performing Loans in Central and Eastern European Countries. *EFZG Working Paper Series*, 07, 1-19.
85. Shu, C. (2002). The impact of macroeconomic environment on the asset quality of Hong Kong's banking sector. *Hong Kong Monetary Authority Research Memorandums*, 1-26.
86. StataCorp. (2013). *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP.
87. Us, V. (2017). A dynamic approach to analysing the effect of the global crisis on nonperforming loans: evidence from the Turkish banking sector. *Applied Economics Letters*, 24(3), 186-192.
88. Walliman, N. (2010). *Research methods: The basics*. Abingdon: Routledge.

## **APPENDIXES**



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## **APPENDIX A: List of Abbreviations**

AR – Arrelano-Bond tests for autocorrelation

BAMC – Bank Asset Management Company

CAR – Capital Adequacy Ratio

CEE – Central and Eastern Europe

CESEE – Central, Eastern and Southeastern Europe

CEMAC - Central African Economic and Monetary Community

CPI – Consumer Price Index

EBA – European Banking Authority

EBCI – European Banking Coordination Initiative

EU – European Union

FE – Fixed Effects

GCC – Gulf Cooperation Council

GDP – Gross Domestic Product

GMM – Generalized Method of Moments

IMF – International Monetary Fund

INEF – Inefficiency

INF – Inflation

LM – Lagrange Multiplier

LSDV – Least Squares Dummy Variable

LTD – Loans to Deposits

MENA – Middle East and North Africa

NKBM – Nova Kreditna Banka Maribor

NLB – Nova Ljubljanska Banka

NPL – Non-Performing Loans

OECD – The Organization for Economic Co-operation and Development

OLS – Ordinary Least Squares

RE – Random Effects

ROA – Return on Assets

ROE – Return on Equity

SEE – Southeastern Europe

UK – United Kingdom

UNEM - Unemployment

VAR – Vector Autoregression

VIF – Variance Inflation Factor

## APPENDIX B: Definition of NPL across Countries

Table 1. NPL's Definitions across Countries

Country	Definition
Bosnia	NPL are loans, which do not provide revenues. Bank has to consider loans as NPL if: a) the principal and/or interest are due, and have not been collected for over 90 days after the original maturity date, therefore they are classified as: Substandard, Doubtful and Loss and b) beneficiary's interest debt, due for over 90 days after the original maturity date, is capitalized.
Bulgaria	Standard loans are defined as past-due less than 30 days, and watch loans as past-due between 31 and 90 days or when the debtor's financial state may deteriorate to an extent that calls the full repayment of the obligation into question. Non-performing loans are defined as past-due 91 to 180 days or when the debtor's financial state has substantially deteriorated and may result in inability to repay his obligations. Loss loans are defined past-due over 180 days or when the debtor suffers a permanent shortage of money other conditions providing grounds to consider that the risk exposure becomes uncollectible.
Croatia	NPLs are 1) placements for which evidence of partial impairment is identified, i.e. partly recoverable placements (risk categories B-1/B-2/B-3), and 2) placements for which evidence of impairment is identified, equal to their carrying amount, i.e. fully irrecoverable placements (risk category C). Placements mean financial assets in a form of granted loans, debt instruments and other receivables, classified by a credit institution into categories of financial instruments designated as "loans and receivables" and "held-to-maturity investments".
Estonia	Loans which are past due more than 90 days or loans placed in the default category by the lending bank based on other information.
Hungary	Non-performing loans are transactions with more than 90 days delinquency. In the case of corporations we apply a customer view while in the case of households we apply both a customer and a contract view.
Kosovo	NPLs are defined as the loans that are past due over 90 days, that include the "Doubtful" and "Loss" category of loans. According to the Central Bank of the Republic of Kosovo definition doubtful loans include loans that are overdue in repayment 91-180 days and loss loans include the category of loans that are overdue in repayment over 180 days.
Latvia	No explicit definition of NPLs. For analysis purposes loans with 90 days overdue are considered as NPLs.
Lithuania	NPL = not impaired but past due >61 days loans + impaired loans + individual specific allowances + collective specific allowances
Macedonia	The claim (any claim -principal, interest, fees) which has not been collected for more than 90 days after the maturity date, the bank shall record on a special account for non-performing claims - credits, interest, and other claims. The claim may be excluded from the category of non-performing claims only if the portion of the claim that fell due has been collected.
Moldova	Assets/contingent engagements classified as substandard, doubtful and compromised are considered nonperforming
Montenegro	NPLs are considered as loans past overdue more than 90 days, but that is not the only criterion. NPLs correspond to "substandard", "doubtful", and "loss" loans.
Romania	NPLs = Loans past due more than 90 days and/or with legal proceeding initiated. NPL s ratio = Loans and interest past due more than 90 days and/or with legal proceeding initiated, gross exposure per Total loans and interest classified
Slovenia	NPLs cover classified claims with delays over 90 days. Classified claims include financial assets at amortised cost and some risk-bearing off-balance-sheet items on which a payment liability could arise. NPLs definition accounts for the total amount of classified claims (in case that the amount of the overdue customer's liabilities to the bank exceeds EUR 1.000, the number of delays has to be started to count and the entire exposure to customer has to be assigned as non-performing - not only the overdue part).

Source: EBCI, *Working Groups on NPLs in Central, Eastern and Southeastern Europe*, 2012, p. 15.



## APPENDIX C: List of Banks included in the Dataset

Table 2. List of Banks

<b>Bank</b>	<b>Ownership of the Bank</b>
<b>Bosnia and Herzegovina</b>	
1. Addiko Bank	Foreign (Austria)
2. Bosna Bank International d.d	Foreign (Saudi Arabia)
3. Sberbank AD Banja Luka	Foreign (Russia)
4. Ziraat Banka BH d.d.	Foreign (Turkey)
5. Vakufska Banka d.d. Sarajevo	Domestic
6. Bor Banka d.d. Sarajevo	Domestic
7. NLB Banka	Foreign (Slovenia)
8. Raiffeisen Bank BH	Foreign (Austria)
9. ProCredit Bank d.d. Sarajevo	Foreign (Germany)
10. UniCredit Bank a.d. Banja Luka	Foreign (Italy)
11. UniCredit Bank d.d	Foreign (Italy)
12. Spakasse Bank dd	Foreign (Austria)
<b>Bulgaria</b>	
13. CIBANK JSC	Foreign (Belgium)
14. Societe Generale Expressbank	Foreign (France)
15. ProCredit Bank EAD	Foreign (Germany)
16. DSK Bank Plc	Foreign (Hungary)
17. Raiffeisen Bulgaria EAD	Foreign (Austria)
18. Eurobank AD Bulgaria	Foreign
19. UniCredit Bulbank AD	Foreign (Italy)
20. Investbank Pls	Domestic
21. Allianz Bank Bulgaria AD	Domestic
22. United Bulgarian Bank - UBB	Foreign (Greece)
<b>Croatia</b>	
23. Adikko Bank	Foreign (Austria)
24. Sberbank d.d.	Foreign (Russia)
25. Raiffeisenbank Zagreb d.d.	Foreign (Austria)
26. Erste & Steiermärkische Bank d.d.	Foreign (Austria)
27. Hrvatska Postanska Bank d.d.	Domestic
28. Societe Generale – Splitska Banka d.d.	Foreign (France)
29. Istarska Kreditna Banka Umag d.d.	Domestic
30. OTP Banka Hrvatska d.d.	Foreign (Hungary)
31. Zagrebacka Banka d.d.	Foreign (Italy)
32. Kreditna Banka Zagreb	Domestic
33. Partner Banka d.d.	Domestic
34. Veneto Banka d.d.	Foreign (Italy)
35. Privredna Banka Zagreb d.d.	Foreign (Italy)
36. Podravska Banka	Foreign
<b>Czech Republic</b>	
37. Unicredit Bank Czech Republic and Slovakia AS	Foreign (Italy)
38. Raiffeisenbank AS	Foreign (Austria)
<b>Estonia</b>	
39. Tallinn Business Bank Ltd	Domestic

table continues

continued

<b>Bank</b>	<b>Ownership of the Bank</b>
40. SEB Pank	Foreign (Sweden)
41. AS LHV Pank	Domestic
<b>Hungary</b>	
42. Erste Bank Hungary ZRT	Foreign (Austria)
43. Unicredit Bank Hungary ZRT	Foreign (Italy)
<b>Latvia</b>	
44. Trasta Komerbanka-Trust Commercial Bank	Domestic
45. Baltic International Bank	Domestic
46. Baltikums Bank AS	Domestic
47. Swedbank AS	Foreign (Sweden)
48. Meridian Trade Bank AS	Domestic
49. Regional Investment Bank	Domestic
50. Norvik Banka	Foreign (Russia)
51. ABLV Bank AS	Domestic
52. SEB Banka AS	Foreign (Sweden)
53. Rietumu Banka	Domestic
<b>Lithuania</b>	
54. UAB Medicinos Bankas	Domestic
55. Swedbank AB	Foreign (Sweden)
56. AB SEB Bankas	Foreign (Sweden)
57. Siauliu Bankas	Domestic
<b>Macedonia</b>	
58. Halk Bank AD Skopje	Foreign (Turkey)
59. TTK Banka AD Skopje	Domestic
60. Stopanska Banka AD Skopje	Foreign (Greece)
61. Silk Road Bank AD Skopje	Foreign (Switzerland)
62. ProCredit Bank AD Skopje	Foreign (Germany)
63. Sparkasse Bank Makedonija AD	Foreign (Austria)
64. NLB Tutunska Banka AD Skopje	Foreign (Slovenia)
65. Ohridska Banka AD Ohrid	Foreign (France)
66. Komercijalna Banka AD Skopje	Domestic
<b>Montenegro</b>	
67. CKB Banka Ad Podgorica	Foreign (Hungary)
68. NLB Banka AD Podgorica	Foreign (Slovenia)
69. Erste Bank AD Podgorica	Foreign (Austria)
<b>Poland</b>	
70. PKO Bank Polski SA	Domestic
71. Bank Pekao SA	Foreign (Italy)
<b>Romania</b>	
72. Banca Romaneasca S.A.	Domestic
73. Bancpost SA	Foreign (Greece)
74. CEC Bank SA	Domestic
75. Piraeus Bank Romania	Foreign (Greece)
76. OTP Bank Romania SA	Foreign (Hungary)
<b>Serbia</b>	
77. Komercijalna Banka AD Beograd	Domestic
78. Societe Generale Banka Srbija AD	Foreign (France)

table continues

continued

<b>Bank</b>	<b>Ownership of the Bank</b>
79. AIK Banka AD	Domestic
80. Piraeus Bank AD Beograd	Foreign (Greece)
81. Raiffeisen Banka AD Beograd	Foreign (Austria)
82. Halkbank AD Belgrade	Foreign (Turkey)
83. Opportunity Banka a.d. Novi Sad	Foreign
84. Eurobank AD Beograd	Foreign (Greece)
85. Banca Intesa AD Beograd	Foreign (Italy)
86. Erste Bank a.d. Novi Sad	Foreign (Austria)
<b>Slovakia</b>	
87. Unicredit Bank Czech Republic and Slovakia AS	Foreign (Italy)
<b>Slovenia</b>	
88. Dezelna Banka Slovenije dd	Domestic
89. Delavska Hranilnica dd Ljubljana	Domestic
90. Banka Koper d.d.	Foreign (Italy)
91. Postna Banka Slovenje dd	Domestic
92. Gorenjska Banka dd Kranj	Domestic
93. SKB Banka dd	Foreign (France)
94. Raiffeisen Banka dd	Foreign (Austria)
95. Sberbank dd	Foreign (Russia)
96. Nova Kreditna Banka Maribor d.d.	Domestic
97. Nova Ljubljanska Banka d.d.	Domestic
98. Abanka d.d.	Domestic

## APPENDIX D: Number of Observations per Country

Table 3. Number of Observations per Country

<b>Country</b>	<b>Number of observations</b>
Bulgaria	80
Bosnia and Herzegovina	96
Croatia	112
Czech Republic	16
Estonia	24
Hungary	16
Latvia	80
Lithuania	32
Macedonia	72
Montenegro	24
Poland	16
Romania	40
Serbia	80
Slovakia	8
Slovenia	88
<b>Total</b>	<b>784</b>

## APPENDIX E: Calculation of the Variables included in the Model

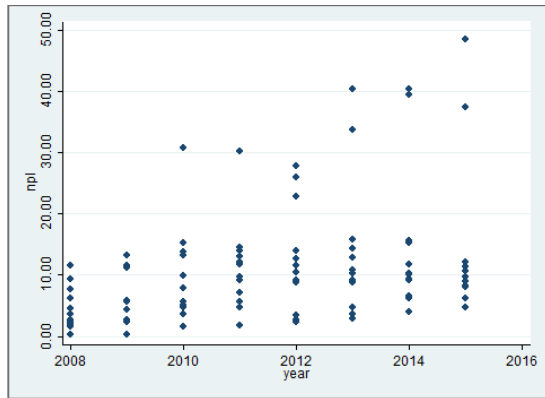
Table 4. Concise Calculation of the Variables

<b>Variable</b>	<b>Calculation</b>
Non-performing Loans Ratio (%)	Non-performing Loans / Total Loans
Capital Adequacy Ratio (%)	Total Capital / Risk Weighted Assets
Return on Assets (%)	Net Income / Average Total Assets
Loans to Deposits Ratio (%)	Total Loans / Total Deposits
Inefficiency Ratio (%)	Non-Interest Expenses / Average Assets

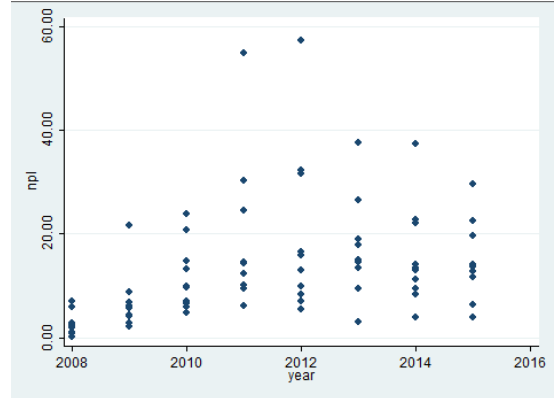
## APPENDIX F: Movement of NPL Ratio across Countries included in the Analysis

Figure 2. NPL Ratio's Movement across Countries

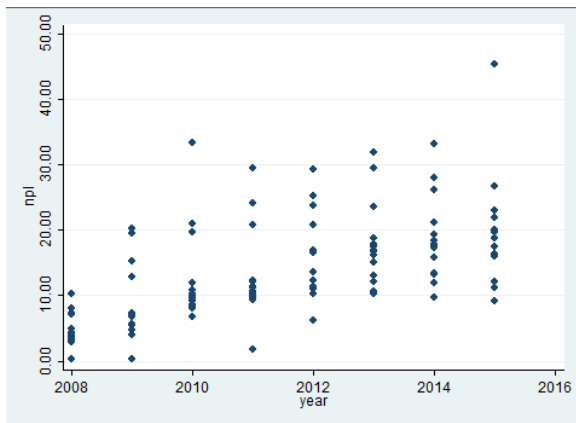
Bosnia and Herzegovina



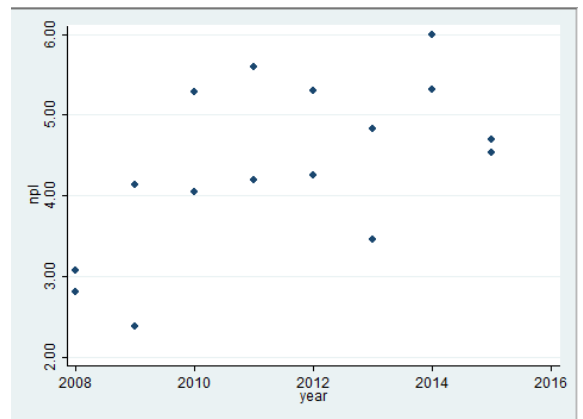
Bulgaria



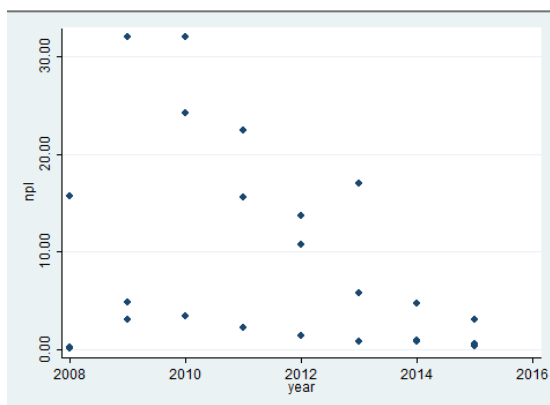
Croatia



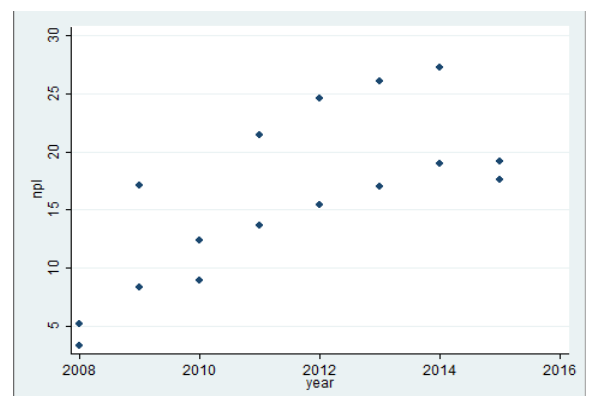
Czech Republic



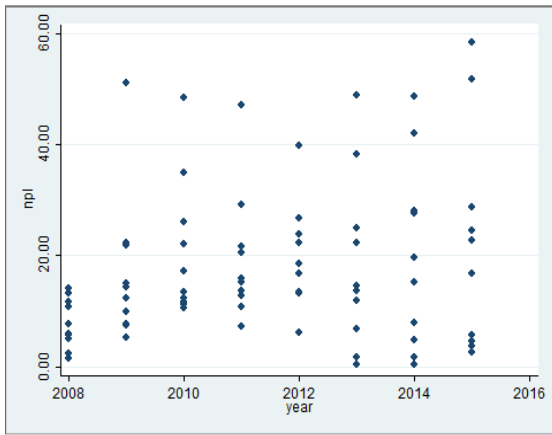
Estonia



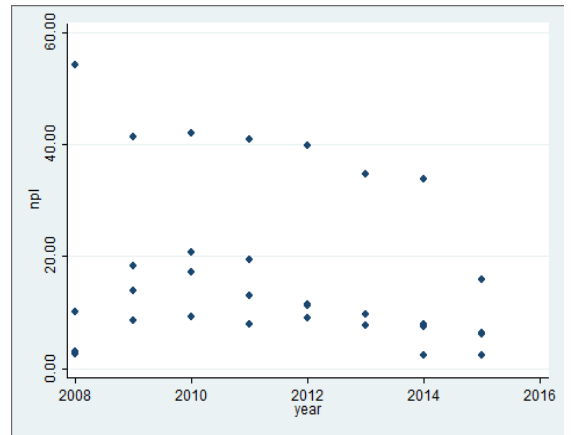
Hungary



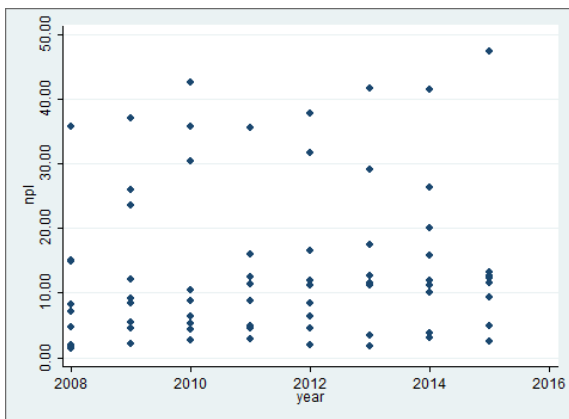
Latvia



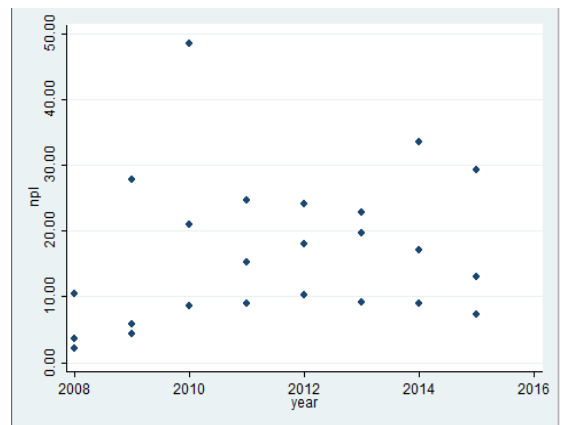
Lithuania



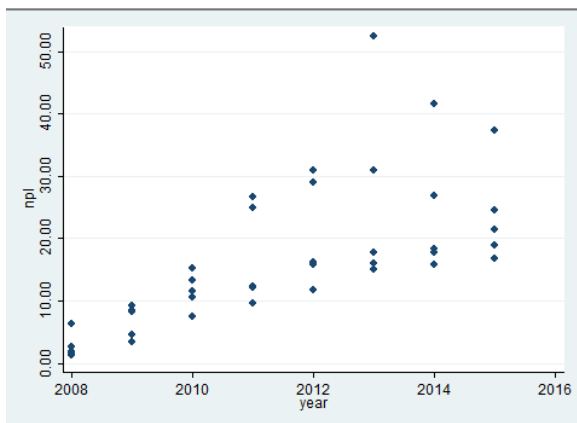
Macedonia



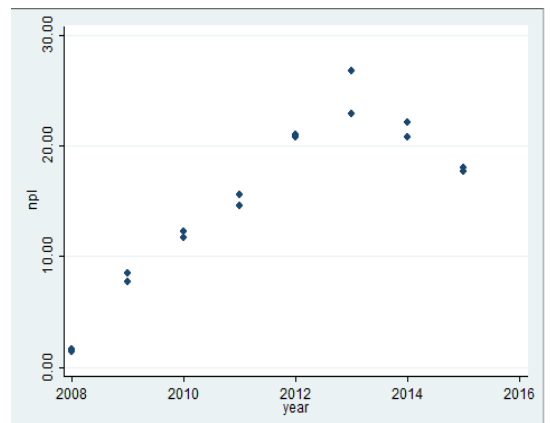
Montenegro



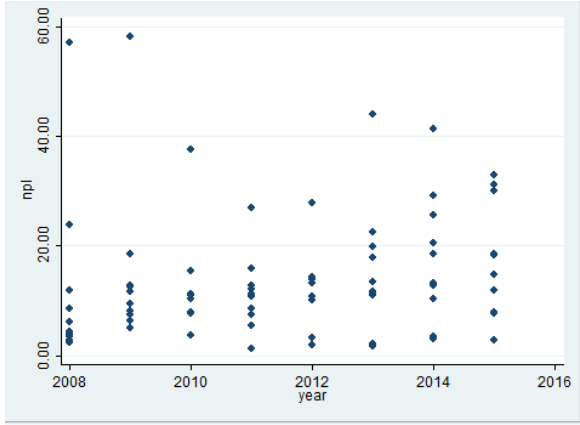
Romania



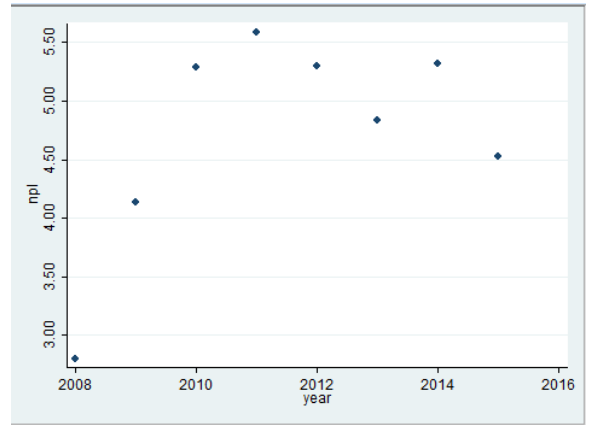
Poland



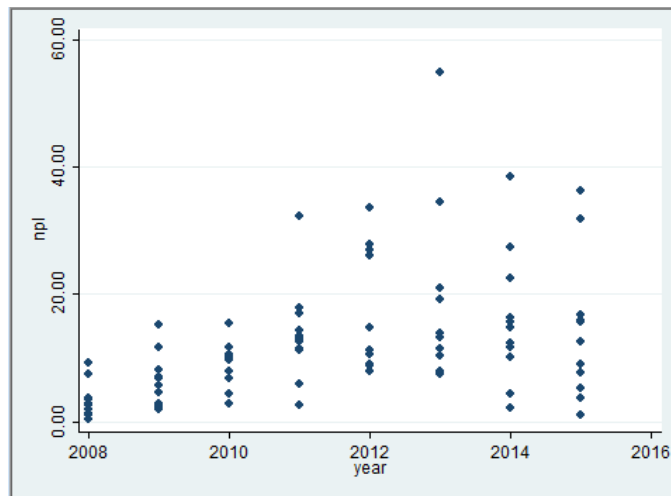
Serbia



Slovakia



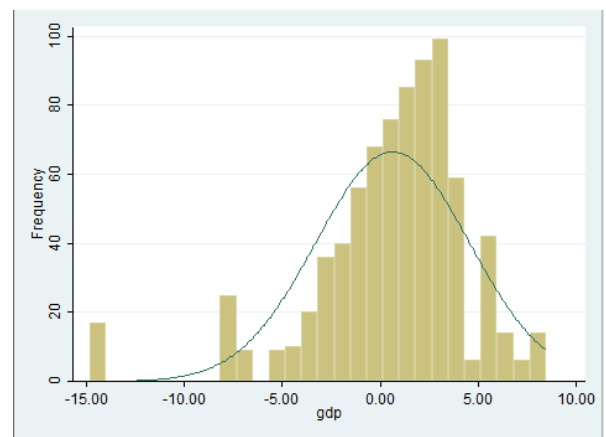
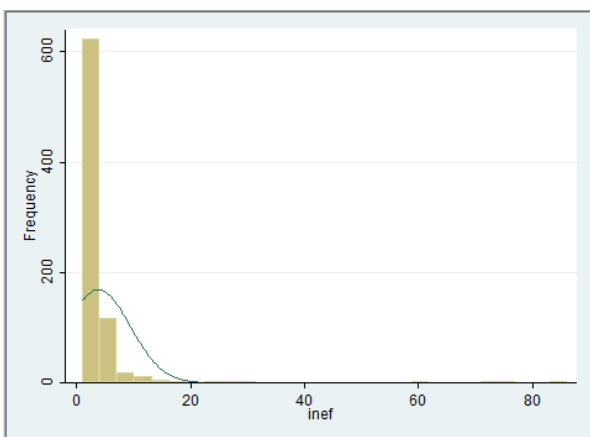
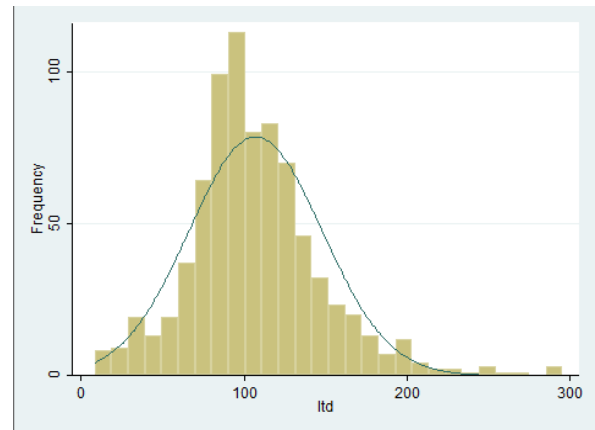
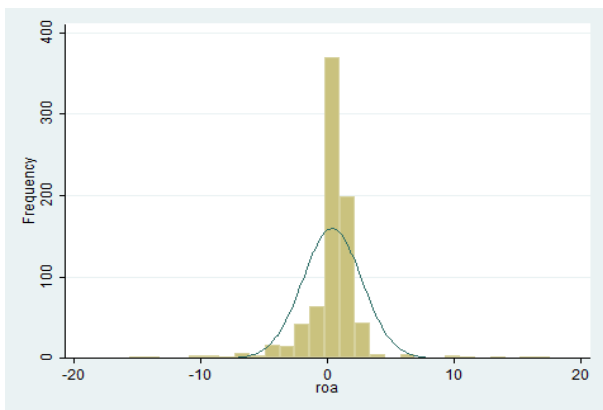
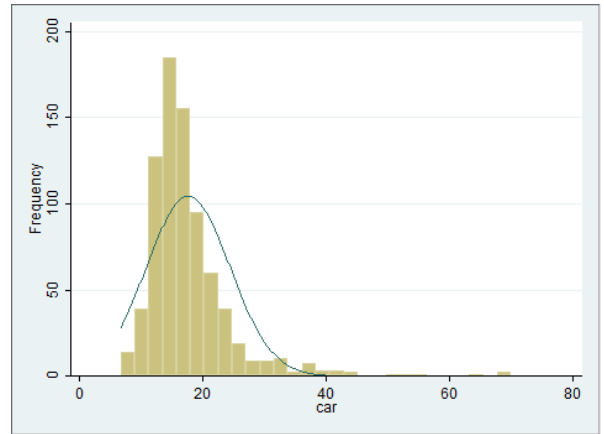
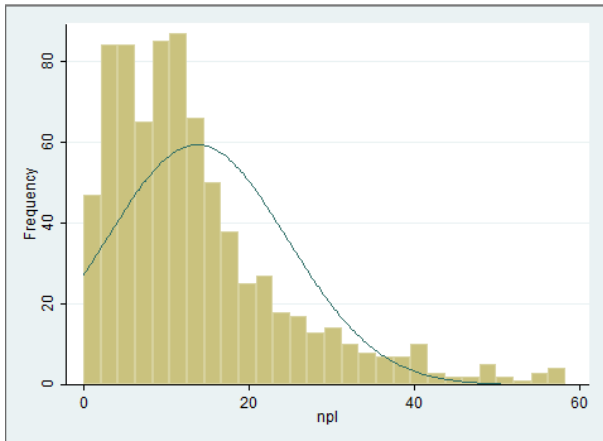
Slovenia



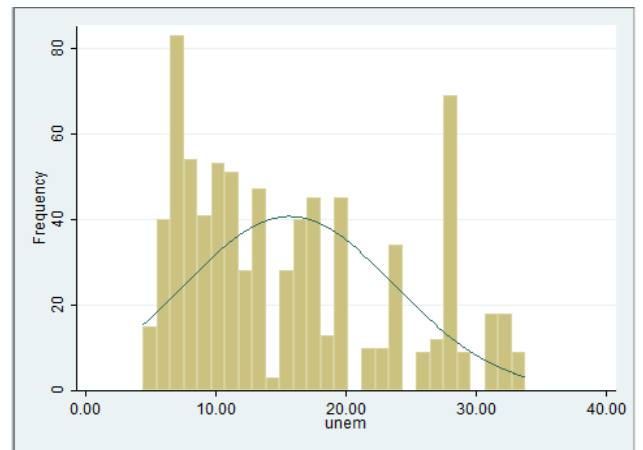
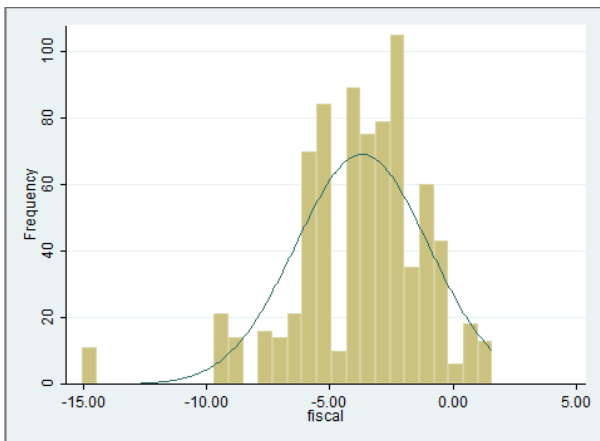
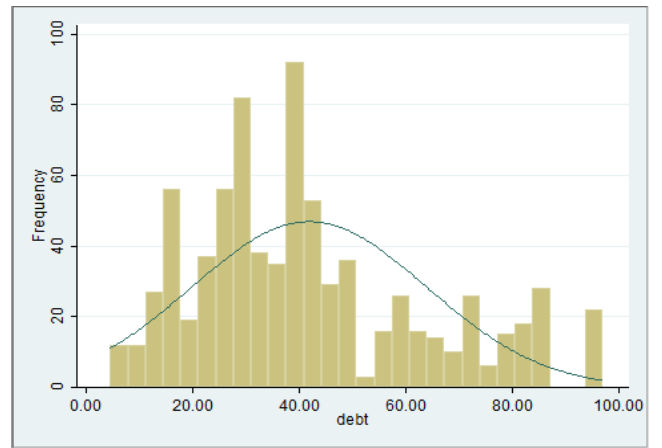
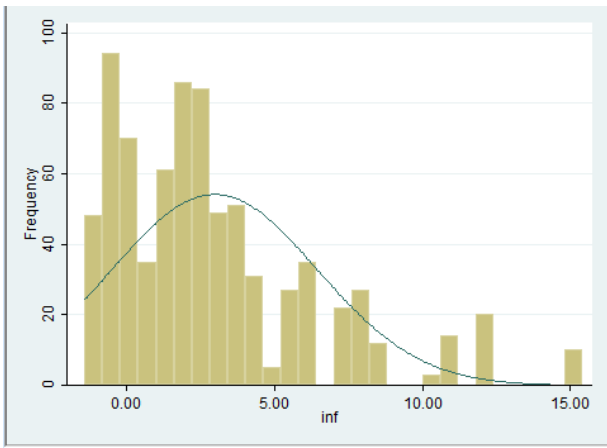
Source: *Own calculations via STATA 13*

## APPENDIX G: Distribution of the Data

Figure 3. Distribution of Data







Source: *Own calculations via STATA 13*

## APPENDIX H: STATA Output from the Tests utilized before the Estimation

Table 5. Test for Multicollinearity

Variable	VIF	1/VIF
fiscal	1.79	0.558032
ltd	1.49	0.669887
own	1.45	0.689145
gdp	1.43	0.697795
debt	1.42	0.702176
inf	1.33	0.752896
inef	1.14	0.880877
roa	1.12	0.893446
unem	1.11	0.897821
car	1.06	0.939872
Mean VIF	1.34	

Source: Own calculations via STATA 13

Table 6. Test for choice between RE or OLS Estimation

Breusch and Pagan Lagrangian multiplier test for random effects

$$npl[bank,t] = Xb + u[bank] + e[bank,t]$$

Estimated results:

	Var	sd = sqrt(Var)
npl	120.0221	10.95546
e	51.9204	7.205581
u	52.90771	7.273769

Test: Var(u) = 0

$$\text{chibar2}(01) = 631.58$$

$$\text{Prob} > \text{chibar2} = 0.0000$$

Source: Own calculations via STATA 13

Table 7. Descriptive Summary

Variable	Obs	Mean	Std. Dev.	Min	Max
npl	784	13.70021	10.95546	.02	58.27
car	784	17.58256	6.786402	6.65	70
roa	784	.3600204	2.327056	-15.65	17.59
ltd	784	107.0046	40.85391	8.37	295.49
inef	784	3.81062	5.629931	1.1	86.19
own	784	.6734694	.4692432	0	1
gdp	784	.623352	3.90949	-14.81	8.46
inf	784	2.975421	3.471457	-1.4	15.43
debt	784	41.76383	22.01175	4.5	97
fiscal	784	-3.692602	2.688963	-15.02	1.6
unem	784	15.61939	8.060433	4.4	33.8

Source: Own calculations via STATA 13

# APPENDIX I: Output from FE and RE Estimation

Table 8. Fixed Effects Estimation

```
R-sq:  within = 0.2602          Obs per group: min =      8
        between = 0.0007        avg =      8.0
        overall = 0.0556        max =      8
```

```
corr(u_i, Xb) = -0.4283          F(9, 677) =      26.46
                                   Prob > F =      0.0000
```

npl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
car	.1587921	.0573389	2.77	0.006	.0462086	.2713756
roa	-1.208133	.1651551	-7.32	0.000	-1.53241	-.8838547
ltd	.0050232	.0134805	0.37	0.710	-.0214453	.0314918
inef	-.1470985	.0627678	-2.34	0.019	-.2703415	-.0238555
l.own	0	(omitted)				
gdp	.0853711	.0857483	1.00	0.320	-.0829934	.2537357
inf	-.408662	.1059815	-3.86	0.000	-.6167539	-.2005701
debt	.0659047	.0299975	2.20	0.028	.0070053	.1248041
fiscal	.3653652	.1422614	2.57	0.010	.0860386	.6446918
unem	.6479466	.1213773	5.34	0.000	.4096254	.8862678
_cons	1.00513	2.655255	0.38	0.705	-4.208394	6.218654
sigma_u	9.1973784					
sigma_e	7.2055815					
rho	.61966466	(fraction of variance due to u_i)				

```
F test that all u_i=0:          F(97, 677) =      9.38          Prob > F = 0.0000
```

Source: Own calculations via STATA 13

Table 9. Random Effects Estimation

Random-effects GLS regression		Number of obs	=	784	
Group variable: bank		Number of groups	=	98	
R-sq: within	= 0.2533	Obs per group: min	=	8	
between	= 0.0283	avg	=	8.0	
overall	= 0.1143	max	=	8	
corr(u_i, X) = 0 (assumed)		Wald chi2(10)	=	220.50	
		Prob > chi2	=	0.0000	
npl	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
car	.127093	.0538661	2.36	0.018	.0215174 .2326685
roa	-1.19913	.1575469	-7.61	0.000	-1.507917 -.8903442
ltd	.0006905	.0120536	0.06	0.954	-.0229342 .0243151
inef	-.1262684	.0610302	-2.07	0.039	-.2458855 -.0066514
1.own	-3.750268	1.778294	-2.11	0.035	-7.235661 -.264876
gdp	.084662	.0853706	0.99	0.321	-.0826613 .2519854
inf	-.3904214	.1023772	-3.81	0.000	-.591077 -.1897658
debt	.0913442	.0233896	3.91	0.000	.0455013 .137187
fiscal	.2628045	.1404226	1.87	0.061	-.0124187 .5380277
unem	.3353078	.0760299	4.41	0.000	.1862919 .4843236
_cons	7.857412	2.42031	3.25	0.001	3.113692 12.60113
sigma_u	7.2737689				
sigma_e	7.2055815				
rho	.50470918	(fraction of variance due to u_i)			

Source: Own calculations via STATA 13

**APPENDIX J: Output from OLS and FE Estimation with included Lagged NPL**

Table 10. OLS with Lagged NPL Variable

Source	SS	df	MS	Number of obs = 686		
Model	53520.9444	11	4865.5404	F( 11, 674) = 123.13		
Residual	26632.5499	674	39.5141691	Prob > F = 0.0000		
Total	80153.4944	685	117.012401	R-squared = 0.6677		
				Adj R-squared = 0.6623		
				Root MSE = 6.286		

npl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
npl						
L1.	.8169504	.0242977	33.62	0.000	.7692421	.8646587
car	-.0304621	.0397856	-0.77	0.444	-.1085808	.0476565
roa	-.4311265	.1098509	-3.92	0.000	-.6468177	-.2154354
ltd	.0002187	.00765	0.03	0.977	-.0148021	.0152394
inef	-.0446657	.0488231	-0.91	0.361	-.1405293	.051198
l.own	-.2595029	.6315736	-0.41	0.681	-1.499591	.9805855
gdp	-.2464468	.0778131	-3.17	0.002	-.3992321	-.0936616
inf	.1186338	.1107617	1.07	0.285	-.0988456	.3361131
debt	-.0096083	.0128159	-0.75	0.454	-.0347723	.0155557
fiscal	-.0545431	.1204147	-0.45	0.651	-.2909761	.1818899
unem	.0130676	.0325507	0.40	0.688	-.0508453	.0769805
_cons	4.581893	1.256415	3.65	0.000	2.114934	7.048852

Source: *Own calculations via STATA 13*

Table 11. FE Estimation with Lagged NPL Variable

```

Fixed-effects (within) regression                Number of obs   =   686
Group variable: bank                          Number of groups =   98

R-sq:  within = 0.4309                        Obs per group:  min =    7
        between = 0.5125                       avg =   7.0
        overall = 0.4765                       max =    7

corr(u_i, Xb) = 0.0597                        F(10,578)      =   43.76
                                                Prob > F       =   0.0000
    
```

npl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
npl						
L1.	.5317558	.0339486	15.66	0.000	.4650781	.5984336
car	.0729691	.0555546	1.31	0.190	-.0361443	.1820825
roa	-.7125957	.1410199	-5.05	0.000	-.9895697	-.4356218
ltd	.018252	.0132336	1.38	0.168	-.0077398	.0442438
inef	-.1323427	.0633538	-2.09	0.037	-.2567744	-.0079111
l.own	0	(omitted)				
gdp	-.0527955	.0802175	-0.66	0.511	-.2103489	.1047578
inf	-.144077	.1461469	-0.99	0.325	-.4311207	.1429666
debt	-.0232111	.0310503	-0.75	0.455	-.0841963	.037774
fiscal	.1592904	.1245552	1.28	0.201	-.0853456	.4039264
unem	.4434765	.1277934	3.47	0.001	.1924803	.6944726
_cons	-.076686	2.558108	-0.03	0.976	-5.101007	4.947635
sigma_u	5.7387652					
sigma_e	5.8344471					
rho	.49173303	(fraction of variance due to u_i)				

F test that all u\_i=0: F(97, 578) = 2.11 Prob > F = 0.0000

Source: Own calculations via STATA 13

## APPENDIX K: Output from Difference GMM Estimation

Table 12. Difference GMM Estimation

```

Dynamic panel-data estimation, one-step difference GMM
-----
Group variable: bank                Number of obs   =   588
Time variable : year                Number of groups =   98
Number of instruments = 40          Obs per group: min =    6
F(12, 576) = 13.89                  avg =   6.00
Prob > F = 0.000                     max =    6
-----

```

npl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
npl					
L1.	.6565737	.0787791	8.33	0.000	.5018444 .811303
car	.5341	.1486351	3.59	0.000	.2421672 .8260329
roa	-1.01025	.4179535	-2.42	0.016	-1.831149 -.189351
ltd	.0577744	.0319548	1.81	0.071	-.0049877 .1205364
inef	-.2964875	.0985738	-3.01	0.003	-.4900955 -.1028796
own					
0	0	(empty)			
1	0	(omitted)			
gdp	-.0449677	.0933253	-0.48	0.630	-.2282671 .1383318
inf	-.1611005	.1837535	-0.88	0.381	-.522009 .199808
debt	-.0760056	.04811	-1.58	0.115	-.1704981 .0184869
fiscal	.2130128	.1907945	1.12	0.265	-.1617249 .5877506
unem	.4774368	.1924126	2.48	0.013	.0995209 .8553527

```

-----
Instruments for first differences equation
Standard
D.(0b.own 1.own gdp inf debt fiscal unem)
GMM-type (missing=0, separate instruments for each period unless collapsed)
L2.(npl L.npl car roa ltd inef)
-----

```

Source: Own calculations via STATA 13

## APPENDIX L: Output from System GMM Estimation

Table 13. System GMM Estimation

```

Dynamic panel-data estimation, one-step system GMM
-----
Group variable: bank                Number of obs   =    686
Time variable : year                Number of groups =    98
Number of instruments = 72          Obs per group: min =    7
F(12, 673) = 49.52                  avg =    7.00
Prob > F = 0.000                     max =    7
-----

```

	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
npl						
L1.	.8191641	.0427349	19.17	0.000	.7352544	.9030738
car	.0236467	.077079	0.31	0.759	-.1276975	.174991
roa	-.4606521	.2714956	-1.70	0.090	-.9937324	.0724282
ltd	.0181578	.0172169	1.05	0.292	-.0156474	.051963
inef	-.0023688	.0670731	-0.04	0.972	-.1340664	.1293288
own						
0	0	(empty)				
1	-1.153808	.9439584	-1.22	0.222	-3.007266	.6996496
gdp	-.2138177	.0838195	-2.55	0.011	-.3783969	-.0492385
inf	.0668553	.1280145	0.52	0.602	-.1845004	.3182111
debt	-.0132747	.0134147	-0.99	0.323	-.0396145	.013065
fiscal	-.0209178	.1416145	-0.15	0.883	-.2989771	.2571414
unem	.0092225	.0333164	0.28	0.782	-.056194	.0746391
_cons	2.629435	2.163538	1.22	0.225	-1.618661	6.877532

```

-----
Instruments for first differences equation
Standard
D.(0b.own 1.own gdp inf debt fiscal unem)
GMM-type (missing=0, separate instruments for each period unless collapsed)
L2.(npl L.npl car roa ltd inef)
-----

```

Source: Own calculations via STATA 13



## APPENDIX M: Output from Simple OLS Estimation

Table 14. Simple OLS Estimation

Source	SS	df	MS			
Model	53520.9444	11	4865.5404	Number of obs =	686	
Residual	26632.5499	674	39.5141691	F( 11, 674) =	123.13	
Total	80153.4944	685	117.012401	Prob > F =	0.0000	
				R-squared =	0.6677	
				Adj R-squared =	0.6623	
				Root MSE =	6.286	

npl	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
npl						
L1.	.8169504	.0242977	33.62	0.000	.7692421	.8646587
car	-.0304621	.0397856	-0.77	0.444	-.1085808	.0476565
roa	-.4311265	.1098509	-3.92	0.000	-.6468177	-.2154354
ltd	.0002187	.00765	0.03	0.977	-.0148021	.0152394
inef	-.0446657	.0488231	-0.91	0.361	-.1405293	.051198
l.own	-.2595029	.6315736	-0.41	0.681	-1.499591	.9805855
gdp	-.2464468	.0778131	-3.17	0.002	-.3992321	-.0936616
inf	.1186338	.1107617	1.07	0.285	-.0988456	.3361131
debt	-.0096083	.0128159	-0.75	0.454	-.0347723	.0155557
fiscal	-.0545431	.1204147	-0.45	0.651	-.2909761	.1818899
unem	.0130676	.0325507	0.40	0.688	-.0508453	.0769805
_cons	4.581893	1.256415	3.65	0.000	2.114934	7.048852

Source: *Own calculations via STATA 13*