Determinants of non-performing loans in Central and Eastern European countries

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Article**
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Abstract

This paper analyses the determinants of the changes in the non-performing loan (NPL) ratio in selected European emerging markets. The model was estimated on a panel dataset using a fixed effects estimator for seven Central and Eastern European (CEE) countries between Q3:2007 and Q3:2012. The countries analyzed are Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia. Although the literature on NPLs is quite extensive, this is the first empirical research on the countries of CEE region using aggregate, country-level data on problem loans. The results suggest that the primary cause of high levels of NPLs is the economic slowdown, which is evident from statistically significant and economically large coefficients on GDP, unemployment and the inflation rate.

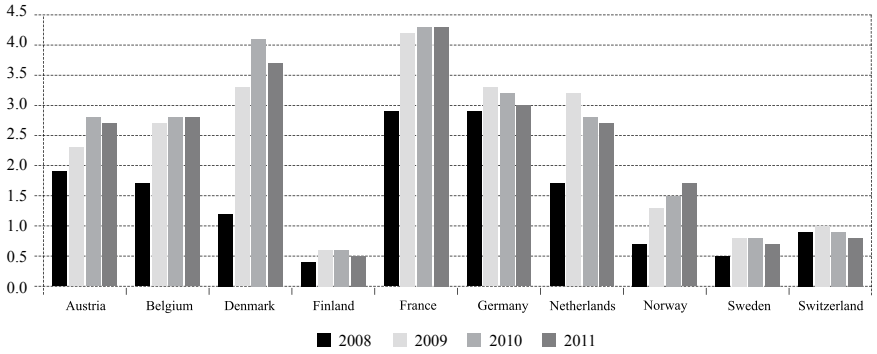
Keywords: non-performing loans, macro-financial linkages, Central and Eastern Europe, panel regressions, financial stability

1 INTRODUCTION

The recent financial crisis has left a legacy of extremely high levels of NPLs in the CEE region. In 2008, countries that had based their economic growth on the booming banking sector (Sirtaine and Skamnelos, 2007) at the beginning of the past decade found themselves faced with a sudden credit growth halt (European Banking Coordination "Vienna" Initiative, 2012). This is attributable to both the reduced demand for financing and reduced willingness to lend on the part of the European banks. The high levels of NPLs are becoming a growing issue, given that experiences from past financial crises show that a lasting recovery requires a "clean-up" of the financial sector. It is also clear that NPLs induce uncertainty and impact the banks' willingness and ability to keep lending, therefore affecting aggregate demand and investments. Furthermore, unresolved NPLs suppress the economic activity of currently overextended borrowers and trap resources in unproductive uses. All of these problems are particularly prominent in the CEE region, where recovery following the extreme economic slowdown has been very weak. To illustrate the strong impact of the global recession on the economic performance of CEE countries, it is sufficient to state that in 2009 all of the 7 countries analyzed in this paper suffered negative annual real GDP growth rates of over 4% (Latvia's economy, for example, contracted by 17.7% in 2009, on a year-to-year basis).

Moreover, despite the efforts from the banking sector and regulatory institutions, NPL levels still remain high, especially compared with the advanced economies in Western Europe. Table 1 shows World Bank data on annual NPL levels for 10 selected advanced European economies. According to the data, the levels of NPLs grew throughout the four-year crisis period in these economies as well, but have not risen above 5%. In the CEE region, on the other hand, Bulgaria, Romania, Latvia and Croatia finished 2011 with NPL ratios of 16.87%, 14.3%, 17.23% and 12.27% respectively.

FIGURE 1
Annual levels of NPLs, 2008-2011



Source: World Bank.

Although the literature on NPLs is quite extensive, this is the first empirical research on the countries of CEE region using aggregate, country-level data on problem loans. This empirical analysis includes 7 countries of the CEE region: Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia. It needs pointing out that the choice of the countries analyzed (as well as the observed time period) was determined primarily by the scarcity of data on NPLs. The data was collected from quarterly financial stability reports by central banks of the 7 countries included in the research; no earlier data were available for all 7 countries (or other CEE countries) – therefore, in order to have a balanced panel for all 7 countries, with aggregate data, this time period was chosen. The model was estimated on a panel dataset using ordinary least squares and including fixed effects. The results suggest that the primary cause of high levels of NPLs is the extreme economic slowdown.

The rest of the paper is organized as follows. Section two provides a summary of the relevant literature discussing the determinants of NPLs. Section three describes some stylized facts about recent developments in the banking sectors of the CEE countries, data used in the analysis and states the potential impact of each variable on the NPL ratio. This is followed by a description of methodology and the presentation of results. Section five concludes.

2 LITERATURE OVERVIEW

The macroeconomic determinants of NPLs, or the quality of bank assets in general, have generated a substantial amount of interest since the outbreak of the financial crisis in the autumn of 2008.

There is a rich theoretical literature on the subject of the interactions between the financial system and the wider economy. The most prominent examples are Bernanke and Gertler (1989) and Bernanke, Gertler and Gilchrist (1998) who develo-

ped the concept of the "financial accelerator", arguing that credit markets are procyclical and that information asymmetries between lenders and borrowers as well as the balance sheet effect work to amplify and propagate credit market shocks to the economy. The Kiyotaki and Moore (1997) model showed how relatively small shocks might suffice to explain business cycle fluctuations, if credit markets are imperfect.

2.1 EMPIRICAL STUDIES: SINGLE ECONOMY ANALYSES

Keaton and Morris (1987) introduced one of the earliest empirical studies on NPLs investigating the causes of loan loss diversity on a sample of 2,500 banks in the USA. Their study showed that a substantial part of the variation in loan losses was due to differences in local economic conditions and to unusually poor performance in particular industries like agriculture and energy. On the other hand, only a minor part of the remaining variation in losses can be attributed to bank-level factors, such as banks deliberately taking greater risks and granting loans that they knew had a high probability of default. Gambera (2000) also analyzed quarterly data on US loans to prove the link between macroeconomic dynamics and bank asset quality. The empirical results suggest that a limited number of regional and national macroeconomic variables are often good predictors of problem loan ratios, and that simple, bivariate VAR systems of one bank variable, one macroeconomic variable, and seasonal dummies can be quite effective. These variables include bankruptcy filings, farm income (particularly for countries where farming has an important role), state annual product, housing permits, and unemployment. Furthermore, VAR methodology was also used in the studies by Blaschke and Jones (2001) for USA, Baboučak and Jančar (2005) for Czech Republic and Hoggarth, Logan and Zicchino (2005) for the United Kingdom. The latter employed UK quarterly data to evaluate the dynamics between banks' write-off-to-loan ratio and several macroeconomic variables. They found that the important factors influencing financial stability and loan portfolio quality were the dynamics of inflation and interest rates. Baboučak and Jančar (2005) found evidence of positive correlation between the NPLs, unemployment rate and consumer price inflation, whereas GDP growth decelerates the NPL ratio. They also found that the real effective exchange rate appreciation does not exacerbate the NPL ratio. Salas and Saurina (2002) compared the determinants of problem loans of Spanish commercial and savings banks, taking into account both the macroeconomic and individual bank-level variables. The GDP growth rate, corporate and family indebtedness, rapid past credit or branch expansion, inefficiency, portfolio composition, size, net interest margin, capital ratio, and market power are all variables that explain credit risk. Jimenez and Saurina (2006) presented an extended piece of research on NPL determinants in Spain, demonstrating that the acceleration of GDP, as well as the decline in real interest rates, brings about a decline in problem loans. They also found that credit growth lagged four years has a positive and significant influence on NPLs, proving that the rapid credit growth today results in lower credit standards and, eventually in higher levels of problem loans. Rajan

and Dahl (2003) used panel regression models to suggest that credit terms have a significant effect on Indian non-performing loans in the presence of bank size induced risk preferences and macroeconomic shocks. The changes in the cost of credit in terms of expectations of higher interest rates induce a rise in NPLs. On the other hand, factors like the horizon of maturity of credit, better credit culture, favorable macroeconomic and business conditions all lead to the lowering of NPLs. Quagliariello (2003) presented a regression between the evolution of Italian NPLs as the dependent variable and a set of explanatory variables: the real GDP growth rate, growth of real gross fixed investment and consumption, change in the unemployment rate, CPI, real exchange rate and M2 growth rate. He showed that the declining GDP growth and increasing unemployment rate have a significant negative effect on loan portfolio quality in Italy. Arpa et al. (2001) also applied regression analysis showing that risk provisions in the total loans of the Austrian banking sector vary with real GDP growth, CPI inflation, real estate price inflation and real interest rates. Shu (2002) examined the NPL ratio in Hong Kong using regression models. His analysis showed that the increasing NPL ratio can be attributed to the increasing nominal interest rates and the number of bankruptcies, whereas the NPL ratio decreases with higher CPI inflation, economic growth and property price inflation. Louzis, Vouldis and Metaxas (2011) explored both bank-specific and macroeconomic determinants of NPLs in Greece, using dynamic panel data sets separately for each loan category (consumer, business loans and mortgages). Their study shows that all categories of Greek NPLs can be explained by macroeconomic variables (GDP growth, unemployment, interest rates, public debt) as well as by management quality.

2.2 PANEL ANALYSES

The Espinoza and Prasad (2010) study on the determinants of NPLs in the Gulf Cooperation Council (GCC) banking sector is one of the first examples of regional empirical research on the topic. It uses a bank-wise panel dataset and fixed effect, difference GMM, and System GMM models. They found strong evidence of a significant inverse relationship between real (non-oil) GDP and NPLs. Their study also attempted to estimate the feedback from rising NPLs to the real economy using a panel VAR. Overall, the model suggested that there is strong but short-lived feedback effect on non-oil growth in the GCC. Nkusu (2011) analyzed NPL determinants and feedback effects for a panel of 26 advanced economies. The findings are in line with previous studies and expectations. They confirm that deterioration in the macroeconomic environment (proxied by slower growth, higher unemployment or falling asset prices) is associated with debt service problems, reflected into rising NPLs. Finally, according to Beck, Jakubik and Piloiu (2013), who used a panel of 75 countries, real GDP growth, share prices, exchange rate and lending interest rate significantly affect NPL ratios. Overall, it can be stated that a considerable amount of empirical evidence regarding the anti-cyclical behavior of NPLs can be found. The common finding of all these studies is that when

there is a slowdown in the economy, the NPL level is likely to increase, as unemployment rises and borrowers face greater difficulties in repaying their debt.

3 DATA AND STYLIZED FACTS

In the following chapter, a discussion on the common treatment of the non-performing loans in macroeconomic statistics will be presented. In addition, the variables used in the analysis and their expected channel of impact on the NPL ratio will be introduced, as well as a short overview of the banking sector in the CEE region.

3.1 DATA

The dependent variable here is the ratio of NPLs to total (gross) loans. The definition of NPLs differs across countries and regions, so it is necessary to be cautious when making international comparisons. The main problem with the NPL data is that there is no internationally accepted standard for NPL measurement. Some of the most commonly used definitions are those by the IMF, Basel Committee for Banking Supervision (BCBS), Institute of International Finance (IIF) and the International Financial Reporting Standards (IFRS). The IMF's definition of NPLs was developed in the framework of the Financial Soundness Indicators (FSIs). The FSI Compilation Guide of March 2006 (IMF, 2006) recommends that "loans (and other assets) should be classified as NPL when (1) payments of principal and interest are past due by three months (90 days) or more, or (2) interest payments equal to three months (90 days) interest or more have been capitalized (re-invested into the principal amount), refinanced, or rolled over (i.e. payment has been delayed by arrangement)." BIS (2006) also advises the 90 days rule, more precisely, "a default is considered to have occurred with regard to a particular obligor when the obligor is past due more than 90 days on any material credit obligation to the banking group." Many national regulations follow the IIF recommendation (IIF, 1999) for classifying loans as standard, watch, substandard, doubtful and loss; non-performing loans usually comprise the categories substandard (interest and/or principal are more than 90 days overdue), doubtful (interest and/or principal are overdue more than 180 days) and loss loans (where the loan is virtually uncollectible; interest and/or principal are overdue for more than a year). The FSI website as well as the World Bank's database offer cross-country comparative presentations of NPL time series. However, for most developing countries, the NPL data presented by both sources are not yet comprehensive, as the time series are rather limited. The data on the NPL ratio in this study is therefore collected from the central banks' databases of each country included in the analysis. This data set contains quarterly observations for 7 countries of the Central and Eastern Europe (CEE) region, from the third quarter of 2007 to the third quarter of 2012. The countries included in the sample are: Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia. Reassuringly, the NPL series are highly correlated with the FSI data. Furthermore, recent research by Barisitz (2011) looks into the national definitions of NPLs in the CEE region and concludes that

NPL definitions based on national credit quality classifications of CEE countries largely appear to be comparable as they are based on the "90-days-past-due criterion".

However, it should be noted that apart from the days of overdue, there are other differences among the definitions and NPL classification criteria across countries. These include taking into account whether or not a judicial procedure has been started against the debtor (e.g. Romania), reporting NPL levels net of provisions (instead of in gross terms, which is the international standard) and the role of collateral and guarantees.

3.2 VARIABLES AND EXPECTED CHANNELS OF IMPACT

The independent variables are commonly used country-specific macroeconomic indicators and the level of loans in the banking sector. The aforementioned macroeconomic aggregates include the real GDP growth, unemployment rate, nominal effective exchange rate (NEER), harmonised index of consumer prices (HICP), share prices index and the 3 month money market interest rate. The data on real GDP growth, unemployment rates, HICP, 3 month money market interest rates and the share prices indices are obtained from Eurostat. Nominal effective exchange rates are calculated as geometric weighted averages of bilateral exchange rates, with 61 economies included in the basket, and are taken from the Bank for International Settlements database. The data on total loans refers to outstanding amounts of domestic loans in all currencies (originally in millions of euro) at the end of each period (quarter), and are retrieved from the European Central Bank statistics.

The relevance and expected signs of the relationships between NPL ratio and the selected variables are as follows:

- Following the results of previous empirical studies on NPLs and their proven countercyclical nature, it can be expected that real GDP growth and employment will be negatively associated with NPLs. A growing economy increases borrowers' income and ability to repay debts and it generally increases overall financial stability.
- An increase of NEER represents an appreciation of the domestic currency. Currency appreciation can weaken debt-servicing capabilities of export-oriented firms and thus increase the NPL ratio. However, it could also positively affect private debtors whose loans are denominated in foreign currency, reducing the NPL ratio. The sign of the relationship between NEER and the NPL ratio is thus indeterminate. However, it should be noted that the countries of the CEE regions are known for a large proportion of foreign currency loans.
- The HICP gives comparable measures of inflation in the countries in the sample. The relationship between NPLs and inflation is ambiguous. Theoretically, inflation should reduce the real value of debt and hence make debt

servicing easier. However, high inflation may pass through to nominal interest rates, reducing borrowers' loan-servicing capacity or it can negatively affect borrowers' real income when wages are sticky. It is also necessary to emphasize the short run relationship between inflation and NPLs as well. If the income does not increase in line with inflation, a rise in inflation increases costs (for both households and corporates) and thus lowers the amount of available funds for debt repayment. Finally, price stability is generally considered a prerequisite for economic growth. Bearing in mind this background, the relationship between NPLs and inflation can be positive or negative. Rinaldi and Sanchis-Arellano (2006) find a positive relationship between the inflation rate and non-performing loans, while Shu (2002) reports a negative relation.

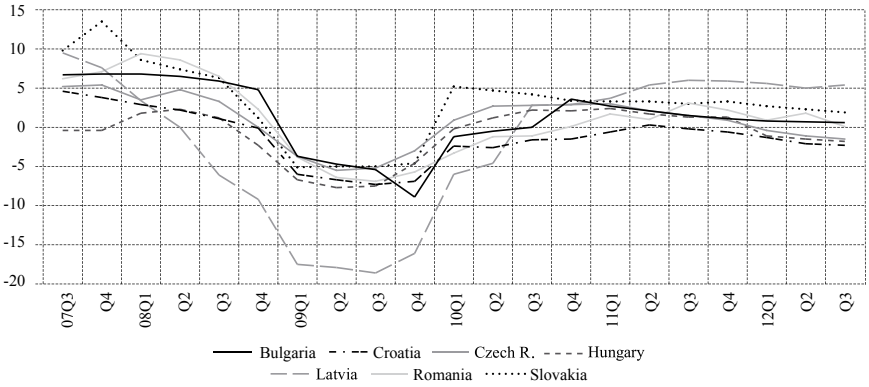
– An increase in interest rates weakens borrowers' debt servicing capacity, more so if loan rates are variable. Therefore, NPL is expected to be positively related to interest rates.
– In the case of share prices, the direct impact on NPLs in not obvious. Beck, Jakubik and Piloiu (2013) use this variable in their examination of NPL determinants, assuming that share prices are correlated with housing prices, on which there are insufficient data. Empirical analysis should then reflect the notion that a drop in the value of collateral for housing loans could negatively affect the quality of consumer loans. At the same time, shares, while rarely used as collateral, might be correlated with other risky assets which serve as a collateral for loans.
– NPLs should increase following rapid credit growth; therefore the increase of domestic loans should be associated with higher levels of NPLs. However, high loan levels could indicate high debt burdens, which make debtors more vulnerable to adverse shocks affecting their wealth or income, thereby raising the likelihood of running into debt-servicing problems.

3.3 STYLIZED FACTS

The CEE region was hit very hard by the global economic slowdown in 2009, especially given the high positive growth rates in the region in the period between 2000 and 2007, i.e. prior to the global recession. In these years, Latvia, for example, had an average annual real GPD growth rate of 8.5%. However, in 2008 Latvia was (alongside Estonia, which is not analyzed in this paper) the only country in the region with a contracting economy – GDP decreased by 2.8% from 2007. In 2009, however, all of the countries in the sample had a negative GDP growth rate. The quarterly data shows that in 2009, in the third quarter, Latvia had an almost incredible GDP decrease of 18.9%; the GDP numbers were also followed by a strong rise in the unemployment figures. In the third quarter of 2007 the unemployment rate in this country was 6.6%, whereas in the first quarter of 2010 it reached 21.1%. Despite dramatic GDP figures from 2009, in 2011 all the countries in the region had positive real GDP growth rates – apart from Croatia.

Economic recovery in this country has been very slow, with persistently high unemployment rates. In 2012, however, two more countries slid back into recession – Czech Republic and Hungary.

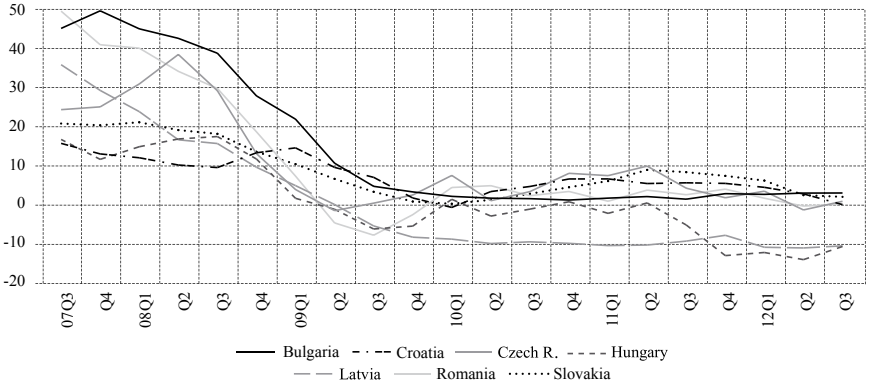
FIGURE 2
Real GDP growth rates



Source: Eurostat.

Figure 3 shows quarterly growth rates of all domestic loans, as compared to the same quarter in the previous year. A strong downwards trend in loan growth rates can be noticed in the graph for virtually all the countries of the CEE region in the period between the third quarter of 2007 and the beginning of 2009. As presented in the banking overview section of this paper, a halt in credit demand, particularly by households, is still a big problem in the countries of the region, and has been slowing down further economic recovery.

FIGURE 3
Loans growth rates



Source: ECB.

Apart from the second half of 2008 and the beginning of 2009 (the start of the global recession) – especially in Romania and Bulgaria, NEER has been relatively stable in all the analyzed countries. It can be argued that NEER is not an appropriate measure for exchange rate volatility in this analysis, and this will be further elaborated in the empirical section of the paper. Finally, inflation rates (as measured by Eurostat's HICP) have been rising steadily in all CEE countries, but particularly in Hungary, Romania, Bulgaria and Latvia.

3.4 BANKING SECTOR OVERVIEW IN CEE

The banking sector development of CEE countries has been a vital part of their overall economic growth and financial integration. As a part of the economic transition, domestic banks had been sold to strategic foreign investors, who were expected to import better bank governance, more modern banking practices and induce better supervision by home authorities. High foreign ownership is still one of the main characteristics of banking sectors throughout the region, as BIS data show that bank assets owned by foreign banks exceed 50 percent of GDP in virtually all countries. This translates into dominant market shares, in some places as high as 90 percent (IMF, 2013c). High foreign ownership has led to high foreign funding in the mid-2000s when foreign banks provided financing to CEE through their own subsidiaries, fueled by high global liquidity and rapid economic growth in the region (IMF, 2013c). This led to a credit boom in the region and a surge in foreign currency loans which raised concerns about the increasing systemic risks to financial stability emerging from such a large exposure of households and the corporate sector to foreign currency risks. Between 2008 and 2012, however, there was substantial deleveraging in CEE countries, where most of the outflows were the result of a reduction in loans to banks. The following section will give a brief overview of the current state of the banking system for each of the analyzed countries.

According to the Banks Bulletin publication of Croatian National Bank (CNB, 2012) (last data available), at the end of June 2012, there were 31 banks operating in Croatia. A total of 17 banks were in majority foreign ownership, the largest number of banks (6) belonging to Austrian shareholders. What is more, these 6 banks alone accounted for 61.6% of total assets of all banks. According to the CNB, a steady rise of NPLs in total bank loans can primarily be attributed to the worsening of the corporate loan quality (especially loans to the construction sector – where NPLs reached 37.8% in June 2012). However, currency risk is a significant issue for Croatian banks given that in, for example, the third quarter of 2012, 56% of total loans were foreign currency-indexed kuna loans, 17% were foreign currency-denominated loans and the rest (27%) were kuna loans. Non-kuna loans are dominantly euro loans, the share of which has increased since 2007 due to the appreciation of CHF/HRK exchange rate. In the third quarter of 2012, 8% of all franc-denominated loans to households were classified as non-performing, compared to 3.3% of those in euro. Finally, the Croatian banking sector is also cha-

racterized by a current halt in credit demand. The CNB states that, regardless of "a number of measures taken by the CNB to encourage more favorable financing of the economy, loans granted held steady in 2012".

The Czech banking system grew rapidly in the run-up to the global recession, but growth has been moderate since 2009. The banking sector is concentrated; the 5 largest banks control 70% of total assets, and they are wholly or majority-owned subsidiaries of big European financial conglomerates (IMF, 2012b). Unlike the other countries in the CEE region, the Czech banking sector has a conservative balance sheet, with a high share of resident deposits and loans denominated in local currency. Credit growth is fueled mainly by domestic deposits with a loans-to-deposits ratio of 70%, and only one fifth of loans are denominated in foreign currency. All of this made the Czech banking sector one of the few in the CEE region which did not need any exceptional measures during crisis. Even though, as of 2012, banks report strong capital, liquidity, and profitability, credit growth is slow and NPLs are at around 5%, which is comparable to NPL levels in advanced economies. Slovakia is very similar to the Czech Republic – its banking sector is also dominated by foreign bank subsidiaries, but the banking system's reliance on external funding is limited, as lending is mostly financed through domestic retail deposits. NPL ratios are relatively low – around 4% in 2012, and have been declining steadily after peaking in 2010 at 5.28% (IMF, 2012b).

The Hungarian banking system and overall financial stability were heavily affected by the global financial crisis. After a slowdown in economic activity, the Hungarian government was forced to implement some rather non-standard measures to balance the budget – such as the banking tax. In this difficult landscape, banks are, naturally, scaling down their operations. Credit growth is projected to remain negative in 2013 on the back of weak household demand and banks' limited appetite to lend (IMF, 2013b). High levels of NPLs (over 16% since Q2:2012) are associated with a high level of Swiss franc-denominated loans and the weakening of the forint. This has prompted the Hungarian monetary authorities to undertake various "unorthodox" measures, compiled under the name of Funding for Growth (MNB, 2013). One part of this plan was to enable the replacement of foreign exchange loans with low-interest forint loans, as well as introduce a temporary exchange-rate limit program. Under the program, borrowers may cap their repayments based on the exchange-rate limit for up to five years. The difference between the capped exchange-rate and the actual exchange-rate during the period is placed in a special account, the balance of which the borrowers will repay later. Nevertheless, levels of NPLs have been increasing steadily up to the third quarter of 2012. The ratio of non-performing loans to total loans is expected to peak at the end of 2013.

Domestic banks in Bulgaria had a market share of 26.4% in 2012, whereas EU subsidiary banks' share was 65.3%. The five largest banks held 49.5% of the

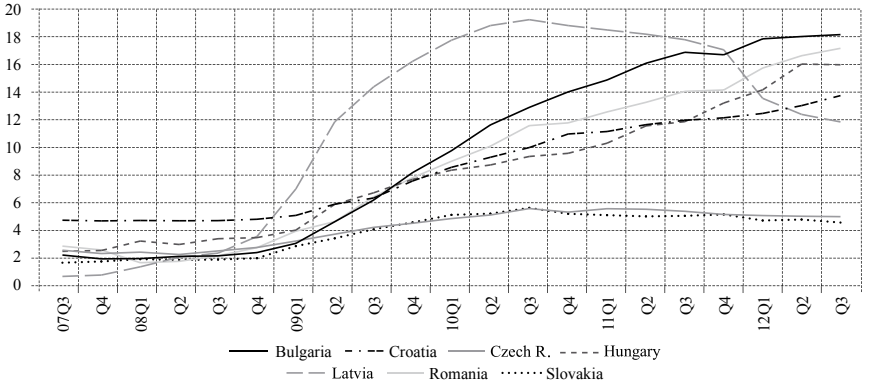
system's balance sheet assets at the year's close (BNB, 2012). Furthermore, in the same year the share of gross loans denominated in euro was 61.3%, where loans in levs accounted for 34.6% of the total loans. Bulgaria is also struggling with the decline of household credit demand, but in 2012 there was an increase in credit demand by the corporate sector. However, despite very high levels of NPLs, the IMF argues that "...macroeconomic and financial stability has been maintained in recent years" (IMF, 2012a).

Despite the economic growth observed in Latvia in 2012, credit institutions' assets continued to shrink, primarily because of private sector deleveraging and low lending activity (BoL, 2012). Latvia had dramatically high levels of NPLs in the period observed – for example, in 2010 NPL ratio was higher than 19%, but as of that peak in mid – 2010, the banking sector has been slowly recovering. The improvement in the corporate loan portfolio has been more marked than the household loan portfolio; partly because the latter was particularly hard hit by the collapse of the housing bubble (over three-fourths of household loans comprise mortgage lending). The share of NPLs is now about 11 percent for corporate loans, but 16 percent for household loans.

At the end of 2012, there were 31 banks in Romanian banking system, with additional 8 foreign bank branches. Two of these 31 banks had fully or majority state-owned capital, and a total of 26 banks had majority foreign capital – 81.8% of the total assets was owned by foreign banks. The top five (largest) banks held 54.7% of aggregate assets in 2012. At the end of 2012, foreign currency denominated loans still held the highest share (62.5 percent) in total loans. However, in Romania the plummeting real estate prices are mentioned as the leading cause of credit portfolio quality deterioration (NBR, 2012).

Finally, to sum up, the lowest levels of NPLs in the sample are recorded in Czech Republic and Slovakia, where NPLs peaked at just over 5 percent in the third quarter of 2010. In the same quarter, NPLs in Latvia reached their highest level (19.43 percent of total loans), whereas in Croatia, Romania, Bulgaria and Hungary, NPL ratios show no sign of slowing down (peaking at 13.89 percent, 17.34 percent, 18.34 percent and 16.19 percent respectively, in the third quarter of 2012 – the last for which the data are available). Interestingly, as previously mentioned, among the countries in this study, the Czech Republic and Slovakia have the lowest levels of foreign currency loans, and the Czech Republic has also had the lowest growth of overall indebtedness over the five years to 2009. In Latvia, for example, loans denominated in currencies other than domestic made up over 92% of total loans (in the final quarter of 2009 and throughout 2010).

FIGURE 4
Non-performing loans ratio



Source: Central banks of selected countries.

4 METHODOLOGY

In this study, panel data techniques are used to analyze and quantify the impact of the macroeconomic and financial variables described above on asset quality during the period between the Q3:2007 and Q3:2012. The estimation technique used is a fixed effects model, which allows controlling for time-constant unobserved heterogeneity across countries. If the equation for the fixed effects model is:

$$y_{it} = x'_{it}\beta + \alpha_i + \varepsilon_{it} \quad (1)$$

the fixed effects approach takes α_i to be a group-specific constant term in the regression model (as usual, β denotes the vector of parameters being estimated, and ε_{it} is the disturbance term). The term *fixed* is used to indicate that the term does not vary over time, not that it is nonstochastic, which does not have to be the case (Greene, 2002). When using fixed effects estimators, it is assumed that something within the individual entity (country in this case) may impact or bias the predictor or outcome variables, and it is necessary to control for this. This is the rationale behind the assumption of the correlation between entity's error term and predictor variables. The fixed effects estimator removes the impact of those time-invariant characteristics from the predictor variables, so the predictor's net effect can be assessed. Another important assumption of the fixed effects model is that these time-invariant characteristics are unique to each individual entity and should not be correlated with other individual characteristics. Each entity is different, therefore, the entity's error term and constant (which captures the individual characteristics) should not be correlated with others. If the error terms are correlated, then the fixed effects model is not suitable. The suitability of the fixed effects model can be assessed using the F-test. Because this analysis is limited to a very specific set of countries, and all of the observed variables are time-varying, it is reasonable

to use this particular estimation technique. Finally, dynamic panel methodology is not applied in this study, as Pesaran, Shin and Smith (1999) argue that in the case where *T* dimension in larger than *N* "traditional procedures for estimation of pooled models produce inconsistent, and potentially very misleading estimates of the average values of the parameters in dynamic panel data models".

4.1 STATIONARITY TESTING

There is a variety of tests for unit roots or stationarity in panel datasets. The Levin, Lin and Chu (2002), Harris and Tzavalis (1999), Breitung and Das (2005), Im, Pesaran and Shin (2003), and Fisher-type (Choi, 2001) tests have as the null hypothesis that all the panels contain a unit root. The Hadri (2000) Lagrange multiplier (LM) test has the null hypothesis that all the panels are (trend) stationary. The assorted tests make different asymptotic assumptions regarding the number of cross-section units in the dataset and the number of time periods for each unit.

Here, the Levin-Lin-Chu test is applied to examine whether any of the series contain a unit root. The null hypothesis is that the series contains a unit root, and the alternative is that the series is stationary. The Levin-Lin-Chu test assumes a common autoregressive parameter for all panels, so it does not allow for the possibility that some countries' data time series contain unit roots while other countries' data time series do not. The Levin-Lin-Chu test requires that the number of time periods grows more quickly than the cross-section dimension, so the ratio of cross-sections to time periods tends to zero. For this reason, this particular test is well suited for datasets with a larger number of time periods than cross-sections – such as the one presented in this paper.[1]

The variables are defined as follows: *nplgr* denotes the yearly percentage changes in NPL ratio, *rgdpgr* is the real GDP yearly growth rate, *unplgr* is the yearly percentage change in the unemployment rate, *hicpgr* denotes annual percentage change in inflation, *neergr* tracks yearly percentage change in the nominal effective exchange rate, *eqgr* denotes the share price indices annual percentage change and *loansgr* are the yearly percentage changes of the quarterly levels of outstanding loans for each country; *ir* are the 3 month money market interest rates.

The Levin-Lin-Chu test decisively rejects the null hypothesis of non-stationarity, at 1 percent, for all variables, except the interest rates, which are thus excluded from further analysis.

[1] It should be noted, however, that the use of presented unit root tests in relatively small samples might be problematic.

FINANCIAL THEORY AND PRACTICE
38 (1) 37-59 (2014)

TABLE 1
Stationarity testing

Variables	t-statistic	p-value
nplgr	-2.3394	0.0097
unplgr	-5.7601	0.0000
rgdpgr	-3.8437	0.0001
neergr	-5.0462	0.0000
eqgr	-9.0780	0.0000
hicpgr	-2.3952	0.0083
loansgr	-4.4803	0.0000
ir	-0.6689	0.2518

Source: Author's calculations.

4.2 MODEL SPECIFICATION AND RESULTS

According to the above considerations, the following equation is estimated:

$$nplgr_{i,t} = \beta_0 + \beta_1 rgpdgr_{i,t} + \beta_2 unplgr_{i,t} + \beta_3 hicpgr_{i,t} + \beta_4 neergr_{i,t} + \beta_5 eqgr_{i,t} + \beta_6 loansgr_{i,t} + \alpha_i + \varepsilon_{i,t} \quad (2)$$

All variables are expressed as logarithmic differences of the original series in order to ensure data stationarity. The βs are parameters, α_i is the unobserved country effect, $\varepsilon_{i,t}$ denotes the disturbances; i and t denote cross-section and time indicators, respectively.

Because of the relatively short time series, this data panel is estimated with ordinary least squares and it includes country fixed effects, which should account for all unobserved country heterogeneity.

Estimation results broadly confirm the postulated relationships between the chosen explanatory variables and the NPL ratio.

The suitability of the fixed effects model can be assessed using the F-test, which is strongly justified in this case (F(6, 105) = 7.55, p-value = 0.000). Furthermore, Wooldridge test for autocorrelation in panel data shows that at 5% the null hypothesis of no auto-relation cannot be rejected.

The estimates indicate that a 1 percentage point higher GDP growth rate lowers the NPL ratio growth rate by 3.97 percentage points. A 1 percentage point increase in the unemployment growth rate increases the NPL ratio growth rate by 1.006 percentage points. These estimates confirm the results obtained from previous empirical studies on NPLs, regarding their countercyclical nature: their levels are rising in recessions and falling in business cycle upturns. Both of these coefficients are highly statistically significant and economically very large, showing

that recent economic developments in CEE countries have a strong negative impact on their financial stability.

Table 2
Estimation results

	Dependent variable: *nplgr*		
Explanatory variable	**Coefficient**	**Std. error**	**t-statistic (prob.)**
rgdpgr	-3.970	0.636	-6.24 (0.000)
unplgr	1.006	0.129	7.82 (0.000)
hicpgr	1.657	0.868	1.91 (0.059)
neergr	0.624	0.426	1.46 (0.146)
eqgr	0.083	0.056	1.49 (0.140)
loansgr	0.128	0.326	0.39 (0.696)
cons	19.122	3.358	5.69 (0.000)
Observations	118		
R-squared	within = 0.83 between = 0.33 overall = 0.77		

Source: Author's calculations.

The NPL ratio growth increases following an increase in inflation rates. This estimate indicates that in this sample of CEE countries, inflation negatively affects banks' asset quality. It can be concluded that the effect of higher interest rates due to inflation and the declining economic conditions usually associated with rising inflation prevails over the positive impact that inflation might have on borrowers' debt servicing capacities. It is important to state that the central banks of the countries in the dataset all name maintaining price stability as their principal objective, as can be verified in the national laws on the said central banks (for example, Law on the Bulgarian National Bank, Article 2: "...the primary objective of the Bulgarian National Bank shall be to maintain price stability through ensuring the stability of the national currency and implementing monetary policy as provided for by this Law."). Such an objective and the overall focus of central banks on keeping inflation low are justified by this particular result within this analysis.

It is not surprising that the coefficient on the share price index is not significant – the countries of the CEE region have small stock market capitalization, and the interactions between macroeconomic or financial sector indicators and stock markets are rarely confirmed in countries with underdeveloped financial markets. Beck, Jakubik and Pilou (2013) have shown that a decline in stock market indices can significantly contribute to an increase in NPLs, but in countries with relatively large stock markets. For countries with small stock markets capitalization relative to GDP, the effect is not statistically significant.

The effect of the growth of the current level of indebtedness is statistically insignificant. This can be attributed to the levels of outstanding loans in the observed period. The data on loan level growth covers the time between the Q3:2007 and Q3:2012 when credit growth in the CEE countries was abruptly halted due to global liquidity shocks caused by the global financial crisis. The NPL ratio in all the countries in our sample, on the contrary, grew rapidly throughout the aforementioned period.

It is somewhat surprising that the coefficient on the increase of NEER is not significant. The countries of the CEE region are characterized by high level of foreign currency loans, and it is expected that the NPL ratio will react strongly to exchange rate volatility. Exchange rate depreciations are, thus, expected to lead to an increase of NPL ratio (growth rate) in countries with a high degree of lending in foreign currency to unhedged borrowers. In this analysis, the country with the highest level of foreign currency denominated loans in total loans is Latvia. However, Latvia has maintained its currency board arrangement vis-à-vis the euro during the crisis, so the exchange rate could not have affected NPLs significantly. On the other hand, since interest rates had to increase to defend the currency board, higher lending rates might have contributed to the large increase of NPLs in that country. Hungary and Croatia are two other countries in the sample where foreign currency lending is widespread. In both countries the depreciation of the national currency against the Swiss franc was associated with the deterioration of bank assets' quality. However, NEER is calculated as the geometric weighted averages of bilateral exchange rates, where the most recent weights are based on trade in 2008-2010. For both countries, the largest weight is on the euro exchange rate (for Croatia 60.6% of the index, for Hungary 51.5%) – which has remained relatively stable during the crisis.

5 CONCLUSION

The econometric analysis of the empirical determinants of NPLs presented in this paper, show that the real GDP growth was the main driver of the increase of the NPL ratio during the past 5 years in CEE countries. The coefficient of the stated explanatory variable is economically large, proving that the slowdown in the economic activity has greatly affected the financial stability of the region. High levels of NPLs across the region are a legacy of the crisis, and as economic recovery came to the countries of the region relatively late and can be described as weak, they are still expected to cause problems.

Given that an increase in inflation rates is estimated to cause growth in the NPL ratio, it can be said that the central banks in the countries of the CEE region are faced with an ambiguous outcome (concerning NPLs) when trying to stimulate growth. On one hand, to support economic recovery (which would lead to a drop in NPL levels), central banks can implement expansionary monetary policy, thus, up to a certain point, increasing GDP and aggregate demand. However, this would

significantly increase inflation rates, which, as estimated, causes NPL ratios to grow. The countries of the region are, however, persistent in keeping inflation rates low, which is, of course, related also to the general economic conditions in each country (high levels of both public and private foreign currency-denominated debt, the obligation to respect Maastricht guidelines, etc.). Finally, it must be emphasized also that some of the countries of the region have very limited space for expansionary monetary policy. Slovakia is a member of the Eurozone, Bulgaria has a currency board arrangement, and some other counties in the sample have effectively pegged exchange rates, which limits the scope of monetary policy.

Except for economic growth, the solution to the problem of NPLs would be a proactive and cooperative approach of creditors, debtors and the regulatory system. This kind of comprehensive approach is particularly important in the CEE region, given that any restructuring would help spur economic recovery, thereby also helping lift the value of collateral backing other loans. Further research would require a longer time series for non-performing loans for each country, which would enable exploring country-specific determinants of NPLs. This in turn would help policy makers to get a clearer image of the steps necessary to stabilize the banking sector in the post-crisis period.

TABLE A1

Robustness tests

	Dependent variable: *nplgr*						
Explanatory variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**
rgdpgr	-3.970 [0.636]***	-3.939 [0.628]***	-3.465 [0.541]***	-3.554 [0.549]***	-3.712 [0.555]***	-3.410 [0.633]***	-3.611 [0.616]***
unplgr	1.006 [0.129]***	1.009 [0.128]***	1.076 [0.120]***	1.047 [0.122]***	0.977 [0.120]***	0.961 [0.124]***	0.962 [0.124]***
hicpgr	1.657 [0.868]*	1.831 [0.743]**	1.468 [0.704]**	1.614 [0.714]**		1.573 [0.831]*	1.112 [0.756]
neergr	0.624 [0.426]	0.699 [0.378]*	0.896 [0.356]**			0.872 [0.415]**	0.613 [0.366]*
eqgr	0.083 [0.056]	0.074 [0.050]				0.156 [0.058]***	0.166 [0.058]***
loansgr	0.128 [0.326]					-0.477 [0.363]	
loansgr_lag						0.697 [0.214]***	0.553 [0.184]***
cons	19.122 [3.358]	18.897 [3.296]	18.744 [3.312]	17.221 [3.323]	23.388 [1.933]	17.081 [3.276]	18.119 [3.189]
Observations	118	118	118	118	118	118	118
R-squared							
within	0.83	0.83	0.83	0.82	0.81	0.85	0.84
between	0.33	0.35	0.31	0.42	0.27	0.43	0.34
overall	0.77	0.77	0.77	0.77	0.75	0.80	0.78

*Standard errors are in parenthesis. * indicates 10% significance level, ** indicates 5% significance level, and *** indicates 1% significance level.*

Source: Author's calculations.

Several nested models are estimated in order to test the stability of the proposed model. According to the results, in all of the specifications both the quarterly growth rate of GDP and the change in unemployment are highly significant, with expected coefficient signs. This confirms the main conclusion of the analysis, which is that the slowdown in economic activity has been the main driver of the increase in NPLs in the CEE region. The coefficient on the increase in inflation rates is also significant in every specification (at 5% and 10% significance level), but one, where lagged loans growth rate is included in the analysis. According to specifications 6 and 7 higher growth rate of loans in previous periods results in higher current growth rate of problem loans, which is in accordance with economic intuition.

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