Effect of macroeconomic determinants on non-performing loans in Central and Eastern European countries

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Abstract: The aim of the paper is to examine and quantify impact of macroeconomic determinants on non-performing loans (NPLs) in 11 selected Central and Eastern European (CEE) countries in the period 1999–2015. The empirical evidence is based on aggregate annual panel data collected from the Bluenomics. Panel regression with fixed effects analysis identified unemployment as the most important macroeconomic factor for NPLs – the relation between unemployment rate and NPLs is proportional. Next, results confirm negative influence of inflation, economic growth and exchange rate on NPLs. Impact of lending interest rate is positive and in line with expectation. Effect of crisis on NPLs is very strong and important as well. Impact of macro-variables is the strongest with a time lag 1 year.

Keywords: NPLs; non-performing loans; economic growth; unemployment; inflation; NEER; nominal effective exchange rate; lending interest rate; CEE countries; crisis.


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1 Introduction

Non-performing loans (NPLs) are loans that are soon to be declared in default, or have already been declared in default. Loans of this type are considered non-performing because the lender is no longer receiving a return on an investment, since the borrower is
no longer paying on the principle or the interest that applies to the loan. As Barisitz (2013) declares, the criteria used to determine if a loan is non-performing varies slightly, while NPLs are universally any loans where payments on the principal or the interest have not been received in the last 90 calendar days.

Due to different practices in Member States, the European Banking Authority (EBA, 2015) set out a harmonised definition of non-performing and forborne exposures in the Single Rulebook for the purpose of reporting on a consolidated basis, as published in Commission Implementing Regulation No. 2015/227. It is necessary to point out that the definition of non-performing exposure depends on several aspects: applicable accounting framework, internal or external view and countries, etc. On an internal level of a single bank, a NPE definition should be closely related to the credit processes. From an accounting perspective international financial reporting standards (IFRS) use neither forbearance nor non-performing definition.

The question of relationship between NPLs and macro-financial linkage has become one of intensively discussed issues since autumn 2008. From the beginning of the financial and economic crisis, share of NPLs increased an average from <3% (2.58% in the end of 2007) to more than 11% (11.38% in 2013 and with a peak ~12.38% in 2011) in the central and Eastern European (CEE) region.

European Bank Coordination ‘Vienna’ Initiative (2012) finds that possibilities exist for stimulating the resolution of NPLs to support recovery. Its report calls for a pro-active cooperative approach to deal with NPLs with distinctive roles for each stakeholder: the relevant country authorities should press ahead with removing burdensome regulatory, tax and legal impediments to NPLs resolution; regulators should tighten supervision appropriately so as to eliminate incentives to let NPLs linger; banks should step up their collective effort to speed up NPLs resolution; and avenues for out-of-court debt restructuring and corporate rehabilitation negotiations between debtors and creditors should be explored.

Šulganová (2016) notes that rising volume of NPLs, i.e., the materialisation of aggregate credit risk, indicates deterioration in quality of banks’ loan portfolios, and possible future loan losses and erosion of banks’ capital. From the other point of view, accumulation of NPLs restricts consumption of households and investment of companies, with the further adverse effects on banking industry. For instance, in the case of feedback effect, the erosion in capital tightens credit standards and restricts access to new loans with further dampening of economic activity. Thus, the mutual relationship between real economy and financial system is the key component for defining the macro-prudential policy.

Also Škarica (2014) points out the high levels of NPLs are becoming a growing issue, given 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 over extended borrowers and trap resources in unproductive uses.

The aim of the paper is to investigate and quantify impact of macroeconomic determinants on NPLs in selected CEE countries in the period 1999–2015. Although it is clear that the both bank specific and macroeconomic factors affect NPLs, the paper in not focused on analysing other than macroeconomic determinants.
2 Literature review

Generally, bank NPLs to total gross loans are the value of NPLs divided by the total value of the loan portfolio (including NPLs before the deduction of specific loan-loss provisions). Barisitz (2013) writes that loan amount recorded as non-performing should be the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue. Supervisors or at least general practice in the majority of Western European countries seem to endorse the rule that for a loan to be non-performing, at least one of two (primary) elements has to be present:

- principal or interest 90 days or more overdue
- existence of underlying well-defined weaknesses of loan or borrower.

However, there are also other (secondary) elements that have an impact on NPL measurement and the comparability of definitions: the question whether a restructured loan is classified as NPL or not, whether the presence of a collateral or guarantee influences loan classification or not, whether the full outstanding value or only part of a loan is reported as non-performing, and whether a bank is required to downgrade all loans to a given debtor if any of these loans are classified as impaired or not.

As Arpa et al. (2001) suggest, a useful way to analyse the macroeconomic determinants of banks’ health is to look at the main risks of banks: market risk (risk that values of underlying assets will decline), interest rate risk, exchange rate risk, default or credit risk (risk that debtors will be unable to repay their debts) and liquidity risk. All these risks are, at least partly, influenced by macroeconomic developments and policies. An additional argument in favour of monitoring macroeconomic indicators for macro-prudential purposes is the fact that the probability of systemic crises is greater when unsoundness is due to cyclical factors, because all banks are more or less exposed to the same conditions.

Studies on NPLs fall into two broad categories, respectively, factors explaining the evolution of NPLs over time. One group focuses on external events such as the overall macroeconomic conditions, which are likely to affect the borrowers’ capacity to repay their loans. The second group attributes the level of NPLs to bank-level factors (moral hazard, bad management, skimming or excess lending). Empirical evidence, however, finds support for both sets of factors. The intention of the paper is to find the main macroeconomic drives for NPLs in CEE countries so the structure of literature review is adapted to this goal.

De Backer et al. (2015) explore the interaction between NPLs and macroeconomic conditions as is illustrated in Figure 1. It shows the NPL determinants, i.e., both macroeconomic conditions and structural factors, as well as NPLs potential influence of macroeconomic conditions via the loan supply.

The empirical literature on the interaction between the macroeconomic conditions and asset quality is vast and miscellaneous. Gambera (2000) notes it is difficult to find a relationship between macroeconomic variables and bank failures. Nevertheless, the empirical results suggest that a limited number of regional and national macroeconomic variables are often good predictors for 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 states where farming has an important role), state annual product, housing permits and unemployment.
Arpa et al. (2001) found evidence that Austrian banks behave procyclically. Overall, some macroeconomic variables such as interest rates, real estate and consumer prices, but not real gross domestic product (GDP) or domestic demand growth rates, can be used to explain the risk provisions, operating income and operating results of Austrian banks during the 1990s. However, macroeconomic developments alone cannot explain the development of microeconomic bank data in a sufficient way. Other factors apart from macroeconomics obviously play a major role in banking.

Figure 1 Interaction between NPLs and macroeconomic conditions (see online version for colours)

Several studies conclude that the macroeconomic environment plays the most important role among credit risk determinants (Bonfim, 2009; Kattai, 2010; Festic et al., 2011; Castro, 2013; Szarowská, 2014). A common finding of these studies is the positive relationship between asset quality and economic growth and the existence of a link between the phase of the business cycle and credit defaults. Therefore, a growth cycle of the economy features a relatively lower share of NPLs to total loans, as both consumers and firms face a better capability in loan repayment. As the expansionary period continues, however, credit is extended to lower-quality debtors and subsequently, when the macroeconomic environment develops less favourably, NPLs and loan losses increase.

Klein (2013) notes that the upward trend of NPLs exhibits strong and negative correlation with pace of economic recovery and reflects in part the consequences of heightened unemployment across the region which, together with depreciated currency and tight financial conditions, weakened the borrowers’ repayment capacity. Beyond the macroeconomic factors, the relatively high variability in NPLs ratio, indicates that there may be non-negligible contribution of banks’ specific factors.

As well Diaconasu et al. (2014) claim there is significant empirical evidence regarding the anti-cyclical behaviour of the NPLs. The general explanation is that higher real GDP growth usually translates into more income which improves the debt servicing capacity of borrowers. Conversely, when there is a slowdown in the economy the level of NPLs is likely to increase as unemployment rises and borrowers face greater difficulties to repay their debt. Salas and Suarina (2002), Espinoza and Prasad (2010) or Nkusu (2011) bring similar conclusions.
Other studies argue that macroeconomic dynamics have an important additional (and independent) contribution, while micro information is considered the most important determinant of loan default (Love and Zicchino, 2006; Melecký and Podpiera, 2012). The authors argue that the distinctive features of the banking sector and the policy choices of each bank, such as ownership structure, prudential regulation of capital or their investment policy are expected to influence the evolution of NPLs.

Researches focused on CEE countries mostly stress that macroeconomic variables are the main determinants of credit risk at the aggregated level. The primary macroeconomic determinant of NPLs based on the theoretical literature of life-cycle consumption models is GDP growth rate. This conclusion is confirmed by Babouček and Jančar (2005) in Czech banking sector or by Männasoo and Mayes (2009) in Eastern European transition economies. Also Čihák et al. (2007) suggests that besides banking sector indicators, relevant macroeconomic explanatory variables should be incorporated in the stress testing of credit portfolio quality in Czech banking system.

Other macroeconomic variables, which are found to affect banks’ asset quality, include an unemployment rate, an interest rate and inflation. Louzis et al. (2012) highlight the role of macroeconomic determinants when investigating banking determinants of NPLs. They write that exchange rate depreciation might have a negative impact on asset quality, particularly in countries with a large amount of lending in foreign currency to un-hedged borrowers, and interest rate hikes affect the ability to service the debt, particularly in case of floating rate loans.

The impact of inflation, however, may be ambiguous. On the one hand, higher inflation can make debt servicing easier by reducing the real value of outstanding loan, but on the other hand, it can also reduce the borrowers’ real income when wages are sticky. As Nkusu (2011) reminds, in countries where loan rates are variable, higher inflation can also lead to higher rates resulting from the monetary policy actions to combat inflation.

There are studies emphasising banking loan portfolio depend on the unemployment rate and long-term interest rates. This macro-financial linkage is confirmed in the Czech Republic (Jakubík, 2007), in Slovenia (Aver, 2008) and in the Baltic States (Kattai, 2010; Fainstein and Novikov, 2011).

Beck et al. (2013) study the macroeconomic determinants of NPLs across 75 countries during the past decade. According to the dynamic panel estimates, the following variables are found to significantly affect NPL ratios: real GDP growth, share prices, the exchange rate and the lending interest rate. In the case of exchange rates, the direction of the effect depends on the extent of foreign exchange lending to unhedged borrowers which is particularly high in countries with pegged or managed exchange rates. In the case of share prices, the impact is found to be larger in countries which have a large stock market relative to GDP.

The empirical evidence done by Diaconu et al. (2014) shows that GDP growth rate, unemployment rate and private indebtedness have the impact on the evolution of NPLs in all analysed countries, namely in Bulgaria, the Czech Republic, Poland, Hungary and Romania. Moreover, they observe a substantial increase in the level of NPLs during the recent economic crisis.

Škarica (2014) analyses the determinants of the changes in the NPL ratio in selected European emerging markets. The model was estimated on a panel dataset using a fixed effects estimator for seven CEE countries between 2007 and 2012. The countries analysed are Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Romania and Slovakia.
His 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.

Most recently, study of Melecký et al. (2015) offers a detailed description of influence of macroeconomic determinants on NPLs in the Czech Republic. It uses data for the period 1993–2014 and the Bayesian estimation method of instrumental variables. The findings reveal positive effect of economic growth and income effect of the exchange rate on the financial condition of borrowers. They also find a negative effect of lending rates on the financial condition of borrowers. The effects of inflation and unemployment are also significant.

The literature also brings a large number of models and empirical evidence on the feedback effects between the real and financial sectors. The impact of the real economy on NPLs is mainly explained by weakening the borrowers’ capacity to repay their debt, while the feedback from NPLs to the real economy is often identified through the credit supply channel. For instance, Espinoza and Prasad (2010) focus on a sample of 80 banks of the GCC region and they conclude that an increase in NPLs reduces credit growth and the non-GDP growth. Nkusu (2011) analyses 26 advanced economies in the period 1998–2009 and finds that adverse shocks to asset prices, macroeconomic performance and credit to the private sector lead to a worsening of loan quality. In turn, higher NPLs lead to a decline in house prices, credit-to-GDP ratio, and GDP growth.

3 Data and model

The aim of the paper is to examine impact of macroeconomic determinants on NPLs in selected CEE countries during the period 1999–2015. The results of above empirical studies are rather heterogeneous, i.e., different papers report different macroeconomic variables as the main drivers of NPLs. This may be due to differences in used econometric models, country samples, observation periods and considered variables. It should be noted that the goal of this empirical evidence is not to find the ideal model describing the behaviour illustrated by the variables, but a nature of relationships between NPLs and selected macro-variables.

The empirical estimation is performed for 11 CEE countries, namely Bulgaria (BG), Czech Republic (CZ), Estonia (EE), Croatia (HR), Latvia (LV), Lithuania (LT), Hungary (HU), Poland (PL), Romania (RO), Slovenia (SI) and Slovakia (SK). The dataset consists of aggregate annual country-level data acquired from the Bluenomics, which compiles time series from Eurostat, OECD database, IMF and the World Bank. Paper uses panel data and calculations are made in the Eviews 9. First, we apply Granger causality methodology. The Granger causality refers to a specific notion of causality in time-series analysis. A time series $X$ is said to Granger-cause $Y$ if it can be shown, usually through a series of $t$-tests and $F$-tests on lagged values of $X$ (and with lagged values of $Y$ also included), that those $X$ values provide statistically significant information about future values of $Y$. Because the Granger causality may not show the full picture about the interactions between the variables we also apply panel regression (in line with, e.g., Louzis et al., 2012; Diaconasu et al., 2014; Škarica, 2014) for identifying the direct impact of macro-variables on NPLs.
3.1 Data specification

The dependent variable used in the model is banks’ NPLs to total gross loans. The independent variables under investigation include the macroeconomic factors and other variables, namely GDP growth (GDP), unemployment (UN), inflation (INF), nominal effective exchange rate (NEER), lending interest rate (IR) and debt (DEBT). Table 1 summarises definitions of variables and their sources.

Table 1 Variable definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPL</td>
<td>Non-performing loans as % of total loans</td>
<td>World Bank</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product per inhabitant % change over previous period (real)</td>
<td>World Bank</td>
</tr>
<tr>
<td>UN</td>
<td>Unemployment rate in % of labour force</td>
<td>Eurostat</td>
</tr>
<tr>
<td>INF</td>
<td>Inflation rate based on average rate of HICP change (%)</td>
<td>IMF, OECD</td>
</tr>
<tr>
<td>NEER</td>
<td>Nominal effective exchange rate (NEER)</td>
<td>World Bank, IMF</td>
</tr>
<tr>
<td>IR</td>
<td>Lending interest rate in % (real)</td>
<td>World Bank</td>
</tr>
<tr>
<td>DEBT</td>
<td>General government debt in % of GDP (consolidated)</td>
<td>Eurostat</td>
</tr>
<tr>
<td>DUMMY</td>
<td>Dummy is equal 0 during years 1999–2007 and it is equal 1 in 2008–2015</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows descriptive statistics of variables. Extremes and big difference in minimum and maximum values is caused by using a long period, e.g., highest share of NPLs and inflation are reported in Romania 1999 (52.6%, respectively, 45.8%) and this exception value are connected with a transformation process (NPLs decreased on 5.2% in 2000, inflation later and more slowly). Contrary, minimum NPLs is reported in Estonia in 2005, but similar low shares were found in the whole period 2000–2007. GDP and unemployment series are significantly influenced by the crisis. The highest and lowest interest rates were in Latvia in 2009 (as a result of financial crisis), respectively 2007, and difference was more than 36% in 2 years. The lower number of observations is caused by a shorter time series for Poland, Slovakia, Slovenia and Lithuania. A higher value of NEER equates to the appreciation of the local currency against the trade-weighted basket of currencies the country is trading with (the highest appreciation was in the Czech Republic in 2008, the deepest depreciation in Romania in 1999). It is necessary to note, that NEER is reported only for Czech Republic, Bulgaria, Croatia, Hungary, Romania, Poland and Slovakia. Extreme difference is seen for DEBT as Estonia has long maintained minimal consolidated debt but Hungary was fully hit by consequences of the financial and economic crisis in 2008–2011.

Many studies point out that using non-stationary macroeconomic variable in time series analysis causes superiority problems in regression. Thus, a unit root test should precede any empirical study employing such variables. Panel unit root tests identified that all-time series are stationary at level data $I(0)$. We applied Augmented Dickey–Fuller test (ADF test). Equation (1) is formulated for the stationary testing.
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\[ \Delta x_t = \delta_0 + \delta_1 t + \delta_2 x_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta x_{t-j} + u_t. \]  \hspace{1cm} (1)

ADF test is used to determine a unit root \( x_t \) at all variables in the time \( t \). Variable \( \Delta x_{t-1} \) expresses the lagged first difference and \( u_t \) estimate autocorrelation error. Coefficients \( \delta_0, \delta_1, \delta_2 \) and \( \alpha_j \) are estimated. Zero and the alternative hypothesis for the existence of a unit root in the \( x_t \) variable are specified in equation (2).

\[ H_0: \delta_2 = 0, \quad H_\alpha: \delta_2 < 0. \]  \hspace{1cm} (2)

The result of ADF test, which confirms the stationary of all time-series on the level data \( I(0) \), is available on request.

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>NPL</th>
<th>GDP</th>
<th>UN</th>
<th>INF</th>
<th>IR</th>
<th>NEER</th>
<th>DEBT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>7.76</td>
<td>3.56</td>
<td>10.54</td>
<td>4.47</td>
<td>5.02</td>
<td>-0.52</td>
<td>34.09</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>5.22</td>
<td>3.98</td>
<td>9.70</td>
<td>3.32</td>
<td>5.02</td>
<td>0.59</td>
<td>34.15</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>52.60</td>
<td>12.93</td>
<td>20.00</td>
<td>45.80</td>
<td>28.69</td>
<td>12.45</td>
<td>80.80</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>0.20</td>
<td>-14.56</td>
<td>4.30</td>
<td>-1.42</td>
<td>-7.67</td>
<td>0.59</td>
<td>3.70</td>
</tr>
<tr>
<td><strong>Std. dev.</strong></td>
<td>6.96</td>
<td>4.54</td>
<td>4.09</td>
<td>5.95</td>
<td>4.33</td>
<td>6.95</td>
<td>18.93</td>
</tr>
<tr>
<td><strong>Skewness</strong></td>
<td>2.12</td>
<td>-1.12</td>
<td>0.61</td>
<td>4.48</td>
<td>0.90</td>
<td>-1.95</td>
<td>0.49</td>
</tr>
<tr>
<td><strong>Kurtosis</strong></td>
<td>11.37</td>
<td>5.67</td>
<td>2.30</td>
<td>29.15</td>
<td>8.19</td>
<td>10.99</td>
<td>2.72</td>
</tr>
<tr>
<td><strong>Probability</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>187</td>
<td>176</td>
<td>185</td>
<td>187</td>
<td>151</td>
<td>118</td>
<td>174</td>
</tr>
</tbody>
</table>

Source: Based on data from Eurostat, OECD, IMF and the World Bank

3.2 Model specification

Empirical evidence uses panel data as panel data have both cross-sectional and time series dimensions and the application of regression models to fit econometric models are more complex than those for simple cross-sectional datasets. Both fixed effects and random effects regressions were performed before analysis. A Durbin–Wu–Hausman test indicated significant differences in the coefficients so model with fixed effects is used in the paper. A panel model with fixed effects can be formally written as (3):

\[ y_{it} = \alpha_i' + \beta' X_{it} + u_{it}, \quad i = 1, 2, \ldots, N, t = 1, 2, \ldots, T, \]  \hspace{1cm} (3)

where \( y_{it} \) depends on a set of \( K \) explanatory variables \( x_{it} \) and the constants are specific to the \( i \)th unit (country) at time \( t \), at the same time but are constant. \( \beta' \) is the vector dimension \( 1 \times K \) constants and \( \alpha_i' \) is a constant representing the effects of those variables, which are characteristic of the \( i \)th observation. \( u_{it} \) error component represents non-significant effects of variables inherent in the \( i \)-team observations and a given time interval. Furthermore, it is assumed it does not correlate with the vector \( x_{it} \), for all the \( i \) and \( t \), and it comes from independent identical distribution with zero mean and constant dispersion (Dougherty, 2007). The suitability of the fixed effects model can be assessed using the \( F \)-test too, which is strongly justified in this case. Furthermore, Wooldridge test
for autocorrelation in panel data shows that at 5% the null hypothesis of no auto-relation cannot be rejected.

The basic model is defined in equation (4) and variables are explained above:

\[
NPL_{it} = \alpha + \beta_1 GDP_{it} + \beta_2 UN_{it} + \beta_3 NF_{it} + \beta_4 NEER_{it} + \beta_5 IR_{it} + \beta_6 DEBT_{it} + u_{it}.
\]  
(4)

A dynamic panel regression has the form (5) and it reflects development of NPLs better as NPLs changes are influenced by earlier NPLs ratio.

\[
NPL_{it} = \alpha + \beta_0 NPL_{it-1} + \beta_1 GDP_{it} + \beta_2 UN_{it} + \beta_3 INF_{it} + \beta_4 NEER_{it} + \beta_5 IR_{it} + \beta_6 DEBT_{it} + u_{it}.
\]  
(5)

Finally, the dummy variable is added to the specification of a model to focus on crisis impact. Dummy is equal zero in years 1999–2007 (a pre-crisis period), and equal 1 in the period 2008–2015 (a post-crisis period). The final equation is defined in equation (6).

\[
NPL_{it} = \alpha + \beta_0 NPL_{it-1} + \beta_1 GDP_{it} + \beta_2 UN_{it} + \beta_3 INF_{it} + \beta_4 NEER_{it} + \beta_5 IR_{it} + \beta_6 DEBT_{it} + \text{dummy}_{it} + u_{it}.
\]  
(6)

4 Results and discussion

4.1 NPLs development

Figure 2 shows significant differences among share of NPLs in countries and during the analysed period.

**Figure 2** Development of NPLs as percentage of total loans (2000–2015) (see online version for colours)

\[\text{Source: Author's compilation based on data from the World Bank}\]
Beginning of a period is linked with transformation of bank sector, restructuring processes during transition from centrally planned to the market oriented economic system. The highest shares of NPLs are detected in the Latvia, in the Czech Republic and Slovakia and also in Croatia and later in Poland. After the ‘clean up’ of financial sector and together with economic recovery, NPLs decreased to the lowest value in average 2.58% in 2007. Following the crisis of 2008/2009, NPLs increased rapidly across CEE countries, sometimes to reach very high levels comparable to those seen in the wake of earlier financial crises. When the global financial crisis reached CEE countries in the fall of 2008, the period of easy, foreign-financed credit came to an abrupt halt and export markets collapsed, plunging the region’s economy into a deep recession. Problems with the quality of banks’ assets emerged soon thereafter and NPL ratios rose sharply from less than 3% before the crisis and stood at over 12% at end of 2011 for the region on average (Figure 2). NPLs problems became most acute in those countries where the economic slump was particularly deep and where the pre-crisis credit boom had been the most extreme: NPLs reached more that 23.3% in Romania (in 2011) and Lithuania (2010) and nearly 20% in Latvia. But last development and economic recovery is followed by decreasing of NPLs in these countries as well (4.6% in Latvia and 6.7% in Lithuania in 2015).

In a large number of countries NPLs came close to those seen during other crises, such as the Asian crisis in 1997/1998 (see Klein, 2013 for details). In contrast, countries that avoided recession, such as Poland, or overcame it very quickly or slightly, such as Estonia or the Czech Republic, experienced a more modest rise of NPL ratios, to peaks of 7.16% and 6.28%, respectively, 6.45%. Currently, a share of NPLs is stabilised and oscillates about 5% of total loans (only 1.68% in Estonia in 2015). The resumption of economic growth in the second half of 2009 led to a slowdown in the rise of NPL ratios and in the better performing economies. However, they are generally still at high levels and the asset deterioration continues in a large number of countries, such as those in South Eastern Europe where the recovery came late and is weak, or in Hungary, where loans denominated in the appreciated Swiss franc continue to cause problems. Moreover, the economic outlook for the entire region is influenced by the crisis in the euro area.

Figure 3 captures that asset quality problems beset both loans to households and loans to companies. In contrast to earlier crises where NPL problems afflicted almost exclusively the corporate sector, this time bad loans to households account for a sizeable share of the problem in CEE countries. This reflects the rapid rise of consumer and housing loans in the run-up to the crisis. Hence, tackling CEE countries’ NPL problem means finding solutions that encompass both corporate debt and different types of household debt (European Bank Coordination ‘Vienna’ Initiative, 2012).

### 4.2 Results of granger causality and model estimations

We apply Pairwise Granger Causality Tests for examining relations between NPLs and macro-variables in short-term, the results are given in Table 3. It is important to mention that the statement for example ‘GDP Granger causes NPL’ does not imply that NPL is the effect or the result of GDP. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term. The null hypothesis should be rejecting if probability is <0.05 (usual level of statistical significance). The example of null hypothesis is that GDP does not Granger-cause NPLs.
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and that NPLs does not Granger-cause GDP. Table 3 summarises results for lag 1 and 2 years. Bold values indicate hypothesis which should be rejected.

**Figure 3** Contribution to NPLs by sector in selected countries in 2011 (see online version for colours)

![Figure 3](image)

**Table 3** Granger causality test

<table>
<thead>
<tr>
<th>Null hypothesis</th>
<th>Lag: 1 year</th>
<th>Lag: 2 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP does not GC NPL</td>
<td>165</td>
<td>23.37</td>
</tr>
<tr>
<td>NPL does not GC GDP</td>
<td>0.93</td>
<td>0.34</td>
</tr>
<tr>
<td>UN does not GC NPL</td>
<td>174</td>
<td>0.13</td>
</tr>
<tr>
<td>NPL does not GC UN</td>
<td>5.43</td>
<td>0.02</td>
</tr>
<tr>
<td>INF does not GC NPL</td>
<td>176</td>
<td>15.11</td>
</tr>
<tr>
<td>NPL does not GC INF</td>
<td>1.76</td>
<td>0.19</td>
</tr>
<tr>
<td>IR does not GC NPL</td>
<td>140</td>
<td>4.65</td>
</tr>
<tr>
<td>NPL does not GC IR</td>
<td>0.53</td>
<td>0.47</td>
</tr>
<tr>
<td>NEER does not GC NPL</td>
<td>111</td>
<td>6.34</td>
</tr>
<tr>
<td>NPL does not GC NEER</td>
<td>0.18</td>
<td>0.67</td>
</tr>
<tr>
<td>DEBT does not GC NPL</td>
<td>163</td>
<td>1.85</td>
</tr>
<tr>
<td>NPL does not GC DEBT</td>
<td>4.23</td>
<td>0.04</td>
</tr>
</tbody>
</table>

GC means Granger-cause.

**Source:** Author’s calculations based on data from Eurostat, OECD, IMF and the World Bank

One can find four examples of the Granger causality from macroeconomic variables (GDP growth, inflation INF, lending interest rate IR and NEER) to NPL for the 1 year lag. The causality from the NPL to the macro-variables is revealed in two cases (DEBT and unemployment UN). With the lag of 2 years, there is again reported Granger causality from GDP to NPL. There is just one case of two-way causality, which was reported for inflation INF and NPL. One can conclude that causality is confirmed for
GDP as well as inflation INF and NPLs. Deeper analysis focused on direct impact of variables is followed.

Table 4 summarises calculated estimations. Model 1 is expressed by equation (4), model 2 by equation (5) and a dynamic model 3 with a crisis dummy by equation (6). Variables in models are chosen in line with above empirical studies. Following the results of previous empirical studies on NPLs and their proved counter cyclical nature, it can be expected that real GDP growth will be negatively associated with NPLs. A growing economy increases borrowers’ income and ability to repay debts and it generally increases overall financial stability (Škarica, 2014).

Table 4  Panel regression estimations

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Std. error</td>
<td>Coefficient</td>
</tr>
<tr>
<td>C</td>
<td>1.41</td>
<td>3.49</td>
<td>5.14**</td>
</tr>
<tr>
<td>NPL–1</td>
<td>0.54*</td>
<td>0.06</td>
<td>0.49*</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.43***</td>
<td>0.23</td>
<td>-0.16***</td>
</tr>
<tr>
<td>UN</td>
<td>0.57**</td>
<td>0.28</td>
<td>0.26**</td>
</tr>
<tr>
<td>INF</td>
<td>-0.07</td>
<td>0.13</td>
<td>-0.56*</td>
</tr>
<tr>
<td>IR</td>
<td>0.54***</td>
<td>0.29</td>
<td>0.31***</td>
</tr>
<tr>
<td>NEER</td>
<td>-0.38*</td>
<td>0.14</td>
<td>-0.21**</td>
</tr>
<tr>
<td>DEBT</td>
<td>0.187**</td>
<td>0.06</td>
<td>-0.06</td>
</tr>
<tr>
<td>Dummy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total observations | 95 | 90 | 90 |
| R-squared          | 0.41 | 0.72 | 0.75 |
| Adjusted R-squared | 0.33 | 0.68 | 0.71 |
| S.E. of regression | 6.35 | 3.44 | 0.28 |
| Durbin-Watson stat | 1.04 | 1.65 | 1.91 |

Symbols *, ** and *** denote statistical significance at the 1%, 5% and 10% level.

Source: Author’s calculations based on data from Eurostat, OECD, IMF and the World Bank

An increase in the unemployment rate should increase the debt burden of households, on the one hand, and decrease the production as a consequence of a drop in the effective demand, on the other hand. Therefore, the relation between unemployment rate and NPLs is directly proportional: an increase in the unemployment rate will lead to an increase of NPLs (Diaconasu et al., 2014). The debt is expected to have a positive linkage with NPLs as it can resulted from a decline phase of business cycle and a decline of demand and decrease of revenues and financial resources or they can have psychological effect connected with a wasteful and irresponsible behaviour of government.
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-serving capacity or it can negatively affect borrowers’ real income when wages are sticky. It is also necessary to emphasise a 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 NPLs, while Shu (2002) reports a negative relation.

It is assumed that exchange rate NEER has negative impact of NPLs as a higher NEER can decrease a volume of loans in foreign currencies. Conversely, rising lending interest rates is supposed to have adverse (positive) effects as well as dummy variable added as a control variable for the economic crises period. Due to the economic recession, debtors have more difficulties to pay their loans, and therefore it is expected it will lead to an increase in the banking credit risk and NPLs.

The result of the most appropriate model for dependent variable is presented by Model 3 (results of others estimations are available on request). Table 4 shows that the estimated coefficients on unemployment rate are positive and statistically significant. The finding confirms assumption that increase of unemployment rate contributes to the limitations of borrowers’ income and leads to a reduction in a payment possibility and morale and increases share of NPLs on total loans. Moreover, the rise in unemployment is the most important macro-factor for NPLs increase as growth of unemployment rate by 1% point is associated with increase of NPL ratio by 0.57% point.

Estimations also confirm expected negative influence of economic growth, inflation and exchange rate on NPLs. Coefficients are negative and statistically significant at standard level. As we assumed, impact of lending interest rate is positive – its rise increases NPLs. Effect of crisis (expressed by dummy variable) on NPLs is very strong and important and statistically significant.

As earlier studies (e.g., Beck et al., 2013; Klein 2013 or Šulganová, 2016) often confirm impact of macroeconomic variables with lag, it is included to the model estimations a time lag too. The optimal time lag seems to be 1 year. The final investigated model can be written as in the equation (7).

\[
NPL = 4.46 + 0.44 \times NPL_{t-1} - 0.26 \times GDP_{t-1} + 0.54 \times UN_{t-1} - 0.45 \times INF_{t-1} \\
+ 0.36 \times IR_{t-1} - 0.17 \times NEER_{t-1} - 0.15 \times DEBT_{t-1} + 3.10 \times DUMMY.
\]  

Focusing on the effect of crisis, it is found that even after using dynamic panel data analysis, the main result concerning the effect of macroeconomic variables on NPLs survives; the main results obtained from all panel regressions are similar.

In this estimation, all independent variables are statistically significant at 5% level. Overall, the model performance is satisfying. The goodness of fit is high – the adjusted coefficient of determination (\( R^2 \)) is relatively high (71%) because macroeconomic variables cannot explain the development of microeconomic bank data in a sufficient way, and as other bank-level factors obviously play a major role in banking. The
probability of $F$ statistic is 0.00 what indicates that model as a whole is statistically significant. Durbin–Watson test is used to detect independence of residuals from the regression analysis. Its value (1.91) indicates the absence of autocorrelation in the residuals and confirms a quality of the model.

In terms of earlier published studies, the results are in line with the findings of empirical evidences such as Jakubík (2007), Aver (2008), Espinoza and Prasad (2010), Gambera (2000), Fainstein and Novikov (2011), Nkusu (2011), Klein (2013), Diaconu et al. (2014) or Škarica (2014), but vary from Arpa et al. (2001), Shu (2002), Rinaldi and Sanchis-Arellano (2006), Bonfim (2009), Kattai (2010), Festic et al. (2011) or Castro (2013). The variety is generated due to differences in used econometric models, country samples, observation periods and considered variables.

5 Conclusions

The aim of the paper was to examine and quantify impact of macroeconomic determinants on NPLs in selected CEE countries in a period 1999–2015. High NPL ratios are a cause for concern for several reasons. Most immediately, they may give rise to financial stress, especially if banks’ provisioning is inadequate, their capital buffers are low, and further NPL rises are in the offing. Furthermore, high NPLs might reflect a deeper problem of general over-indebtedness in the household and corporate sectors. In this case, a combination of deleveraging and debt restructuring would be called for and robust credit growth going forward would be problematic. The third concern is that lingering weakness in loan portfolios becomes a drag on economic growth.

It was performed empirical evidence on aggregate annual panel data collected from the Bluenomics. Next variables were used for testing the impact on NPLs: GDP growth, unemployment rate, inflation rate, nominal effective exchange rate, lending interest rate and debt to GDP.

Panel regression analysis identified the statistically significant impact of all analysed independent variables on NPLs. The most appropriate result is found for a time lag 1 year. Growth of unemployment is the most important macroeconomic factor for NPLs as increase of unemployment rate by 1% point is associated with increase of NPL ratio by 0.54% point. This is in line with the assumption that an increase in the unemployment rate increases a debt burden of households, on the one hand, and decrease the production as a consequence of a drop in the effective demand, on the other hand. Therefore, the relation between unemployment rate and NPLs is proportional.

As assumed, results indicate negative influence of inflation, economic growth and exchange rate on NPLs. Coefficients are negative and statistically significant at standard levels. Impact of crisis and lending interest rate is positive and in line with expectation. Effect of crisis (expressed by dummy variable) on NPLs is very strong and important and statistically significant.

Determination of models is relatively high (ca. 70%), whereas macroeconomic conditions and developmental one cannot explain the development of NPLs in a sufficient way as other bank-level factors (e.g., moral hazard, management, skimping or excess lending) play an important role in banking. Also the value of Durbin–Watson test (1.91) suggests the absence of autocorrelation in the residuals from the regression analysis and confirms a quality of the model.
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References


Effect of macroeconomic determinants on non-performing loans


