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The Determinants of NPLs in Emerging Europe, 2000-2011

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Abstract. The emerging Europe has been hardest hit by the surge in the non-performing loans (NPLs) in the aftermath of the global financial turbulence and the crisis-induced recession. The surge in the NPLs generated a severe banking distress, and left a legacy of a debt overhang that dramatically constrained bank lending and served as a drag on economic growth in the post-crisis period. We quantitatively study the determinants of loan losses in static and dynamic panel models with a focus on the linkages between the macro-financial vulnerabilities and a wide range of bank specific variables in 20 emerging European countries during 2000-2011. Our results indicate that the NPL dynamics have been particularly sensitive to real GDP growth, and inflation, while bank profitability as a proxy for management quality plays a significant role in constraining loan defaults. By contrast, higher lending rates may lead to adverse selection problems, and hence reduces loan quality. There is also some weak evidence that rapid credit growth as a measure of excessive risk taking in lending serves as a precursor to worsening loan portfolio quality. We observe, based on a unique data set, that banks in the region increasingly employ advanced risk management regimes (Internal Rating Based, IRB) with the potential to better monitor and evaluate loan quality and hence, rein on problem loans.

Keywords. Non-performing loans in emerging Europe, Panel estimation, Generalized Method of Moments
JEL. G21, G28, G32.

1. Introduction

The onset of the global financial crisis in late 2008 followed by the sovereign debt strains in the European Union has left a legacy of non-performing loans (NPLs) in emerging Europe. Prior to the crisis, emerging European countries have registered a rapid yet unsustainable credit growth, fueled by massive capital inflows largely intermediated by the foreign-dominated banking sectors and that ended abruptly with the advent of the global financial crisis (2008-2009). As a result, in the post-2009 period, the non-performing loans in the region surged with the sharp deterioration in loan quality (Brown and Lane, 2011) and the ratio as percent of volume of loans outstanding currently stands at 11 percent on average in the region (European Banking Coordination "Vienna" Initiative (EBCI), 2012).

Although the accumulation of bad loans did not threaten the overall bank stability[1], the gravity of the problem differed substantially across the region and banks showed varying performance both in terms of the deterioration in their credit quality, and hence, in terms of the level of NPLs during the 2009-2011 period.[2] Figures 1-3 in the Appendix show the evolution of the NPL ratios for each group in the sample. As is clear, NPLs are higher on average, almost double the magnitude

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of the ratios registered in Central Europe and hence, more problematic for the East and Southeast European economies, reaching unprecedented levels in some countries in the region.

The rapid deterioration in loan portfolio quality could be attributed to the severe contraction in the economic activity and the subsequent stagnation in credit, partly due to the constrained access of banks in the region to wholesale borrowing markets which led to a sizeable reduction in their profitability. Given the relatively slow resolution of the problem, it is feared[3] that the lingering NPLs and debt overhang can continue to hold back economic recovery by fostering a permanent state of credit stagnation, which currently remains subdued in most of the region.

A growing body of research argues that problem loans can be explained by both macro-specific factors and bank-level characteristics in addition to measures of institutional quality, effectiveness of prudential regulations and risk management sophistication. Several papers assess macro-financial linkages between credit markets and macroeconomic performance (Espinoza & Prasad, 2010; Nkusu, 2011) while others investigate the effects of worsening loan quality on the macro economy using the vector autoregressive (VAR) method as in Quagliariello (2008) and the panel-vector autoregressive (PVAR) system as in Espinoza and Prasad (2010) and Nkusu (2011). On the other hand, several articles investigate the role of bank-specific factors behind in the deterioration of loan quality (Salas and Saurina, 2002; Espinoza and Prasad, 2010; Louzis et al., 2011; Nkusu, 2011). Additionally, Podpiera (2004) employs an extended panel data set of 65 countries for the period 1998-2002 and finds a significant effect for the compliance with Basel Core Principles on NPLs, controlling for different levels of financial and economic development and other macroeconomic and structural factors. In contrast, Sundararajan et. al. (2001) find that an overall index of BCP compliance is not a significant determinant of measures of bank soundness, namely nonperforming loans (NPLs) and loan spreads. Stein et. al. (2003) use an extensive databank on default rates in order to quantify the competitive advantages that can be gained by a credit institution from applying more advanced rating systems.

This paper analyzes the key driving factors behind the region's loan quality dynamics and in particular, the relative importance of macroeconomic and bank-specific factors for the evolution of NPLs for a panel data of 20 emerging European countries[4] for the 2000-2011 period. We study the dynamics of NPLs in static (fixed and random effects) and dynamic (GMM) panel models, employing a wide range of variables, while controlling for the impact of the global financial crisis. In recent years, banks in the region have increasingly moved in the direction of better risk management and implemented advanced internal-based risk management regimes (Internal Rating Based, IRB) to better monitor and evaluate loan quality but still lag behind their Western European counterparts. Using a unique data on the IRB usage rates in each country's banking system, we also explore whether IRB improves loan quality, and reduce the incidence of credit defaults. Clearly, our results on the effectiveness of IRB should be treated with caution due to the short span of implementation period. To our knowledge, no previous empirical literature have investigated the causes of loan defaults in emerging Europe, based on dynamic panel methods, while using a rich set of macro-financial data enhanced with a risk management measure, IRB.

Our study confirms in the context of emerging Europe that NPLs are counter-cyclical and adverse macroeconomic shocks worsens credit risk. It shows that he NPL dynamics have been particularly sensitive to specific macroeconomic variables, most notably, the real GDP growth, and inflation. Among several bank-level measures, bank profitability as a proxy for management quality plays a

significant role in constraining loan defaults. In contrast, lending rates (and interest spread) raise the rate of credit defaults by leading to adverse selection problems. There is also some weak evidence that rapid credit growth as a measure of excessive risk taking in banking serves as a precursor to NPLs. Rapid credit growth enhances bank fragility and serves as a precursor to a severe deterioration in the quality of loan portfolios. The fact that the loan quality dropped severely in the post-crisis period, underlines the vulnerability of region's banks to the external shocks transmitted thorough strong trade and financial links to Europe. We also find that banks in the region increasingly employ advanced risk management regimes (Internal Rating Based, IRB) with the potential to significantly reduce the incidence of problem loans. Our empirical findings are expected to guide policy decisions to ensure financial system soundness by designing and implementing appropriate countercyclical macro-prudential regulation and advanced internal risk-management regimes at the bank level to enhance monitoring of early warning indicators of a possible banking distress due to loan defaults.

The paper proceeds as follows: The next section discusses the related literature on the NPLs. Section 3 discusses the data, the variables and the expected signs. Section 4 presents the econometric methodology, justifies the regression specifications and presents the results of the Fixed Effect, Random Effect and GMM estimations. Section 5 concludes with a summary of findings and policy implications.

2. Literature Review

The interaction between adverse macroeconomic shocks and the deterioration in loan quality is well-documented for both advanced and developing economies. The empirical literature provides evidence on the linkages between business cycles and performance in banking. Economic booms are associated with rising revenues, which strengthen the borrower's debt servicing capacity. On the other hand, recessionary shocks are transmitted to bank balance sheets through a worsening of their credit portfolio. Pesola (2001, 2010) argues that loan losses from the banking crises in Nordic and other European countries stem from the high exposure of banks to strong adverse aggregate shocks, and the overall level of financial fragility as measured by aggregate indebtedness, affects banks' loan losses jointly with macroeconomic shocks. Moreover, the impact of an adverse macroeconomic shock is amplified if the prevailing level of financial fragility (indebtedness) is high. Nkusu (2011) study a panel of 26 advanced economies for the 1998-2009 period and confirms that adverse macroeconomic shocks associate with rising NPLs.[5] These results confirm repeatedly that the NPLs are highly sensitive to systemic macroeconomic disturbances and business cycle shocks.

A growing trend in the literature attributes loan quality not only to macroeconomic factors but also bank-specific characteristics and highlight the significance of bank-level vulnerabilities for worsening loan quality. Espinoza and Prasad (2010) study a dynamic panel model to assess the relative significance of a rich array of macro and bank specific variables for loan losses.[6] Using a panel of 80 banks in the Gulf Cooperative Council (GCC) region in 1995-2008, they find that NPL ratio worsens as economic growth decelerates and interest rates and risk aversion increase. In their view, the financial crisis during 2008-2009 highlights the strong linkages that exist between macroeconomic conditions and the banking system specifics as key determinants of NPLs. Their confirmed hypothesis is that that the more fragile a banking system is, the more likely it is to experience problems when an unexpected macroeconomic shock hits. Bofondi and Ropele (2011) find that the ratio of bad loans to the outstanding amount of loans at Italian

banks can be explained by the general state of the economy, the cost of borrowing, and the burden of debt. Yet, these variables affect households and firms at differential lags. Quagliariello (2007) also finds that the quality of loans at Italian banks follows a cyclical pattern related to the evolution of business cycles and that it also depends on bank-specific factors. Dash and Kabra (2010) analyzes the evolution of NPLs in the Indian bank system with a focus on the interplay between macroeconomic factors such as GDP growth, inflation, real effective exchange rate, and the bank system characteristics given by real interest rate, bank size, annual growths in loans and ratio of loans to total assets. Salas and Saurina (2002) confirms for Spanish banks that, in addition to real GDP growth and past credit growth, leverage, portfolio composition, bank size, capital-assets ratio and market power affect credit risk and explain variations in NPLs. Louzis et al. (2011) investigate the determinants of NPLs in different loan categories such as consumer loans, business loans and mortgages in the Greek banking sector and confirm that both macroeconomic fundamentals and management quality matter for the level of credit defaults.

3. Data, Variables and Expected Signs

Our data consists a rich array of macroeconomic and banking data taken from the IMF, World Bank, and a country-level measure of IRB from the European Banking Authority (EBA). Our data covers the timing of the global financial crisis (in addition, the partially overlapping Eurozone crisis of 2009-11) and hence, gives us an opportunity to split the sample into pre- (pre-2009) and post-crisis (post-2009) periods to analyze the effect of the crisis on the NPLs in the region with the help of a post-crisis dummy, DPOSTCR.

TABLE 1. *Descriptive Statistics for Selected Variables*

	Pre-Crisis			*Post-Crisis*		
	Obs	Mean	St. Dev	Obs	Mean	St. Dev
NPL	119	8.252101	10.20108	54	10.61852	5.229635
RGRWTH	162	5.500988	2.678149	54	-.1770371	5.881756
INF	162	10.73194	18.77969	54	4.747889	10.01778
CAP	146	11.12055	4.593382	54	10.89245	3.368511
BPRIVCRGDP	155	32.4491	18.27733	54	54.71167	22.17066
OVERHEAD	162	4.488642	2.300409	54	3.695741	3.455342
ROE	162	13.5213	8.206247	54	2.244074	17.41388
ROA	162	1.573704	1.184457	54	.3751852	1.85437
LOANDEP	162	105.9376	62.07555	54	121.1706	36.28833
LOANLOSS	127	71.01102	38.89395	54	67.96111	27.7014
IRB	162	.0119284	.0610242	54	.1572926	.2308934

We conduct our econometric analysis to assess how various macroeconomic and banks-specific variables affect the pattern of NPLs but also consider a novel and unique measure, IRB, for the percent of banks in a given country implementing advanced risk management systems to control credit risk. Table 1 gives the descriptive statistics on selected indicators for both pre-crisis and post-crisis period.

It can be observed that on average, emerging European banks became less profitable, both in terms of ROE and ROA measures, yet still more cost-efficient as measured by overhead expenses, OVERHEAD in the post-crisis period. More importantly, they had less control over their credit risk as they register significantly more NPLs in the latter period. On the other hand, these banks are less capitalized as measured by CAP in the aftermath of the crisis. Strikingly, although there exists

a wide variation in terms of the intensity of IRB adoption rates across banks, the region's banks have dramatically increased their IRB usage from 1.1 percent to 15.7 percent in the post-crisis period in their attempt to control their credit risk while saving on expensive capital. The trend in loan loss provisions to total loans, LOANLOSS, suggests that banks provisioned less reserves for their credit risk exposures in the post- crisis period, possibly due to more intense employment of IRB.

At the macro-level, we include real GDP growth (RGRWTH) as a proxy for credit demand as well as business cycle shocks. In several studies on NPLs, there is a strong relation between macroeconomic vulnerabilities and non-performing loans and that recessions are key determinants of bad loans (Nkusu, 2011; Quagliarello, 2007; Salas and Saurina, 2002; Pesola, 2007; Dash and Kabra, 2010).[7] Hence, we expect a negative link between RGRWTH and NPL as credit risk is countercyclical and banks tend to better control their credit risk when the real economy is growing. We also include the change in CPI for inflation, INF, in our regression specifications. We expect a negative impact of inflation on NPL to the extent that rapid price increases worsen market frictions, forcing banks to ration credit (Boyd et. al., 2001). On the other hand, higher inflation can make debt servicing easier by reducing the real value of outstanding loans and hence, there may also be an additional negative impact of inflation on credit default, enhancing the effect of the negative sign on NPL. Yet, INF can also worsen the level of NPL when it captures deterioration in macroeconomic fundamentals and growing economic uncertainty. In this latter case, it might have a positive effect on NPL.[8] Inflation can affect negatively the ability of the borrower to service debt. Furthermore, when loan rates vary during time, inflation is most likely to affect negatively borrowers' loan servicing capacity as long as lenders on the other hand will adjust rates to maintain their real returns (Nkusu, 2011).

In addition, we use FX for the nominal exchange rate with negative or positive effects on on NPLs. One implication is that it can negatively affect the competition that exists between export-oriented firms, harming their debt servicing capacity (Fofack, 2005). The other implication is that the exchange rate can improve the debt-servicing capacity of those firms or borrowers that borrow in foreign currency (Nkusu, 2011).

PREM stands for the risk premium on lending is calculated as the interest rate charged by banks on loans to private sector customers minus the "risk free" Treasury bill interest rate at which short-term government securities are issued or traded in the market. Higher the risk premium means that the country is considered as risky and this implies that the ratio of NPLs will be higher in those countries where the default risk is large. If the risk premium on lending is low, banks will have to issue fewer loans, reducing the number of non-performing loans.

On the other hand, several bank characteristics affect the risk-taking behavior in lending and the risk management practices of banks, which can lead to high-risk loan portfolios. A number of bank-specific controls have been included in the panel regressions as in the literature (Quagliariello, 2007; Salas and Saurina, 2002; Espinoza and Prasad, 2010). Since the charter value of banks increase with more profitability, higher return on equity, ROE, is likely to curb incentives for risk-taking and may improve performance in monitoring loan quality. We include ROE or return on assets, ROA in our regressions as we expect higher profitability to lead to lower levels of NPLs.

Loan to deposit ratio, LOANDEP is used as a measure of banks' relative access to external funding, and availability of wholesale funding which may also stand for the degree of financial deepening in the banking system. This effect is likely to

reduce NPL if it signals the quality of bank management as well. Yet, it may also serve as an indicator of risk-taking on the part of bank managers, as higher loans to deposits ratio may reflect the choices of bank managers for riskier loans as opposed to holding safer government securities. Larger the proportion of bank assets allocated to loans, greater the credit risk exposure, leading to a higher level of NPL. Hence, we expect either positive or negative sign for this variable, depending on which of the two effect dominates.

Additionally, bank equity to assets, CAP, stands for the degree of bank solvency and may curb incentives for risk-taking for bank managers so we anticipate its sign to be negative. This variable is an approximation of banks' financial health and strengths. If the bank capital faces a decline due to moral hazard incentives of banks' managers, banks will experience higher NPLs since their position will be riskier (Espinoza and Prasad, 2010). We also add several other bank-specific variables such as LOANLOSS (loan loss reserves to gross loans) as a proxy for expected loan defaults and prudent measurement and management of these credit risks and 5-bank concentration ratio, CONCEN, to control for concentration in banking in different regression specifications.

In line with the literature, we believe that managerial quality and cost efficiency of banks do matter for loan quality as in Louzis et al., (2011), Berger and DeYoung (1997) and Podpiera and Weill (2008). These authors attribute problem loans to bank-specific factors such as a worsening in banks' cost efficiency. We include two measures of efficiency in our regressions specifications: OVERHEAD measures the operating costs including overhead expenses as percent of total assets and these variables are expected to have a positive effect on the NPL variable.

As in Salas and Saurina (2002), we also include a variable, CRGRWTH in our regressions in lagged form. This is because rapid credit growth may lead to adverse selection, and may be associated with reduced credit quality as risk taking intensifies during such periods, adversely affecting the level of non-performing loans. Consequently, more reserves need to be provisioned for rising level of bad loans. Additionally, bank-credit to the private sector as percent of GDP, BPRIVCRGDP, is a measure of financial depth and is expected to have a negative effect on NPL.

Lending rate, LENDR, is the bank rate on loans and usually this interest rate meets the financing needs of the private sector. Banks charging the highest interest rates are those that later have higher levels of problem loans (Salas and Saurian, 2002). Higher lending rates may induce adverse selection in the pool of potential borrowers and raise the risks of default on loans. In addition, in the face of adverse income shocks, the borrower has greater probability to default when interest payments on borrowed funds are larger. Hence, higher lending rates are expected to enhance loan defaults. Interest rate spread, SPR, is calculated as the difference between the interest rate charged by banks on loans minus the interest rate paid by banks on deposits and is expected to have a positive sign. Both lending rates and the interest spread as a proxy for cost of bank intermediation and market concentration should have a negative effect on loan quality.

LY is a proxy for financial fragility calculated the total outstanding loans to nominal GDP (Pesola, 2010) and is expected to have a positive sign. It may also stand for financial deepening with a negative effect on NPLs. To the extent that it captures the risk appetite of banks, we expect the positive effect to dominate (Dash and Kabra, 2010). INDX is the index of accountability, transparency and the rule of law as a proxy for the institutional quality with a negative effect on NPLs. As the judicial system resolves credit disputes more effectively, this index is expected to reduce the incidence of problem loans. Additionally, LOANDEP stands for the

loan to deposit ratio and measures the degree to which funding comes from abroad to finance loans and can proxy for aggressive lending by banks through foreign borrowing, and possibly enhanced risk taking in lending.

NRFB is the number of foreign owned banks and is usually associated with better risk management strategies, which may assist in building low risk loan portfolios. A larger foreign share in the banking sector is usually associated with lower reserves or a better loan portfolio quality. Yet, foreign banks may also engage in risky lending strategies, especially when their parent banks expect greater profitability from their subsidiaries located in emerging economies. LIQ is computed as the liquid assets to bank assets and serves as an approximation for bank efficiency. If the liquidity of a bank is low, this implies that its solvency is also low with a negative effect on NPLs (Salas and Saurina, 2002). It may also indicate risky managerial behavior, creating more chances of experiencing credit risks.

4. Econometric Methodology

4.1 Panel Estimation: Fixed and Random Effect Models

We report a set of panel regressions to disentangle the impact of macro-specific and bank-specific variables on NPLs. In all of our regressions, we include a post-crisis dummy for the period 2009 and on–DPOSTCR– to distinguish between pre- and post-crisis behavior of NPLs in emerging European banking. All panel regressions contain macroeconomic variables and bank-specific, time-varying control variables that measure the financial characteristics of the banks.

We first estimate static fixed effect (FE) and random effect (RE) models and apply first F-test to test for the pooled OLS of Hausman test to determine whether the individual fixed effects are significantly correlated with the explanatory variables. The fixed effect model assumes that intercepts vary across the countries and can thus account for possible unobserved time invariant heterogeneity across countries. A random effects model, on the other hand, assumes that the individual country intercepts are random variables drawn from a common distribution.

Our results strongly reject pooled OLS (POLS) in favor of fixed effects estimation, confirming the presence of a significant degree of country-level heterogeneity in NPL dynamics. The Hausman test also favors fixed effects estimation over random effects.

After a series of serial correlation tests, we find that our dependent variable, exhibits a significant degree of serial correlation and persistence, which requires a dynamic specification in a panel context. Our estimations show that NPLs are very persistent, suggesting that the response of credit losses to the macroeconomic shocks could take time to materialize and possibly captures the feedback effect from loan losses back to the real economy. As a result, our modified panel specification includes a lagged dependent variable, $\boldsymbol{NPL_{it-1}}$ and becomes:

$$\boldsymbol{NPL_{it} = \delta_o NPL_{it-1} + \Sigma\beta_j MacroVar_{it-1} + \Sigma\gamma_k BankVar_{it-1} + \delta_1 dPostCr_{it} + \varepsilon_{it}} \quad (1)$$

$$\boldsymbol{\varepsilon_{it} = \vartheta_i + \mu_t + u_{it}}$$

where $\boldsymbol{\vartheta_i}$ captures unobserved country-specific fixed effects, $\boldsymbol{\mu_t}$ is the unobservable time effect, and $\boldsymbol{u_{it}}$ is the white-noise error term. $\boldsymbol{NPL_{it}}$ is the logarithmic transformation of the aggregate ratio of non-performing loans to total loans whereas the lagged dependent variable, $\boldsymbol{NPL_{it-1}}$ captures persistence in loan

quality over time.[9] The set of explanatory variables include both macro-specific and bank-specific variables, and the post-crisis dummy.

MacroVar$_{it-1}$ is a vector of j macroeconomic variables including the real GDP growth (RGRWTH), bank credit to the private sector to GDP ratio (BPRIVCGDP), domestic credit growth rate (CRGRWTH) and inflation (INF). All of the macro variables enter equation (1) with a lag to account for plausible delay with which macroeconomic shocks affect banks' credit portfolio. The macroeconomic variables are taken as strictly exogenous[10], while bank-level variables are all one-period lagged to control for potential endogeneity problem and are modeled here as predetermined.[11]

TABLE 2. *Pooled OLS, Fixed and Random Effects Estimation*

Dependent Variable: (Log) Non-Performing Loans to Total Loans (LNPL)

	POLS (robust)	*FE (robust)*	*RE*
LNPL(-1)	.6692743***	.5616002***	.6636189***
RGRWTH	-.0229839*	-.0237798*	-.0229879*
INF	-.0354177***	-.0288233***	-.0347289***
CRGRWTH(-1)	.2078946	.149949	.2062253
LENDR	.0285032***	.0089371	.0273084***
ROA	-.0554295**	-.0343023	-.0540935**
LOANLOSS	-.0037429**	-.0075513**	-.0040067**
DPOSTCR	.326366***	.3563691***	.3280824***
No. Obs.	104	104	104
Rsq (within)	0.8608	0.8386	
F-test (p-value)	0.000		
Hausman Test (p-value)		0.000	

***Note:** *** significant at 1%; ** significant at 5%; * significant at 10%.

We address concerns about the presence of unit roots in the series by conducting panel unit root tests for unbalanced panels. The Fisher-Augmented Dickey-Fuller (ADF) and Im-Pesaran-Shin unit root tests, which are suitable for unbalanced panels, were conducted for all the variables used in the data set with time trends, lags and demeaning of cross-sectional means. Both the Fisher and Im-Pesaran-Shin tests of unit roots consistently rejected the presence of unit roots for all variables included in regression specifications, indicating that they are stationary.[12] Hence, we include them in equation (1) in levels without differencing. Based on the LM test for the joint significance of time effects, we find time effects to be jointly insignificant at 1 percent level, and hence, we only employ a post-crisis dummy, DPOSTCR instead.

In Table 2, we present the results from pooled OLS, Fixed and Random effects regressions by including a lagged dependent variable in specifications. In all regressions, lagged NPL is highly significant, suggesting strong persistence in the NPL series. However, the results should be treated with caution, as POLS estimation is inconsistent in the presence of country-level heterogeneity. On the other hand, fixed and random effects specifications with a lagged dependent variable cause bias in estimation. Notwithstanding these issues, several specifications have been tried with different combinations of macro and bank-specific variables. The variables presented in Table 2 turned consistently significant in almost all regressions and this is why we report only these results. In addition, the signs and significance of the variables are almost identical regardless of the estimation method, confirming the robustness of our results.

4.2 System and Difference-GMM Estimation

Since NPL series display a considerable amount of persistence, dynamic panel estimation is the appropriate to generate consistent estimation. Hence, we apply

both system and difference- GMM estimation (two-step, robust) (Arellano and Bond, 1991; Arellano and Bover, 1995) and report the results in Table 3. System-GMM with forward orthogonalization procedure removes panel fixed effects and has the added benefit of better preserving sample size in our unbalanced panel than its alternative, the difference GMM. System GMM is preferred because exploiting the additional moment conditions in the levels equations provides a dramatic improvement in the accuracy of the estimates when the dependent variable is persistent (Blundell and Bond, 2000). The first-difference GMM estimator may potentially suffer from problems associated with weak instruments, such as substantial finite sample bias. The system GMM specification is estimated using the xtabond2 command in Stata (Roodman, 2005). We control the number of instruments by limiting our analysis to 2 lags as this helps avoid bias due to too many instruments in a relatively small sample.[13]

We apply several GMM specification tests and the Arellano and Bond test for autocorrelation of order 1 and 2. The p-values greater than the significance level show that the null hypothesis of no second-order autocorrelation (first-order autocorrelation does not imply inconsistent estimates, but we also find no evidence for it) should not be rejected and this confirms the validity of our instruments. Hence, our system GMM regressions are well-specified. As the p-values show, the Sargan tests fails to reject the validity of the exclusion restrictions at any common significance level. The Hansen-test of over identifying restrictions also suggests that the instruments are appropriate.

Despite their different approaches, system GMM and difference- GMM as well as RE and FE and POLS all arrive at essentially similar results as to the sign, and the statistical significance of most variables in regression specification. This confirms that our results are robust to different specifications, although the precision of the estimated coefficients differs across different methods.

TABLE 3. *Difference and System GMM Estimation*

Dependent Variable: (Log) Non-Performing Loans to Total Loans (LNPL)

	System-GMM (Two-step robust)	*Diff-GMM (Two-step)*	*Diff-GMM (Two-step robust)*
LNPL(-1)	.6473829***	.5201994***	.6116519***
RGRWTH	-.0284554***	-.0287665***	-.0292947*
INF	-.0509454***	-.0279753***	-.0303967**
CRGRWTH(-1)		.3272964**	.3453989
LENDR	.0636785***	.016262	.0259842
BPRIVCRGDP	.002424		
CAP		.0323014	
ROA		-.0499429***	-.073125**
LOANLOSS		-.013734***	-.8708316***
DPOSTCR	.3439542**	.0821813	.113305
IRB	-.3578975		
No. Obs.	109	71	73
No. Instruments	27	18	16
Wald test statistics	503.34	2.84e+06	4112.86
AR(1) p-value	0.099	0.3378	0.9021
AR(2) p-value	0.415	0.8063	0.7207
Sargan p-value		0.4120	0.4752
Hansen p-value	0.878		

***Note:** *** significant at 1%; ** significant at 5%; * significant at 10%.

Based on the Tables 2 and 3, our econometric results show that lagged dependent variable, NPL(-1) is significant for all specifications, confirming a

considerable amount of persistence in NPL dynamics in the region. As expected, NPLs increased significantly in the post-crisis period as evidenced by the significant positive sign of the DPOSTCR variable and this result is robust in different specifications and when controlling for a battery of bank-specific and macroeconomic variables. In almost all specifications, RGRWTH, INF, ROA, LOANLOSS, LENDR appear significant with the correct signs. Most notably, RGRWTH and INF as proxies for macroeconomic shocks are significant in all models, confirming that as in other countries, the emerging European banks are quite vulnerable to macroeconomic risks and high volatility in the GDP. In addition, inflation, INF is very significant with a negative impact on the NPLs, suggesting that inflation reduces the real debt obligations of borrowers and hence, lowers the level of credit defaults. As expected, lending interest rate, LENDR (along with interest rate spread, SPR) has a significant positive effect on the level of credit risk, raising the cost of loans and borrowers' ability to service their loans. There is some evidence based on the signs of BPRIVCRGDP and lagged CRGRWTH that rapid credit growth leads to a faster accumulation of NPLs but these variables are significant in only limited number of regressions (Tables 2 and 3). Still, they both have the correct signs in line with the literature which condemns unsustainable lending booms as a factor leading to increased financial fragility in the emerging European banking. This result may also justify central bank actions to limit excessive lending growth to ensure financial stability.

On the other hand, a rich variety of variables considered in different specifications such as LIQ, NRFB, INDX, OVERHEAD, CONCEN do not affect NPLs in a significant manner, so they have been dropped from estimation. It is also noteworthy that IRB (taken as an endogenous variable, and instrumented as such in System GMM specification) has the right sign but lacks significance, possibly because of the short span of data. This confirms that sophisticated risk management systems implemented at the bank level has the potential to improve loan quality and reduce the incidence of loan defaults.

5. Conclusions

Understanding the causes of NPLs is crucial for designing appropriate prudential regulatory measures to reinforce financial stability in the banking sectors, and to strengthen their robustness to better absorb macroeconomic shocks. Our empirical results support the view that NPL dynamics are strongly influenced by domestic macroeconomic factors such as periods of low growth and recessions as there is strong evidence of a significant inverse relationship between GDP growth and nonperforming loans. This underlines the importance of macro-specific business cycle shocks as the critical variable for loan defaults. Equally important is the significance of the global financial turbulence in raising the level of NPLs, and hence, the vulnerability of the banks and the borrowers in the region to external shocks via trade and financial links. Inflation is yet another variable which strongly affects NPLs in a negative manner.

We also find some evidence that rapid credit growth is a precursor (and serves as a warning indicator) for the subsequent surge in the NPLs, and financial fragility along with high lending rates and interest rate spreads. Hence, the regulators should closely monitor the rate of credit growth to prevent an excessive and destabilizing increase in the overall NPL levels and adopt policy measures to reduce the lending rates by cutting taxes on intermediation, fostering competition and required reserve ratios. A stronger focus on macro-prudential regulation, particularly through capital and liquidity buffers, and countercyclical provisioning, could help mitigate the

impact of macroeconomic risks on the banking systems of the region and the feedback effects of rising credit risks on their economies.

Although bank-specific factors such as capital adequacy, liquidity, market concentration and the degree of foreign ownership do not seem to play a significant role in influencing the level of NPLs, bank profitability as a proxy for management quality has a strong negative influence on NPLs, similar to the effect of loan-provisioning as a proxy for prudent lending behavior. This suggests that better-managed banks are also better in loan evaluation and monitoring and hence, experience lower rates of NPLs. Our results, interestingly, show that foreign banks do not seem to differ from (or have superiority over) their domestic counterparts in terms of reining in on credit defaults contrary to expectations. Foreign banks, with experience and better management skills, are expected to build lower risk portfolios and thus restrain the growth of bad loans. Our results may point to the aggressive lending style (and somewhat excessive risk taking) of most foreign banks in the emerging economies in search for relatively high profit expectations from their affiliated banks in the region.

In the last few years, the emerging European banks have begun to implement advanced risk management techniques such as internal risk management techniques (IRB) in compliance with the Basel Core Principles but they significantly lag behind their Western European counterparts in promoting such risk control mechanisms. In this paper, we find some evidence that such risk management regimes have the potential to reduce NPLs, while generating capital savings, thereby help promote more profitability and stability for these banking sectors. Tighter supervision of banks and better monitoring of credit risks thorough advanced risk management systems reduce the incidences of excessive risky taking by banks and help stabilize NPL levels. Banks should regularly monitor loan quality through such measures and use stress tests for different levels of contingencies to alert regulators on potential bank weaknesses. Transparency of bank balance sheets is invaluable for the regulators as early-warning signals can be corrected in an effective and timely manner. The justice system and the legal framework should also be strengthened to resolve potential disputes between banks and the borrowers and hence, to promote a fast resolution of NPLs with effective and timely liquidation of collateral, given the limited market for distressed debt in the region.

Notes

[1] In emerging Europe, high capital adequacy ratios and relatively high provisioning provide important buffers against bank insolvency due to NPL write-offs. An average capital adequacy ratio of about 17 percent puts these banking systems at the top end of the spectrum in international comparisons. Loan provisioning at relatively high levels are also considered prudent.

[2] Fast credit expansion was the main contributor to economic growth in these countries prior to the financial and economic crisis of 2009-2010. The entry of foreign banks, particularly banks from EU-15 countries intermediated large capital inflows into the region's affiliated banks. Given the huge untapped catching-up and profit potential and the progress made in EU integration, by the end of 2008, foreign bank penetration into the region reached well above 80 percent of total banking sector assets in most countries, with Austrian, German, Italian and French investors taking the lead. It is argued that the rising profit orientation and the increase in the risk proclivity of foreign banks was the main driver behind the fast credit growth rates in the emerging European banks. The global economic crisis and the subsequent increase in bad loans led to a breakdown of this debt-led growth model in the region.

[3] The danger lies in the fact that unresolved NPLs tend to constrain recovery from the recession in the region as debt overhang due to the overextended borrowers hinders the reallocation of their assets to more productive uses.

[4]Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia FYR, Moldova, Poland, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Turkey, and Ukraine.

[5] The study uses a variety of macroeconomic indicators such as GDP growth, unemployment, inflation, interest rates, changes in housing and stock price indices, private sector credit to GDP growth and exchange rate.

[6] They use real GDP growth, stock market returns, interest rates, world trade growth, VIX index (a proxy for global risk aversion), capital adequacy ratio, ROE, size, lagged net interest margin and lagged credit growth.

[7] In a recession, real GDP growth slows down or turns negative, generating an increase in credit default rates. By contrast, a positive growth in real GDP leads to higher income, which in turn contributes to higher debt servicing capacity of the borrowers and thus lowering the ratio of non-performing loans.

[8] For instance, Fofack (2005) claims that inflation contributes to high level of non-performing loans in those countries that use flexible exchange rate regimes.

[9] The ratio of reserves for impaired loans to total loans is bound by zero and is equal to one. We use its logarithmic transformation so that it spans a wider interval over $[-\infty; +\infty]$ (see Salas and Saurina, 2002; Espinoza and Prasad, 2010).

[10] These variables can be instrumented by themselves as "IV-style" instruments in System GMM estimations. See Roodman (2006).

[11] Hence, they are instrumented in the GMM-style in the same way as the lagged dependent variable.

[12] The null hypothesis is that all series are non-stationary and the alternative hypothesis is that at least one of the series in the panel is stationary.

[13] The macroeconomic variables were considered as strictly exogenous (i.e. can be instrumented by itself as a one-column "IV-style" instrument, see Roodman, 2006), while the lagged bank-level variables, including the IRB, were modeled as predetermined (and need to be instrumented GMM-style in the same way as the lagged dependent variable).

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Appendix: NPL Dynamics in Central, Eastern and Southeastern Europe

Figure 1:

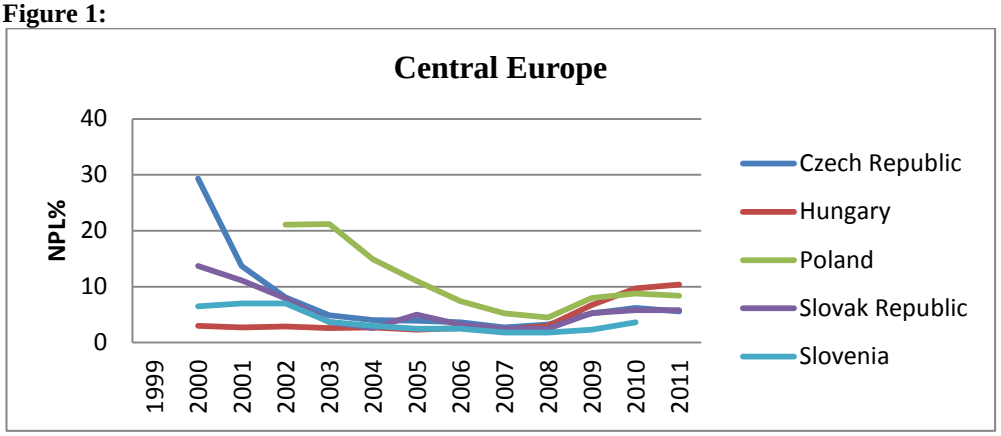

Figure 2:

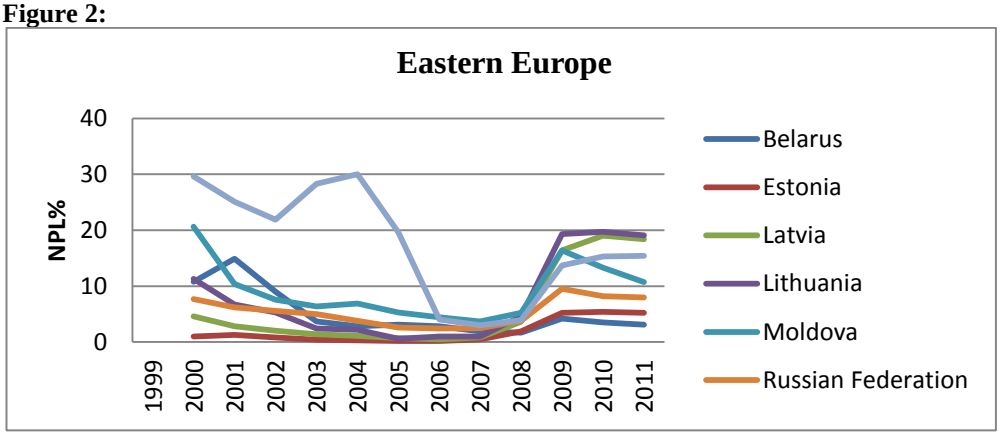

Figure 2: