The Banking Sector and Macroeconomic Performance in Central European Economies[*]

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Abstract
We present empirical evidence on the macroeconomic variables affecting non-performing loan (NPL) ratios in five central European economies (CEEs). We reach four main conclusions. First, a slowdown in economic activity can be expected to deteriorate the NPL ratios in the CEEs. Second, in four out of the five countries, foreign direct investment growth appears to improve NPL ratios. Third, an increase in real interest rates has a negative impact on the financial position of borrowers and loan portfolio quality in all the five CEEs. Fourth, in a majority of CEEs, increasing credit to the private sector increases the NPL ratio, indicating a need to strengthen the supervision of banks' lending activities.

1. Introduction

A remarkable feature of the financial markets over the last few decades has been the prominence of credit and asset price booms, often associated with rapid rates of growth in real fixed investment, a strengthening of foreign trade, an increase in employment, and rapid growth of wages. In the industrial countries, a sharp run-up in credit volume and asset prices (particularly equity and real estate prices) occurred in the early 1970s. A second cycle began in the mid-1980s and turned to a bust in the early 1990s. Examples include the banking crises in the Nordic countries and Japan in the late 1980s, the Mexican crisis of 1994, and the severe banking problems encountered in East Asia in 1997 and 1998.

In response to the global financial crisis in the 1980s and 1990s, national and international institutions began monitoring the soundness of the financial system more carefully. As a result, the set of financial stability indicators has been extended to include a range of sub-indicators, which deal not only with financial infrastructure and markets, but also with the real and government sectors as the main debtors of financial institutions. The indicators that measure financial stability can be divided into internal factors, external factors, and contagion factors (Mörttinen et al., 2005). Regulatory capital vs. risk-weighted assets, interest margins and non-interest expenses vs. gross income, return on assets and return on equity are appropriate quantitative internal indicators. The spread between the highest and lowest inter-bank rates as an indicator of contagion influences liquid assets with regard to short-term liabilities, liquid assets in relation to total assets, as well as the cost-income ratio. Banking sec-

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tor results are also determined by the macroeconomic environment, which influences the values of external indicators such as credit relative to GDP, the net open position in foreign currency relative to capital, the geographical distribution of loans relative to total loans, as well as foreign-currency-denominated loans relative to total loans. According to studies by Schinasi (2005) and Kool (2006), balance-sheet quality can be noted from financial derivatives relative to capital, market assessment of risks, and the ratio of non-performing loans to total loans (the NPL ratio).

When analyzing the state of the banking sectors and the macroeconomic conditions in the new EU member states, two main features can be singled out (Brzoza--Brzezina, 2005). First, the catching-up process in these economies – combined with the banking sectors' general procyclicality – reinforces the demand for already-growing credit. Second, nominal convergence and the lowering of interest rates increases demand for leveraging among companies, and boosts private consumption. The financial acceleration literature (Terrones, Mendoza, 2004) gives some insights into the mechanism of how credit expansion could turn out to be unsustainable. Rapid credit growth itself poses a risk of increasing the NPL ratio, even though there is little empirical evidence that credit expansion typically leads to financial crisis (Égert, Backé, Žumer, 2006). The new EU member states have been shown not to have excessive lending growth (Kiss, Nagy, Vonnák, 2006), but changes in credit growth relative to GDP growth should be commensurate with macroeconomic fundamentals in order to preserve long-term economic growth in these countries (Arpa, Reininger, Walko, 2005).

While there is a range of empirical studies examining the macroeconomic factors that affect the size and evolution of NPLs in developed market economies, similar analyses of banking sector performance among the new EU member states are rather rare and limited in their country coverage. The goal of this article is to fill this gap by covering five central European economies (Hungary, Poland, the Czech Republic, Slovakia, and Slovenia). The article is structured as follows: Section 2 gives a brief overview of the relevant literature on the macroeconomic variables explaining the dynamics of NPLs. Section 3 provides an outline of banking sector development and performance in the CEEs. An empirical analysis, together with a discussion of the results, can be found in Section 4. The key conclusions are stated in the final section.

2. Review of the Literature

Table 1 presents a brief summary of the countries, methodologies, and conclusions of the most empirical studies on the macroeconomic factors influencing NPLs.

Several conclusions emerge from the above set of investigations. First, the majority of studies confirm that GDP growth represents a major challenge to loan portfolio quality, and the dynamics of NPLs have been proven to be pro-cyclical with respect to GDP growth. Periods of economic growth and strong demand for a country's exports have a positive effect on the domestic corporate sector. Second, studies employing variables for unemployment show that an increase in the unemployment rate increases the default rate for the household sector and deteriorates NPLs with regard to households. Third, according to Baboušek and Jančar (2005) and Hoggarth, Logan, and Zicchino (2005) rising inflation makes borrowing more expensive and causes a considerable drop in loan portfolio quality. Fourth, the empirical evidence

TABLE 1 Overview of the Literature on the Macro-determinants of NPLs

Authors	Country	Methodology	Results
Gambera (2000)	USA	Using bivariate VaR models (employing variables such as unemployment, sector income, number of bank-ruptcies, car sales, and agricultural, commercial, industrial, and real estate loans) the author investigates the impact of economic development on loan portfolio quality.	This study proved the link between macroeconomic dynamics and bank asset quality. Yields can be used to make accurate predictions of the future effects of the business cycle on asset quality, and cyclical factors can be used for asset quality forecasting.
Arpa et al. (2001)	Austria	Single-equation regression analysis focusing on the risk provisions and operating income of Austrian banks.	The authors conclude that the share of risk provisions in the total loans of the banking sector varies indirectly with real GDP growth and real interest rates, and directly with CPI inflation and real estate price inflation.
Blaschke and Jones (2001)	USA	Proposes applying the VaR methodology to investigate the transmission from real GDP, inflation, the nominal interest rate, and the terms of trade, to the NPL ratio.	The authors proved the impact of GDP growth and the business cycle on credit risk and also on the quality of banks' loans.
Shu (2002)	Hong Kong	The author relies on regres-sion analysis and examines nominal interest rates, the CPI, property prices, equity prices, number of bank-ruptcies, the unemployment rate, and real GDP as the dependent variable.	The analysis indicates that the NPL ratio rises with increasing nominal interest rates and an increasing number of bankruptcies, but decreases with higher CPI inflation, economic growth, and property price inflation. Deflation squeezes out corporate profitability and adversely affects borrowers' ability to repay.
Quaglia-riello (2003)	Italy	The author presents a regres-sion between the evolution of NPLs as the dependent variable and a set of expla-natory variables: the real GDP growth rate, growth of real gross fixed investment and consumption, change in the unemployment rate, the CPI, the real exchange rate, and the M2 growth rate.	Proves that decreasing real GDP growth and increasing unemployment have a significantly adverse effect on loan portfolio quality, while the real exchange rate and consumer price index fail to significantly affect it.
Babouček and Jančar (2005)	Czech Republic	The authors investigated economic developments in the Czech banking sector through unemployment, real GDP growth, exports, imports, the real effective exchange rate, the CPI, and credit growth as indicators of NPL ratio performance using an unrestricted VaR methodology.	The study proved that the appreciation of the real effective exchange rate does not deteriorate the NPL ratio; increasing unemployment and inflation deteriorate the NPL ratio, while faster GDP growth decelerates the NPL ratio.

(continued)

TABLE 1 Overview of the Literature on the Macro-determinants of NPLs *(continued)*

Authors	Country	Methodology	Results
Čihák and Heřmánek (2005), Čihák et al. (2007)	Czech Republic	The authors compared system-focused stress testing methods (VaR, Monte Carlo simulations, etc.) and discuss issues relating to the design of stress tests for the Czech banking system.	The authors suggest (besides banking sector indicators such as capital adequacy, credit risk, and other relevant factors) incorporating different shocks into models, non--bank financial indicators, and relevant macroeconomic factors (e.g., the exchange rate and the interest rate) in order to perform stress testing.
Hoggarth, Logan, and Zicchino (2005)	United Kingdom	Applies the VaR approach to investigate the link between loan write-offs and the output gap, retail prices, real estate prices, the nominal short-term interest rate, and the real exchange rate.	The important factors indirectly influencing financial stability and loan portfolio quality are the dynamics of inflation and interest rates.
Jakubík (2007b)	Czech Republic	The author employs the regression method for NPL inflow estimation using real GDP, real effective exchange rates, the CPI, the loan to GDP ratio, unemployment, and the real interest rate as explanatory variables.	The default rate for the corporate sector is determined by the appreciation of the real effective exchange rate and by the increase in the loan to GDP ratio; the default rate for households deteriorates via unemployment and interest rate increases.
Zeman and Jurča (2008)	Slovakia	The authors apply the multivariate regression method using real GDP, the output gap, exports, industrial production, oil prices, the CPI, M1, nominal interest rates, and nominal exchange rates as explanatory variables for NPL dynamics.	Real GDP, the nominal exchange rate and the nominal interest rate are the most important variables influencing NPL dynamics. A slowdown in GDP growth is not expected to substantially threaten the banking system. Exposure to interest rate growth through the direct channel and foreign currency risk through the indirect channel was proven to be due to the high level of openness of the economy.

suggests that growth of interest rates adversely affects NPLs through two channels (see, for example, (Zeman, Jurča, 2008)). Initially, more expensive sources and loan installments with floating rates decrease the ability of firms and households to meet their financial obligations. Later on, increasing interest rates may also decrease the economic value of banks, due to an unhedged interest rate position. An increase in short-term interest rates (paid on liabilities) forces banks to increase the interest rates paid to depositors, but because the asset sides of bank balance sheets usually consist of loans of longer maturity at fixed interest rates, banks cannot increase their lending rates quickly enough; they must then shoulder the losses because of maturity transformation. Fifth, the empirical record associated with explicit analysis of the exchange rate-NPL relation is mixed, partly as a result of heterogeneous specifications for exchange rate variables and partly because researchers were examining economies with different degrees of foreign trade openness as well as with dissimilar debt exposure in individual sectors.

In addition to the studies quoted in *Table 1*, there is circumstantial evidence of other macroeconomic factors that can be considered relevant in affecting the quality of a loan portfolio and the asset quality in a banking system. Following Jappelli and Pagano (1994) and Eichengreen et al. (1999), it can be seen that although saving surpluses allow a move toward capital account convertibility – thereby further reducing the risk of a bank crisis – it can be argued that in an environment of imprudent lending strategies in the banking sector, growth in the level of available finances may precipitate a financial crisis and harm economic development. The soft budget constraints prevalent in many transition countries on loans to enterprises may also lead to considerable losses in the corporate and banking sectors when investments turn out to be counterproductive (Berglöf, Roland, 1995). In addition, the liquidity of the banking system and the quality of its loan portfolio can be at stake if the expansion of domestic loans is fuelled by enormous capital inflows in circumstances such as a balance of payments crisis, exchange rate instability, and disruptions in the financial markets (Calvo, Mendoza, 2000).
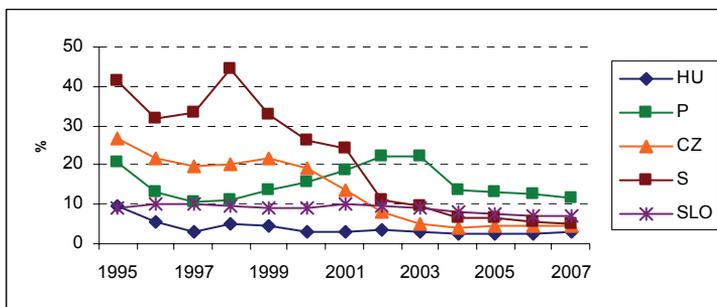
3. The Macro-Environment and Banking Sectors in the CEEs

The transition economies share a common problem: their banking sectors in the early 1990s were dominated by a relatively small number of large, state-owned institutions that had become burdened by large volumes of NPLs. We can point to two reasons for this: first, these countries had to deal with large amounts of NPLs inherited from the past, and second, new NPLs mounted in the balance sheets of commercial banks due to a lack of experience, government intervention, and ill-designed privatization methods. The privatization of the banking systems in the CEEs was aimed not only at attracting capital injections and increasing efficiency in the financial services sector, but also at eliminating inappropriate incentives for bank management.

Different countries employed different privatization strategies. While Hungary went for a quick sale of its banks to foreign investors, Poland combined public offerings with management buyouts and some placements with foreign strategic investors. In Hungary, the government sold part of its bad loans to the Hungarian Development Bank. Another part of the bad loans was left for banks to work out; banks attempted to sell the loans to various private companies that appeared on the market. Loans which could not be worked out were transferred to the Hungarian Development Bank, which in many cases had to write off the debt. The state cleared the debts from bank portfolios through an exchange for government bonds wherein the majority of the debts taken over by the government were written off. In Poland, rather than transferring NPLs from bank balance sheets to a state asset management agency, the state presented the banks with treasury bonds, in return for which they were to actively pursue working out the NPLs with debtor enterprises, typically resulting in debt-equity swaps or bad debt write-offs. Smaller banks were restructured and sold or merged into stronger banks. In addition, foreign banks applying for licenses to operate in Poland were obliged to provide affordable credit or acquire troubled banks in return. While the operational characteristics of the Polish domestic banking system improved as a result of these initiatives, the continued strong role of the state meant that soft loans were still granted to state enterprises.

In the Czech Republic, the partial privatization of commercial banks began with a voucher privatization program. Because of lax regulations in the financial sec-

FIGURE 1 NPL Ratio Dynamics in the CEE

tor, the result of the voucher privatization process was detrimental to corporate governance in the banking sector. Foreign investors in the Czech Republic did not facilitate the removal of NPLs from balance sheets or any state debt guarantees. The investors chose not to undertake extensive debt restructuring, instead selling off some assets and engaging in creative accounting. In 2000, the Czech National Bank was forced to take over the sector's administration. There has been an improvement in the quality of the balance sheets of the surviving banks, as low-quality credit has been taken off the banks' balance sheets and passed on to *Konsolidační banka* (Consolidation Bank) or sold at a discount to other banks. In Slovakia, the balance sheets of all of the larger state-owned banks were cleaned up in 1999–2001 by provisioning for NPLs or moving them to the Slovak Consolidation Agency and replacing them with government bonds. Until the restructuring of the Slovak banking sector in 1999, the share of NPLs in total loans varied between 30 and 40 % (*Figure 1*), implying that much of Slovakia's high level of investment was not used productively. Slovenia's focus has been on bank rehabilitation in anticipation of privatization. Slovenia initiated banking sector reforms by placing three of its largest banks under the control of the Bank Rehabilitation Agency, and then pursuing a "good bank-bad bank approach" in which good banks shed their sister banks, re-emerged, and cleaned up their balance sheets.

In all five CEEs, the NPL ratio has been decreasing in recent years (*Figure 1*), both through the resolution of the problem of old NPLs, and through an increase in the quality of new loans and progress in the effectiveness of legal reforms as measured by the EBRD's legal transition indicator (*Table 2*). The restructuring of the countries' banking sectors has also been strongly shaped by external economic conditions. A high degree of openness, reported in *Table 2*, illustrates, for example, the extent to which output growth in the selected CEEs is influenced by their ability to increase exports. Despite the fact that substantial progress has been made in achieving a sufficient degree of nominal convergence in these economies, they are all plagued by accumulating current account deficits, which are mainly financed by a steady increase in inflows of FDI, portfolio investment, and foreign currency loans.

TABLE 2 Selected Economic Indicators for the CEEs

	Exchange rate regime	Export/GDP,[a] current account/GDP (2006)	FDI/GDP[b] (2005/06)	EBRD index of banking sector reform[c] (2005)	Capital adequacy[d] (2005/06)	Foreign banks[e] (2005)	Loans in foreign currency to total loans in % (2005)
Hungary	Target zone (EUR)	76.9 -6.6	6.9/5.4	3.7	15/11.5	81	39
Poland	Float	40.4 -3.2	3.1/4.1	3.3	14.6/13.2	75	27
Czech Republic	Managed float (EUR)	75.9 -3.3	9.3/4.2	4.0	17/10.8	95	11
Slovakia	ERM II since Nov. 2005	85.6 -8.2	4.4/7.6	3.3	13/10.9	96	26
Slovenia	Euro zone from Jan. 2007	67.5 -2.8	1.6/1.0	3.3	21/10.8	42	38

Notes: [a] export of goods and services as a percentage of GDP

[b] inflow of FDI as a percentage of GDP

[c] The EBRD indicators of banking sector reform are measured on a scale from 1 to 4: score 1: underdeveloped financial sector; score 2: internal currency convertibility established, significantly liberalized interest rates and credit allocation; score 3: substantial progress achieved in establishing prudential regulation and supervision framework; score 4: level of reform close to BIS institutional standards

[d] solvency ratio

[e] asset share of foreign banks as a percentage of total assets

Source: (ECB, 2007), (BACA, 2008), (IMAD, 2008)

In Hungary, the removal of unrecoverable loans from banks' balance sheets and government-financed bank recapitalization were the means used to get banks in shape (Várhegyi, 2002). As many state-owned banks became insolvent (triggering further recapitalization), the main objective of the restructuring program was to make banks attractive to foreign investors. Foreign-owned banks account for a high share of the banking sector's total assets (see *Table 2*).

The banking sector in Hungary is relatively small compared to the size of the economy, but in terms of the funds channeled into financial intermediaries, the majority (80 %) of savings are placed within banks and other credit institutions. Half of Hungarian enterprises operate without bank finances, which is partially due to the poor creditworthiness of these enterprises. One third of loans to enterprises are denominated in foreign currency; such loans are attractive to companies that have been able to manage exchange rate risk at lower interest rates (Szapáry, 2002). The data for Hungary in *Table 2* show, however, that the share of foreign currency loans is close to 40 % of total loans.

The Hungarian practice of operating banks mainly as holding companies – offering a wide range of financial services and owning financial institutions – allowed owners to allocate risks within the holding and thereby avoid the capital requirement regulations. This strategy made it possible to hide a group's capital shortages for many years. In order to handle this problem, the Hungarian Supervisory Authority was established in 2000 and the capital adequacy ratio has remained above the minimum envisaged under the Basel Accord. Concerning the legal framework, in the early 1990s the judicial environment was weak and the Bankruptcy Act did not provide adequate protection for creditors. The law stipulated voluntary bankruptcy when a company had overdue debt and allowed a three-month debt service moratorium without

envisaging negotiations with the creditor. Consequently, insolvent companies suspended payments to their creditors. This resulted in huge bank losses (Várhegyi, 2002). Despite a change in the rules regarding voluntary bankruptcies, banks continued to be disadvantaged when companies were liquidated (this problem was partially solved by a decline in the frequency of bankruptcies and liquidations). Protection of creditors' rights has been greatly improved by an amendment to the mortgage law concerning the enforcement of the right to pledge in September 2001.

The Polish banking system was transformed into nine independent regional banks at the beginning of the transition period. Another major factor in the banking sector's evolution was the arrival of foreign entrants in the mid-1990s, which spurred consolidation among the sector's largest banks (Balcerowicz, Bratkowski, 2001). Currently, around 75 % of the sector's assets are controlled by foreign banking institutions (*Table 2*). In the period 1997–2000, the effectiveness of the banking sector supervision institutions was strengthened, and changes in prudential norms and an increase in the level of guarantees for bank deposits were introduced. In January 1998, a new Banking Act and a new National Bank of Poland Act came into force, introducing a new banking supervision model. The regulatory framework conforms to the prudential guidelines issued by the Basel Committee. A Capital Requirements Act required capital increases until the end of 1999. Banks below the capital requirements started to seek foreign investors, and in January 1999 Poland lifted the restrictions on foreign banks with regard to purchasing bigger stock blocks.

Despite the asset growth of the Polish banking sector, the total assets to GDP ratio in the period 1993–1998 was substantially lower than in most EU member states, and the pace of increase in the volume of loans was faster than that of deposits and credit maturity was extended (ibidem, 2001). Banking results were improved primarily by the expansion in the sector's lending volume, an improvement in transaction volumes, and improvements in the general economic conditions in 1999. Although the share of NPLs in total sector lending exceeded 20 % in 2002 and 2003, it has fallen substantially in recent years (*Figure 1*), partly due to an easing of the National Bank of Poland's classification standards and partly due to the relative expansion of banking sector lending.

In the Czech Republic, following a period of optimism and heavy credit expansion until 1997, the banking sector experienced a period of insufficient capital adequacy, non-transparent ownership structures, related lending, and a huge bad-loan problem. As a result, domestic banks suffered losses and the large state banks had to be bailed out, while small and medium-sized domestic banks had to be given special attention in a restructuring program. At the same time, banks under foreign control behaved prudently and were profitable. The increasing role of foreign-owned banks bolstered the Czech banking sector, but their activities broadened only after strategic foreign investors became majority owners of the formerly state-owned banks (Bárta, Singer, 2006). The development of medium-sized banks, which are mainly foreign banks and foreign bank branches, has only gradually eroded the dominance of the larger banks.

Between 1995 and 2000, the composition of banks' assets developed toward "safer" assets such as deposits with the Czech National Bank and other banks, T-bills, and CNB bills. This can be seen as a cautious response of domestic banks to the severe bad-loan problem that emerged during this period (*Figure 1*). To sum up,

notwithstanding improvements, poor asset quality represented a substantial financial burden on the Czech banking sector, as is evident from the provisioning costs of large Czech banks, which are markedly higher than the average in the CEEs and Western Europe (ibidem, 2006).

The economic environment favorably influenced the Slovak banking sector after 2000. This applies both to external factors, such as growth in the global economy and continuing positive developments in banking groups across the EU, and to domestic factors, in particular Slovakia's macroeconomic development. A fall in interest rates exerted increased pressure on net interest margins. There was a decline in interest expenses, partly due to the interest policy of banks, as banks radically reduced their deposit rates, and partly because of changes in the assets and liabilities of the Slovak banking sector. Banks compensated for the decline in interest rates in their asset operations through increased lending to households.

The growth in household lending, due to the reported high liquidity of the Slovak banking sector (SNB, 2004), was a significant contributor to the sector's high NPL ratio until 2001. A large part of household lending was at a variable or short--term interest rates, which on the one hand reduced the interest rate risk for banks, but on the other hand increased households' sensitivity to any increase in interest rates and thus also the credit risk of banks. The subsequent development of the credit risk of households has depended to a large degree on the level and nature of their debt and the development of macroeconomic variables. The efforts of several banks, in particular those which have incurred a high share of NPLs to businesses in past years, have led to a fall in the volume of loans as well as institutional changes.

In Slovenia, the consolidation of the banking sector and the relatively high level of concentration are primarily due to mergers between domestic banks in order to achieve a critical mass and to remain competitive. Although market entry barriers were removed in the late 1990s, few foreign investors are currently present compared with other Central and Eastern European countries. This is in stark contrast to the situation in the Czech Republic and Slovakia, where around 96 % of the banking sector is foreign-owned (*Table 2*).

A change in the Slovenian accounting rules at the start of 2002, due to the abolition of certain revaluation methods, had a positive net effect on profits. Falling interest rates clipped spreads from 2000 onwards and put pressure on banks' net interest margins; this was further intensified by the liberalization of capital movements, which ushered in competition from foreign banks. The Bank of Slovenia has taken measures over the years to ensure an appropriate supply of credit as well as adequate capital resources and liquidity. The Slovenian Banking Act of 1999 was amended in March 2002 and now includes capital adequacy guidelines for banks and savings institutions. The central bank can increase the minimum capital adequacy ratio of 8 % if it sees a higher risk justifying this. Although the solvency ratio of banks has dropped steadily, it is still above the minimum requirement of 8% (*Table 2*).

While the favorable macroeconomic environment has generally been conducive to banking sector stability (Festić, 2007), some areas remain where further changes are needed with regard to improvements in the legal environment, engaging in a wider range of financial activities, and the level of financial intermediation. Slovenia's banking sector has not had the same recourse as the sectors in other Central and Eastern European countries to the know-how that foreign investors can supply in

the fields of product development, risk management, technology, and cost efficiency. This know-how could help boost Slovenian banks' competitiveness.

4. Empirical Analysis and Discussion of Results

In this section, the relationships between the NPL ratio and macroeconomic variables are analyzed in order to assess the banking sector's vulnerability to bad loan performance on the macroeconomic level. In the first subsection, we present the applied data and methodology, whereas in the second subsection, the empirical results are discussed.

4.1 Data and Methodology

Following previous studies on the determinants of NPLs (Quagliariello, 2003), (Babouček, Jančar, 2005), (Zeman, Jurča, 2008), we constructed a data set of 19 explanatory variables that are usually employed in such models. The NPL variable is specified as the share of all nominal loans that are at least 90 days past due in total nominal loans granted to the corporate and household sectors in an individual country. Some authors (for example, Jakubík (2007b)), emphasize that NPL inflow is a better NPL variable for empirical estimates in CEEs than the stock of NPLs, because some NPL outflows have been driven by one-off NPL write-offs, and may have been driven by administrative measures. In the new EU member states, for example, a significant proportion of defaulted loans have been removed from banks and substituted with government bonds. Since we could not obtain consistent NPL inflow time series for the five CEEs, we had to rely on the use of an NPL ratio series, as described above, for the dependent variable in our analysis. Quarterly time series expressed as growth rates were used for the period from the first quarter of 1995 to the first quarter of 2007 in order to explain the NPL ratios in Hungary, Poland, the Czech Republic, Slovakia, and Slovenia. In collecting the necessary data, we relied on the internal database of the BACA (2007), EIPF (2007) and the databases of central banks in the individual countries. The key statistics of all the time series are given in the accompanying Excel file.

On the basis of the covariance matrix and the contributions of eigenvalues to the explained variance, we chose the time series which gave the maximum level of explanation of NPL ratios and which explain the residual factors of endogenous variable movements (Kavkler, Böhm, 2006). After excluding the strongly correlated variables (Wall, Rechtsteiner, Rocha, 2003), the following time series for economic activity and external trade were originally utilized: real GDP, real exports of goods and services (in bn of the domestic currency deflated by the consumer price index), the nominal exchange rate (defined as national currency per $), and the real effective exchange rate in each country, expressed as the weighted average of the country's currency relative to a basket of other major currencies (measured as the foreign price of the domestic currency) and adjusted for the effects of inflation. The interest rate variable was covered by the real long-term (lending) 5-year interest rate and by the real short-term (lending) 6-month interest rate. In addition, we used the time series of real savings of the private sector with banks, expressed in the domestic currency, real credit to the private sector (loans to households and corporations obtained from banks in the country, expressed in the domestic currency and expressed as a share of real GDP), the number of insolvent companies (i.e., companies unable to repay loans that are more than 90 days past due), real foreign direct investment in

TABLE 3 The ADF Unit Root Test for CEE's

Variable	Hungary		Poland		Czech Republic		Slovakia		Slovenia	
	Original	Trans-formed	Original	Trans-formed	Original	Trans-formed	Original	Trans-formed	Original	Trans-formed
NPL	-2.4344	-4.7366***	-2.4461	-12.307***	-1.2603	-6.3276***	-1.7892	-3.7895***	-4.4258**	-9.7586***
GDP	-0.7601	-6.4661***	-1.8491	-12.332***	-1.2156	-4.4313***	-1.5601	-8.3162***	-1.9932	-3.7006***
EXP	-1.2458	-9.2548***	-2.3070	-13.904***	-1.7895	-4.9862***	-1.1433	-11.592***	-1.8246	-9.7844***
EXCHR	-1.8932	-10.874***	-2.0015	-8.7673***	-0.0232	-11.007***	-2.0131	-9.0623***	-3.3213**	-15.831***
REFFEXCHR	-0.5949	-11.122***	-1.9713	-10.120***	-2.6493*	-12.124***	-0.2246	-9.6654***	-2.8834*	-11.809***
INTRI	-0.7315	-12.702***	-1.8359	-14.026***	-2.0383	-13.703***	-1.6854	-14.804***	-2.8740*	-8.2994***
INTRs	-0.7305	-10.148***	-1.0460	-9.7905***	-1.7474	-8.9494***	-1.0025	-10.369***	-1.7432	-9.0402***
SAVINGS	-3.3299**	-4.5668***	-1.4982	-12.367***	-1.0656	-3.6021***	-2.5044	-12.371***	-1.4705	-3.5466***
CREDITS/GDP	-1.8975	-7.4587***	-2.1789	-6.4521***	-3.0255*	-6.9875***	-3.2452*	-7.9875***	-2.8782*	-8.8756***
INSOLCn	-4.4619***	-10.655***	-3.1854**	-9.8436***	-2.7845*	-12.458***	-1.9752	-7.2543***	-2.4584	-9.8745***
FDIn	-0.2154	-5.9874***	-0.3762	-6.0947***	-1.9878	-5.4583***	-2.5475	-11.458***	-2.6873*	-10.745***
REWAG	-2.1546	-3.9936***	-2.2653	-10.692***	-2.5412	-12.125***	-1.7456	-4.7886***	-1.8757	-5.8753***
UNEMPLOY	-2.9875**	-8.4452***	-3.5487***	-7.8742***	-2.0342	-3.9872***	-1.2619	-7.3635***	-2.0782	-3.8891***

Notes: Critical values at 1%, 5% and 10% level of significance are -3.4731, -2.8802 and -2.5768, respectively. *** denotes 1% level of significance, ** denotes 5% level of significance and * denotes 10% level of significance. Transformed time series as difference of percentage change measured in percentage points.

Symbols: NPL: non-performing loans ratio, GDP: real gross domestic product, EXP: real export of goods and services, EXCHR: nominal exchange rate, REFFEXCHR: real effective exchange rate, INTRI: real long-term (lending) 5-years interest rate, INTRs: real short-term (lending) 6-months interest rate, SAVINGS: real saving of private sector with banks, CREDITS/GDP: real credits to private sector as the share of real GDP, INSOLCn: number of insolvent companies, FDIn: real foreign direct investment in non-financial sector as the share of real GDP, REWAG: real labor costs relative to real household income, UNEMPLOY: standardised un-employment rate.

the non-financial sector (as a share of GDP), real labor costs relative to real house-hold income, and the time series of standardized unemployment rates. All the real variables were corrected by the individual country's consumer price index.

Because the analysis including the dummies did not change the results significantly, we decided to employ only the annual growth rate differences for the time series of real GDP, real export of goods and services, and the standardized unemployment rate (quarterly data – year-on-year basis).

Moffatt and Salies (2003) demonstrate that logarithmic approximation is accurate only if the rates of change of the variables are reasonably small. Since the dynamics of the NPL ratio are sometimes large, this approximation would produce a significant downward bias in the simulation, all the time series are transformed into percentage changes in the original time series expressed as percentage points. After deriving the transformed time series and avoiding spurious regression, stationarity of all the selected time series (*Table 3*) was obtained at the 1% significance level (Dickey, Fuller, 1979), although the unit root test revealed that at least one time series for each country already seemed to be a candidate for stationarity in the original form. The Breusch-Godfrey LM test and the ARCH model were employed to check for autocorrelation in the residuals and in the error variance (see *Table 4*). The key statistical properties of all the time series used in the analysis of each country are given in the accompanying Excel file.

In our work, we relied on ordinary least squares and the VaR methodology. The lag length selection in the models specified was based on the Akaike information criterion and the Schwarz information criterion. The ARMA technique incorporates residuals from previous observations into the regression model for the current observation. If the correlogram shows that a serial correlation dies off after a small number of lags/increasing number of lags, the series will obey a low-order moving average process/autoregressive process (MA/AR) (Ruey, Tiao, 1984). According to the Chow forecast test, which was used for proving the stability of the estimated functions, we accepted the hypothesis regarding structural stability (Thursby, 1982).

The VaR models include a considerable number of variables and it is necessary to test each of them for exogeneity. The testing for exogeneity follows the methodology proposed by Greene (2003). Greene (2003, p. 582) clarifies that the tests for exogeneity can be based on the concept of Granger causality applied to individual equations and examined by the Wald test in order to test the significance of a particular explanatory variable. The reaction of a variable to an impulse generated by another variable is assumed to reveal the causal relationship between them (Engle, Granger, 1978) and the relative importance of each random innovation in affecting the variables in the models.

Macroeconomic shocks affecting the NPL ratio were analyzed by impulse ressessment of the robustness of the impulse analysis to re-ordering of the variables. Since there are correlations between some residuals, it is necessary to examine the sensitivity of the responses to re-ordering of the variables, and recursive identification is used, which separates the residuals into orthogonal shocks using Cholesky factorization of the covariance matrix of residuals (Canova, 2003). Recursive identification subsequently attributes all the contemporaneous correlations of the residuals and all of the effects of any common components on the variable that is ordered first in the VaR system. Each impulse or shock equals one standard deviation of the time se-

TABLE 4 Estimated Models for CEE's for the Period 1995:01 to 2007:01

Dependent variable for Hungary: DNPL			
Explanatory variable	*Coefficient*	*Std. error*	*t-statistic (prob.)*
DGDP$_{(-4)}$	-0.1879	0.0558	-2.4587 (0.0068)
DEXCHR$_{(-1)}$	1.0646	0.1079	6.0245 (0.0000)
DINTRI	1.1458	0.1145	5.0757 (0.0000)
DSAVINGS$_{(-5)}$	-0.1402	0.0457	-3.2547 (0.0043)
DINSOLCn$_{(-2)}$	1.2879	0.0897	6.7517 (0.0000)
DREWAG	-0.1827	0.0158	-5.2106 (0.0000)
MA(1)	0.5874	0.0687	4.1174 (0.0000)
Adj. R^2 = 0.8084, S.E. = 0.1561, SSR = 2.4587, AIC = -2.0457, DW = 1.8978, LM$_{(4)}$ = 3.9245 (0.5256), LM$_{(8)}$ = 1.1259 (0.7984) Chow forecast test (1998:01–2006:04) = 0.8578 (0.8574)			

Dependent variable for Poland: DNPL			
Explanatory variable	*Coefficient*	*Std. error*	*t-statistic (prob.)*
DGDP$_{(-3)}$	-1.2178	0.1245	-6.6451 (0.0000)
DEXCHR	0.8452	0.0745	4.0743 (0.0017)
DINTRI	0.4451	0.0152	3.1751 (0.0041)
DCREDITS/GDP$_{(-4)}$	0.0847	0.0039	3.2542 (0.0052)
DFDIn$_{(-4)}$	-0.7254	0.0219	-6.4754 (0.0025)
DREWAG	-0.2651	0.0168	-5.4689 (0.0043)
AR(1)	0.8971	0.0452	5.8743 (0.0000)
Adj. R^2 = 0.7985, S.E. = 0.0698, SSR = 0.8284, AIC = -2.7781, DW = 2.0356, ARCH$_{(4)}$ = 0.0987 (0.8897), ARCH$_{(5)}$ = 0.1956 (0.8563) Chow forecast test (1996:04–2006:03) = 0.7871 (0.8712)			

Dependent variable for the Czech Republic: DNPL			
Explanatory variable	*Coefficient*	*Std. error*	*t-statistic (prob.)*
DEXP$_{(-2)}$	-1.3541	0.0723	-3.8765 (0.0023)
DREFFEXCHR$_{(-1)}$	-0.6453	0.1962	-5.0356 (0.0005)
DINTRI$_{(-4)}$	0.7965	0.0892	5.9781 (0.0000)
DCREDITS/GDP$_{(-5)}$	0.4987	0.0562	4.7894 (0.0012)
DFDIn$_{(-3)}$	-0.2635	0.0605	-4.4214 (0.0010)
DUNEMPLOY$_{(-2)}$	0.2287	0.0875	6.4752 (0.0042)
MA(1)	0.3862	0.0398	4.8963 (0.0000)
Adj. R^2 = 0.7578, S.E. = 0.1139, SSR = 0.2654, AIC = -2.9786, DW = 2.1154, LM$_{(4)}$ = 0.6485 (0.8945), LM$_{(8)}$ = 1.8872 (0.7761) Chow forecast test (1997:04–2006:03) = 0.6358 (0.7558)			

Dependent variable for Slovakia: DNPL			
Explanatory variable	*Coefficient*	*Std. error*	*t-statistic (prob.)*
DEXP$_{(-3)}$	-0.4681	0.0425	-5.1751 (0.0039)
DEXCHR$_{(-1)}$	0.8154	0.0512	4.4362 (0.0012)
DINTRs$_{(-2)}$	0.6954	0.0864	6.5451 (0.0000)
DSAVINGS$_{(-4)}$	1.4547	0.1429	5.2374 (0.0000)
DCREDITS/GDP$_{(-4)}$	0.6287	0.0548	6.5238 (0.0000)
DFDIn$_{(-3)}$	-0.3845	0.0390	-5.8542 (0.0029)
MA(1)	0.7065	0.0287	4.8754 (0.0000)
Adj. R^2 = 0.7364, S.E. = 0.1384, SSR = 0.3354, AIC = -2.3841, DW = 2.2154, LM$_{(4)}$ = 1.6879 (0.8084), LM$_{(8)}$ = 0.8506 (0.8954) Chow forecast test (1998:04–2006:04) = 0.8674 (0.8248)			

(continued)

TABLE 4 Estimated Models for CEE's for the Period 1995:01 to 2007:01 *(continued)*

Dependent variable for Slovenia: DNPL			
Explanatory variable	*Coefficient*	*Std. error*	*t-statistic (prob.)*
DEXP$_{(-3)}$	-0.7781	0.0175	-6.8971 (0.0014)
DREFFEXCHR$_{(-1)}$	-0.7254	0.0397	-5.1455 (0.0009)
DINTRs	0.3687	0.0376	3.9754 (0.0000)
DSAVINGS$_{(-4)}$	1.6872	0.0875	6.8751 (0.0000)
DCREDITS/GDP$_{(-4)}$	0.2875	0.0107	3.7854 (0.0007)
DFDIn$_{(-3)}$	-0.1254	0.0346	-3.4587 (0.0000)
MA(1)	0.7987	0.0538	4.4632 (0.0000)
Adj. R^2 = 0.8387, S.E. = 0.0487, SSR = 0.6214, AIC = -2.845, DW = 1.9745, LM$_{(4)}$ = 1.5987 (0.7584), LM$_{(8)}$ = 0.7364 (0.8974) Chow forecast test (1998:03–2006:04) = 0.7584 (0.8245)			

Notes: The Breusch-Godfrey serial correlation LM test for the null hypothesis of no serial correlation in the residuals. The ARCH serial correlation test for the null hypothesis of no serial correlation in the error variance. The Chow forecast test for the null hypothesis of no structural change in the estimated function. Values in brackets are *p*-values. The time lag of individual coefficients is given in subscripts. The letter D before the variable denotes the percentage change measured in percentage points. See *Table 3* for a definition of the variables.

ries for the respective variable and causes the other time series to respond (Pesaran, Shin, 1998).

4.2 Results

The estimates from the regression analysis for Hungary, listed in *Table 4*, indicate that a rise in GDP of one percentage point, while the other predictors are held constant, decreases NPL ratio growth by 0.19 percentage points. An increase in real wage growth lowers the growth of the NPL ratio by 0.18 percentage points. Growth of the nominal exchange rate, with a regression coefficient of 1.06, has a stimulating effect on the NPL ratio. An increase in savings growth by 1 percentage point decreases NPL ratio growth by 0.14 percentage points. The responses of the dependent variable to long-term real interest rates and an increasing number of insolvent companies are robust, with regression coefficients of 1.15 and 1.29, respectively.

In Poland, a rise in the credit to GDP ratio by 1 percentage point increases the growth of the NPL ratio by 0.08 percentage points, indicating a weak effect on NPL ratio growth. The regression coefficients of long-term real interest rates and nominal exchange rates are 0.45 and 0.85, respectively. Note that in our estimates for Poland, the only variables that significantly improved the NPL ratio were GDP growth, with a regression coefficient of -1.22, followed by foreign direct investment, with a coefficient of -0.73 (*Table 4*).

According to the estimates for the Czech Republic, export growth has the largest stabilizing effect on NPL ratio growth. The impact of real effective exchange rates and foreign direct investment on NPL ratio growth is at least halved, but the ratio between them remains negative. The magnitude of the regression coefficients, 0.23 and 0.80, can be detected by variables in the unemployment rate and long-term real interest rates, respectively. In addition, if the credit to GDP ratio rises by 1 percentage point, and other predictors are held constant, then the growth of the NPL ratio increases by 0.5 percentage points.

We stress that in our empirical investigation for Slovakia, the only variables that have decreased the growth of the NPL ratio are the growth of exports and foreign

TABLE 5 Impulse Response Analysis for CEE for the Period 1995:01 to 2007:01

				Hungary			
Period	*DNPL*	*DGDP*	*DEXCHR*	*DINTRI*	*DSAVINGS*	*DINSOLCn*	*DREWAG*
4	0.0024	-0.0123	0.0401	0.2004	-0.0039	0.1987	-0.0397
8	0.0059	-0.0297	0.0575	0.3385	-0.0145	0.3251	-0.0645
12	0.0027	-0.0342	0.0796	0.5134	-0.0345	0.5742	-0.1175

				Poland			
Period	*DNPL*	*DGDP*	*DEXCHR*	*DINTRI*	*DCREDITS/ /GDP*	*DFDIn*	*DREWAG*
4	0.0078	-0.2325	0.0187	0.0019	0.0045	-0.0168	-0.0287
8	0.0094	-0.3547	0.1687	0.0458	0.0025	-0.0478	-0.0689
12	0.0048	-0.4475	0.2784	0.1756	0.0147	-0.2978	-0.0894

				Czech Republic			
Period	*DNPL*	*DEXP*	*DREF-FEXCHR*	*DINTRI*	*DCREDITS/ /GDP*	*DFDIn*	*DUN-EMPLOY*
4	0.0005	-0.0327	-0.0044	0.0871	0.0174	-0.0019	0.0048
8	0.0016	-0.1616	-0.0089	0.1756	0.0215	-0.0022	0.0165
12	0.0007	-0.2943	-0.1164	0.3687	0.0306	-0.0029	0.0198

				Slovakia			
Period	*DNPL*	*DEXP*	*DEXCHR*	*DINTRs*	*DSAVINGS*	*DCREDITS/ /GDP*	*DFDIn*
4	0.0028	-0.0112	0.0157	0.0197	0.0975	0.0198	-0.0136
8	0.0019	-0.0198	0.1399	0.1689	0.1884	0.1297	-0.0245
12	0.0006	-0.0987	0.2758	0.2375	0.2974	0.1989	-0.0394

				Slovenia			
Period	*DNPL*	*DEXP*	*DREF-FEXCHR*	*DINTRs*	*DSAVINGS*	*DCREDITS/ /GDP*	*DFDIn*
4	0.0017	-0.0198	-0.0115	0.0268	0.0876	0.0154	-0.0021
8	0.0007	-0.0312	-0.0296	0.1298	0.1898	0.0274	-0.0215
12	0.0014	-0.1754	-0.1397	0.2145	0.3048	0.0418	-0.0346

Notes: The letter D before the variable denotes the percentage change measured in percentage points. See *Table 3* for the definition of variables.

direct investment. Furthermore, the results show that an increase in real savings by 1 percentage point increases the growth of the NPL ratio by 1.45 percentage points. Growth in the nominal exchange rate, the short-term real interest rate, and the credit to GDP ratio also stimulate growth of the NPL ratio.

In Slovenia, faster exports and real effective exchange rates have slowed down NPL ratio growth (regression coefficients of -0.78 and -0.73, respectively). Foreign direct investment has also decreased the NPL ratio, but its influence appears to be weaker (*Table 4*). An increase in savings by 1 percentage point raises the growth of the NPL ratio by 1.69 percentage points, while an increase in short-term real interest rates and the credit to GDP ratio of 1 percentage point spurs the growth of the NPL ratio by 0.37 percentage points and 0.29 percentage points, respectively.

The results of the impulse response analysis are given in *Table 5*. They are based on VaR ordering using the procedure developed by Pesaran and Shin (1998). In order to ensure consistency in the presentation of the results, we have quoted the sequence of estimated variables as listed for each individual country in *Table 4*.

In Hungary and Poland, GDP growth decelerated the NPL ratio in the time period from 4 to 12 quarters. Although after 2002 a deterioration in the global busi-

ness cycle reduced Hungarian exports, and profitability and creditworthiness deteriorated in certain domestic economic sectors, these events did not change the positive influence of GDP growth (underpinned by strong consumption) on the dynamics of the NPL ratio in the period observed. The rapid growth of the Polish economy on one hand, and the favorable macroeconomic situation on the other, improved credit quality and helped lower the NPL ratio in Poland, despite a short period of weaker economic growth before 2002. The estimates in *Table 5* show that an increasing value of foreign direct investment had a decelerating effect on the NPL ratio in Poland, while the NPL responses to depreciation of the nominal exchange rate have been accelerating in Hungary as well in Poland, probably due to the sizeable share of foreign currency loans in both economies.

In Hungary and Poland, interest rate impulses have accelerated the growth of the NPL ratio. The Central Bank of Hungary has a history of responding to currency moves (depreciation pressures) with changes in interest rates (Pawłowski, 2006). Government securities have also attracted a substantial part of banking funds, thereby crowding out lending to the enterprise sector and resulting in further real interest rate growth in Hungary (Szapáry, 2002). In 2001, the Polish economy entered a period of slower GDP growth, triggered by over-investment and a jump in real interest rates from the previous year, thus contributing to a decline in the quality of loan portfolios. The banking sector was also hit by interest rate shocks due to the large stock of government securities on its books (defaulted loans were replaced by government bonds). After an increase in default rates, banks were more cautious before granting corporate loans, which resulted in higher interest rates. As the results in *Table 5* prove, an increasing number of insolvent enterprises in Hungary accelerated the NPL ratio in the time period from 4 to 12 quarters – a result that can be ascribed mainly to insufficient protection of creditor rights before 2001.

In the case of the Czech Republic, the variables accelerating the growth of the NPL ratio are: the credit to GDP ratio, long-term real interest rates, and unemployment rates. It is important to emphasize that interest rate margins were high in the Czech Republic, suggesting a higher level of credit risk, especially for small enterprises. Unemployment rates were also on the rise after 1996. The figures for Slovakia (*Table 5*) reveal that growth of the credit to GDP ratio, short-term real interest rates, savings, and nominal exchange rates accelerated the NPL ratio for the time period in question. The National Bank of Slovakia usually rejects the option of depositing the excess liquidity of commercial banks and bids in regular tenders in order to attempt to slow down the appreciation of the domestic currency and enable key rates to be lowered. On the one hand, the easing of monetary policy via a reduction in interest rates at a time of high growth manifested itself in excessive credit growth and an overheating of the Slovak economy. On the other hand, the entry of new foreign investors, who created new export-oriented capacities, and the availability of credit for business entities, fostered the development of the Slovak (as well as the Czech) production sector and contributed to a decelerating response of the NPL ratio to export impulses.

In Slovenia, exports, foreign direct investment, and real effective exchange rates have decelerated the NPL ratio, while the responses of the NPL ratio to short--term real interest rates, savings, and the credit to GDP ratio have been accelerating in the observed time period. The excess supply of foreign currency – through the po-

licy of monetary targeting and implicit real exchange rate targeting – conflicted with the counter-inflationary policy of the Bank of Slovenia in pursuing the ultimate goal of domestic currency stability. Due to underdeveloped financial markets and less marketable central bank securities, monetary goals were hindered and monetary restraints were needed to eliminate the excess liquidity. The excess liquidity in Slovenia was absorbed by central bank bills. High yields on Bank of Slovenia bills contributed to an average interest rate spread well above those in the EU, reducing the pressures for any restructuring to make the banking system more competitive and also leading to a deterioration in loan portfolio quality in Slovenia.

Table 6 summarizes the key findings that can be derived from the empirical testing conducted above. The empirical findings broadly agree with the theoretical assumptions quoted in the literature. We can point to the following proven hypotheses.

The procyclicality of GDP growth and banking sector performance in the sense of decelerating the NPL ratio is corroborated in Hungary and Poland. The banking sector benefits from favorable export dynamics in the Czech Republic, Slovakia, and Slovenia. This is due to NPL ratio deceleration on export impulses (*Table 6*). The limited growth prospects in export-oriented industries could therefore ultimately lead to economic contraction with direct implications for loan performance in these countries. Our results for the Czech Republic and Slovenia do not support the hypothesis that the appreciation of real effective exchange rates contributes to the build-up of a credit crisis through shifts in international competitiveness coupled with a deterioration in the terms of trade.[1] With the exception of Hungary, the results also imply that foreign direct investment in the selected economies contributed to growth in the competitiveness of export enterprises. The subsequent boost in economic activity generated improvements in the NPL ratio.

Savings deteriorated the NPL ratio in the case of Slovakia and Slovenia due to excess liquidity in the banking sector, which fueled the increasing credit demand. In fact, our estimates for Poland, the Czech Republic, Slovakia, and Slovenia support the hypothesis that growth in the amount of available finance and strong credit activity in the banking sector might harm banking performance – most likely due to soft loan constraints. In Slovenia, for example, an attempt was made to stimulate long-term savings with banks and higher real interest rates were offered on deposits in the domestic currency. Consequently, disposable savings with banks sustained higher liquidity in the banking sector and also credit growth. Similarly as in Slovenia, inflows of foreign capital contributed to significant growth in liquidity in the Slovak foreign exchange market and the surplus liquidity created an additional supply of loans, despite the sterilization efforts of the central bank. In particular after 2002, banks endeavored to use the excess liquidity by providing a large number of small consumer loans. To sum up, the widespread occurrence of soft loan policies on the micro level, despite the shift to prudent lending policies in recent years, remains inscribed in the memory of the time periods studied for these economies.

The impact of nominal exchange rate shifts on the NPL ratio depends on varying degrees of sensitivity in the corporate and household sectors. Depreciation of nominal exchange rates can have a positive effect on the corporate sector, especially if the mounting share of its foreign currency loans is successfully funded through

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[1] Such an inference has also been drawn for the Czech Republic by Babouček and Jančar (2005).

TABLE 6 Hypotheses Tested for the CEEs

Hypothesis	Explanation	Hypothesis supported?				
		HU	P	CZ	S	SLO
GDP growth decelerates NPL ratio growth	The theory of financial and real sector procyclicality.	Yes	Yes	–	–	–
Export growth decelerates NPL ratio growth	The theory of financial and real sector procyclicality.	–	–	Yes	Yes	Yes
Increasing appreciation of the real effective exchange rate accelerates NPL ratio growth	Appreciation (of the domestic currency due to productivity gains) weakens exports and GDP growth due to decreased competitiveness of the domestic economy.	–	–	No	–	No
Growth of foreign direct investment decelerates NPL ratio growth	The positive impact of foreign direct investment is visible in the diversification of foreign trade structures and in the improvement of competitiveness in export industries.	–	Yes	Yes	Yes	Yes
Growth of savings accelerates NPL ratio growth	Ample liquidity in the banking sector deteriorates the NPL ratio due to soft loan constraints.	No	–	–	Yes	Yes
A rising credit to GDP ratio in the private sector accelerates NPL ratio growth	Soft loan policies reduce market clearing and the restructuring of domestic capacities, while loan portfolio quality deteriorates if investment activity is counterproductive.	–	Yes	Yes	Yes	Yes
Increasing depreciation of the nominal exchange rate accelerates NPL ratio growth	Loan portfolio quality deteriorates due to a high share of loans denominated in foreign currency if the domestic currency depreciates.	Yes	Yes	–	Yes	–
Growth of real labor costs (relative to household income) accelerates NPL ratio growth	Real wage growth (on the back of productivity gains) worsens the loan repayment capabilities of households.	No	No	–	–	–
Growth in real interest rates accelerates NPL ratio growth	Loan portfolios are interest-rate sensitive. Higher real interest rates decrease loan repayment capabilities.	Yes	Yes	Yes	Yes	Yes
Growth in the number of insolvent companies accelerates NPL ratio growth	Loan portfolios deteriorate because of difficulties in the enterprise sector and insufficient protection of creditors' rights.	Yes	–	–	–	–
Unemployment accelerates NPL ratio growth	Growing unemployment limits the loan repayment capability of the household sector.	–	–	Yes	–	–

Notes: HU: Hungary, P: Poland, CZ: Czech Republic, S: Slovakia, SLO: Slovenia

higher profitability of export sales, but it can also have a negative effect on households. According to our calculations (*Table 6*), a depreciation of the domestic currency worsens the NPL ratio in Hungary, Poland, and Slovakia, thus indicating a dominant foreign-debt exposure for household borrowers.[2]

Based on the significant estimates for the real labor cost variable, we could not provide evidence in the case of either Hungary or Poland for the hypothesis that the growth of the NPL ratio is propelled by increasing real wages.

Studies by Jakubík (2007a) for the Czech Republic and by Zeman and Jurča (2008) for Slovakia have reported that rising real interest rates cause an increasing

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[2] A similar conclusion can be found for Slovakia in (Zeman, Jurča, 2008).

NPL ratio. As the supported hypothesis in *Table 6* testifies, real interest rate variables have had a significant impact on the NPL ratio in all five CEEs. The effort to fight stubborn inflation and establish sufficient monetary credibility has often led to high real interest rates in the observed economies, which have evidently aggravated their NPL ratios.

5. Conclusions

We have examined a battery of macroeconomic variables that can account for developments in NPL ratios among the CEEs in the period 1995–2007. Our empirical results broadly agree with the theoretical assumptions and with the evidence found in relevant studies. In particular, four main conclusions can be highlighted. First, an improvement in the economic conditions – through growth of either real GDP or export demand – positively influenced banking sector performance in all the selected economies. The favorable macroeconomic environment has therefore reduced the amount of systemic risk and played a role in influencing the NPL ratio in the countries analyzed. In this context, bank behavior is procyclical and may reinforce the current development of the business cycle. Second, in four out of the five CEEs, foreign direct investment growth appears to have improved the NPL ratio. Obviously, such capital flows contribute not only to the diversification of foreign trade structures in these countries, but also to an expanding financial capacity of FDI-restructured enterprises. Third, according to our estimates, an increase in real interest rates deteriorates the financial position of borrowers in all the economies scrutinized in this article. Finally, in all the CEEs but Hungary, rising levels of credit to the private sector increase the NPL ratio – most likely due to soft loan constraints and inadequate credit risk management. Even if some convergence in real interest rates can be expected in the light of the intensified monetary integration among the four CEEs moving toward the euro, the negative impact of growing interest rates and credit activity on a country's NPL ratio, as reported in this article, calls for further improvements in the supervision of banks in these economies.

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