Banking Contagion under Different Exchange Rate Regimes in CEE[1]

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The global crisis of 2008 caused both liquidity shortage and increasing insolvency in the banking system. The study focuses on credit default contagion in the Central and Eastern European (CEE) region, which originated in bank runs generated by non-performing loans granted to non-financial clients. In terms of methodology, the paper relies on one hand on review of the literature, and on the other hand on a data survey with comparative and regression analysis. To uncover credit default contagion, the research focuses on the combined impact of foreign exchange rates and foreign private indebtedness.

Keywords: financial contagion, banking, Central and Eastern Europe, foreign exchange rate, non-performing loan

JEL-codes: F31, F37, G17, G21, G33

1. Introduction

The US financial crisis of 2007-2009 and the EU recession hit the European banking system gravely. Moreover, the Central and Eastern European (CEE) banking market showed a variety of individual hazardous impacts from national policies, foreign exchange rates, and solvency. The crises led to stricter regulation and control in the banking sector: first and foremost, the increasing capital adequacy and solvency limits of Basel III.

Though in the second decade of the 21st century, the CEE commercial banking sector has been operating in market economies for some time, the region has a legacy of the command economy that lasted until 1989. Benczes (2008) summarized this impact of the past on a banking sector which got liberalized and privatized a few decades ago and which was shifted

towards a two-tier system and opened to foreign investors, who played the role of majority owner in an undercapitalized transition region. Besides, CEE markets are characterized by small scale, low financial penetration, and low degree of product diversification. This process generated individual characteristics for the vulnerability and stability of the CEE banking sector (Benczes 2008: 128-138). According to Jokipii and Lucey (2002), by the 2000s, privatization, deregulation, liberalization of licensing, and capitalization by foreign investors had been finished in the CEE banking sectors. The 1990s already saw market clearing by bank failures, especially in the case of under-capitalized, domestic small banks.

The regional and historical characteristics led to a relatively dynamic expansion of crediting from a low level of activity. This credit growth was accelerated by the economic catching-up of the region. (Kiss et al. 2006) The favourable global economic and financial circumstances and the medium-term growth of the CEE region led to risky exposure by lending activity measurable in credit/deposit ratio. As Benczes (2008: 135) argued, the CEE banking sector had to face challenges to *"find the appropriate balance between an increased lending activity and to maintain a stable functioning"*.

Small scale, fragmented market structure is typical in CEE not only because of the fragmented country structure of the region, but also because of the various national financial-fiscal-monetary policy mixes and strategies. Sovereign risks and interest rate policies affected the structure of loans and deposits differently. Before the global and euro zone crisis, all CEE countries had national monetary autonomy. Some of them chose the strategy to pass it on to the European Central Bank as soon as possible (Slovenia, Slovakia, Estonia, Latvia), or have been planning to do it soon (Bulgaria, Romania, Lithuania). Some others have strived – at least since 2010 – to preserve the national currency (Czech Republic, Poland, and Hungary). Some monetary authorities applied strict and high interest rates, some did not; some countries had higher foreign reserves, others had lower in the eve of the crisis, etc. These differences in policy modified and differentiated the credit and deposit structures of the countries. Due to the differences of national risk premium and interest rate policies, in those countries (Hungary, Baltics, Romania, Ukraine) which kept high rates beside giving opportunity for foreign currency loans, the depreciation of emerging market currencies by a global panic found their households and firms deeply indebted in euro, Swiss francs and other foreign currencies. Those countries which kept their risk premium close to or under the euro zone in market rates, experienced insignificant exchange rate exposure in their loans. Thus, it is reasonable to expect that financial contagion was not uniform in the region.

The purpose of this study is to analyse the balance sheet and cash-flow impacts of various exchange rate risks in the CEE banking systems. The availability of data determined the countries included in the regression analysis, with the following countries being included: Bulgaria, the Czech Republic, Croatia, Romania, Hungary, Poland, Slovakia, Slovenia, Estonia, Latvia, Lithuania, Russia, Ukraine, and Serbia. Although referred to at times, Bosnia and Herzegovina, Moldova, FYROM (Macedonia), Belarus, and Albania are not subjects of this analysis.

The hypothesis is that the difference of foreign exchange regimes and policies resulted in different contagion intensity in the CEE countries. The assumption is that the change of the foreign exchange (FX) rate determines the ratio of non-performing loans in the CEE countries in different degrees, depending on the exchange rate regime and the share of foreign loans during the global financial and economic crisis. Therefore, the FX asset crisis of banks depended on the volatility of foreign exchange, namely, the volume of the currency crisis induced by the global and European financial and output processes.

This study will give an overview on the relationship between banking contagion and foreign exchange risk and its relevance in CEE, and then makes or cites correlation calculations on exchange rate impacts. The methodology is, first, to introduce the banking path that led to the specific state of CEE countries after the global crisis of 2008. Then linear regression is calculated to examine the hypothesis in relation to FX and non-performing loans.

The CEE political decision-makers have treated the exchange rate primarily as a tool for competitiveness and economic growth. This strengthened the importance of short-term effects. The motivation of seeking correlation between exchange rate policy and financial contagion is to find the different impacts that various policies have.

2. The theory and methodology of financial contagion

The idea of the hypothesis originates in Darvas and Szapáry (1999) who analysed the financial contagion in the capital markets under different exchange rate regimes. The authors analysed the appropriate exchange rate regimes to defend the national capital markets from international financial crisis. For this purpose their study surveyed CEE and Israeli regimes from the aspect of nominal and real exchange rates, interest rates, risk spreads, variability of interest rates and the reaction of stock and bond markets for the previous variables. This paper focuses on bank financing. Caramazza et al. (2004) examine the financial linkages through creditors in currency crises. Their study establishes that currency crises have trade and

financial implications. This means that there is a shift in the investors' sentiment about risk perception, and that is why they rebalance their portfolio internationally. To reduce their exposure in assets with increasing risk, investors withdraw their money from deposits and securities of certain regions. Because of information asymmetry, securities will be liquidated not only in the region in crisis but in other ones with a similar risk and vulnerability profile as well, without fundamental reasons (Obstfeld (1994) calls this "second generation crisis"). The conditions of a currency crisis are defined by Camarazza et al. (2004) so that there is a significant depreciation of foreign exchange after robust appreciation of the real effective exchange rate (REER), and decrease in foreign reserves.

From our perspective, the banking contagion under different CEE monetary policies will be in the focus of this analysis. The financial contagion can be understood very broadly on any financial markets and systems. We are interested in a narrower meaning related to banking contagion only. Several definitions exist to describe the different aspects of financial contagion. Diamond and Dybvig (1983) explained it as a coordination failure between deposits and their use. Besides, their approach is that bank runs are not accidental but self-fulfilling risks. In their early model, the vulnerability of banks was connected to the conflict between the withdrawal of deposits and the investments into illiquid (long term) assets. Battacharya et al. (1998) worded it as bank runs triggered by adverse information. Allan and Gale (1998) concentrated on the strong correlation between business cycles and bank runs by claiming financial crises as "inherent" parts of the business cycle. Bandt and Hartman (2001) joined the coordination failure explanation by defining banking contagion as a systemic failure of fundamentally solvent institutions. This systemic risk is manifested by co-movements, cross-market events and interdependences (Forbes –Rigobon 2002).

For example, Manz (2002) or Schoenmaker (1998) distinguished two origins of contagion: one is the case when the debtors' failure results in the creditors' failure, namely the contagion occurs through capital connections. The other case is called information contagion when the collapse of a bank or asset induces liquidation in mass, namely depositors and investors rescue their money from similar banks and assets (the latter has significant literature: Chen (1999), Acharya – Youlmazer (2003), Ahrony – Swary (1983), but this scenario has not been typical of the CEE banking sector under the period of global crisis since 2008.)

The contagion from capital linkages (or credit channel) is described by Schoenmaker as a "complex web" of interbank connections. The exposure always depends on the size of the borrowing bank and not of the lending one. And since 2008, the market must recognize that even borrowers of a "too big to fail" size are not riskless either.

Kollman (2010) interprets the contagion concept as a mismatch between liquidity of bank assets and liabilities, which creates fragility in the banking system, thus multiplying the individual crisis impacts. Short deposits and long term loans are in contradiction in sense of liquidity. In the model of Diamond and Dybvig (1983), the stochastic, excessive withdrawal of deposits causes costly liquidation of bank assets, and maybe a default, too. Especially in a globalized financial market, banks hold international assets and liabilities, which create a geographical channel for contagion by global credit crunch. This is a typical cash-flow contagion approach, which derives the crisis from friction of maturity. Such a bank run is caused by a change of expectations when consumption appetite increases while saving propensity shrinks in parallel. The cash-flow contagion model was developed by Chari and Jagannathan (1988) and Gorton (1985) by introducing asymmetric information and this way the risk of long term assets, namely, the depositors are not informed about the use of their deposits. This factor makes it possible to analyse bank runs induced by panic when the depositors see *en masse* withdrawals but do not know whether it happens because of increasing consumption or non-performing loans.

We can observe crisis from the aspect of default as well. The question of balance sheet contagion approach is the following: how can financial contagion appear and spread in a bank's assets? A general balance sheet of banks can be helpful. Among the assets, we can find cash, interbank loans, credit to non-bank partners, equity holding, as well as equipment and premises. In the liabilities, there are equity, interbank deposits, retail/wholesale deposits, and subordinated debt. Obviously, the spread of non-performing interbank debits and credits and the non-performing non-financial partners' loan can cause capital linkage-related contagion. Besides, the depreciation of cross-holding financial equity can cause contagion through a financial market channel. Cross-holdings redistribute the liquidity in liquid times with plenty of credit supply, but in the case of liquidity shortage, withdrawals from deposits exceed short-term assets, that is why long term asset liquidation becomes necessary. This leads to the depreciation of claims.

Allen and Gale (2000: 4) explain that the interbank market and retail banking operate by very different mechanisms. The mismatches in retail banking enforce the bank to liquidate long term assets to be solvent toward short term depositors. The interbank failure occurs when a commercial bank cannot get any liquidity from other banks if its credit demand is in excess. The excess demand appears, first, in a single region, but can quickly spread to the neighbouring ones, which ultimately causes need for liquidation and thus the depreciation of

long term assets. Namely, the infected regions experience a decreasing value of their claims, which reduces the solvency and lending capacity of banks.

Allen and Gale (2000) constructed a 'liquidity preference' model which can analyse small shocks causing large contagion effects in the banking sector. The main risk in their understanding is rooted in the alternative of banks that they can choose for what term to lend their current deposits: short or long. Based on the previous theory of business cycle-related financial crisis (Allen – Gale 1998), this model seeks real correlation and linkages between regions under financial contagion. In the model, liquidity preference is stochastic, which motivates risk sharing. The liquidity preference model is able to treat variously integrated financial markets from the aspect of a complete market structure, where every entity has impact on every other, up to the incomplete and disconnected market structures where the regions are particularly disintegrated or isolated. The banking crisis is understood as an excess demand for liquidity of the sum of the regions. They found evidence that an incomplete banking market structure with unilateral exposure among banks can show contagion.

When it comes to financial contagion, it actually it the probability of the spread of crisis (Lagunoff – Schreft 1998). Rochet and Tirole (1996) applied this approach to bank runs, namely, they surveyed the probability of the system collapse from the fall of one bank. Kiyotaki and Moore (1998) followed how the liquidity shortage goes through the credit chain.

Can banks do individually anything against financial contagion? *Ex ante,* prudent lending and low credit/deposit ratio used to be preventive, but sooner or later every bank got tempted to achieve high profit from a booming period of loans and asset prices – just like in the Minsky-cycle of financial crisis (Minsky 1982; 1992). As Losoncz (2009) summarized, since the practice of the financial sector led to the crisis of 2007-2009, it seems that the preventive approach is very limited. *Ex post,* reaction to crisis means adjustment to the changed deposit withdrawal habit or to the increasing likelihood of default. Banks can try to reduce the volume of claims with more limited lending, decrease the credit/deposit ratio by collecting deposit and stopping crediting, clean their balance sheet from defaulted credit, cut the costs of operation, turn away from lending toward other banking activities, etc. (Losoncz – Nagy 2010). After the occurrence of a crisis, surviving banks have a very narrow and path-dependent room for manoeuvre for a longer period.

The measurement of contagion can mean various models. There are models for probability, effect, etc. Corsetti et al. (2001) criticized the contagion models and called attention to the empirical volatility of correlation and covariance between regional financial markets. For

example, Schoenmaker (1998) used a regression model based on Lancaster (1990) and Heffernan (1995).

Jokipii and Lucey (2007) measured the contagion in CEE banking sector as a co-movement of national markets with a two sample t-test, regression analysis and Granger causality test. Their correlation coefficients indicate the persistence of banking contagion between the CEE countries –Poland, Hungary and the Czech Republic only. This analysis showed strong correlation in case of contagion effect from the Czech Republic to Hungary and not in any other direction. This result was earlier recognized by Morzuch and Weller (1999) who strengthened the interesting fact, that a national financial crisis in 1990s did not really affect the neighbouring CEE countries, namely regional bank runs did not cause cross-border contagion, even after liberalization. They also tried to find its reasons. Their model assumes that bank runs are launched by second generation crises, namely speculation. Speculation is based on a continuous appreciation of financial assets from quick profit targeting capital inflow into the financial markets of an emerging market after financial liberalization. However, the undercapitalized CEE region quickly found big, effective, prudent and well capitalized multinational banks with lower risk exposure. Besides, small local banks typically have no international connections. This is known from Gropp et al. (2009), who examined the European banking sector, and they found evidence for cross-border banking contagion only in the case of large banks because the cross-border exposure of small banks is insignificant. Their methodology was to collect stock price and debt of banks excluding the small ones trading under 1000 shares in more than 30% of trading days. The purpose was to measure the distance to default, which is defined as follows: "[...] *the difference between the current market value of the assets of a firm and its estimated default point, divided by the volatility of assets*". "*The value of equity is modelled as a call option on the assets of the company. The level and the volatility of the assets are calculated with the Black/Scholes model using the observed market value and volatility of equity and the balance-sheet data on debt.*"

Árvai et al. (2009) concentrated on the cross-border interbank spill-over between Western and Eastern Europe. They highlight the significance of ownership, namely the importance of the foreign parents of CEE banks. It can be expected that foreign ownership had softened the financial contagion in CEE commercial banks as parent banks capitalized their affiliates, and turned into red in household and corporate crediting. This way there has been a really strong cross-market rebalancing in the region. They recognized an asymmetric dependency of CEE countries on the Western European banks, which also strengthens our assumption that banking contagion is very much determined (softened) by multinational foreign banks. The

measured exposure of Western banks (except Austrian and Swedish ones) is small. The contagion effect is more likely if the lender is concentrating on the CEE region. The authors proved that CEE bank crediting is very much affected by extra-regional banks because these countries are heavily exposed to Western European banks.

Morzuch and Weller (1999: 5-6) found that, besides the presence of multinational banks in CEE region, the following lowered the contagion risk in the 1990s. This is a very instructive list as many of them were not true in the 2000s:

- High risk premium threatened from local borrowing. This did not remain true for the 2000s, since in some countries market rates became low; other countries circumvented the high national rates with authorization of foreign-currency credit.

- Foreign exchange appreciation, which has been very typical in other emerging countries – mostly because of the exchange rate peg –, did not happen in CEE countries, so the financial assets did not become overvalued. This characteristic was neither completely true for CEE in the 2000s as some countries used pegging (Baltics, Bulgaria), or the interest rate policy strengthened the national currency unduly (Hungary, Romania).

- Default risk was low because of the economic prosperity. Before 2008 it was particularly true, but default risk was lower especially due to the high liquidity of global markets.

- Maturity risk from high share of short term loans, which can result in a quick wave of defaults, was not significant because of cautiously high reserves of official foreign assets. This was neither true in the 2000s. It was indicated by the general 20-30% depreciation of CEE national currencies fundamentally in every CEE country (except the Baltic countries and Bulgaria pegging strictly) that in terms of their foreign reserves, CEE national banks were unprepared for the sudden illiquidity in the end of 2008.

Klein (2013) analysed the impact of macroeconomic variables on credit default. This survey was based on a dynamic panel regression distinguishing bank-level (equity-to-assets, ROE, Loans-to-assets, change of loans), country specific (unemployment, inflation, exchange rate) and global variables (euro zone GDP growth, volatility of S&P 500 as a risk aversion indicator).

The following methodology is built on linear regression analysis with SPSS. The predicting variable is the extent of change of FX rate. The dependent variable is the ratio of non-

performing loans. Attention is focused on the betas as indicators of strength of relation and the r^2 as a goodness of fit indicator.

As mentioned above, there are several studies that use regression analysis on a broad range of macroeconomic or banking level factors of contagion. Regressions are calculated to examine the hypothesis, namely, that a change of the FX rate determines the ratio of non-performing loans in the CEE countries in different degree depending on exchange rate regime and share of foreign loans during the global financial and economic crisis.

It is clear that the credit default is determined not only by the FX rate (see the models of Schoenmaker 1998 or Klein 2013). For example, the following multivariate regression including FX rate impact, GDP growth and nominal interest rate can be an appropriate function:

$$NPL = \beta_0 + \beta_1 FXDIF_i + \beta_2 i_i + \beta_3 \Delta GDP_i + \varepsilon_i \, , \tag{1}$$

where NPL is the ratio of non-performing loans to total loans, ΔGDP_i is the change of quarterly GDP, i_i is the quarterly three-month market rate, and $FXDIF$ is the ratio of the quarterly average exchange rate difference from average exchange rate of 2nd quarter of 2008 (right before the crisis), in euro to national currency:

$$FXDIF_i = (FX_i - FX_{Q2,2008}) \, / \, FX_{Q2,2008} \, . \tag{2}$$

The complex analysis of CEE countries already has been made by Klein (2013) as referred to above. Our focus is on FX impact because Klein's model ignored the importance of foreign currency credit ratio and the exchange rate regime on spot rate (see explanation later). We seek a relationship between nominal FX depreciation shocks and credit default contagion. Nominal FX is reasonable as external loan financing is sensitive on the spot rate but not on REER or NEER.

The function for this regression is the following:

$$NPL = \beta_0 + \beta_1 FXDIF_i + \varepsilon_i \, , \tag{3}$$

Of course, the FX exposure resulting in a credit default can be the simplest to channel by the foreign currency loans into the banking system. This cannot be ignored. To preserve the transparency of the analysis, it is preferable to create clusters in the dimensions of change of FX rates, change of non-performing loans rates, and share of foreign loans form the total assets before doing the regression analysis. The change of FX rate will be established as follows: substitute in equation (2) is $i = (2009Q2, 2010Q2, 2011Q2, 2012Q2)$ country-by-country. Change of non-performing loans ratio means what the difference was in the end of 2008, 2009, 2010, 2011, 2012 in comparison to the end of 2007. The share of foreign loans from the total assets will be paired year-by-year.

The countries in the survey are the Czech Republic (CZ), Hungary (HU), Poland (PL), Slovakia (SK), Slovenia (SI), Romania (RO), Bulgaria (BG), Estonia (EE), Latvia (LV), Lithuania (LI), Croatia (HR), Ukraine (UKR), Russia (RU) and Serbia (RS).


3. Contagion in the CEE

3.1. The pre-crisis structure of CEE from the aspect of contagion

First of all, to understand the various contagion effects of the global crisis, we have to know the pre-crisis characteristics of the CEE banking sector. Árvai et al. (2009) found significant inter-linkages within Europe. The CEE banking sector depends on the Western European banks very much. In the CEE banking market, financial risk exposure is concentrated to Austrian, German and Italian banks, and in case of Baltics, to Swedish ones. As it is clear from Figure 1, the post-Communist transitionary past of CEE and South East Europe (SEE) resulted in aggressive banking strategies and a fast extension of credits. From the calculation of Árvai et al. (2009:7) it can be established that the speed of credit extension was 43% in the Baltics and 15.5% in the V4 countries before the crisis (from 2004 to 2007) as a cumulated change, in the transition and integration period. Árvai et al. (2009) observed an inverse relationship between the degree of development and credit growth. However, it is more important to recognize generally about CEE countries that the extension of credits were significantly faster than the growth of deposits (see Figure 1). This finally created a credit/deposit ratio, where the credits significantly exceeded the deposits, which resulted in an interbank contagion risk.

The general tendency of CEE (according to Raiffeisen 2013) is that loans significantly exceeded deposits before the crisis, which was followed by a correction forced by the global markets. From this ratio it could be foreseen which countries had to face serious balance-sheet contagion risk from uncovered credit defaults. This risk was multiplied by the exchange rate

factor in case of Ukraine, Hungary, Croatia, Romania, Belarus, and Serbia. Besides, those countries faced the crisis with a less fragile banking sector with a loan/deposit ratio under 100 percent.

Figure 1. Funding of credit expansion from 2003 to 2007
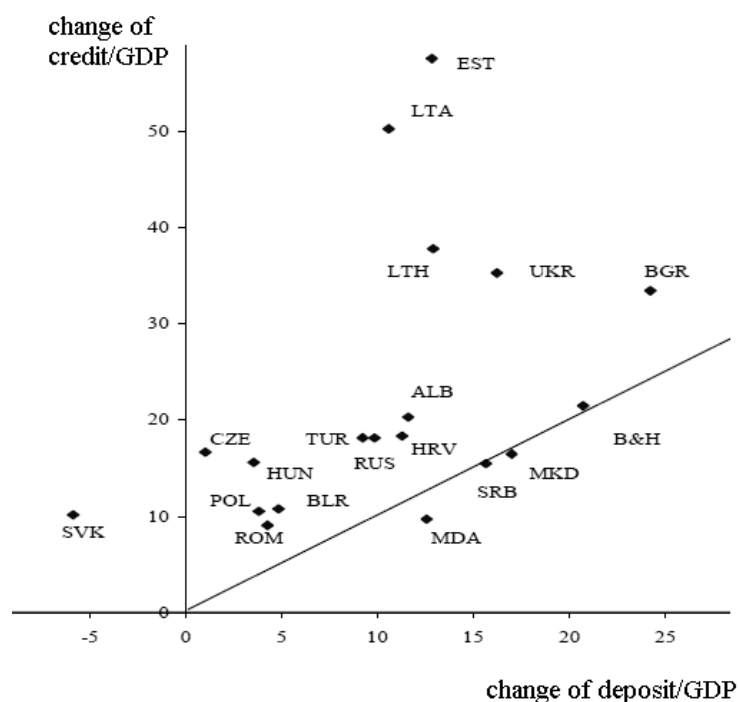
Source: Árvai et al. (2009: Figure 4).

3.2. Credit contagion

Klein (2013) sought the reasons for non-performing loans in CEE and SEE regions. As it is clear from his regression analysis, there is a not too strong but significant negative correlation between GDP growth and the increase of credit defaults. He specifically found that recession is a factor of contagion. His paper tried to find a connection between credit default and other macroeconomic indicators as well but these significances are questionable, or many of them are not significant even at 10%.

However, Klein (2013) found evidence that the solvency of CEE debtors is a little bit sensitive to the recession of the euro zone. He concluded that, in case of

> the bank-level indicators, the estimations show that a higher equity-to-assets ratio leads to lower NPLs, therefore confirming the "moral hazard" effect; and higher profitability (RoE) contributes to lower NPLs and suggests that better managed banks have, on average, better quality of assets. […] Unlike in other studies mentioned earlier, other bank-level indicators such as the bank size and expense-to-income ratio were not found to have significant impact.

On the macroeconomic level, the results show that an increase in unemployment contribute to higher NPLs, thus validating the strong link between the business cycles and the banking sector's resilience. In addition, both higher inflation and the depreciation of currency were found to increase NPLs.

Concerning global environment factors (Klein 2013:12):

Higher volatility index and lower Euro area growth reduce the firms' capacity to repay, perhaps because of higher rates in the international financial markets, which reduce the firms' ability to rollover their debt, and because of lower export revenues. In addition, these two factors may also lead to lower external funding of the banks and therefore may result in negative credit growth […].

In the case of FX rate effects, Klein (2013) could find a very week correlation with credit default, and in the case of some of the methods applied by him, it had no significance. (More general methods of moment were applied.) This calculation ignored tow facts: firstly, some countries in the region have used fixed FX rates. Fixed or almost fixed nominal spot rate cannot have room to measure effects. We have to note that FX rate impact can be measured not only by nominal spot rate but by any real effective exchange rate as well. However, REER-based calculation cannot focus merely on FX spot rate nominal effects, which matters for the debtors' solvency. Secondly, the share of loans based on foreign currency and foreign borrowing has importance in the volume of FX rate impact. For example, the sharp credit growth in Baltic countries was absolutely financed from foreign credit in euro, thus the net foreign liabilities to the private sector credit climbed up to 35-55% in 2008. Meanwhile, in the Czech Republic, this ratio remained negative, namely there was internal financing. Most of the CEE countries had this ratio in the range of 5 to 25% (IFS data from Árvai et al. 2009:10-11). That is why, in our analysis, we run a regression only on those countries and periods which have no fixed FX rate and no membership in the single currency zone. Besides we create clusters of countries according to domestic and foreign financing ratios.

Figure 2 shows the difference between countries indebted mostly in foreign or local currency. Although the private loan to GDP ratio is comparable between Slovakia and Hungary, or between Poland and Romania, but the multiplication of non-performing loans is significantly faster as a result of the crisis in the case of Hungary and Romania, which were financed from foreign loans.

The FX rate depreciation hit mostly Hungary, Poland, Romania and Ukraine with a depreciation of 20 to 30%. If we compare this with the ratio of foreign currency credit and

external financing, it will be clear that these two factors strongly determined the banking contagion based on credit default risk. Besides, if we consider the pre-crisis HUF, RON, UAH, HRK highly overvalued by high market rates in comparison to euro rates, it can be understood how the foreign currency loans could become toxic assets in these countries, while the rest of CEE was affected "only" by the other factors of credit default (global recession, national recession, unemployment). From market interest rates (Figure 3) it is clear that before the crisis, Romania, Croatia, and Hungary had to compensate fundamental risks with high national market rates. Thus, it was clear that local actors turned to FX credits with significantly lower market rates. In the case of ROE and ROA analyses (Raiffeisen 2013), it is harder to connect the damage of banks to the FX rate impact. It is more likely that discretionary effects, such as banking tax, or national recession factors determined the earnings much strongly.

Figure 2. Growth of loans-to-GDP ratio (2004-2008) and of non-performing loans (2008-2011)
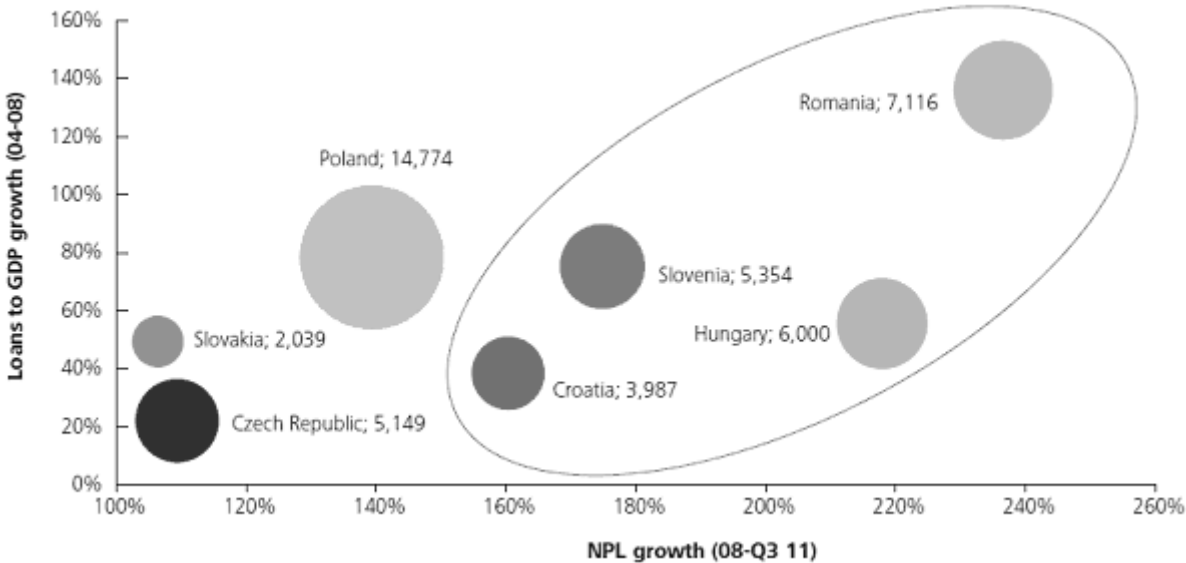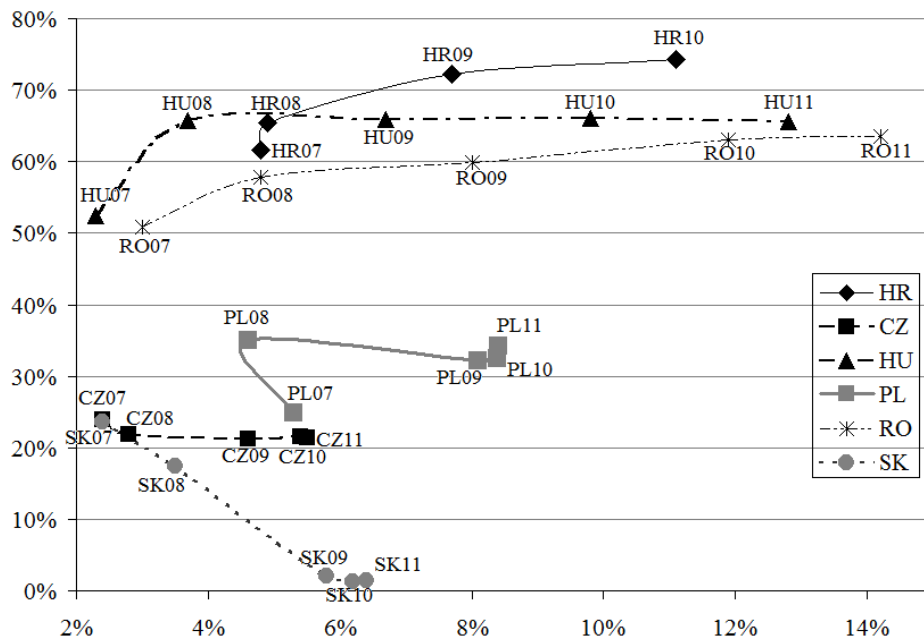

Source: Deloitte (2012)

Figure 3. Three month monthly market interest rates, 2005-2013
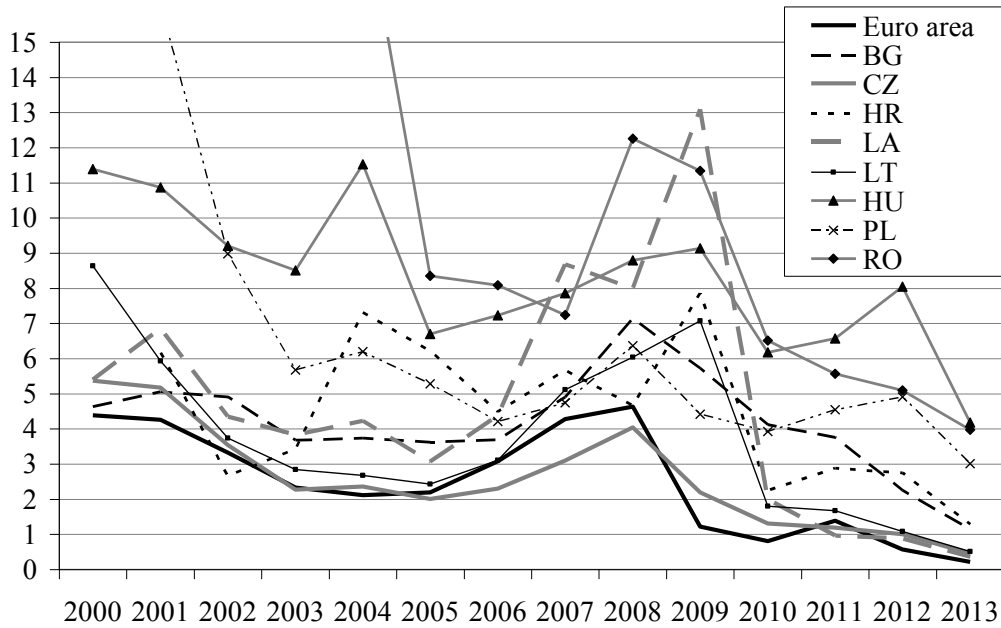
Source: Eurostat

Figure 4. Share of Non-performing loans and foreign currency loans from total loans, 2007-11

Source: author's composition based on Raiffeisen (2013)

Note: dots represent country-year combinations, e.g. HR10= Croatia in 2010

3.3. The FX impact analysis

According to the methodology explained in section 2, the first stage of analysis is to create clusters in two steps. The first step is shown in Figure 5, which includes the change of FX rate

and the change of NPL ratio. The second step is incorporated into Figure 6, where countries with a volatile exchange rate regimes are split into two further groups.

According to Figure 5 and Figure 6, three groups of countries can be distinguished: (1) the group of rigid FX rate countries, which used a currency board or a similar arrangement, or adopted the euro. (2) The group of locally financed countries, which means that although they had volatile FX rates, the significant majority of the loans was financed in local currency. (3) The group of foreign-financed countries which means that apart from a volatile FX rate, they were financed in foreign (currency) loans with high FX risk.

From Figure 5 it is obvious, that those countries which had pegging to euro or joined the euro zone early on the eve of the crises could not have a significant impact from the euro FX rate. In the case of euro zone members and successful currency boards, we simplify the situation to no FX risk. It does not make sense to analyse the spot rate impact on credit default. These countries can be excluded from our FX analysis: Bulgaria, Estonia, Lithuania, Latvia, Slovenia, Slovakia and Croatia. Only Hungary had been indebted significantly in a different currency (CHF), where cross rates still matter in HUF-EUR-CHF relations, but this country is not in the rigid rate group.
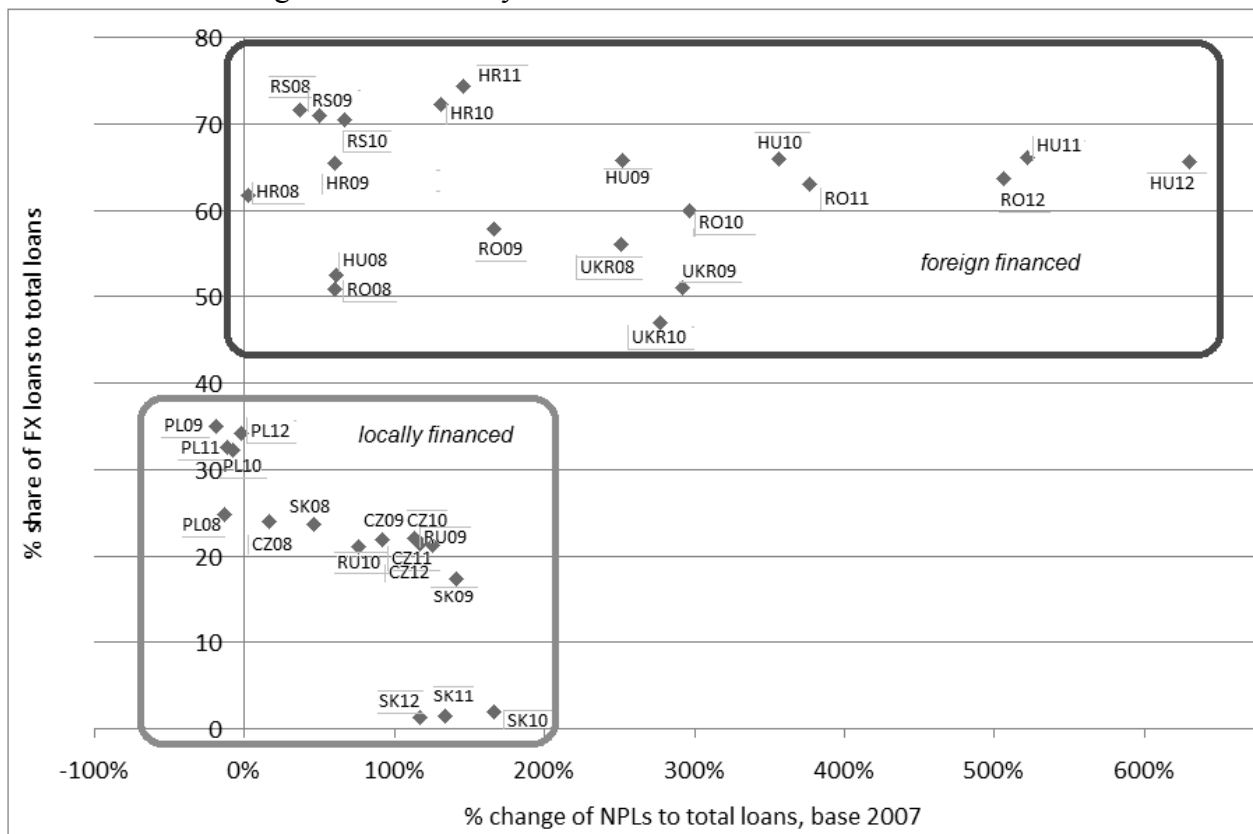
From Figure 6 with the rest, we have to recognize that the countries from the group of locally financed ones in crediting had a very narrow credit channel to accumulate the FX risk in the banking system through loans. The following ones belong to the locally financed group: Poland, the Czech Republic and Russia. At the same time, it has been opposite in the group of foreign-financed countries. The foreign-financed group includes Serbia, Hungary, Ukraine, and Romania. Croatian data are also indicated in Figure 6 to show its indebtedness, but as it has had a peg with a narrow floating margin, the country is not included in the regression analysis for the reasons explained about pegging.

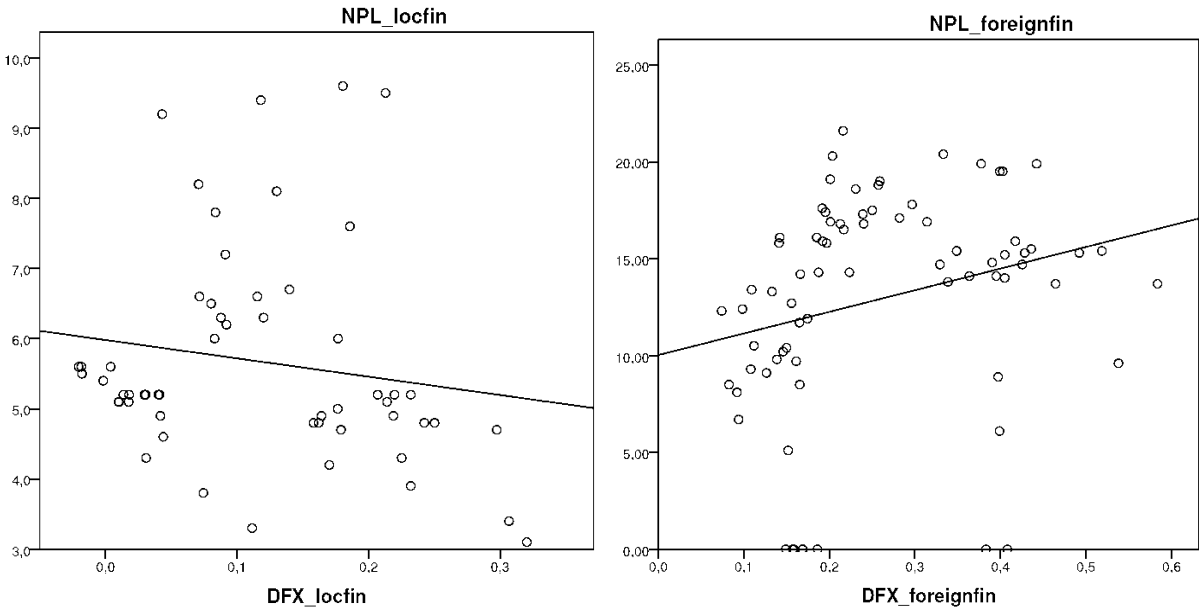Figure 5. Clusters by change of FX rate and of NPL ratio
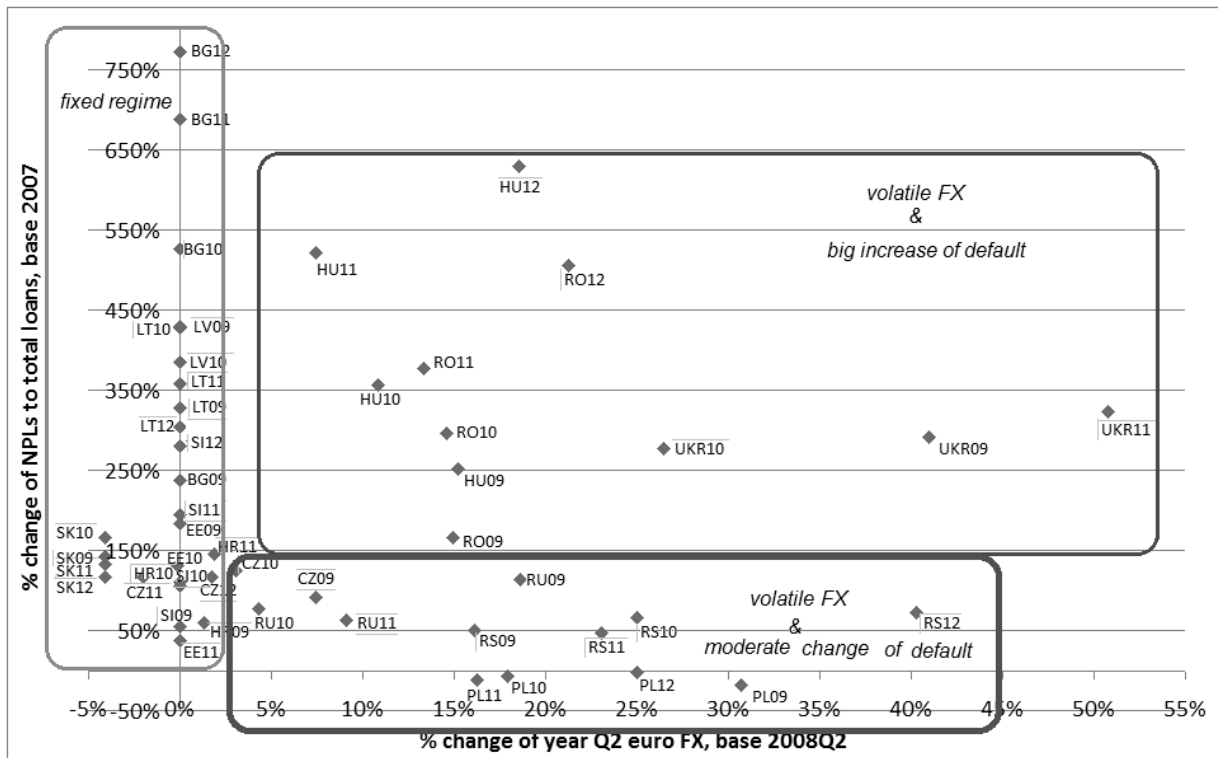
Source: author's composition based on data from the ECB, the national banks, IMF Financial Soundness Indicators, and the Federal Reserve Bank of Saint Louis,

Note: dots represent country-year combinations, e.g. RS10= Serbia in 2010.

Figure 6. Clusters by share of FX loans and of NPL ratio

The result of linear regression analysis is summarized in Figure 7. Although results are not robust, difference can be measured between states of local or foreign currency financed economies in the regression of the NPL ratio and the FX rate volatility. We can establish that in the case of countries financed in foreign currency, the ratio of NPL has had stronger correlation with changes in FX rates. This difference appeared both in the constant and the beta, and also in the case of r^2. The r^2 is small in both groups, which means that the regression curve does not fit the variables very well. The standard error of estimation is bigger in the case of foreign currency financed economies, which suggests a weaker accuracy of beta. However, the significance of the estimation on foreign currency financed group is $0.03 < 0.05$, which means that the estimator is correct with an accuracy of 95 percent. At the same time, the significance of the estimation on the local currency financed group is 0.25, which means that this estimator cannot be considered acceptable.

In summary, we can conclude that the currency of indebtedness and the national policies led to a portfolio of loans by currency mattered in credit default during the crisis, which thus determined the credit contagion, too.

Figure 7. Regression curve estimation by countries financed from local currency (*locfin*) or from foreign currency (*foreignfin*), 2009-2013, quarterly data

Source: author's composition based on data from the ECB, the national banks, IMF Financial Soundness Indicators, and the Federal Reserve Bank of Saint Louis,
Note: NPL= non-performing loans, DFX= $FXDIF_i$

Table 1. Regression results

Dependent variable	r2	standard error of estimation	sum of squarres of regression	sum of squarres of residuals	F-test	degree of freedom of residual	Sig.	constant	beta
NPL_locfin	0.025	1.5213	3	123	1.347	53	0.251	5.981	-2.614
NPL_forreignfin	0.062	5.58868	152	2311	4.871	74	0.03	10.024	11.155

Source: author's calculation

4. Conclusions

In this paper, we analysed the contagion effects in the CEE region. We established the relevant aspects of banking contagion in the region. We excluded the information contagion because of its regional irrelevance. We cited the previous researches on correlation between macroeconomic indicators and banking contagion in CEE region. The change of GDP, the FX rate, the interest rate can significantly determine the credit defaults and this way the contagion risk. We focused on the FX rate impacts.

We can recognize that the CEE region has had specific banking and policy circumstances affecting the risk of contagion. The countries in the region are not unanimous in source of risk and structure of crediting. Although, the region had common, similar post-Communist transitionary past, the more than two decades of market economy created significant policy, economic and social differences, which were enough to differentiate among the national economies. It must be taken into account that multinational ownership has significance in the CEE region as a softener of contagion risk. Besides, the policy differences before the crisis determined the inherited stock of external or FX debt on the national level.

We classified the CEE countries by non-performing loans, FX rate volatility and currency composition of loans. The countries with a pegged euro rate (strict pegging or euro membership) were classified where the actual volatility of FX spot rate is zero, which means that its impact on debtors' solvency is insignificant. We split the rest of the countries into two groups, one with majority of local currency loans, and another with foreign currency loans. The separate regression analysis of the two groups showed differences, therefore we could conclude that the currency of loan financing has had determining power on the accumulation of credit defaults during a recession period. Consequently credit contagion is measurable in the CEE region and it was multiplied by the FX risk.

It has been proved that those countries which believed they could finance themselves and their private sector from FX loans with low risk premium with high country risk actually worsened their own external financial position. The difference can be observed in the regression analysis by clusters.

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