The effects of prudential policy measures on financial stability in post-transition countries[*]

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Abstract

The empirical research of prudential measures effectiveness is still scarce, especially for central and southeast European countries. The aim of this paper is to analyze the effects of prudential policy on financial stability of post-transition bank-oriented countries using panel data analysis approach. Using the sample of central and southeast European countries for the period 1998 – 2010, we found that these measures generally reduce the level of non-performing loans, increase the level of profitability, partially affect banking system liquidity, but do not improve credit to deposit ratio. We point out two main conclusions: (1) prudential measures positively affect banking system stability expressed through financial stability indicators; (2) prudential measures represent important instrument of a central bank orchestra.

Key words: *prudential measures, monetary controls, financial stability, bank-oriented financial systems, panel data analysis*

JEL classification: *E58, G28*

1. Introduction

The global financial crisis exposed all the flaws of overly expanding banking policies, which resulted in credit booms without taking into account the truth credibility of borrowers. This implied all the flaws of regulation system as well

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as improvidence and incompetence of the central bank governors, especially in developed countries. Due to less developed financial markets and conservative central banking, Central and Southeast European (CSE) countries were characterized by implementation of prudential policy measures which aimed at mitigating and managing rapid credit growth that represented a threat to economic and financial stability. Financial stability is to be accomplished and maintained by monetary policy, but above all with prudential policy (Hunter, 2008). Moreover, Padoa-Schioppa (2002) states that monetary policy is important, but not crucial to achieve financial stability. Its role in preserving financial stability should be seen in implementation of monetary policy and prudential supervision. IMF (2010) also points out that financial stability should be addressed mainly by using macroprudential tools. However, do they really improve financial stability?

There are several papers analyzing this question. Macroprudential measures have mainly been adopted by emerging market economies, with emerging Asia outstanding in the group, making them a predecessor in their use. Common measures often included limits on loan-to-value ratios and changes in reserve requirements. These measures resulted mainly in slowing credit growth and helping banks to withstand the unwinding of imbalances (IMF, 2010). Moreover, the experience of Asian economies show that these measures have a synergy effect and that together they are more effective. Caruana (2010) points out the experience of the Reserve Bank of India, which has introduced measures to restrain credit growth for housing and consumer finance in order to reduce excessive speculation in equity and commodity markets, and to build up buffers through countercyclical provisioning. Various prudential, monetary and administrative measures were adopted by the CSE countries as well (Hilbers et al., 2005). They wanted to reduce rapid growth in bank credit to private sector, which was perceived as a potential source of instability. Moreover, research made by Qureshi et al. (2011) and Lim et al. (2011) showed that prudential measures can affect credit growth. Similarly, Tovar et al (2012) examined the effectiveness of reserve requirement system on credit growth, confirming its efficacy. Finally, Schou-Zibell et al. (2010) gained interesting results considering effectiveness of prudential measures on financial soundness indicators. However, abovementioned literature focuses mainly on analysis of prudential instruments effectiveness on credit growth. Therefore, in our research we try to find out whether their final goal, the financial stability i.e. stability of banking sector, is achieved.

Our hypothesis is that prudential instruments and monetary controls enhance banking sector stability, namely they diminish the credit risk (the share of NPLs) and improve the profitability, primary liquidity and Loan-To-Deposit (LTD) ratio[3].

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[3] LTD ratio is a first indicator of banking sector health. A very high ratio is considered to be alarming; because it can endanger banks' liquidity i.e. banks might not have liquidity to cover unforeseen fund requirements.

The paper is structured as follows: Section 2 provides literature review and Section 3 describes and explains methodology. Section 4 brings empirical results obtained by panel data analysis approach. Finally, Section 5 concludes the paper. The appendix provides description of variables and sample composition.

2. Literature review

This section discusses theoretical and practical definitions of financial stability and the importance of prudential measures in central bank's instrument orchestra. Additionally, it reviews empirical researches considering the impact of prudential measures on financial stability.

2.1. Financial stability

After the period of high and unstable inflation rates in 70's, monetary stability has been recognized as the main goal of central bankers. However, the period of Great Moderation has resulted in three periods of the Global Recession – 1982, 1991 and 2009 (Kose et al., 2009) which were closely related to the financial instability and the financial crisis. Due to the high costs that financial crisis induces[4], the financial stability is becoming more and more explicit aim of central bankers. Questions regarding its importance and the importance of measures that help achieve it have been characterizing discussions of financial experts and authorities worldwide. Nevertheless, unlike monetary stability, which is defined as the price stability or low and stable inflation, simple procedure of defining the financial stability poses an array of problems.

The definition of financial stability has different forms dependent on the period, country and research. Literature does not offer a unique and generally accepted definition, which is reasonable, taking into account the specificity of each country's financial system, as well as the functional specificity of each research. That makes researches in this area difficult to implement and it diminishes their comparability. However, researchers tend to propose their quantitative measures according to their sample and time period that their research encompasses. Definitions of financial stability can be divided in two groups: (i) *positive or particular definitions* which are targeted to certain segments of financial system (financial institutions, financial markets and financial infrastructure), and (ii) *negative or inverse definitions* that define financial instability. Several definitions of both groups will be pointed out.

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[4] According to Eichengreen (2004) average loss is 9% GDP, while in some countries it reaches 20% of GDP. According to Reinhart and Rogoff (2009) estimated costs of banking crisis, depending on methodology, range from 2% in USA (1984) to 55% in Argentina (1981).

Regarding *positive definition*, Schinasi (2004) defines financial stability as the soundness of financial institutions, financial markets conditions, and effectiveness of the various components of the financial infrastructure. Duisenberg (2001) states that financial stability refers to the smooth functioning of the key elements that make up the financial system. According to Buiter (2008) financial stability refers to (i) the absence of asset price bubbles, (ii) the prevention or mitigation of systemically significant funding illiquidity and market illiquidity and (iii) the prevention of insolvency of systemically important financial institutions. Münür et al. (2008) emphasize the stability of the banking system, as a key element for financial stability, while Aspachs-Bracons et al. (2006) define financial fragility which is characterized by reduced profitability of the banking sector and its potential default. Considering *inverse definitions* we point out two of them. Issing (2003) states that financial instability is related to the bubbles in the financial markets and the volatility of financial markets, and for Ferguson (2002), financial instability involves some notion of market failure or externalities that can potentially impinge on real economic activity.

By listing the concepts of financial stability we showed that, so far, no agreement has been reached in the literature on financial stability definition. However, the mentioned authors agree on the importance of financial institutions and financial markets, whereas the significance of each segment depends on the structure of the financial system.

Both groups of definitions have their own quantitative expressions. Positive definitions can be expressed through performance of financial markets (e.g. volatility and deviation of stock market prices), financial institutions (capital adequacy, profitability, non-performing loans) or financial infrastructure (the level of Lamfalussy standards achievement), while the negative ones can be expressed as financial crisis. They are mostly found in researches based on work of Demirgüç-Kunt and Detragiache (1998). Among quantitative expressions of positive definitions oriented to financial institutions prevail the ones based on financial soundness indicators (FSI) proposed by IMF (2003). In particular, FSI includes core and encouraged set of financial soundness indicators. However, due to scarce encouraged set data base, especially in CSE countries, researchers are prone to use core set of FSI (Männasoo 2004, Geršl and Heřmánek 2006, Mohanty and Turner 2008). Core set includes: capital adequacy (expressed as regulatory capital to risk-weighted assets, regulatory Tier 1 capital to risk-weighted assets or nonperforming loans net of provisions to capital), asset quality (nonperforming loans to total gross loans or sectoral distribution of loans to total loans), earnings and profitability (return on assets, return on equity, interest margin to gross income, noninterest expenses to gross income), liquidity (liquid assets to total assets or liquid assets to short-term liabilities) and sensitivity to market risk (net open position in foreign exchange to capital).

Measuring the share of banks assets to total financial institutions assets, as well as significance of financial institutions in relation to financial markets, banking sector in CSE countries has pivotal role in financial intermediation and therefore is crucial for financial stability. Due to bank-oriented financial systems of selected CSE countries, we define financial stability as the bank stability and measure it by following indicators: nonperforming loans to total gross loans and return on equity (FSI), liquid assets to total assets (claims on central banks to total assets as used by Herrero and del Rio, 2003) and the LTD ratio as widely accepted indication of bank's health.

2.2. Prudential policy as an instrument in central bank's orchestra

Although central banks were already involved in maintaining financial stability and in preventing liquidity crisis acting as a LOLR, financial crises were not prevented. Therefore, a change in central bank's framework is indeed needed. This change does not mean the abandonment of the existing framework but its amendment. Hence, price stability will continue to be the main or one of the main central bank's objectives. However, price stability will not be pursued at all costs, but will be in line with the achievement of other objectives, namely financial stability. The fact is that price and financial stability are largely overlapping (Schinasi 2006). These stabilities, actually, mutually reinforce each other (Mishkin, 1997) and, at the same time, make achieving monetary and financial stability possible in the long run, but with changes in current monetary and prudential framework (Borio, 2006), and with further progress in prudential policy (Smaghi, 2010, Blanchard et al., 2010). In such cases, as Cukierman (2011) states, additional instruments should be developed to maintain financial stability in order to leave interest rate policy to focus on the price stability. Additional instruments are to be found in prudential policy. Prudential policy can be defined as policy aimed at limiting the accumulation of financial risks, in order to reduce the probability and mitigate the impact of a financial crash (Angellini et al., 2012). In accordance with the principle of Tinbergen, there are two instruments and tools for achieving two goals – interest rate policy for achieving price stability objective and prudential and regulatory measures for achieving financial stability objective.

However, there is a vast discussion whether the jurisdiction of prudential instruments is to be in central banks (ECB, 2001; Betbeze et al., 2011). Among arguments against the accommodation of prudential measures under the aegis of the central bank one can find: the possibility of excessive concentration of power in one institution, risk of red tape, lower efficiency, a potential conflict of interest, which may result in moral hazard and loss of reputation and credibility of the central bank, the tendency of creating financial conglomerates and the blurring of differences between the financial products and intermediaries. In today's world there is no practical difference between traditional financial intermediaries. It means that they

are all involved in the same markets. Thereby, monitoring becomes less effective in controlling excessive risk-taking, because they cannot monitor the entire financial groups or conglomerates, but only some of their components. Therefore, prudential measures should be let to other supervisory authorities, which control these conglomerates.

On the other hand, more power means greater accountability, transparency and ability to function. It also means the centralization of information (synergies between supervision and monetary policy) means better decision-making and thus easier implementation of monetary policy. Moreover, as focusing on systemic risk is based on prudential control of systemic risk as well as on control of individual intermediaries, central bank can better assess not only possibility, but also the strength of potential financial markets disorder, as well as other factors affecting the stability of financial intermediaries. The separation of these functions would result in a greater orientation towards the stability of individual institutions, reducing the focus on systemic risk. Finally, the independence and technical expertise are two characteristics that cannot be disproved to central banks. Specifically, the independence of institutions is crucial for effective surveillance and central banks today can be considered as independent institutions. In addition, an exceptional expertise and analytical capacity of professionals, who work in the central banks, should be noted as well. Tymoigne (2010) also stresses that the central bank is neither "stupid" nor "ignorant" when analyzing situation and predicting the future. On the contrary, the central bank is an institution that holds a key position in combating financial instability because of its ability to observe past, its experience in dealing with macroeconomic problems and its role as a lender of last resort. The central bank knows more than the CEO or any other financial analysts about what happened in the past, because human nature ignores lessons from the past.

Overall prudential policies are designed to increase the stability as well as resilience of the financial system as a whole and not just of individual institutions or markets. They should be equally used by central banks and other supervisory agencies, which should be cooperative. Also, it is important to stress out that monetary authority is not able to achieve financial stability on its own, but their prudential measures should be supported by monetary and fiscal policy as well.

2.3. Research review

Financial stability is to be achieved with traditional monetary instruments, but also with the use of prudential measures. There is a wide array of prudential measures and classified into different categories by various authors (Gonzales 2009, IMF 2010, Betbeze et al. 2011). This paper is based on classification proposed by Borio and Shim (2007). According to them, *prudential measures* are to be divided in: (i) *prudential instruments*: loan-to-value ratios, loan provisioning rules, capital

standards, limits on debt-repayment-to-income ratio or debt-repayment-to-debt ratio or credit-line-to-income ratio, credit exposure to a sector; and (ii) *monetary controls*: marginal and average reserve requirements, limit on credit growth, liquidity requirements.

The use of *prudential instruments and monetary controls* by the central bank should contribute to greater stability of the banking system, because these measures either explicitly order higher capital and liquidity requirements or, by restricting credit growth, confine banks exposure to credit and currency risk.

This area has not been sufficiently researched, because of a relatively limited use of these instruments in the past and deficient data availability. However, there are some similar researches which do not take into account the banking stability indicators, but the credit growth. Borio and Shim (2007), analyzing effects of prudential measures in 18 countries, concluded that, regardless of statistical significance and taking into account that the size of the dummy coefficient does not vary much across specifications, prudential measures reduced credit growth between 4% – 6% in the years immediately following their introduction. Therefore, their results suggest that the introduction of prudential measures, sometimes supported by monetary measures, contributes, on average and at least temporary, to containment of the booms. That would also imply that in the long run they contribute to financial stability, especially the banking sector stability. Hilbers et al. (2005) analyzing, among others, the use of prudential measures in 10 central and east European countries, banking stability indicators and credit growth data, concluded that policy responses, some of which were circumvented, were eventually effective in reducing the credit growth. In addition, they pointed out that these measures aimed at ensuring sound lending practices and maintaining the resilience of the financial system to adverse shocks. They stated that these measures do not need to be relaxed automatically as soon as the threat to macroeconomic stability subsides. Furthermore, the importance of prudential measures in decreasing the credit growth and helping banking sector withstand the unwinding of imbalances was identified by IMF (2010). They pointed out that implementation of macroprudential measures resulted in a decrease of the credit growth in emerging countries, especially in emerging Asia. Besides, they suggested that the effectiveness is enhanced when a set of measures is implemented, rather than one single measure. Moreover, dynamic reservations adopted in Spain were aimed at reducing the credit growth, but the effect was relatively weak. The loan growth was still high, although lower than it would have been if these measures were not introduced. However, high levels of credit indicate the complexity of the credit booms and that it is difficult to influence them by using a single prudential or monetary instrument or only by standard instruments of monetary policy (Frait and Komarkova, 2009). Qureshi et al. (2011) have constructed indices of prudential measures and capital controls for 51 emerging market economies over the period 1995 – 2008 and, among other

things, have shown that capital controls and FX-related prudential measures are associated with a lower proportion of FX lending in total domestic bank credit and a lower proportion of portfolio debt in total external liabilities. Moreover, they have concluded that other prudential policies such as maximum loan-to-value (LTV) ratios, limits on domestic credit growth, asset classification and provisioning rules, sectoral limits on loan concentration, dynamic loan-loss provisions, and counter-cyclical capital requirements, help to restrain the intensity of aggregate credit booms. Lim et al. (2011), using quarterly credit growth data for 49 countries, have shown that many of the most frequently used instruments, such as loan-to-value ratio, debt-to-income ratio, ceilings on credit growth, reserve requirements, countercyclical capital requirements and time-varying/dynamic provisioning, are effective in reducing pro-cyclicality. Moreover, they concluded that the effectiveness of measures is sensitive to the type of shock facing the financial sector. In addition, Schou-Zibell et al. (2010) examined financial soundness and identified its determinants by using data on 59 economies (developing economies in Asia, South America, and Europe, as well as selected developed economies) for the 1993-2008 period. They quantified the impacts of selected variables on key financial soundness indicators, including capital adequacy, asset quality, and earnings and profitability. Among others, they concluded that real GDP growth and GDP per capita were negatively associated with NPLs, particularly with the latter in developed economies and emerging Europe. They revealed that inflation showed a negative relationship with NPLs in developed economies, but a positive relationship in emerging Latin America and that domestic credit, provided by the banking sector, is positively associated with NPLs. Also, Tovar et al. (2012) have analyzed the effectiveness of reserve requirement (RR) system in selected Latin America countries. Their conclusion is that RR influences real private bank credit growth and that RR is a useful policy tool to "lean against the wind" and avoid the buildup of imbalances. However, using RR as a countercyclical tool has modest and short-lived effects on credit growth. Besides, their results show that RR plays a complementary role to monetary policy, even in inflation targeting regimes. De Ramon et al. (2012) modeled the effects of proposed Basel III liquidity and capital ratio on macroeconomic benefits and costs. They found that, in the long run, new ratios will produce positive net benefits for the UK. They will reduce the probability of systemic crisis occurrence, which permanently reduces the level of the UK GDP. To our knowledge, no other research considering this topic has been done.

Due to complexity of financial stability and numerous factors that can affect it, in our research, besides monetary measures, we also test the significance of other variables. Control variables included in the model are based on the theoretical assumptions and empirically proved determinants of banking instability. Therefore, most of the chosen control variables are those suggested by Demirgüç-Kunt and Detragiache (1998) and Hanschel and Monnin (2005). All variables can be divided into three groups: macroeconomic, financial and regulatory variables.

Among macroeconomic variables we control for: economic growth (GDP growth), economic development (GDP p/c), the inflation rate, the real interest rates, budget deficit (budget deficit/GDP) and external debt (external debt/GDP). Financial variables include: the ratio of M2 to international reserves, the ratio of domestic credit to GDP and capital liberalization. The third group of variables includes regulatory variables i.e. prudential instruments and monetary controls. The group of regulatory variables represents distinction in comparison to previous research.

The significance of macroeconomic and financial variables was mainly tested in accordance with financial i.e. banking crises. Banking crises (banking instability) are commonly preceded by significant contraction in GDP. Conversely, the *GDP growth* positively affects banking stability as it diminishes the share of non-performing loans and improves banking profitability and liquidity. Demirgüç-Kunt and Detragiache (1998), using the sample of 23 developed and developing countries for the 1982-1995 period, and Hardy and Pazarbasioglu (1999), using the sample of 38 developed and developing countries for the 1980-1997 period, found that the GDP growth was an important determinant of banking distress. Moreover, Gunsel (2008) showed, on the example of the banking sector in Northern Cyprus, that the fall in the real GDP increased the credit risk and probability of default. Therefore, economic contraction weakened the ability to serve the debt which resulted in a higher share of non-performing loans, lower profitability and lower liquidity. It also increased the LTD ratio, because of optimism and increased loans. Also, according to Frait and Komarkova (2009), the unemployment rate follows GDP growth with a lag and affects banks' earnings indirectly. The *GDP per capita* is expected to be positively correlated with the stability of the banking system. As a result of increase in total assets (wealth) of all domestic sectors, banks profitability and liquidity should enhance and exposure to credit risk should reduce. Moreover, due to more wealth, banks should increase loans, meaning that the LTD ratio should rise.

High *inflation rates* are associated with increased probability of banking instability. In a period of high inflation it is difficult to predict real profits and assess credit risk (Gunsel, 2008). Sudden changes in inflation have negative impact on interest rates which results in higher credit risk i.e. higher share of NPLs. It finally results in deterioration of banking capital and collateral values, and weakens banks balance sheets, diminishing profitability and reducing liquidity. Demirgüç-Kunt and Detragiache (1998) and Hardy and Pazarbasioglu (1999) found that inflation rate significantly determined banking crises. However, low inflation (or deflation) reduces bank profit margins. Since the period of low and stable inflation stimulates excessive risk-taking, which results in the credit growth, especially to lower credit rating clients, long term consequences are higher share of NPLs and lower profitability. An increase in real interest rates raises the probability of banking instability. The results of Demirgüç-Kunt and Detragiache (1998) and Hardy and Pazarbasioglu (1999) indicate that real interest rates are a significant determinant

of banking crises. The lagged one-period real interest rate is also confirmed as significant in research by Gunsel (2008). An unanticipated rise in interest rates leads to a significant loss of firms balance sheets due to decreases in their cash flows, which are the result of higher interest payments. Real interest rates impend with liquidity problems in a financial system that would indicate deterioration in bank loan portfolios and potentially in a slowdown in the economic growth rate. In such an environment banks are faced with increasing financial and credit risks (Gunsel, 2008). Therefore, an increase in interest rates increases the probability of default and the share of NPLs. It also diminishes profitability, primary liquidity ratio and the LTD ratio.

Rising ratio of the budget deficit to the GDP increases the probability of banking instability. Namely, if a budget is in surplus or minimal deficit, it is more likely that government can recapitalize problematic banks and avoid instability. The results of Demirgüç-Kunt and Detragiache (1998) and Gunsel (2008) show that the ratio of the budget deficit to the GDP is positively related to banking instability, because governments with a weak financial position postpone implementation of measures to strengthen the health of banking sector, which is characterized by high level NPLs and low profitability. Excessive *external debt* of the country implies a large domestic sector indebtedness and questions domestic ability to meet future obligations. Besides fulfilling obligations to external creditors, obligations to a domestic banking sector might also be questionable in a situation of great indebtedness, which increases credit risk and NPLs and abates profitability. Moreover, if a domestic banking sector is heavily foreign owned, there is a permanent risk of funds withdrawal effecting liquidity of domestic banking sector. Moreover, higher external debt implies a weaker credit rating of a country and, therefore, more expensive capital and higher interest rates, which may lead to a lower banking stability. Considering the LTD ratio, as banking sectors of selected countries are mainly foreign-owned, it is expected that the increasing external debt leads to a rise in the LTD ratio. This is because domestic banks are a significant generator of external debt in selected countries as capital inflows in these countries are stimulated by the higher ROE. Therefore, the external debt is expected to be positively correlated with profitability and the LTD ratio, and negatively with NPLs and liquidity.

The ratio of monetary aggregate *M2 to reserves* shows the risk of banks' exposure to currency crises. This ratio measures the ability to withstand external shocks and ensure the convertibility of the local currency. A sharp increase in the ratio of money supply and a low level of reserves are capable of triggering a currency crisis (Gunsel, 2008). Demirgüç-Kunt and Detragiache (1998), Domac and Martinez-Peria (2003) and Gunsel (2008) found that the ratio of M2/reserves is a significant variable that increases the probability of banking crises, because of exposure to currency risk and unhedged foreign liabilities, which imply exposure to credit risk

and higher probability of NPLs increase and a decrease in profitability. Moreover, in case of bank run, which results in a withdrawal of liquid monetary assets and deposits, banking liquidity will be threatened as well. Rapid *growth of domestic credit*, expressed as the ratio of domestic credit to the GDP, increases the banking sector vulnerability to shocks and probability of banking instability. Namely, Hardy and Pazarbasioglu (1999) and Domac and Martinez-Peria (2003) showed that banking crises are correlated with the growth rate of the real domestic credit, while Demirgüç-Kunt and Detragiache (1998) argued that the growth rate of credit in the past increases the probability of crises. Therefore, lending booms reflect a rise in riskier loans i.e. loans to clients with lower credit rating, which in case of a shock can result in decline of the quality of bank assets, higher NPLs and lower profitability. Besides, the growth of domestic credit is expected to be positively correlated to the LTD ratio. Finally, given the greater degree of *capital liberalization* and greater possibility of sudden inflows and outflows, capital openness is expected to have a negative effect on financial stability. Capital openness is measured by the index of capital account openness developed by Chinn and Ito (2008). A positive correlation between expansion of capital flows and bank instability is affirmed by Hardy and Pazarbasioglu (1999).

3. Methodology

Research methodology was adjusted to the selected sample. As it has already been mentioned, the selected CSE countries have bank-oriented financial systems. Sinclair (2001) argues that financial institutions i.e. banks play a key role in developing countries financial systems, in the sense that they provide liquidity and allocate capital. Similarly, Ribnikar and Košak (2006) point out that the consolidation process in banking industry had a tremendous impact on the developments in banking sectors of new EU and candidate member countries. Therefore, we have chosen the banking stability indicators. Before we argue the selected choice of variables, we will confirm the domination of banking sector in financial systems of the selected CSE countries. Table 1 shows deposit banks' assets and market capitalization as a percentage of the GDP in the selected CSE countries.

It can be seen that the share of deposit banks assets to the GDP is two times higher than the share of market capitalization of the listed companies on the Stock Exchange to the GDP. This means that the banking sector is a more important part of their financial systems than financial markets. Specifically, the share of deposit banks assets in relation to the proportion of the market capitalization of listed companies to the GDP in sampled countries is, on average, 2.53 times higher. Therefore, the importance of banking sector is crucial for general financial stability of these countries. However, it should be noted that in CSE region some companies,

firms, banks and other financial institutions can borrow directly in the international capital markets and directly from their parent companies abroad, meaning that there are alternatives to banks and local stock exchange markets.

Table 1: CSE countries – bank-oriented financial systems

– in percent (%)

Characteristics of financial system of CSE countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Deposit banks assets	452.32	480.36	511.84	565.35	608.80	654.92	730.50	812.19	780.14	883.30
Market capitalization	209.99	199.39	186.12	215.91	278.80	309.73	379.02	492.93	473.64	641.80

Notes: Albania, Bosnia and Herzegovina and Montenegro are not included; Moldova till 2005, Croatia and Macedonia till 2008, Serbia 2003 onwards

Source: Beck, K., Demirgüç-Kunt, A. i Levine, R. E. (A New Database on Financial Development and Structure)

Considering the banking stability indicators, this paper analyzes stability through three selected core FSIs, namely: banks' exposure to credit risk (non-performing loans to total loans ratio) and banks' profitability (rate of return on equity); banks' ability to respond to short-term shocks (the liquidity ratio expressed as the ratio of claims on central banks to total assets as used by Herrero and del Rio, 2003). Finally, we consider the LTD ratio as a widely accepted indication of a bank's health.

The choice of indicators is based on some research that proved their significance for banking sector stability. Appropriateness of ROE and ratio of NPLs to total loans is based on the research of Čihak and Schaeck (2010) who tested several variables as indicators of the banking crisis. Using nonparametric tests they showed that ROE is a good indicator of banking instability i.e. that it identifies increasing systemic banking problems. Moreover, ROE was also proved as a statistically significant indicator using a logit model. Furthermore, they confirmed that contemporaneous NPLs to total loans ratio is useful in identifying banking turmoil. In addition, Toby (2008) stated in his research that the increased number of defaults and reduced profitability of the banking system are the clearest characteristics of the crisis. Similarly, Bardsen et al. (2006) concluded that the combination of default probability of banks and other economic agents, combined with the profitability of banks, could identify financially fragile financial system. Furthermore, Gonzalez-Hermosillo (1999), among others, came to a conclusion that high level of non-performing loans to total loans are leading indicators of banking distress. Finally, an adequate level of liquidity is essential for normal functioning of financial

institutions. What's more, liquidity is being recognized as even more important factor in maintaining stability, due to the announced changes that will occur after introducing and implementing Basel III accord. Namely, liquidity coverage ratio is planned to be introduced in 2015.

The data set for this research includes FSIs and other explanatory variables (Appendix A) for period 1998-2010 for following 18 Central and Southeast European countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Slovak Republic, Slovenia, Serbia, Turkey. The data for banking stability indicators and most of explanatory variables are obtained from International Financial Statistics (IMF database) and World Development Indicators (World Bank database). 1998 was chosen since the data on FSIs for CSE countries are not available for the period before. The same problem was indicated by Čihak and Schaeck (2010), who point out that the data on the indicator of financial stability, appeared since 1994 and in some countries even later. Data on prudential instruments and monetary controls were obtained by Borio and Shim (2007) and Hilbers et al. (2005) and were complemented by author's database which was created by analyzing central bank's publications (Financial stability publications, Annual Reports and Bulletins) of selected countries, financial system stability assessment by IMF and communicating central banks.

Due to fact that collected data have temporal and spatial dimension we decided to use panel data method. In order to take into account the dynamic relationship of chosen variables we have applied dynamic panel data model to a dataset of abovementioned 18 economies. Namely, Schou-Zibell et al. (2010) showed that there was a strong dependence of the current value of an FSI to its immediate past.

In order to solve the problem of lagged dependent variable being correlated with the error term, we used generalized method of moments (GMM) estimator developed by Arellano and Bond (1991). Moreover, we use GMM two step estimator. Lagged dependent variables will serve as instrumental variables. The estimated model in which *i* denotes country and *t* stands for a year is the following:

$$FSI_{i,t} = \alpha + \beta_1 FSI_{i,t-1} + \beta_2 PRUD_{i,t} + \beta_3 MONCON_{i,t} +$$
$$+ \beta_4 PRUD \cdot MONCON_{i,t} + \beta_n X_{i,t} + \varepsilon_{i,t}.$$

FSI is a financial stability indicator, *PRUD* represents prudential measures, MONCON monetary controls, *PRUDMONCON* represents the interaction effect of prudential measures and monetary controls, *X* represents the vector of other independent variables, while $\varepsilon_{i,t}$ represents the error term. Prudential measures, monetary controls as well as their interaction effect are expressed as dummy variables.

In order to test statistical significance of the model, i.e. validity of the assumptions underlying both the difference and system estimators, we used *Sargan test* of orthogonality between instruments and residuals and *second-order autocorrelation test*. Sargan test examines whether our restrictions are overidentified. Namely, by introducing each new instrumental variable, a new moment condition i.e. restriction, must be satisfied. We set the hypothesis that the selected instrumental variables are uncorrelated with the residuals. If the null hypothesis is not rejected, all conditions are met, and instruments are accepted. Introduction of additional instrumental variables improves efficiency, but our estimator becomes biased. Therefore, one should choose the optimal number of instruments so that the hypothesis of Sargan test is accepted, and that biasness is not increased. By testing the absence of serial correlation of the second order in residuals in the first difference, which is a necessary condition for obtaining reliable estimation, initial assumption of serial correlation absence in random error can be confirmed and our parameter estimation is affirmed to be consistent.

4. Empirical research and discussion

The results of our model are presented in Table 2 and Table 3. It is important to point out that, according to theoretical and empirical assumptions, the effects of prudential measures were tested with lagging variables which were created by shifting these independent variables one year back (lag1PRUD, lag1MON, lag1PRUDMON).

The consistency of the GMM estimator was tested by the Sargan and second-order autocorrelation test. The Sargan test of over-identifying restrictions, which tests the validity of the instruments, provides no evidence of misspecification, meaning that there is no correlation between instruments and residuals. The second-order autocorrelation test, which examined the serial correlation in error term $\varepsilon_{i,t}$, provides no evidence on the second-order autocorrelation of the residuals. This means that our instruments were well selected and that our results are statistically significant. This implies both for Table 2 and Table 3.

Table 2: The impact of prudential instruments, monetary controls and their interactive effect on non-performing loans and profitability

Variable	NPL (M1)	NPL (M2)	NPL (M3)	ROE (M4)	ROE (M5)	ROE (M6)
NPL_L1 / ROE_L1	.7801085[***]	.8872095[***]	.8116279[***]	.3471405[***]	.6731538[***]	.5062207[***]
lag1PRUD	-.827553[***]			13.47294[**]		
lag1MON		-2.097364[**]			19.77391[**]	
lag1PRUDMON			-2.989463[*]			-27.86434
GDPp/c	-.000472[***]		-.0003551[**]	-.0056844	-.007548[**]	-.0009793
GDPgrowth	-.378594[***]	-.361779[***]	-.413976[***]	1.695861[***]	2.177066[***]	1.655718[***]
Inflation	-.104772[***]	-.0902387[**]	-.130724[***]	.5919507[**]	1.089948[***]	.2889212
M2/reserves	2.298785[**]	.3940433[**]	1.90826[**]	6.523142	5.432991	-2.881286
lag1RealIntersetRates	-.139207[***]	-.162997[***]	-.1292493[**]	-.1259802	.2394883	.0265974
lag1ExternalDebt/GDP	-.0608167[**]	-.0688527[**]	-.0296448	-.113919	.0181602	.1156178
lag1Creditdomestic	.1092432[***]	.0959304[**]	.0764176	.6736098	.7852952[*]	.1722898
Lag1GDPp/c		.0000607				
lag1CapitalOpeness				139.9759[*]	195.2712[**]	33.76768
lag1Budgetdef/GDP				2.282783[**]	1.510381	.6916001
Constant	1.112078	2.455934[**]	1.012633	-78.82542	-131.1087[**]	-21.12732
Number of observations	161	163	161	150	150	150
Wald test	1782.31[***]	810.37[***]	2399.80[***]	3139.48[***]	3014.81[***]	917.21[***]
Sargan test (p-value)	8.080621	7.001324	7.97268	3.597502	1.403648	1.862058
Arellano-Bond test AR(1)	-2.2104[**]	-2.3685[**]	-2.4065[**]	-1.9016[*]	-.77358	-1.6141
Arellano-Bond test AR (2)	-.08599	-.04652	.36995	-.5444	-1.3029	-.38202

Note: [*], [**], [***] indicates significance at the 10. 5 and 1 percent level respectively

Source: Author's calculation

It can be noted from the tables below that *prudential instruments* have statistically significant impact on the share of non-performing loans to total loans at the significance level of 1%, on profitability at 5%, liquidity at 1% and credit to deposit ratio at 10%. As the impact on NPLs and profitability is negative; and on liquidity and credit to deposit ratio positive, our results are not fully consistent with the expected results. Namely, prudential instruments tend to mitigate credit growth implying decrease of banks realized profits, which at that moment decreases their stability through the prism of profitability. On the other side, in the long run it leads to a greater stability, if observed through the share of non-performing loans. Furthermore, these measures improve the level of liquidity assets in total bank assets, but on the other side, they do not improve the LTD ratio. The possible explanation is that banks, after the prudential measures have been introduced

Mario Pečarić, Josip Visković • The effects of prudential policy measures on financial...

24   *Zb. rad. Ekon. fak. Rij. • 2013 • vol. 31 • sv. 1 • 9-34*

aiming to reduce the credit growth, have endeavored to keep the high loans level by placing more loans on existing deposits or by finding other sources of their funding. In addition, in some countries, as crisis evolved, there was a withdrawal of deposits from banks, which also affected the change in this indicator.

Table 3: The impact of prudential instruments, monetary controls and their interactive effect on liquidity and the LTD ratio

Variable	LIQ (M7)	LIQ (M8)	LIQ (M9)	LTD (M10)	LTD (M11)	LTD (M12)
LIQ_L1 / LTD_L1	.6749244***	.6209255**	.6648253***	.162597***	.1594356***	.1579432***
lag1PRUD	.0112032***			.0222065*		
lag1MON		-.0057664			.021975	
lag1PRUDMON			.0058552			.0646058**
GDPp/c	-7.05e-06***	-6.53e-06**	-6.93e-6 ***	.0000227**	.0000169*	.0000163*
GDPgrowth	.0009471**	.0009106**	.0008948*	-.019180***	-.014779***	-.0159755***
Inflation	-.0006967***	-.0007927***	-.0007676***	.0081051***	.0114522***	.0112711***
M2/reserves	-.0368775***	-.0361169***	-.0364838***	-.114771***	-.0658282**	-.0601283
lag1RealInterestRate	-.0015927***	-.0014741***	-.001571***	-.0036276	-.0003957	-.0017714
lag1ExternalDebt/GDP	.0002235	.0002129	.0001364	.0017861	.0028468**	.0026753*
lag1Creditdomestic	.0007222	.0006797	.0008929	.0062602***	.0034576*	.0037541**
lag1Budgetdef/GDP				.0020431	.008417	.0108943**
Constant	.1539374***	.1655932***	.1542621***	.6212238***	.5727916***	.5938744***
Number of observations	164	164	164	163	163	163
Wald test	635.71***	153.01***	492.19***	594.14***	25851.86***	12641.74***
Sargan test(p-value)	7.913338	7.09734	7.325493	7.128555	4.331938	10.27024
Arellano-Bond test AR (1)	-2.3004**	-2.2187**	-2.1428**	-1.6737	-1.1621	-1.2215
Arellano-Bond test AR (2)	-1.4808	-1.5428	-1.5168	-1.4802	.73727	.66009

Note: *, **, *** indicates significance at the 10. 5 and 1 percent level respectively

Source: Author's calculation

Furthermore, it can be seen that the *monetary controls* showed a statistically significant impact on the share of NPLs and the profitability at 5% significance level. Their effect on liquidity was proven as statistically insignificant. The effect on NPLs is negative, while the relationship with the profitability is positive, which is consistent with the expected results. It can also be noted that the monetary measures do not influence liquidity ratios. The reason for this is that their primary role is to influence the cost of financing and thereby the credit growth, at the same time limiting development of financial imbalances. However, they did not affect the LTD ratio, which can be explained by the same arguments used for prudential instruments.

For further analysis the *interaction variable* was created to estimate the effect of the simultaneous use of prudential instruments and monetary controls. Namely, it is considered that the measures are more effective, if a set of measures and not just one type is implemented. Therefore, their interaction should be significant for selected indicators of stability. Interaction effect of prudential instruments and monetary controls proved statistically significant at 10% significance level on the share of non-performing loans and at 5% on the LTD ratio. It was not proven significant on profitability and liquidity. Still, when interpreting these results, one should be cautious, because of the relatively small number of observations in which the country at the same time uses some forms of prudential instruments and monetary control within the same year. In the analyzed sample, we have only 24 such observations. However, despite the small number of observations, Sargan and Arellano Bond test shows the significance of the set model. The 24 abovementioned observations lead us to one more conclusion. Namely, only 24 of total 234 observations show that only 24 times countries simultaneously used these measures i.e. only 10.26%. Here, we believe, there is some room for improvement. At the same time, we have in mind that in order to prevent development of financial imbalances, which cause financial instability, central banks should be more prone to take advantages of interaction effect of various measures than using a particular instrument or a measure individually.

Considering other control variables we have found interesting results. The effect of the *GDP growth* on selected stability indicators is statistically significant. Namely, it decreases the share of NPLs, what is in line with Schou-Zibell et al. (2010). It increases profitability and liquidity and it negatively affects the LTD ratio. This is consistent with expected results and in line with similar previous research, which analyzed the effect of the GDP growth on financial (banking) crisis (Demirgüç-Kunt and Detragiache, 1998; Hardy and Pazarbasioglu, 1999; Gunsel, 2008). Particularly, the GDP growth has a positive effect on the stability of the banking system, because during the economic growth, creditworthiness of borrower increases, which affects the strength of banks. It specifically increases profitability, decreases the share of NPLs and it improves liquidity. On the other hand, when economy suffers economic contraction, creditworthiness deteriorates. The number of defaults increases which leads to the NPLs increase and the decrease of profitability. This also confirms that banks, which were highly exposed to lending booms during the economic growth, are led to high instability during a deep and prolonged recession (Hanschel and Monnin, 2005). Moreover, we show that the GDP growth negatively affects the LTD ratio, meaning that during the economic growth banks, despite the increase of loans, receive a significantly higher level of deposits, which results in the LTD decline. The *GDP per capita* is negatively correlated with NPLs, as proved by Schou-Zibell et al. (2010), profitability (only in model M5) and liquidity. The correlation with the LTD is positive, meaning that as a country is more developed it has a higher LTD ratio. Hence, contrary to the expected results, the growth in

the GDP p/c increases the LTD ratio and decreases profitability and liquidity. The explanation is twofold. Firstly, at higher income levels the country is characterized by greater optimism and certainty. The banking system feels stable under the high level of development. In these circumstances, there is a looser banks' policy during the lending boom (the growth of the LTD). When the negative shock occurs, banks suffer lower profitability. Another explanation relates to the fact that the GDP p/c is a proxy for the business cycle, while the unemployment represents the real indicator of the business cycle. Thereby, the GDP p/c does not directly reflect the real phase of an economic cycle.

High *inflation rates* proved statistically significant while decreasing the NPLs level and liquidity, and increasing the profitability and the LTD ratio. This is partially in contrast to the expected results and the previous research done by Schou-Zibell et al. (2010). Namely, it seems that in a period of high inflation banks are able to predict real profits and assess the credit risk as NPLs do not increase while the profitability increases. This is in contrast to Gunsel's (2008) results. Higher inflation rates stimulate the credit growth (the LTD ratio) further, which results in the increased profitability as the interest rate income represents important share of banks income. However, it is important to stress that selected countries had the average inflation around 8.68% in the analyzed period, and most of the previous studies analyzed the period of higher average inflation rates. Lagged *real interest rates* proved to be a partially statistically significant variable, which is not in line with the previous studies (Demirgüç-Kunt and Detragiache, 1998; Gunsel, 2008). According to these studies, the growth in real interest increases the likelihood of instability in the banking system. However, they proved significant only when affecting the level of NPLs and liquidity. They were not proven to be significant neither on the profitability nor on the LTD ratio. Higher real interest rates do not increase NPLs, meaning that business sector anticipates the growth in real interest rates, and thus does not fail to meet its obligations to banks. On the other hand, real interest rates growth diminishes primary liquidity ratio confirming the expected result.

The results show that the ratio of the *budget deficit* to the *GDP* does not have a significant effect on banking stability indicators. Actually, it proved significant only in two (M4 and M12) of all our models indicating a higher profitability and the LTD ratio. This means that budget deficits are financed by domestic banks which increases the LTD ratio and the profitability, as government is deemed a sound and credible borrower. A country's *external debt* proved to be statistically significant only in case of the NPLs and the LTD ratio. Positive correlation with the LTD ratio is in line with the expected results reflecting the fact that banks in the CSE countries represent a significant generator of external debt, which they use as a source of credit funding, which results in the increase of the LTD ratio. The effect on the NPLs is negative, which contradicts the expected results. A possible interpretation

of these results is that given loans were used productively which enabled regular service of external obligations.

The results also reveal that the *M2 to reserves* ratio increases the NPLs share and decreases the liquidity and the LTD ratio, while it does not affect the profitability. The possible explanation is that, as the previous studies have shown that the M2/reserves ratio is mainly related to the currency crisis (Demirgüç-Kunt and Detragiache, 1998; Domac and Martinez-Peria, 2003). Some of these countries suffered domestic currency depreciation, what aggravated clients credit capacity to meet their debts and the bottom line was an increase in the NPLs. Considering a decreased liquidity indicator, a possible explanation is that due to a higher level of the M2/reserves ratio and potential currency problems, banks hedged themselves against potential depreciation through foreign exchange instruments, which do not represent the most liquid assets, thereby decreasing liquidity indicator. Many previous studies showed that the *growth of credit* (the ratio of domestic credit to the GDP) increases vulnerability of banks to destabilizing shocks. Specifically the credit growth, with a lag, leads to a higher bank instability, i.e. banking crises, as shown in the studies of Demirgüç-Kunt and Detragiache (1998), Hardy and Pazarbasioglu (1999) and Domac and Martinez-Peria (2003). Our results partially confirm these results. Namely, the credit growth positively affects the LTD ratio. Moreover, as the credit growth is higher, the problem of asymmetric information, namely moral hazard, rises. It results in lower lending standards and finally, when shock occurs, in a higher degree of the NPLs. This is in line with Schou-Zibell et al. (2010) and Hanschel and Monnin (2005), the latter stating that the more credit ratio deviates from its long-term trend, assuming that banks cannot fully protect themselves against the credit risk, the greater is the likelihood of instability in the later periods. However, the credit growth does not significantly affect the liquidity and profitability. Finally, the index of *capital openness* proved statistically significant only on profitability. It was proved insignificant on other variables and excluded from the model. The positive effect on the profitability means that as the CSE countries have liberalized their capital account, capital inflows "flood" their banking sector motivated by higher ROE that subsidiary banks owned by foreign banks realize in contrast to their homeland returns.

5. Conclusions

The results proved that prudential instruments and monetary controls contribute to a higher stability of the banking sector and thus to general financial stability. Specifically, prudential instruments and monetary controls affect the banking sector stability by reducing the credit growth rate, which is identified by a lower share of the NPLs in total loans, higher profitability and improved liquidity. Furthermore, our results show that despite the imposed measures, banks continue to keep the rate

of the credit growth by, beside deposits, using alternative sources of funding. Other control variables affecting our stability indicators are: economic growth, economic development, the inflation rate and M2 to reserves ratio. The real interest rates, external debt and domestic credit growth proved partially significant, while budget deficit and capital liberalization were significant only in two of our 12 models.

We propose changes in central banks instrument orchestra underlying the importance of prudential measures, which should become a significant factor in central bank's strategies. Namely, prudential instruments and monetary controls proved significant in providing stable banking sector, which is a prerequisite for overall macroeconomic stability and sustainable economic growth.

The main limitation of our research is limited data base i.e. short time series. Namely, since the data on the FSIs for the CSE countries are not available for the period before 1998, our study was conducted on the period of 13 years. Moreover, macroprudential measures are beginning to be frequently used since recently, which also shortens our time series.

The abovementioned limitations offer a good basis for further research in order to extend temporal and spatial data series. The challenge of future research also lies in better understanding of the interaction between monetary and macroprudential policy, and in a more detailed analysis of particular prudential instruments. This should contribute to establishing and developing a better policy for mitigating the credit growth and financial imbalances. Finally, the future research should be oriented to recognizing and constructing specific macroprudential set-up for financial stability that is supposed to be adapted to characteristics of the named countries.

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Utjecaj prudencijalne politike na financijsku stabilnost post-tranzicijskih zemalja

Mario Pečarić[1], Josip Visković[2]

Sažetak

Empirijska istraživanja učinaka prudencijalnih mjera su rijetka, posebno u zemljama srednje i jugoistočne Europe. Cilj ovog rada je analizirati učinke prudencijalne politike na financijsku stabilnost post-tranzicijskih bankocentričnih zemalja putem panel analize podataka. Koristeći uzorak zemalja srednje i jugoistočne Europe za razdoblje 1998. – 2010. otkrili smo da ove mjere općenito smanjuju udio loših kredita, povećavaju razinu profitabilnosti, djelomično utječu na likvidnost bankarskog sustava, ali ne poboljšavaju pokrivenost kreditnih plasmana depozitima. Naša dva temeljna zaključka su sljedeća: (1) prudencijalne mjere pozitivno utječu na stabilnost bankarskog sustava izraženu putem indikatora financijske stabilnosti; (2) prudencijalne mjere predstavljaju važan instrument u orkestru središnjih banaka.

Ključne riječi: *prudencijalne mjere, monetarne kontrole, financijska stabilnost, bankocentrični financijski sustavi, panel analiza*

JEL klasifikacija: *E58, G28*

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Appendix – Data description

Dependent variables:

Asset quality – Nonperforming loans to total gross loans (percent of total gross loans in the banking system)

Bank's health – loan to deposit ratio

Liquidity – claims on central bank to total assets

Profitability – return on equity (aggregate returns as a percent of aggregated equity)

Control variables:

Budget deficit – difference between revenues and expenditures of the state budget

Capital liberalization – capital openness index based on dummy variables that express the degree of restrictions in cross-border movements. Data source are annual reports on exchange arrangements and exchange restrictions

Domestic credit to GDP – domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available

Economic growth – annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Economic development – GDP per capita

External debt – debt owed to nonresidents repayable in foreign currency, goods, or services. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt. Data are in current U.S. dollars.

Inflation – annual change in consumer price index (in %)

Monetary controls: marginal and average reserve requirements, limit on credit growth, liquidity requirements

M2 to reserves – ratio of broad money to official foreign exchange reserves

Prudential instruments: loan-to-value ratios, loan provisioning rules, capital standards, limits on debt-repayment-to-income ratio or debt-repayment-to-debt ratio or credit-line-to-income ratio, credit exposure to a sector

Real interest rate – lending interest rate adjusted for inflation measured by the GDP deflator