Market Structure and Financial Stability of Banks in Central and Eastern European Countries: Does Concentration Matter?

Renata KARKOWSKA – Małgorzata PAWŁOWSKA***

Abstract

The aim of this paper is to verify the impact of the market structure on financial stability in the banking sectors in Central and Eastern European countries, with particular emphasis on the change in the concentration and the share of foreign capital in the period 1999 – 2015. Using the methodology of panel regression, GMM estimator, we examine the implications of banks' concentration on bank stability of a group of countries from Central and Eastern Europe. Because many empirical studies have examined the role of market concentration, we complement our results with findings on the market concentration-bank fragility trade-off. Employing a concentration ratios (CR5 and HHI) we find that CEE banks are more fragile within a concentrated environment. Our results also reveal that the persistence of risk is affected by the level of bank concentration and this effect is exacerbated mainly during downturns. Finally, the results of this research did not lead to any definite conclusions as to the role of foreign capital participation and rather indicate the impact of bank size and concentration on bank stability.

Keywords: *banking, concentration, foreign capital, stability, Central and Eastern European countries*

JEL Classification: F36, G2, G21, G34, L10

Introduction

Since the late 1990s, banking sectors in Central and Eastern European countries are characterized by a significant share of foreign capital and a high level of concentration (see Figures 1 and 2 in Statistical Appendix). This may enhance

* Renata KARKOWSKA, University of Warsaw, Krakowskie Przedmieście 26/28, 00-927 Warsaw, Poland; e-mail: rkarkowska@wz.uw.edu.pl

** Małgorzata PAWŁOWSKA, Warsaw School of Economics, Al. Niepodległości 162, 02-554 Warsaw, Poland; e-mail:mpawlo1@sgh.waw.pl

the competitiveness of financial institutions and encourage them to make riskier investment, making them more fragile. Central and Eastern European countries have been playing the role of host countries for banks from a number of countries in Europe. Parent financial institutions were located mostly in Western Europe (Austria, Belgium, Greece, Germany, France, Italy, the Netherlands, Portugal, Spain) and in the United States. The inflow of foreign capital was connected with the privatization process of the banking sectors of Central and Eastern European countries and caused an increase in concentration. The current market structure of Central and Eastern European countries is a natural consequence of the earlier privatization of domestic banks and an inflow of strategic investors to those banks, and the MandAs (mergers and acquisitions) process between parent banks. An important feature of the banking sectors of Central and Eastern Europe (CEE) countries is that banks are relatively small in comparison to the other EU banks and have relatively simple traditional business models (Pawłowska, Serwa and Zajączkowski, 2015). Finally, the financial crisis caused an increase in systemic risk associated with cross-border links between large international banks and their affiliates in CEE countries. Consequently stability of the banking sector is a subject of great interest in bank supervision and among academics, but is also of interest at a broader macroeconomic level.

Therefore in this study, we investigate how the market structure, creating by the level of concentration and the foreign capital affect stability of banking sector in Central and Eastern European countries. In our study we use a sample of 136 banks in 10 CEE countries (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia), over the period 1999 – 2015. Having in mind that the Central and Eastern Europe region includes countries with different development levels (transition and developing countries which have already completed reform changes), we investigate how stability of their banking sectors may be related to the level of concentration linked to the growth of international financial groups. In this paper, the dynamic panel regression model (the generalised method of moments (GMM)) and a cross-country estimator was used. The GMM estimator was proposed by Arellano and Bond (1991) and generalised by Arellano and Bover (1995) and Blundell and Bond (1998).[1] We shed light on the stability-concentration nexus by estimating key variables: risk-taking, the degree of concentration and share of foreign capital.

Because many empirical studies have examined the role of market concentration, we complement our results with findings on the market concentration-bank fragility trade-off. Employing a concentration ratios (CR5 and HHI) we find that CEE banks are more fragile within a concentrated environment. The major

[1] The use of a GMM estimator also accounts for possible correlations between any of the independent variables. For a thorough description of the various GMM estimators, see Baltagi (2001).

contribution of this study to the literature is that it determines the relationship between the market structure and bank stability in the period 1999 – 2015 in 10 CEE developing countries and also covers the period after the global financial crisis. This research covers sixteen years: prior to the global financial crisis, during the global financial crisis and after the crisis.

This study consists of three parts and a summary. The first part is a broad literature review concerning the link between concentration and stability. The second part presents data and empirical models. The third part presents the results of the analysis based on the panel data. The summary provides an overview of the empirical results and the conclusions that we made.

1. Literature Review and Hypotheses

The theoretical literature on the link between the market structure and stability is indecisive about what prudent policies towards banks would be the best (Karkowska, 2017; Schaeck, Čihák and Wolfe, 2006; Vives, 2010). It should be noted that there is no scientific consensus on whether bank concentration leads to greater or lesser stability in the banking sector (cf., Schaeck, Čihák and Wolfe, 2006; Schaeck and Čihák, 2008; Vives, 2010).

There are two main hypotheses in the literature about the relationship between concentration and stability in banking, which are seemingly contradictory: concentration-fragility and concentration-stability. The concentration-fragility hypothesis predicts that bank mergers cause an increase in overall systemic risk. The results obtained by De Nicolò et al. (2004) underline this 'concentration-fragility' hypothesis by presenting empirical evidence for a positive relationship between concentration and banking system fragility using the Z-score methodology. In contrast, the concentration-stability hypothesis argues that consolidation in banking leads to decreases in idiosyncratic bank risk and could improve the overall stability of the financial system. The 'concentration-stability' hypothesis argues that consolidation in banking coincides with a decrease in individual banks' risk and, consequently, a decrease in systemic risk (Allen and Gale, 2004). On the one hand, low concentration, which may create higher competition, may enhance financial stability by pushing unstable banks out of the market. On the other hand, competition can encourage banks to take greater risks in order to become more profitable (Bikker and Leuvenstein, 2014). Boot and Thakor (2000) emphasise that large banks tend to improve capital allocation and make fewer but higher quality investments which enhance their soundness. Keeley (1990) and Hellman, Murdoch and Stiglitz (2000) argue that banks with more market power generate higher profits and have a greater buffer to bankruptcy.

Cetorelli and Peretto (2000) provide empirical evidence that that increased concentration in the banking sector gives banks the opportunity to screen the quality of borrowers. However, Konecný and Cástek (2016) emphasize a weak, but statistically significant negative relationship between ownership concentration and performance in all businesses. Finally, a third way reconciles the two strands of literature by theoretically and empirically demonstrating the existence of a U-shaped relationship between competition and risk (Berger, Klapper and Turk--Ariss, 2009; Liu, Molyneux and Wilson, 2013). To sum up, both theoretical and empirical literature strands are unclear about the effects of concentration in banking on stability and systemic risk (Vives, 2016).

It should be noted that banking sectors in Central and Eastern European countries are characterised by a significant share of foreign capital and a high level of concentration. The literature concerning foreign banks can be divided into two groups: concerning industrial and emerging markets. Studies focusing on industrialised countries find that foreign owned banks perform significantly worse than domestic banks or not differently from domestic banks (see, among others, DeYoung and Nolle, 1996; Claeys and Vander Vennet, 2008; Havrylchyk and Jurzyk, 2011). As regards foreign banks in transition countries, foreign owners brought modern technology, market-oriented decision-making and competition. Moreover, Vives (2010) demonstrated that low barriers to entry and openness to international capital in Central and Eastern European countries are positively correlated with the level of stability. It should be noted that the impact of foreign banks is unambiguous. On the one hand, the pre-global financial crisis evidence suggests that foreign bank participation brought many benefits to developing countries including financial stability (Bonin, Hasan and Wachtel, 2005). On the other hand, the recent global financial crisis highlights the role of multinational banks in the transmission of shocks across countries. In addition, foreign banks can be a channel through which shocks in one country are transmitted and affect the supply of credit in another country. Therefore, foreign banks can introduce financial instability (Claessens and Van Horen, 2013).

The question whether concentration influences stability of banks is examined by a large body of literature and reveals mixed results also in emerging markets (Chen, Harford and Li, 2007; Greenaway, Guariglia, and Yu, 2014, Cuestas, Lucotte and Reigl, 2017; Lapteacru, 2017). Bank concentration is important because it can influence bank managers' ability to diversify bank risk. Ozili and Uadiale (2017) focus on bank concentration in the Nigerian banking sector and find that banks in highly concentrated sectors have a higher ROA ratio and net interest margin while banks with dispersed concentration have lower return on assets. Yeyati and Micco (2007) emphasise that from the 1990s on, Latin American

banking sectors saw a growth in concentration and foreign penetration that prompted different implications for financial stability and the activity of domestic banks. They find that increased concentration did not weaken banking competition in the region, but foreign penetration did. But can we state the same about the relationship between concentration and stability in CEE? Thus, in our study, we aim to verify the hypothesis: H1: *The link between the market structure and stability is much stronger in highly concentrated banking sectors.*

Anginer, Demirguc-Kunt and Zhu (2014) find that greater competition (less concentration) encourages banks to take more diversified risks, making the banking system less vulnerable to shocks and more stable, but they study an international sample consisting of 1872 banks in 63 countries from 1997 to 2009. Also, Weis, Neumann and Bostandzic (2014) tested the impact of concentration on stability and found that bank mergers and greater concentration cause an increase in overall systemic risk. Similar results were obtained by Uhde and Heimeshoff (2009) for banks across the EU-25 over the period from 1997 to 2005. However, our study also concerns the period of crisis, which constitutes the main contribution to the literature. Is the relationship similar after the crisis? How does it look in developing countries in Europe? According to macroprudential literature, reduced risk-taking should limit the procyclical behaviour of banks. This argument leads us to the prediction that: H2: *The relationship between bank concentration and stability is negative during economic slowdowns.*

Wu et al. (2017) investigate whether foreign bank presence affects the risk of domestic banks in 35 emerging economies located in Central and Eastern Europe, Latin America and Asia during the period of 2000 – 2014. They adopt the Z-score indicator as the bank risk measure and the assets owned by foreign banks as a share of the banking sector total assets. They find evidence that the risk of domestic banks increases with the penetration of foreign banks in the host economy. This confirms that there are both bright and dark sides of the presence of foreign banks in developing economies. Palecková (2017) estimate the efficiency of banks that belong to the financial conglomerate in the group of Visegrad countries during the 2009 – 2013 period and don't confirm that conglomerates were more efficient than their specialized competitors. Haas and Horen (2012) document that international banks that had to refinance long-term debt in an illiquid market transmitted these shocks across borders by limiting lending in many emerging European countries that depend on cross-border credit from Western European banking groups. Those authors focus on the 75 largest banks from high-income countries, which had a share of over 90% of the cross-border lending market in the pre-crisis period (2006 – 2007) and in the crisis period (2008 – 2009). Considering this, we expect: *H3: Bank stability is determined by the share of foreign banks.*

2. Research Design and Model Specification

The aim of this paper is to find the relationship between market structure and stability in Central and Eastern European countries. We start our research in 1999 because on 1 January 1999, the third stage of the European Monetary Union (EMU) began and international banks became involved in cross-border mergers and acquisitions. MandAs were often initiated by foreign owners that merged in-a-country banking businesses in the aftermath of mergers of their parent companies abroad. Furthermore, that period also saw an increased share of foreign capital in the banking sectors in Central and Eastern European countries.

We use the Z-score formula proposed by Fu et al. (2014, pp. 64 – 77) and Tabak et al. (2013, pp. 3855 – 3866) as an individual bank stability measure:

$$ZSCORE_{n,i,t} = \frac{\left(LEV_{n,i,t} + ROA_{n,i,t}\right)}{\sigma\left(ROA_{n,i,t}\right)} \qquad \text{Eq. 1}$$

where

$ZSCORE_{n,i,t}$ – Z-score for individual bank *n*, in country *i*, in year *t*;

$LEV_{n,i,t}$ – capital ratio of bank *n*, in country *i*, in year *t*;

$ROA_{n,i,t}$ – profitability to assets ratio of bank *n*, in country *i*, in year *t*;

$\sigma\left(ROA_{n,i,t}\right)$ – standard deviation of *ROA* of bank *n*, in country *i*, in the period 1999 – 2015.

The *Z-score* ratio allows us to have a time-varying measure of bank instability, which overcomes endogeneity problems.

For robustness check and as the alternative measure of bank's stability, we use also the bank's leverage ratio as the dependent variable:

$$LEV_{n,i,t} = \frac{E_{n,i,t}}{TA_{n,i,t}} \qquad \text{Eq. 2}$$

where

$E_{n,i,t}$ – equity in bank *n*, in country *i*, in year *t*;

$TA_{n,i,t}$ – assets of bank *n*, in country *i*, in year *t*;

The general model estimating the stability and market structure nexus is:

$$\begin{aligned} ZSCORE_{n,i,t} &= \beta_1 ZSCORE_{n,i,t-q} + \beta_2 CR5_{i,t} + \beta_3 CR5\text{x}PROCYCL_{i,t} + \\ &+ \beta_5 FOREIGNBANK_{i,t} + \beta_6 SIZE_{n,i,t} + \beta_7 LOANS\_TA_{n,i,t} + \\ &+ \beta_8 LIQUID\_GAP_{n,i,t} + \beta_9 REG\_CAPITAL_{n,i,t} + \beta_{10} UNEMPLOY_{i,t} + \varepsilon_{i,t} \end{aligned} \qquad \text{Eq. 3}$$

where the dependent variable $ZSCORE_{n,i,t}$ denotes the *Z-score* for individual bank *n*, in country *i*, in year *t*.

The independent variables in the baseline model are as follows:

- $CR5_{i,t}$ – bank asset concentration in country *i* in year *t* determined by the concentration ratio: the share of the five largest banks' total assets CR5; also for robustness check, by the Herfindahl-Hirschman index for assets (the sum of the squares of the market share of individual banks $HHI_{i,t}$) for each country *i* for each year *t*.[2]
- $CR5xPROCYCL_{i,t}$ – the impact of concentration on bank stability during economic downturns is determined by the concentration ratio multiplied by a country crisis dummy. The coefficient of the interaction between CR5 and the crisis indicates the presence of the concentration crunch effect; a positive coefficient indicates that bank stability may be constrained by concentration during the crisis period, a negative coefficient would imply that banking concentration may exert significant impact on stability during downturns;
- $PROCYCL_{i,t}$ – country crisis dummy (1 = economic downturns, 0 = economic growth);
- $FOREIGNBANK_{i,t}$ – determined by foreign ownership for country *i* in year *t*, as a percentage of the total banking assets that are held by foreign banks. A foreign bank is a bank where 50% or more of its shares are owned by foreigners (Claessens and Van Horen, 2014);
- $SIZE_{n,i,t}$ – determined by the logarithm of total bank assets, for individual bank *n*, in country *i*, in year *t*;
- $LOANS\_TA_{n,i,t}$ – is the loans to total assets ratio, for bank *n*, in country *i*, in year *t*;
- $LIQUID\_GAP_{n,i,t}$ – is the bank loans to deposits ratio, for bank *n*, in country *i*, in year *t*;
- $REG\_CAPITAL_{n,i,t}$ – is the bank regulatory capital ratio, for bank *n*, in country *i*, in year *t*;
- $UNEMPLOY_{i,t}$ – determined by the annual rate of unemployment in country *i*, in year *t*. Finally, we included the random effect – $\varepsilon_{i,t}$.

Through a dataset that covers 136 European banks spanning the period 1999 – 2015 and the methodology of panel regression, the empirical findings document the determinants of banking risk-taking. The full range of banks come from 10 CEE developing countries (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia). We try to identify the sensitivity of the stability risk indicator to a number of market structure variables.

[2] Concentration ratios: the *k* bank concentration ratios (*CRk*) and Herfindahl-Hirschman indices (HHI) are often used in structural models explaining competitive performance in the banking industry as a result of the market structure (Bikker, 2004, pp. 63 – 64).

We compute the measure of bank stability using the Bankscope database, which reports bank balance sheet data. We use unconsolidated statements since they are preferred to avoid differences in balance sheets of headquarters and subsidiaries. Macroeconomic variables are obtained from the following databases: OECD Statistics, ECB (Statistical Data Warehouse) and the World Bank. We relate the data to descriptive statistics of the selected variables (Table 1 in Statistical Appendix) and the mean of Z-score for particular countries (Table 5).

A recent stream of studies estimates the effects of competition and market power on stability in mature economies, but our survey provided new evidence on the relationship between concentration and stability in the 10 CEE developing countries. In our research, we rely on a traditional SCP model assuming that a more concentrated system leads to lesser competition (Pawłowska, 2016).

In our estimations, we used a dynamic panel data analysis and the generalised method of moments (GMM) proposed by Arellano and Bond (1991). This paper uses a system GMM which was fully developed by Blundell and Bond (1998). Being GMM estimators, the Arellano-Bond estimators include one- and two-step variants (Arellano and Bond, 1991; Blundell and Bond, 1998). However, using the two-step GMM estimator may impose a downward (or upward) bias in standard errors (t-statistics) due to its dependence on the estimated residuals. This may lead to unreliable, asymptotic statistical inference (Bond, 2002; Bond and Windmeijer, 2002; Windmeijer, 2005), especially in data samples with a relatively small cross-section dimension (Arellano and Bond, 1991; Blundell and Bond, 1998). However, the system GMM procedure allows for a finite-sample correction to the two-step covariance matrix derived by Windmeijer (2005). Taking into account the above factors, this paper uses a two-step robust estimator for the baseline model. Furthermore, we used several tests proposed by Arellano and Bond (1991) and Arellano and Bover (1995) to evaluate these assumptions. The first one is the Hansen test of over-identifying restrictions, which tests the overall strength of the instruments for a two-step estimator (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). We then used the Arellano-Bond tests for AR(1) and AR(2) in first differences.

3. Results and Discussions

In order to carry out a quantitative assessment of the relationship between the market structure and stability in Central and Eastern European countries, we provided panel data estimations. Before we conduct panel regression estimations, we run a correlation analysis to ensure our data are free from severe multicollinearity issue. Table 2 in Statistical Appendix presents correlation coefficients

between key selected variables. The correlation coefficients are estimated for a sample of 136 banks across 10 countries from Central and Eastern Europe in the period 1999 – 2015. ZSCORE is negatively correlated with bank concentration and foreign ownership. Table 3 presents the results of three regressions using a two-step robust GMM estimator. For each of the estimations, we also reported the Hansen test results at the bottom of the table as well as the Arellano-Bond tests (AR(1) and AR(2)). The model seemed to fit the panel data reasonably well, as the Hansen-test showed no evidence of over-identifying restrictions.

There are both bright and dark sides of the presence of foreign banks in Central and Eastern European countries. Despite serving as a solid source of liquidity and financing in local markets, foreign banks penetration may lead to an increase in domestic banks' risk, suggesting likely higher competition and trade-off between stability and credit quantity. Hence, we could state that a country that liberalises its banking market for foreign institutions moves to an environment of higher competition, which is an incentive to take more risk in order to maintain stable profits. Banking sectors in Central and Eastern European countries are characterised by a high share of foreign banks and high concentration in terms of assets (see Figure 1 in Statistical Appendix). Consolidation in the Central and Eastern European countries' banking sectors led to changes in concentration measured with CR5 ratios. The increase in concentration ratios was enhanced by mergers and acquisitions conducted by large banks. However, the banking sectors within Central and Eastern European countries are not homogeneous, e.g. the Polish banking sector is characterised by a relatively low level of concentration and a low level of foreign capital, while in Estonia and Lithuania both ratios are very high.

Therefore, to prove Hypothesis *H1: The link between the market structure and stability is much stronger in highly concentrated banking sectors*, we split our sample into several groups and estimated five models: (1) Model 1 – the full sample, (2) Model 2 with CR5 > 60, (3) Model 3 with CR5 > 70, (4) Model 4 with CR5 > 80, (5) Model 5 with CR5 > 90.

In order to investigate the relationship between bank stability (measured via the Z-score) and bank concentration (measured via CR5 ratio), we first employed the GMM model for the full sample of data (Model 1). In the next steps, we estimated four Models (2) – (5) as to whether the stability-concentration link is changed when CR5 increased by 10% (Model 2 with CR5 > 60, (3) Model 3 with CR5 > 70, (4) Model 4 with CR5 > 80, (5) Model 5 with CR5 > 90).

In Table 3 in Appendix A, a negative and significant coefficient (β_2) was found for bank asset concentration. It means that concentration – measured in terms of the share of the five largest banks' total assets (CR5) – had a negative and significant influence on stability in 10 CEE countries. Meanwhile, it is noted

significant only for economic downturns when we show the interactions between concentration ratio and economic downturns multiplied by a country crisis dummy (CR5*PROCYCL). The interaction is negative during an economic decline and stronger for models with higher CR5 ratio. In all the regressions, we find that bank concentration is negatively related to bank stability, meaning that: when concentration is low (Model 2), instability is lower (–0.007), and on other hand, when concentration is high (Model 5), instability is stronger (–0.012). This result may confirm that concentration is important for financial stability. This also implies that an increase in the concentration in banking sector in CEE countries will increase the instability of commercial banks and raise the systemic risk. As when the system is dominated by a few large banks, the failure of a single bank might constitute a systemic event and lead to a fire sale. Our results can't support the market structure and the efficient hypotheses, which emphasize a positive relationship between bank concentration and performance (Almeida and Divino, 2015; Saona, 2011), however the findings show that after long periods of mergers and acquisitions of CEE financial systems, basically by foreign banks might arise some problems in the evolution of the banking system in the region. Such processes demonstrated in a large concentration of banks and further evidenced in the increase of the size of the banks are typical for developing countries. This result is consistent with the finding by Saona (2016), which show evidence of several major relationships involving bank concentration and profitability in seven Latin American countries from 1995 to 2012. Another interesting finding is that for the all model (1 – 5), we find an almost negative relationship between a bank's size (SIZE) and its Z-score ratio (–0.798 in Model 1 and –1.309 in Model 5, respectively). This finding indicates that a bank's optimal stability ratio is a negative function of its size. Intuitively this results make sense, that the larger is bank the more concentrated is banking system and the lower expected stability. These findings support our two hypotheses: (H1) that the link between the market structure and stability is much stronger in highly concentrated banking sectors, and (H2) the relationship between bank concentration and stability is negative during economic slowdowns.

In the analysis, we also added foreign ownership as a percentage of the total banking assets that are held by foreign banks (FOREIGNBANK). The results in all models show an insignificant influence of foreign banks on bank stability. Thus we have to reject hypothesis H3, that bank stability is determined by the share of foreign banks. It should be noted that in the literature the impact of foreign banks is unambiguous and the a further research should focus on different measure of foreign banks (see Claessens, Demirguc-Kunt and Huizinga, 2001; Claessens and Van Horen, 2014; Levine, 2003; Unite and Sullivan, 2003).

Furthermore, an additional alternative measure of financial development used in this work measured in terms of the loans to the private sector as a percentage of the total assets (LOAN_TA) had a positive and significant impact on the Z-score. It means that intermediation (i.e., greater loans in total assets) has a positive impact on financial stability in CEE.

This finding supports the hypothesis that the greater availability of credit to the real sector in the economy is linked to higher competition and more developed banking sectors. Finally, in all Models (1) – (5), the bank's regulatory capital ratio ($REG\_CAPITAL$) positively and significantly influenced the Z-score. This result may confirm that capitalisation of individual banks is very important for financial stability.

3.1. Robustness Checks

This section describes some robustness tests we have performed. Firstly, we have computed leverage as a second measure that defined financial stability to determine the robustness check: $LEV_{n,i,t}$ (based on equation 2). Leverage is a key financial indicator of banking risk (DeYoung and Roland, 2001; Lorenzoni, 2007; Stein, 2010; Clichici and Moag, 2019). Therefore Basel III attributes the Global Financial Crisis to the build-up of excessive leverage. Secondly, we have used different approaches to measure concentration as Herfindahl-Hirschman Index: $HHI_{i,t}$.

Table 4 in Statistical Appendix presents the results of regressions using the GMM estimator when we use the bank's leverage ratio (LEV) as the dependent variable in equation (3). A negative and significant coefficient (β_2) was found for bank asset concentration during economic downturns in models (1) – (4). This result may confirm that bank concentration is negatively related to bank stability. We also find in all estimations a negative relationship between concentration and bank stability when we used the HHI index as an alternative proxy for the bank concentration measure.

The above results gave a positive verification of hypotheses: *H1* and *H2*, and rejection of hypothesis *H3*. However, the results of this research did not lead to any definite conclusions as to the role of foreign capital participation; the results showed rather an impact of banking concentration on financial stability of CEE banks. Our results are consistent with result of Lapteacru (2017) who find that banking market concentration tends to make banks riskier in CEE banking sectors in the period 1995 – 2003. Furthermore, similar to Lapteacru (2017) we complement our results with findings on the market concentration-bank fragility trade-off.

Conclusions

This paper contributes to the literature by analysing how concentration and foreign capital in the banking sector in Central and Eastern European countries affect bank stability in the period 1999 – 2015. This research covers sixteen years: prior to the global financial crisis, during the global financial crisis and after the crisis; the ZSCORE ratio is used as the dependent variable to proxy for bank stability; the CR5 ratio is used as bank concentration, and a percentage of the total banking assets that are held by foreign banks as foreign ownership.

This paper finds that bank concentration affect bank stability in commercial banks in Central and Eastern Europe. An important element of our analysis is also that economic crisis affected the relationship between stability and concentration in commercial banks. Furthermore, we find that concentration has a stronger impact on bank stability in more homogeneous banking, where the herding behaviour is stronger. Even when financial reforms and supervisory power are increased, the results suggest that concentration remains negatively associated with bank stability. However, the results of this research did not lead to any definite conclusions as to the role of foreign capital participation; the results showed rather an impact of bank size and concentration on bank stability.

Finally, our results similar to Lapteacru (2017) are also compatible with the concentration-stability link in the theoretical literature based on the 'concentration--fragility' hypothesis. This result is particularly interesting for policy makers because it suggests that high concentration influences instability of the banking sector. Furthermore, this paper provides valuable insights for banking supervisors about the role of the market structure in stability risk. Our observations may raise concerns about the potential negative impact of the growth of individual banks arising, on the stability of the banking sector. The results confirm that banks are not getting bigger and that the bank size affects financial stability.

References

ALLEN, F. – GALE, D. (2004): Financial Intermediaries and Markets. Econometrica, *72*, No. 4, pp. 1023 – 1061.

ALMEIDA, F. D. – DIVINO, J. A. (2015): Determinants of the Banking Spread in the Brazilian Economy: The Role of Micro and Macroeconomic Factors. International Review of Economics and Finance, *40*, No. 1, pp. 29 – 39. Available at: <http://dx.doi.org/10.1016/j.iref.2015.02.003>.

ANGINER, D. – DEMIRGUC-KUNT, A. – ZHU, M. (2014): How does Competition Affect Bank Systemic Risk? Journal of Financial Intermediation, *23*, No. 1, pp. 1 – 26. DOI: 10.1016/j.jfi.2013.11.001.

ARELLANO, M. – BOND, S. R. (1991): Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies, *58*, No. 2, pp. 277 – 297.

ARELLANO, M. – BOVER, O. (1995): Another look at the Instrumental Variable Estimation of Error-component Models. Journal of Econometrics, *68*, No. 1, pp. 29 – 51.

BALTAGI, B. H. (2001): Econometric Analysis of Panel Data. 2nd ed. Chichester, UK: John Wiley & Sons Ltd.

BIKKER, J. A. (2004): Competition and Efficiency in a Unified European Banking Market. Cheltenham: Edward Elgar.

BIKKER J. A. – LEUVENSTEIJN, M. (2014): A New Measure of Competition in the Financial Industry. London: Routledge.

BERGER, A. N. – KLAPPER, L. F. – TURK-ARISS, R. (2009): Bank Competition and Financial Stability. Journal of Financial Services Research, *35*, No. 2, pp. 99 – 118.

BLUNDELL, R. – BOND, S. (1998): Initial Conditions and Moment Conditions in Dynamic Panel Data Models. Journal of Econometrics, *87*, No. 1, pp. 115 – 143.

BOND, S. (2002): Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice. Portuguese Economic Review, *1*, No. 2, pp. 141 – 162.

BOND, S. – WINDMEIJER, F. (2002): Finite Sample Inference for GMM Estimators in Linear Panel Data Models: A Comparison of Alternative Tests. London: Mimeo, Institute for Fiscal Studies.

BONIN, J. P. – HASAN, I. – WACHTEL, P. (2005): Privatization Matters: Bank Efficiency in Transition Countries. Journal of Banking and Finance, *29*, No. 8 – 9, pp. 2155 – 2178. DOI: 10.1016/j.jbankfin.2005.03.012

BOOT, A. – THAKOR, A. (2000): Can Relationship Lending Survive Competition? Journal of Finance, *55*, No. 2, pp. 679 – 713.

CETORELLI, N. – PERETTO, P. F. (2000): Oligolipoly Banking and Capital Accumulation. [Working Paper, No. 2000-2.] Chicago: Federal Reserve Bank of Chicago.

CHEN, X. – HARFORD, J. – LI, K. (2007): Monitoring: Which Institutions Matter? Journal of Financial Economics, *86*, No. 2, pp. 279 – 305. DOI: 10.1016/j.jfineco.2006.09.005.

CLICHICI, D. – MOAG, S. (2019): The Effects of Prudential Policies on Bank Leverage and Insolvency Risk in Central and Eastern Europe. Economic Modelling, *81*, September, pp. 148 – 160. Available at: <https://doi.org/10.1016/j.econmod.2018.12.016>.

CLAESSENS, S. – DEMIRGUC-KUNT, A. – HUIZINGA, H. (2001): How does Foreign Entry Affects Domestic Banking Markets? Journal of Banking and Finance, *25*, No. 5, pp. 891 – 911.

CLAESSENS, S. – van HOREN, N. (2013): Impact of Foreign Banks. Journal of Financial Perspectives, *1*, No. 1, pp. 29 – 42.

CLAEYS, S. – VANDER VENNET, R. (2008): Determinants of Bank Interest Margins in Central and Eastern Europe: A Comparison with the West. Economic Systems, *32*, No. 2, pp. 197 – 216.

CUESTAS, J. C. – LUCOTTE, Y. – REIGL, N. (2017): Banking Sector Concentration, Competition and Financial Stability: The Case of the Baltic Countries. [WP 2017-7.] Tallinn: Bank of Estonia.

De HAAS, R. –van HOREN, N. (2012): International Shock Transmission after the Lehman Brothers Collapse: Evidence from Syndicated Lending. American Economic Review: Papers & Proceedings, *102*, No. 3, pp. 231 – 237.

De NICOLÒ, G. – BARTHOLOMEW, P. – ZAMAN, J. – ZEPHIRIN, M. (2004): Bank Consolidation, Internationalization, and Conglomeration: Trends and Implications for Financial Risk. Financial Markets, Institutions and Instruments, *13*, October, pp. 173 – 217.

De YOUNG, R. – NOLLE, D. E. (1996): Foreign-Owned Banks in the United States: Earning Market Share or Buying It? Journal of Money, Credit and Banking, *28*, No. 4, pp. 622 – 636. Available at: <https://doi.org/10.2307/2078074>.

De YOUNG, R. – ROLAND, K. P. (2001): Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Total Leverage Model. Journal of Financial Intermediation, *10*, No. 1, pp. 54 – 84.

FU, X. – LIN, Y. – MOLYNEUX, P. (2014): Bank Competition and Financial Stability in Asia Pacific. Journal of Banking and Finance, *38*, January, pp. 64 – 77.

HAVRYLCHYK, O. – JURZYK, E. (2011): Inherited or Earned? Performance of Foreign Banks in Central and Eastern Europe. Journal of Banking and Finance, *35*, No. 5, pp. 1291 – 1302.

GREENAWAY, D. – GUARIGLIA, A. – YU, Z. (2014): The More the Better? Foreign Ownership and Corporate Performance in China. The European Journal of Finance, *20*, No. 7 – 9, pp. 681 – 702. DOI: 10.1080/1351847X.2012.671785.

HELLMAN, T. F. – MURDOCH, K. C. – STIGLITZ, J. E. (2000): Liberalization, Moral Hazard in Banking and Prudential Regulation: Are Capital Requirement Enough? American Economic Review, *90*, No. 1, pp. 147 – 165.

KARKOWSKA, R. (2017): The Relevance of Financial and Economic Factors for Determining Banking Risk across Europe. [CASE Working Papers, N. 7 (131).] Warsaw: CASE – Center for Social and Economic Research, pp. 1 – 33. Available at: <https://case-research.eu/files/?id_plik=5314>.

KEELEY, M. C. (1990): Deposit Insurance, Risk and Market Power in Banking. American Economic Review, *80*, No. 5, pp. 1183 – 1200.

KONECNÝ, L. – CÁSTEK, O. (2016): The Effect of Ownership Structure on Corporate Financial Performance in the Czech Republic. Ekonomický časopis/Journal of Economics, *64*, No. 5, pp. 477 – 498.

LAPTEACRU, I. (2017): Market Power and Risk of Central and Eastern European Banks: Does More Powerful Mean Safer? Economic Modelling, *63*, pp. 46 – 59.

LEVINE, R. (2003): Denying Foreign Bank Entry: Implications for Bank Interest Margins. [Working Paper, No. 222.] Santiago: Central Bank of Chile.

LIU, H. – MOLYNEUX, P. – WILSON, J. O. (2013): Competition and Stability in European Banking: A Regional Analysis. The Manchester School, *81*, No. 2, pp. 176 – 201.

LORENZONI, G. (2008): Inefficient Credit Booms. The Review of Economic Studies, *75*, No. 3, pp. 809 – 833.

OZILI, P. K. – UADIALE, O. (2017): Ownership Concentration and Bank Profitability. Future Business Journal, *3*, December, pp. 159 – 171. DOI: 10.1016/j.fbj.2017.07.001.

PALECKOVÁ, I. (2017): Efficiency Change of Banking Sectors and Banks in the Financial Conglomerates in Visegrad Group Countries. Ekonomický časopis/Journal of Economics, *65*, No. 1, pp. 79 – 92.

PAWŁOWSKA M. – SERWA, D. – ZAJĄCZKOWSKI, S. (2015): International Banking and Liquidity Risk Transmission: Evidence from Poland. IMF Economic Review, *63*, No. 3, pp. 585 – 605.

PAWŁOWSKA, M. (2016): Market Structure, Business Cycle and Bank Profitability: Evidence on Polish Banks. Bank i Kredyt, *47*, No. 4, pp. 341 – 364.

SAONA, P. (2011): Determinants of the Profitability of the US Banking Industry. International Journal of Business and Social Science, *2*, No. 22, pp. 255 – 269.

SAONA, P. (2016): Intra- and Extra-bank Determinants of Latin American Banks' Profitability. International Review of Economics and Finance, *45*, No. C, pp. 197 – 214. Available at: <https://doi.org/10.1016/j.iref.2016.06.004>.

SCHAECK, K. – ČIHÁK, M. – WOLFE, S. (2006): Are More Competitive Banking Systems More Stable. [IMF Working Paper WP/06/143.] Washington, DC: International Monetary Fund.

SCHAECK, K. – ČIHÁK, M. (2008): How does Competition affect Efficiency and Soundness in Banking? [ECB Working Paper, No. 932.] Frankfurt am Main: European Central Bank.

STEIN, J. L. (2010): Greenspan's Retrospective of Financial Crisis and Stochastic Optimal Control. European Financial Management, *16*, No. 5, pp. 858 – 871.

TABAK, B. M. – FAZIO, D. – CAJUEIRO, D. O. (2013): Systemically Important Banks and Financial Stability: The Case of Latin America? Journal of Banking and Finance, *37*, No. 10, pp. 3855 – 3866.

UHDE, A. – HEIMESHOFF, U. (2009): Consolidation in Banking and Financial Stability in Europe : Empirical Evidence. Journal of Banking and Finance, *33*, No. 7, pp. 1299 – 1311. Available at: <https://doi.org/10.1016/j.jbankfin.2009.01.006>.

UNITE, A. A. – SULLIVAN, M. J. (2003): The Effect of Foreign Entry and Ownership Structure on the Philippine Domestic Banking Market. Journal of Banking and Finance, *27*, No. 12, pp. 2323 – 2345.

VIVES, X. (2016): Competition and Stability in Banking, the Role of Regulation and Competition Policy. Princeton and Oxford: Princeton University Press.

VIVES, X. (2010): Competition and Stability in Banking. [Policy Insight, No. 50.] London: CEPR Centre for Economic Policy Research.

WEIS, G. N. F. – NEUMANN, S. – BOSTANDZIC, D. (2014): Systemic Risk and Bank Consolidation: International Evidence. Journal of Banking and Finance, *40*, pp. 165 – 181.

WINDMEIJER, F. (2005): A Finite Sample Correction for the Variance of Linear Efficient Two--step GMM Estimators. Journal of Econometrics, *126*, No. 1, pp. 25 – 51.

WU, J. – CHEN, M. – JEON, B. N. – WANG, R. (2017): Does Foreign Bank Penetration Affect the Risk of Domestic Banks? Evidence from Emerging Economies. Journal of Financial Stability, *31*, pp. 45 – 61. DOI: 10.1016/j.jfs.2017.06.004

YEYATI, E. L. – MICCO, A. (2007): Concentration and Foreign Penetration in Latin American Banking Sectors: Impact on Competition and Risk. Journal of Banking and Finance, *31*, No. 6, pp. 1633 – 1647. DOI: 10.1016/j.jbankfin.2006.11.003.

Statistical Appendix

Table 1

Summary Statistics

	ZSCORE	CR5	CR5*PROCYCL	HHI	HHI*PROCYCL	FOREIGNBANK	UNEMPLOY
mean	13.47	62.13	11.99	0.09	0.02	63.43	0.094
standard dev.	30.32	11.52	28.62	0.04	0.04	17.90	0.036
max	76.35	100.00	100.00	0.27	0.21	88.00	0.207
min	–13.82	43.81	0.00	0.00	0.00	0.00	0.039
N	1 440						

	SIZE	LOAN_TA	LIQUID_GP	REG_CAPITAL	ROA	LEV
mean	14.39	1.004	18.360	0.169	0.034	10.982
standard dev.	1.72	13.779	415.61	0.124	0.894	4.971
max	17.78	444.672	133.50	2.703	28.828	92.930
min	4.06	0.000	0.000	0.004	–0.413	0.004
N	1 440					

Notes: The sample includes observations from 10 Central and Eastern European countries, spanning the period 1999 – 2015.

ZSCORE (Eq. 1) – individual bank stability measure, CR5 represents bank asset concentration in the country. Country crisis dummy is proxied by PROCYCL variable, HHI – the Herfindahl-Hirschman index for assets for each country; HHI*PROCYCL – are determined by taking the HHI ratio and country crisis dummy; SIZE (log) accounts for total bank assets; FOREIGNBANK is the bank foreign ownership, as percentage of the total banking assets that are held by foreign banks; LOANS_TA is bank loans to total assets ratio; LIQUID_GAP is bank loans to total deposits ratio; UNEMPLOY is annual unemployment rate in country; ROA – bank return on assets ratio; LEV (Eq.2) – bank leverage ratio.

Source: Authors' own study.

Table 2

Correlation Matrix

	ZSCORE	CR5	CR5*PROCYCL	HHI	HHI*PROCYCL	FOREIGNBANK	SIZE	LOANS_TA	LIQUID_GAP	REG_CAPITAL	UNEMPLOY	ROA	LEV
ZSCORE	1.00												
CR5	–0.07**	1.00											
	(0.01)												
CR5*PROCYCL	0.01	0.11***	1.00										
	(0.70)	(0.00)											
HHI	–0.09***	0.73***	–0.01	1.00									
	(0.00)	(0.00)	(0.65)										
HHI*PROCYCL	–0.02	0.01	0.87***	0.17***	1.00								
	(0.49)	(0.51)	(0.00)	(0.00)									
FOREIGNBANK	0.09***	0.16***	–0.08***	0.21***	–0.07**	1.00							
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)								
SIZE	0.06*	–0.10***	0.03	–0.07**	0.02	0.30***	1.00						
	(0.02)	(0.00)	(0.18)	(0.01)	(0.40)	(0.00)							
LOANS_TA	0.01	0.00	–0.01	–0.06*	–0.01	–0.00	–0.14***	1.00					
	(0.64)	(0.86)	(0.69)	(0.01)	(0.75)	(0.97)	(0.00)						
LIQUID_GAP	0.00	0.04	–0.00	0.10***	–0.01	–0.01	–0.06*	–0.00	1.00				
	(0.94)	(0.16)	(0.87)	(0.00)	(0.74)	(0.77)	(0.02)	(0.99)					
REG_CAPITAL	0.04	0.07*	–0.00	–0.09**	–0.05	–0.08**	–0.30***	0.05	0.02	1.00			
	(0.13)	(0.02)	(0.94)	(0.00)	(0.06)	(0.01)	(0.00)	(0.07)	(0.46)				
UNEMPLOY	0.03	0.02	–0.10***	–0.11***	0.00	–0.05**	–0.24***	–0.01	0.06*	0.03	1.00		
	(0.30)	(0.27)	(0.00)	(0.00)	(0.88)	(0.01)	(0.00)	(0.64)	(0.02)	(0.24)			
ROA	0.01	0.01	–0.02	–0.07*	–0.01	–0.00	–0.14***	1.00***	–0.00	0.05*	–0.01	1.00	
	(0.55)	(0.76)	(0.55)	(0.01)	(0.57)	(0.86)	(0.00)	(0.00)	(0.90)	(0.05)	(0.65)		
LEV	–0.01	0.02	–0.01	0.00	–0.01	0.03	–0.01	–0.00	–0.00	0.00	–0.01	–0.00	1.00
	(0.62)	(0.50)	(0.62)	(0.90)	(0.62)	(0.25)	(0.65)	(0.93)	(0.94)	(0.95)	(0.75)	(0.92)	

Note: ZSCORE (Eq. 1) – individual bank stability measure, CR5 represents bank asset concentration in the country. Country crisis dummy is proxied by PROCYCL variable, HHI – the Herfindahl-Hirschman index for assets for each country; HHI*PROCYCL – are determined by taking the HHI ratio and country crisis dummy; SIZE (log) accounts for total bank assets; FOREIGNBANK is the bank foreign ownership, as percentage of the total banking assets that are held by foreign banks; LOANS_TA is bank loans to total assets ratio; LIQUID_GAP is bank loans to total deposits ratio; UNEMPLOY is annual unemployment rate in country; ROA – bank return on assets ratio; LEV (Eq.2) – bank leverage ratio. The p-value denotes significance levels at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively.

Source: Authors' own study.

T a b l e 3

Market Structure and Banking Stability in Central and Eastern European Countries, Period 1999 – 2015

	Model (1) ***full sample***	**Model (2)** ***CR5 > 60***	**Model (3)** ***CR5 > 70***	**Model (4)** ***CR5 > 80***	**Model (5)** ***CR5 > 90***
	b/se	b/se	b/se	b/se	b/se
ZSCORE(-1)	0.161**	0.039	0.031	–0.038	0.066
	(0.07)	(0.10)	(0.09)	(0.08)	(0.23)
ZSCORE(-2)	0.079	0.116	0.088	0.119	–0.092
	(0.07)	(0.08)	(0.12)	(0.08)	(0.22)
CR5	–0.086*	0.015	0.015*	0.064	0.168
	(0.05)	(0.05)	(0.04)	(0.05)	(0.20)
CR5*PROCYCL	–0.007**	–0.007**	–0.003	–0.011**	–0.012**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
FOREIGNBANK	–2.916	–1.714	–6.507	0.551	–5.840
	(7.20)	(5.97)	(6.04)	(9.50)	(15.69)
SIZE	–0.798*	–0.893*	–0.644	–1.309**	–0.246
	(0.69)	(0.51)	(0.51)	(0.62)	(1.28)
LOANS_TA	13.486***	11.808***	11.513***	12.855***	10.310
	(4.27)	(3.35)	(3.62)	(4.18)	(6.33)
LIQUID_GAP	0.006	0.006	0.007	0.003	0.002
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
REG_CAPITAL	0.320***	0.276***	0.257***	0.311***	0.323**
	(0.05)	(0.04)	(0.05)	(0.05)	(0.12)
UNEMPLOY	–0.074*	0.124	0.037	0.085	0.190
	(0.08)	(0.07)	(0.08)	(0.10)	(0.21)
CONSTANT	0.000	–6.155*	–7.015**	–6.161**	–5.519
	(0.01)	(2.48)	(2.56)	(2.14)	(3.59)
No observations	617	547	441	203	117
No banks	104	96	82	73	47
AR1	–2.9	–1.8	–1.5	–1.1	–1.4
p value	0.0	0.01	0.01	0.03	0.2
AR2	–1.8	–2.3	–1.7	–1.9	–0.0
p value	0.1	0.0	0.1	0.1	1.0
Hansen test	96.3	84.9	71.8	36.0	26.8
p value	1.0	1.0	1.0	1.0	1.0

Notes: The sample of all banks from 10 European countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia). Data range 1999 – 2015.
The model is given by Eq. (2). The symbols have the following meaning: ZSCORE (Eq. 1) – individual bank stability measure, $CR5_{i,t}$ – bank asset concentration in country *i* in year *t*, PROCYCL – country crisis dummy (1 = economic downturns, 0 = economic growth, $CR5*PROCYCL_{it}$ – are determined by taking the concentration ratio and country crisis dummy, $SIZE_{n,i,t}$ – logarithm of total bank assets, $FOREIGNBANK_{i,t}$ – foreign ownership, as percentage of the total banking assets that are held by foreign banks; $LOANS\_TA_{n,i,t}$ is loans to total assets ratio; $LIQUID\_GAP_{n,i,t}$ is bank loans to total deposits ratio; $UNEMPLOY_{i,t}$ is annual unemployment rate in country. The models have been estimated using the GMM estimator with robust standard errors. Standard Error (se) are given in parentheses. The p-value denotes significance levels at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively.

Source: Authors' own study.

T a b l e 4

Market Structure and Banking Risk (LEV – leverage ratio as the dependent variable) **in CEE Countries, Period 1999 – 2015**

	Model (1) ***full sample***	**Model (2)** ***CR5 > 60***	**Model (3)** ***CR5 > 70***	**Model (4)** ***CR5 > 80***	**Model (5)** ***CR5 > 90***
	b/se	b/se	b/se	b/se	b/se
LEV(-1)	–0.754 (0.47)	–1.009* (0.57)	–0.543*** (0.15)	–0.293*** (0.09)	–0.353*** (0.08)
LEV(-2)	0.000 (0.00)	0.000 (0.00)	0.000 (0.00)	–0.116** (0.06)	–0.137** (0.07)
CR5	0.006 (0.10)	–0.056 (0.12)	0.045 (0.10)	0.128 (0.13)	–0.197 (0.28)
CR5*PROCYCL	–0.011* (0.01)	–0.015** (0.01)	–0.014** (0.01)	–0.005 (0.01)	–0.010 (0.01)
FOREIGNBANK	1.409 (17.58)	–2.495 (19.40)	6.408 (14.17)	7.118 (11.21)	–38.967** (18.35)
SIZE	2.469 (2.08)	3.791 (3.10)	1.309 (0.85)	1.438 (1.04)	4.648** (1.95)
LOANS_TA	–27.845* (15.65)	–36.315* (21.67)	–20.532*** (5.46)	–31.512*** (5.58)	–21.197*** (8.11)
LIQUID_GAP	0.002 (0.01)	0.000 (0.01)	–0.006 (0.01)	–0.000 (0.00)	0.000 (0.00)
UNEMPLOY	–0.266** (0.12)	–0.422** (0.19)	–0.224 (0.20)	–0.469*** (0.16)	–0.611*** (0.21)
CONSTANT	0.000 (0.01)	0.000 (0.00)	9.355* (4.35)	12.986 (7.68)	19.810** (7.10)
No observations	619	549	443	203	117
No banks	104	96	84	73	47
AR1	0.6	0.7	0.4	–0.3	–0.3
p value	0.6	0.5	0.7	0.8	0.8
AR2	–1.7	–1.1	–2.0	–1.5	–1.2
p value	0.1	0.3	0.0	0.1	0.2
Hansen test	90.5	87.3	74.6	40.5	17.0
p value	0.4	0.5	0.9	1.0	1.0

Notes: The sample of all banks from 10 European countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia). Data range 1999 – 2015.
The model is given by Eq. (2). The symbols have the following meaning: $LEV_{n,i,t}$ (Eq.2)– bank leverage ratio, $CR5_{i,t}$ – bank asset concentration in country *i* in year *t*, PROCYCL – country crisis dummy (1 = economic downturns, 0 = economic growth, $CR5*PROCYCL_{it}$ - are determined by taking the concentration ratio and country crisis dummy, $SIZE_{n,i,t}$ – logarithm of total bank assets, $FOREIGNBANK_{i,t}$ – foreign ownership, as percentage of the total banking assets that are held by foreign banks; $LOANS\_TA_{n,i,t}$ is loans to total assets ratio; $LIQUID\_GAP_{n,i,t}$ is bank loans to total deposits ratio; $UNEMPLOY_{i,t}$ is annual unemployment rate in country. The models have been estimated using the GMM estimator with robust standard errors. Standard Error (se) are given in parentheses. The p-value denotes significance levels at * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, respectively.

Source: Authors' own study.

Table 5

Mean of ZSCORE in Particular Countries, Period 1999 – 2015

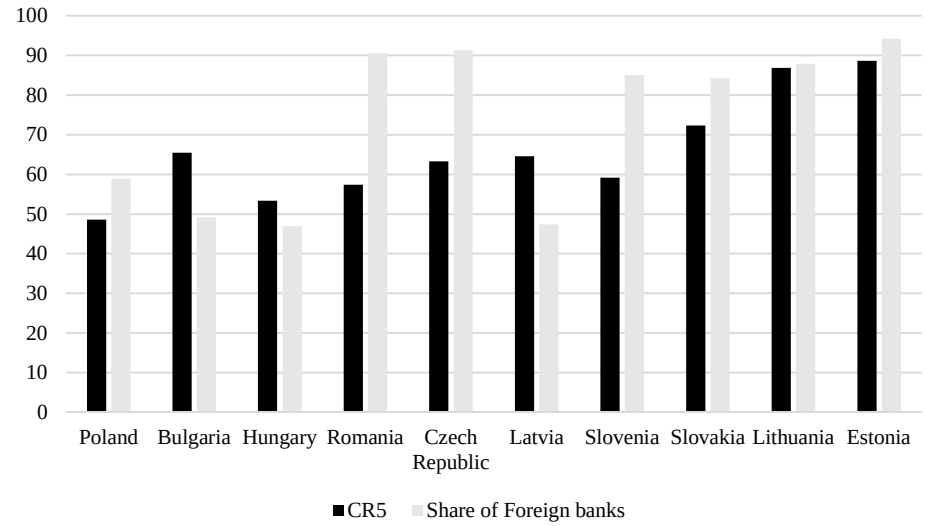
	Bulgaria	Czech Republic	Estonia	Hungary	Lithuania	Latvia	Poland	Romania	Slovakia	Slovenia
1999	19.00	22.27	8.87	5.98	7.21	11.30	7.12	9.53	7.71	5.69
2000	19.80	17.25	7.65	7.72	6.21	10.28	11.09	11.95	7.85	11.40
2001	15.47	17.49	7.59	8.87	5.76	8.93	10.47	9.94	7.77	13.33
2002	15.74	14.63	7.48	9.25	6.06	8.05	13.71	12.83	7.97	13.50
2003	16.67	12.77	7.10	8.69	11.06	7.48	11.16	7.36	7.52	13.38
2004	14.97	22.89	6.96	9.22	8.60	7.16	26.98	7.22	7.04	11.60
2005	13.07	21.05	6.36	9.15	10.51	6.73	25.23	6.31	5.81	10.81
2006	12.96	21.06	7.43	8.51	9.49	6.35	26.17	4.89	6.06	10.28
2007	12.63	18.96	6.55	8.28	9.01	6.05	24.96	4.90	5.54	9.98
2008	12.40	20.46	6.52	7.00	8.60	5.74	20.07	5.73	5.40	7.79
2009	12.98	23.64	4.49	8.36	10.08	2.92	19.54	5.64	5.45	10.33
2010	13.27	23.62	6.80	8.59	8.92	4.69	21.18	6.04	5.52	11.81
2011	13.27	23.32	8.13	7.35	8.32	6.42	23.98	6.56	5.14	12.61
2012	13.89	25.37	13.58	70.50	10.09	6.97	25.49	5.71	4.69	12.68
2013	34.05	23.30	13.30	71.73	10.06	6.46	24.64	7.14	2.81	12.96
2014	44.07	36.53	12.78	107.44	8.35	5.80	25.38	5.75	10.37	13.11
2015	14.12	36.74	7.97	7.03	8.56	7.70	28.92	11.82	11.90	12.17
Total	18.75	23.16	8.71	24.76	9.04	6.79	23.60	7.09	6.55	11.56

Notes: The sample of all banks from 10 European countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia). Data range 1999 – 2015. ZSCORE (Eq. 1) – mean of individual bank stability measure.

Source: Authors' own study.

Figure 1

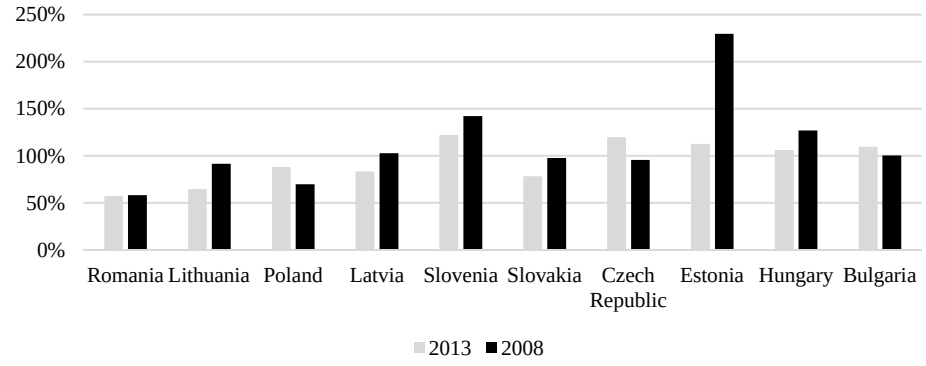
CR5 Ratios and Share of Foreign Banks in Central and Eastern European Countries in 2015 (%)



Source: Authors' own calculation based on ECB Statistical Data.

Figure 2

Size of the Central and Eastern European Countries Banking Sector in Relation to GDP in 2013 and 2008 (%)



Source: ECB Statistical Data.