The Nineteenth Dubrovnik Economic Conference

Organized by the Croatian National Bank

Ivan Huljak

Market Power and Stability of CEE Banks

Hotel "Grand Villa Argentina",
Dubrovnik
June 12 -14, 2013

Draft version

Please do not quote

Market power and stability of CEE banks*

Ivan Huljak**

Abstract

In spite of growing number of empirical studies, especially after the start of financial crisis, literature fails to provide conclusive answers on the relationship between bank competition and stability. We contribute to the existing literature by conducting a bank level analysis of market power implications on CEE bank stability using Bank-scope data from 1997-2012. At the same time, we promote a relatively new indicator of bank market power: Competition efficiency frontier, as a control of Lerner index specificity. Consistent with the Competition - fragility view, our results suggest that banks with more market power are more stable as a result of lower portfolio risk. Also, our results suggest that CEE banks use their market power to generate informational rents instead of economic rents, as we find no evidence of those banks charging excess prices on their clients. For banks in CEE countries where economic crisis increased risk materialization, increasing competition from the early 2000s, may have been a factor decreasing bank stability which may bear significant implications for upcoming years when competition is likely to increase further.

Keywords: bank competition, bank stability, CEE countries

JEL classification: D43, E43, E50

*The views expressed in the paper are authors` own, and do not necessarily represent the views of the Croatian National Bank.

** Croatian National Bank, ivan.huljak@hnb.hr

Contents

1. Introduction

The stability of banking sector is an important topic in economic and social context since banking crisis can have substantial negative effects on economic output and social welfare.[1] Yet, banking sector stability is determined and linked to many factors usually grouped in macroeconomic, financial and structural (Jahn, Kick, 2011). One of the factors influencing the bank stability is the level of competition which is defined as a level of rivalry between firms (Whish, 2005). In the period of prolonged financial crisis, the motive for investigating this relationship is quite clear which results in rising of the number of work on this matter. Looking from the CEE banks perspective, this issue becomes even more important, since they witnessed a noticeable increase in competition over the last decade which could even further increase as they become more integrated in EU common banking market.

Although fairly rich and rapidly growing after the start of the crisis, literature fails to reconcile traditional view that competition leads to fragility with somewhat younger view that competition promotes bank stability, with both views having theoretical and empirical background to some extent. In the meantime, a third group of researchers recently emerged claiming that the relationship between bank competition and stability is complex one and even case dependent (Allen and Gale, 2004). Apart from standard issue of different specifications of various models, there are a couple of down-to-earth reasons for inconclusiveness of these results. First of all, economic practice fails to find a simple and consistent indicator of bank market power which makes robustness check of the main market power indicator (Lerner index) often difficult; especially since (some eighty years after its introduction into economic literature) different authors produce different Lerner indices for the same countries. Second, measuring bank stability often proves a difficult task itself as the term itself is rather abstract and often observed only ex post. This usually results in authors using different indicators of banks stability: non-performing loans ratio, value adjustment costs, or some binary indicator based on default threshold. However, it should be noted that practitians in recent years started accepting Z-score as an indicator of bank market power. But, converging to a standard measure Z-score itself can be misleading since it is a product of two separate stabilities (portfolio and leverage) and besides, Z-score tends to reward the stability of earnings, even though on a low level.

To address mentioned issues and explore the specificities of industrial organisation in the banking sector, we conduct a bank level analysis. We contribute to the bank competition - stability research area in a couple of manners. Firstly, besides a standard indicator of market power, Lerner index, we promote a relatively new measure of bank-level market power, Competition-efficiency frontier (Bolt and Humphrey, 2010.), that helps us to control for the specificity of Lerner index and makes results robust to a choice of market power measure. Additionally, market power indicator less depended on the prices the banks charge allows us to consider exercising market power in broader view (even outside the pricing strategy). Further on, our relatively long sample (1997-2012), allows us to look at the pre-crisis and crisis period separately and contribute to the CEE countries crisis related literature. Also, we calculate a wide set of other indicators for CEE banks that help us to see the competition

[1] Leaven and Valencia (2012): *Systemic Banking Crises Database: An Update*, provide and extensive and up-to date overview of country-level banking crisis including policy responses and fiscal costs.

implications better. These include: franchise value, regulatory burden, X-efficiency, etc. Special attention in the paper is given to the choice of indicators as we believe that recent literature may have reached a consensus on them a bit too soon in order to attend the techniques. Finally, we also explore the components of stability and interest margins that market power has influence on. The reminder of the paper is structured as follows. Section 2 explains briefly the relationship between market power and stability in banking. Section 3 describes data and methodology. Section 4 explains the results while Section 5 concludes.

2. Relationship between bank competition and stability - literature overview

Theoretical and empirical work gives contrasting predictions on the relationship between bank competition and stability.[2] Although results vary in every fashion, one could consider earlier work on this matter more inclined to the view that competition decreases bank stability, and more recent somewhat more inclined to opposing view. Because of this inconsistency, a third approach started to emerge based on the idea that relationship between competition and stability is complex one and even case dependent (Allen and Gale, 2004). Other ideas state that this relationship is not necessarily linear or even intuitive (Matutes and Vives, 1996, Caminal and Matutes, 2002, Boyd, 2004, Allen and Gale, 2004, Boyd 2006).

The traditional view on the relationship between competition and stability suggests that increased rivalry between banks makes them more prone to risk taking which in turn makes them more fragile. After the Financial crisis of 2007/2008, this, **competition - fragility** view gained momentum with increased competition being viewed by a number of economists as a factor stimulating sub-prime activities in United States, or Swiss franc loans in some CEE countries.[3] The view that more competitive environment makes banks more fragile finds a confirmation in many papers that not only confirm the relationship, but also offer the channels for its materialization. Most of the researches confirming **competition - fragility** view use the **franchise value hypothesis** as the explanation for banks with higher market power being more stable.

Franchise value channel is relatively simple to explain. Bank with market power has more potential and it can choose whether and in which area to use its` market power. Because of this potential the bank is rewarded on the market and has a market value well above the book value. Therefore franchise value can be seen as a form of non-physical, goodwill-alike value that represents a form of bank potential but also an opportunity cost of bank failure. Having an extra value in their possession, bank owners have incentive to avoid unnecessary risk. As Besanko and Thakor (1993) suggest, banks which appropriate informational rents from developing relationships with borrowers have more incentives to limit risk exposure. On the other hand, the loss of market power decreases the franchise value of a bank and shuts down

[2] Beck (2008) gives a rather extensive overview of the literature and points to additional in-depth literature survey by Carletti and Hartman (2003) and Allen and Gale (2004).

[3] Anecdotal evidence from Croatia suggests that it was competition that stimulated Swiss franc loans expansion as the bankers themselves admitted in: Fifth CNB Bank Survey (2006). Appart in Croatia, Swiss franc loans share in total loans amounts to over 5% in their peak in Hungary, Poland, Romania, Serbia and Slovenia.

this disciplining mechanism (Demsetz and others, 1996). The whole concept actually relies on the fact that bank owners and managers are the ones choosing the bank risk level. In the same time, they are aware of the market power their bank has (no matter how much of it has been exercised) as Marcus (1984) and Dermine (1986) show in theoretical work. Similarly, Chen and others (1986) and Keeley (1990) set theoretical and empirical evidence on franchise value hypothesis with emphasize on the deregulation process as the driver of the increased competition and fragility.

Using different techniques, Suarez (1994), Adwards and Mishkin (1995) Hellman and others (2000) confirmed the trade-off between bank competition and stability.[4] Other researchers rely on the effect bank competition has on the banking sector supervision, regulatory policy, loan portfolio diversification, etc. However, the franchise value concept is generally well accepted and intuitive. Besides market power, factors leading to higher franchise vale are considered to be: size, efficiency, reputation and relationship with clients (Furlong and Kwan, 2006).

Besides franchise-value channel, economic theory points to three additional channels through which competition lead to greater fragility. The first channel is the effect that the competition has on the banking supervision; usually presented through the idea that more concentrated banking sectors are easier to supervise and more efficient supervision lead to stability (Allen and Gale, 2000 and Beck, 2008). The second channel is represented through the relationship between bank competition and payment systems. According to this channel, competition depletes excess liquidity in banks, as in the period of external shocks the potential for interbank liquidity pooling is reduced (Saez i Shi, 2004.). Finally, competition can have a negative effect on bank stability through the insufficient loan portfolio diversification. As Mishkin (1999) shows, higher market share allows for better risk diversification in loan portfolio which allows for continuation in loan activity in the period of recession.

However, this traditional view, where competition increases fragility of the banking system, is often challenged by, somewhat younger, competition - stability view which claims that market power can reduce stability of banks (Boysd and De Nicolo, 2005). According to this view, market power decreases bank stability as a result of risk-shifting process which is an idea is based on the two standard banking issues: moral hazard and adverse selection. The theoretical ground for this view was laid by Stiglitz and Weiss (1981) by showing that higher interest rates that result from the lack of competition can easily increase moral hazard and adverse selection which results with increased risk in the loan portfolio. Higher interest rates change the quality structure of clients (by increasing the share of clients with less elastic demand for credit) which increases non-performing loans. Similarly, Koskela and Stenbacka (2000) show that pricing competition among banks leads to lower interest rates and higher level of investments. However, this does not affect bank default rate and therefore there is no trade-off between competition and stability. Boyd and De Nicolo (2005) used risk shifting paradigm to show positive connection between concentration and fragility via the influence of

[4] Similar conclusions can be found also in: Repullo (2004) who used a dynamic model of imperfect competition to show that in a certain circumstances competition leads to fragility, Jimenez (2007) who showed that by accepting more risk, managers are actually trying to put deponents in worst off position and Bolt and Tieman (2004) who also conclude that increased competition leads to increased risk with the banks growing by increasing the risk in their portfolio.

competition on client behaviour. They find that increased competition reduces credit risk and increases financial stability.

Besides the risk shifting paradigm, the theory also mentions "too-big-to fail" policy as the reason of competition increasing stability. The rationale behind this explanation is that regulators are usually willing to help systematically important institutions in order to prevent the shock spilling through the entire sector. However, by knowing that they are systematically important, bank tend to be more prone to risk taking which makes the system less stable. This thesis has one additional dimension: the idea of being systematically important can influence even the depositors of a bank, who then become less interested in monitoring the bank they save with (Mishkin, 1999, Beck, 2008). Final argument of competition – stability proponents is that concentrated banking sectors are not easier to monitor because banks with higher market share are involved in more complex business activities which regulators have problem monitoring (Beck and others, 2006).

Recent work, especially after the start of the financial crisis, approached the competition - stability research basically from another angle, by employing more advanced techniques and by allowing for the non-linearity of the main relationship. Martinez-Miera and Repullo (2010) extended the Boyd and De Nicolo (2005) famous risk-shifting approach and allowed for imperfect correlation in loan defaults to show that relationship between competition and risk is U-shaped, with Hakenes (2010) and Schnabel (2011) reaching the similar conclusion. Wagner (2010) overturned Boyd and De Nicolo results by allowing borrowers to have a risk appetite of their own which results with banks choosing the risk level in the environment where the interest rates are driven down by competition. Also, Beck, Demirguc-Kunt and Levine (2006) and Schaeck, Cihak and Wolfe (2009), show that more concentrated systems are less likely to witness a banking crisis of some kind. Also, Schaeck and Cihak (2011), Berger, Klapper and Turk-Arisis (2009) show that competitive environment stimulates holding of higher capital which compensates more risk they are taking. Finally, Beck, De Jonghe and Schepens (2011) show that increase in competition will have bigger impact on banks` risk in countries with stricter activity restrictions, more homogenous market structure and deposit insurance and more effective systems of credit sharing.

Excluding the literature using concentration measures as a proxy of competition, literature on the bank competition – stability relationship in CEE is rather scarce. However, recently, two papers, Turk Arisis (2010) and Agoraki and others (2011), used Lerner index in bank level research to confirm that increase in bank market power leads to greater bank stability.

3. Methodology

3.1. Data and variables

The specificity of research focused bank competition is the necessity of generating own key variables which makes research on this matter rather data consuming and technically demanding[5].

All bank level data were obtained from the Bureau van Dijk/Fitch Bankscope database while real GDP growth was obtained from Eurostat web service. Our initial sample includes 415 banks from 15 CEE countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Serbia, Slovakia, Slovenia and Romania. With bank-level market power being the most data consuming variables, we remove the outliers by dropping banks with Lerner outside the -1, +1 range and by dropping banks outside 5th and 95th percentiles in competition efficiency frontier distribution.[6] Because of market power and x-efficiency calculation, our initial sample of 3555 observation is reduced to 1421 (in Lerner specification) and 579 (CEF specification). The coverage of banking sector assets in our dataset amounts to around 80% of the banking sector assets in average country. However, countries are not evenly represented in this bank-level research with some of the EU acceding and candidate countries entering our sample in the last couple of years.

However, working on CEE countries has two advantages. Firstly, banks in CEE countries mostly compete within the country. This means that, although residents (especially corporate) from the CEE countries do borrow from abroad, from time to time, CEE banking sectors can still be seen as relatively closed market. Also, as recent literature suggests (Beck and others, 2011), heterogeneity often influences cross country analysis. Analysing a relatively homogenous group, somewhat reduces this issue.

Variables used in or research can be divided in these four groups:

a) Bank stability (dependent variable in our main equation). Apart from Z-score, a composite indicator of bank default risk and its` components, we also use credit risk indicators: Non-performing loans ratio, Value adjustment costs to assets, uncovered non-performing loans to capital.

b) Measure of individual bank market power: Lerner index and Competition efficiency frontier.

---

[5] Perhaps the most extensive review of the lack of this consistency was presented in Carbó et al., 2009, who showed the magnitude of these differences on sample of 1912 banks in 14 European countries from 1995 to 2001. The authors found that R-squared between the Lerner index and the H-statistic was only 0.06 while the R-squared between the HHI and these two measures were, respectively, 0.09 and 0.05. The lack of robustness of these results is a good motivation for authors worldwide to keep researching this area.

[6] In theory, Lerner index should move within 0 and 1 range. However, having banking business specificity in mind, we also allow Lerner index to drop to -1 because of the weak loan performance and rising marginal costs in some banks.

c) Other bank-specific (control) variables that measure bank franchise value, efficiency, size, funding, liquidity, regulatory burden, net-interest margin, implicit loan rate, implicit customer deposit rate, equity to assets, market share, credit growth.

d) Macro-variables that explain general macroeconomic environment where banks operate: real GDP growth, country dummies, crisis dummies.

Compared with country-level research, bank-level research on competition-stability relationship offers the advantage of observing the process from the banks` perspective. However, as Beck (2008) claims, bank level research often produces most inconsistent results on competition - stability relationship. One of the reasons for these inconsistencies is the fact that the literature on bank competition - stability nexus may have gone too far regarding the techniques and models, while left the issue of selecting variables and indicators sidelined. For instance, most of the research will focus on the Lerner index – Z-score relationship. However, having in mind that both Lerner index and Z-score encompass profitability in some form in numerator, these results could be mechanical more than economical. Because of these issues, constructing the variables should be done with special care.

Measuring individual bank market power is technically challenging, especially when working with countries with lower data quality.[7] This is one of the reasons why we use two measures of bank market power: Lerner index and competition efficiency frontier (CEF). Apart from robustness, using these two indicators also generates additional information. While Lerner index is a classical indicator of market power exercised in pricing strategy, CEF is a relative measure of bank resistance towards competition.[8]

Apart from the bank individual market power, additional indicators are required in our research as the standard banking data does not tell the whole story. Being a non-observable term, bank stability as a variable is rather specific. We use Z-score, a standard composite indicator of bank stability that combines risk, earnings and capitalisation. We also use a decomposition of this indicator, as well as other standard portfolio risk indicators: non-performing loans ratio, value adjustment costs and uncovered NPLs.

For bank cost efficiency we use X-efficiency (XE) concept that combines alocative and technical efficiencies of the bank that are both under the influence of bank management. Unlike cost-to income ratio, X-efficiency is not dependent on economies of scale and is therefore convenient for testing out the quiet life hypothesis.[9]

Finally, bank franchise value indicator is calculated as the ratio of bank market value to book value.[10] Calculating a franchise value is important, since (in competition - fragility view) the disciplining mechanism within the bank is the protection of this value. With CEE banks rarely

---

[7] A detailed explanation and calculation of key variables is presented in the Appendix.

[8] Kraft and Huljak (2011) applied CEF on a cross section of banks within one country and suggested that competition may vary on different market segments in single country.

[9] According to this hypothesis, banks with more market power allow themselves to lose a bit of their potential cost efficiency as the pressure to increase efficiency is absent.

[10] Our ratio represents a simplified version of Tobin q.

having an active equity market, we impute the market value by calculating the present value of operating revenue.

Table 1: Descriptive statistics

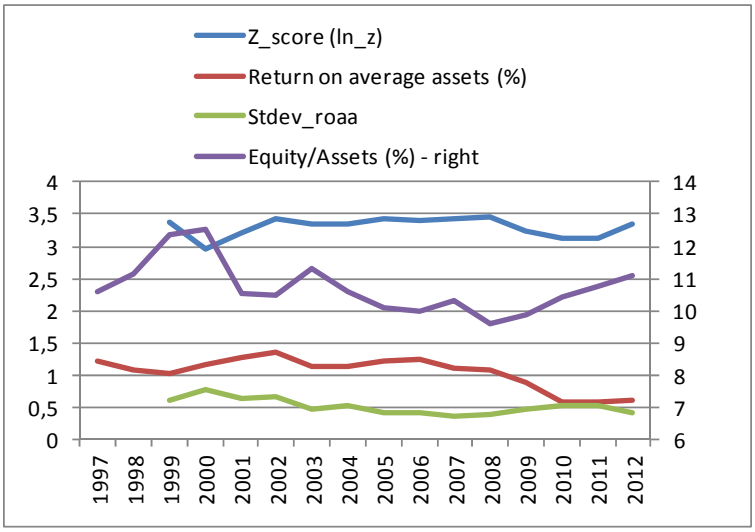
	Description	Number of obs	Mean	Source
Stability indicators				
(ln) Z-score	Composit stability indicator: portfolio and leverage stability	2268	3.2	Calculated
(ln) Portfolio_stability	-	1893	1.1	Calculated
(ln) Leverage_stability	-	2286	3.2	Calculated
Non-performing loans ratio	Non-performing loans to total gross loans	1542	0.0989	Bankscope
Value adjustment costs to assets	-	2786	0.0095	Bankscope
Uncovered NPLs to capital	Gross value of non-performing loans to capital	1077	0.3981	Bankscope
Empirical indicators				
Marginal cost	Cost of producing additional output	2767	0.0741	Calculated
Lerner index	Bank-level absolute market power indicator	2111	0.2728	Calculated
Comp. efficiency frontier	Bank-level relative market power indicator			Calculated
X-efficiency	Bank-level relative cost efficiency indicator	1421	0.7195	Calculated
Translog-cost functions				
Price of labour	Labour force costs to number of employees	2783	0.0328	Bankscope
Price of physical assets	Other operating costs to physical assets	2786	0.0002	Bankscope
Spread to operating costs	Spread ravenue to operating costs	2241	0.2789	Bankscope
Labour to deposit ratio	Cost of workforce to customer deposits	2716	0.0805	Bankscope
Tangible assets to deposit ratio	-	2714	0.1013	Bankscope
Unit processing cost	Non-interest earning assets to interest earning assets	2786	0.1436	Bankscope
Unit tangible assets costs	Oportunity cost of keeping physical assets (loan interest rate)	2780	0.0203	Bankscope
Other bank-specific data				
Bank average cost of capital	Weighted average cost of liabilities	2786	0.0417	Calculated
Bank franchise value	Market value to book value	2736	0.0223	Calculated
Net interest margin	(Interest income-Interest costs) / assets	2786	0.0472	Bankscope
Implicit loan rate	Interest income / loans	2130	0.1209	Calculated
Implicit deposit rate	Interest costs / customer deposits	1991	0.0689	Calculated
Credit growth	Year delta	2560	0.3095	Bankscope
Coverage	Loan loss provisions to non-performing loans	1505	0.3995	Bankscope
Market share	-	2786	0.0007	Bankscope
Interbank ratio	Placements to other banks to liabilities to other banks	2209	1.7378	Bankscope
Equity to assets	-	2786	0.1333	Bankscope
Regulatory burden	Placements to central bank to total assets	2071	0.0737	Bankscope
Loan to deposit ratio	Total loans to customer deposits	2714	0.6288	Bankscope
Loans to assets ratio	Total loans to total assets	2784	0.5409	Bankscope
Liquidity ratio	(Cash, deposits at other banks and short term securities) / assets	2766	0.4470	Bankscope
Price	Implicit loan rate	2130	0.1209	Bankscope
Non-interest income relevance	Comisions and fees to assets	2763	0.0113	Bankscope
Return on assets	Pre tax earnings to assets	2786	0.7512	Bankscope
Standard deviation of Roaa	-	2498	1.0338	Bankscope
Macro variables				
Output GAP		2786	10.3	Eurostat
Crisis dummy		-	-	Eurostat

Source: Own calculation based on Bankscope data

3.2. Stylized facts

Our relatively long sample provides an opportunity to explain CEE banking sector stability in historical context. In late 90s CEE banking sector stability was challenged by earnings volatility which resulted mostly from the credit risk materialisation that even took form of banking crisis in a couple of countries[11]. In the aftermath of the crisis, banks had relatively high capital adequacy, however, high volatility of earnings and their lower level decreased the Z-score index. In the period around 2000 the process of market consolidation gathered pace, which was stimulated by the foreign investors entrance (Kasman et al, 2010). In the period from 2001 to 2008 bank enjoyed a period of high credit growth accompanied with high loan portfolio quality which resulted with stable and high earnings which brought their Z-score to historical maximum.

Figure 1: Z-score and its` components for medial CEE bank



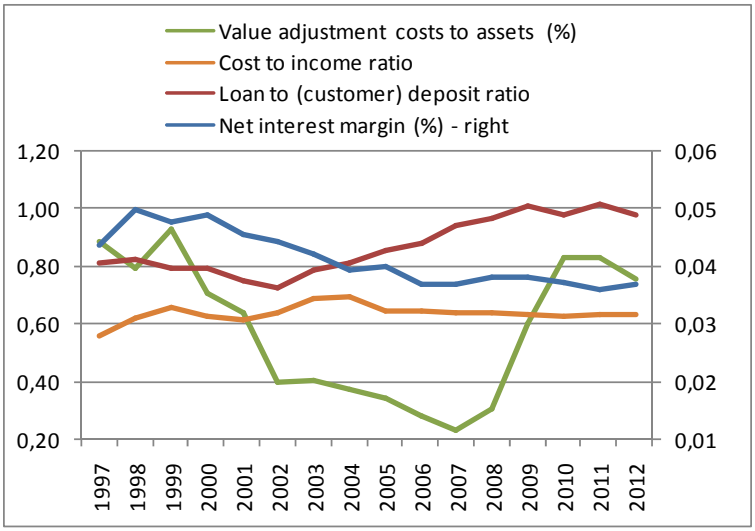
Source: Own calculation based on Bankscope data

In the period of tranquillity (2001-2008), net interest margin decreased which is often described (heuristically) in literature as a result of bank competition. However, in the period of increasing loan to assets ratio and the decrease of capitalisation, lower net interest margins was still enough for banks to record new profitability heights. In this period, strong credit growth was in large portion financed from foreign financial institutions, leading to the increase of loan to deposit ratios. Regarding efficiency, standard Cost to income ratio suggests that after 2003 banks managed to increase their efficiency and keep it stable since. However, this indicator is significantly under the influence of economies of scale and technological progress which makes him unreliable for judging the managerial cost efficiency.

[11] As Honohan i Klingebiel (2000): *Controlling Fiscal Costs of Banking Crises*, mention six CEE countries went through a full blown banking crisis in some form (Bulgaria, Czech, Croatia, Hungary, Poland, Slovenia) with social cost ranging from 3% to 30% of GDP.

After 2008, and the onset of the financial crisis, value adjustment costs increased and interest revenue decreased which eroded bank earnings and reduced Z-score to a ten-year minimum. With banks becoming more risk averse, their capitalisation levels started increasing which was accompanied by loans stagnation. In the same time, net interest margin started to stagnate as interest rates increased with additional pressure of loan quality on interest income.

Figure 2: Other standard banking indicators for medial CEE bank

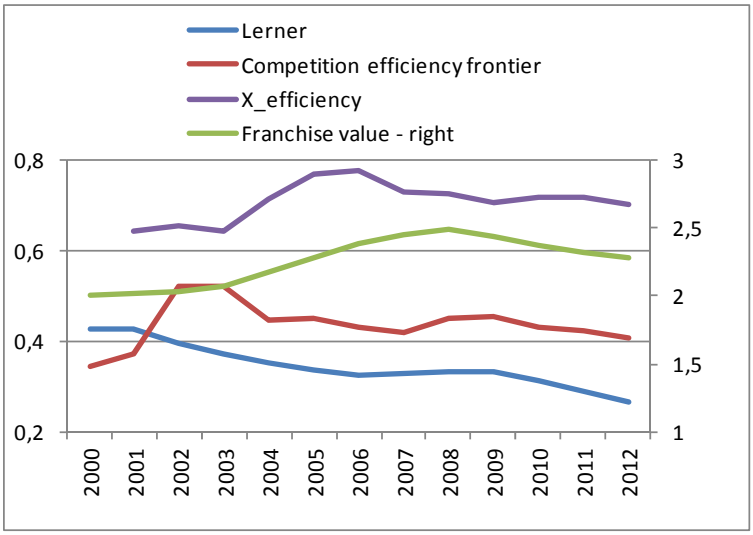


Source: Own calculation based on Bankscope data

Using the additional, empirical indicators, we are able to generate information that helps us explain further CEE banking sector trends and put the competition - stability relationship into historical perspective. First of all, in the period of rapid decrease of net interest margins, bank competition in CEE countries seems to have increased as both of our competition indicators suggest. Increased competition after 2003 seems to be the result of a couple of factors. First of all, because of consolidation process, the number of banks decreased and with larger banks slowly entering all the segments of banking (especially SMEs), number of banks trying to reach one client, increased. Relatively similar was the effect of easily available foreign financing, usually from parent banks, which allowed banks to engage more of their assets into placements to private sector.

After 2008 bank franchise value decreased as bank average cost of capital increased and operating revenue started to decline. Its decrease in the period of decreasing market power and decreasing stability offers first anecdotal support for Franchise-value concept. Finally, there seems to be no efficiency increase in the period after the crisis started. Managerial (X) efficiency seems to increase until 2006, which is probably a result of less efficient bank leaving the market. It appears that after the crisis banks did not reduce their cost to income ratio owing to increased managers' efficiency. This was probably the result of banks decreasing unit administrative costs or simply selecting cheaper inputs, as we see the decline of X-efficiency.

Figure 3: Empirical banking indicators for medial bank, 5 year moving averages



Source: Own calculation based on Bankscope data

3.3. Model

The year 2008 is the year of significant economic slowdown and the start of the effective financial crisis in most of the CEE countries as the performance of medial bank (Figure 1 and Figure 2) clearly shows. For this reason, the econometric analysis is conducted on two sub-samples, pre-crisis period from 1997 to 2007 and the crisis period from 2008 to 2012. Our choice of sub-periods is also confirmed by Chow test that shows evidence of the break in the relationship between explanatory variables and the dependent variable for the period 2008 to 2012. We use fixed effects to control for the all time-invariant differences between countries. To confirm the feasibility of fixed effect, we use Hausman test (as suggested Greene, 2008) and reject the null hypothesis that random effect are preferred. We also test the multi-colinearity (a phenomenon often witnessed with trans-log functions) while choosing variables for model. Finally, using the bank-level fixed effects or running a two-stage least squares regression (to control for possible endogenuity of market power by instrumenting it with its own lag) does not change the results noticeably.

With testing the relationship between bank competition and stability, we proceed the following way. As a first step, we conduct a relatively simple elasticity test to confirm the relationship between franchise value and market power. This serves as a robustness test not only for franchise value concept, but also for our market power indicators. In the second step we use our main equation to test the competition fragility hypothesis by modelling bank stability using a market power indicator alongside other control variables which corresponds with the majority of the bank-level research. Apart from the composite stability indicator, Z-score, we use its components: portfolio stability and leverage stability, as well as other stability indicators. In the next step, we model net interest margin, implicit loan and deposit interest rates to test weather market power translates into higher cost of funding for clients.

Finally, we run a simple test of quiet life hypothesis as one of the available non-pricing strategy.

According to the Franchise value paradigm, market power should explain a part of the franchise value, alongside other, more tangible indicators. Regarding the choice of variables, our approach here is similar to De Jonghe, andVander Vennet (2007) approach, although we use relative simple model for franchise value. Our franchise value elasticity test is the following:

$$FV_{it} = f(MP_{it}, XE_{it}, NIM_{it}, MS_{it}, INT\_BANK_{it}, EA_{it}, REG_{it}) + \varepsilon, \quad (1)$$

with FV - franchise value, MP - market power, XE – x-efficiency, NIM - net interest margin , MS - market share, INT_B - interbank ratio (placements to / liabilities from other banks), EA - capital to assets, REG - regulatory cost (share of assets held at central bank). The subscripts i and t are for bank and year respectively.

Following Beck and others (2011) we use a set of bank-specific variables and macro variable to model bank stability in our main equation with market power as a main controlling variable. We use the following model:

$$ST_{it} = f(MP_{it}, MK\_SH_{it}, EFF_{it}, LIQ_{it}, LTD_{it}, GR_{it}) + \varepsilon, \quad (2)$$

with ST - bank stability, MK_SH - market share, EFF - efficiency, LIQ - liquidity, LTD - loan to deposit ratio for bank i in a year t, with GR being the country-level economic growth. The subscripts i and t are for bank and year respectively.

To model net interest margin, implicit loan and deposit interest rates, we use a simplified model similar to Dumičić and Ridzak (2012):

$$NIM_{it} = f(MP_{it}, MK\_SH_{it}, EFF_{it}, LTD_{it}, LTA_{it}, EA_{it}, NII\_SH_{it}, CR\_GR_{it}, NPLR_{it}, COV_{it}, GR_{it}) + \varepsilon \quad (3)$$

with, LTA - loans to assets, NII_SH - non-interest income share, CR_GR - credit growth, NPLR - non-performing loans ratio, COV - non-performing loans coverage. The subscripts i and t are for bank and year respectively.

Finally, we test the Quiet life hypothesis on CEE banks with following equation (simplified to Coccorese and Pellechina, 2010):

$$EFF_{it} = f(MP_{it}, MK\_SH_{it}, LTD_{it}, REGUL_{it}, LIQ_{it}, CR\_GR_{it}, EA_{it}) + \varepsilon, \quad (4)$$

with REGUL- being the ratio of assets held at the central bank for bank i in a year t.

4. Empirical results

Our franchise value elasticity test shows positive and statistically significant relationship between bank market power and franchise value. This test is often skipped in the empirical literature, with most of the authors taking for granted that market power influences franchise

value. As expected, market power strongly influences franchise value, regardless of the used market power indicator. Apart from market power, bank size also increases franchise value. Looking from the "intangible" point of view, this seems reasonable since bigger banks usually enjoy *goodwill* in form of cheaper work-force (workers being willing to work for larger bank for smaller wages) and economies of scale. Factors decreasing bank franchise value are as expected regulatory burden and equity to assets ratio. Regulatory burden is often seen as a typical factor decreasing the franchise value and the main argument against strict regulation of the market. Regulatory burden leads to lower franchise value and decreases opportunity cost of bank default. Equity to assets ratio has similar effect as banks with higher capitalisation (induced by regulation or business circumstances) can't engage their full potential and have to protect themselves from unexpected circumstances with extra capital. Regarding other variables, higher intermediation efficiency (net interest margin) also increases franchise value, since it encompasses bank know-how. Surprisingly, cost efficiency does not seem to increase franchise value.

Table 1: Franchise value elasticity test

	Lerner index				CEF			
	OLS		Country f.e.		OLS		Country f.e.	
Dep_ Franchize value								
market power	0,550	***	0,524	***	0,912	***	0,841	***
x_efficiency	-0,257	**	-0,117		0,019		0,009	
nt interest mar	0,081	***	0,110	***	0,129	***	0,134	***
market share	1,188	***	1,103	***	1,322	***	1,061	***
interbank	0,000		0,000		0,000		0,000	
equity to asset	-0,060	***	-0,059	***	-0,069	***	-0,065	***
regulation	-1,836	***	-1,540	***	-2,487	***	-2,274	***
_cons	2,771	***	2,287	***	2,250	***	2,061	***
N	728		728		307		307	
r2	0,44		0,51		0,51		0,58	

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

Using Lerner index in our main equation confirms competition - fragility relationship as banks with higher market power have significantly higher Z-scores which is a result of both: portfolio and leverage stability. However, it is worth mentioning that this connection is valid only in crisis period. In pre-crisis period, we find no significant relationship between market power and stability. This is due to the standard lag in banking business and the fact that in favourable period, even inferior banks will do reasonably well as they will only be accumulating risks. Those risks materialize eventually, but in the meantime, those banks will report relatively stable and sometimes even higher returns and capital ratios.

However, as Beck and others (2011) suggest, the correlation between Lerner index and Z-score could be spurious since they both include profitability in numerator. In our sample, an increase in market power is associated with increase in profitability, but also with the decrease in earnings volatility. But, although our Lerner - Z-score positive correlation is not mechanical, but also economical (as we find positive connection between Lerner and: higher profitability, lower volatility and higher capital levels as well), we keep an eye on the specificity of Lerner index. In this model specification, apart from market power, loan to deposit ratio and bank size in crisis period also positively influence bank stability. This is in

line with the view that larger, foreign owned banks (with more market power) benefit from the more available and affordable capital which reduces their volatility in crisis period. Also, generally speaking, deleveraging process of foreign owned CEE banks started in 2011 and 2012 meaning that the banks in our sample enjoyed more than solid foreign parent support in most of the crisis period.

The same model specification, but with CEF as a market power indicator does not result in such a clear relationship between market power and Z-score. This is the part where using Z-score components proves to be beneficial. Using the Z-score components, we see that banks with higher relative market power (CEF) have higher portfolio stability in crisis period while we see no clear connection between market power and leverage stability. This difference bears down to the differences in indicators themselves. Lerner index is correlated with bank size, and with larger banks increasing their relative capitalisation after 2008, it makes no surprise to find a positive connection between Lerner and leverage stability. On the other hand, CEF is unrelated to size as it allows smaller banks to have market power on segmented CEE banking market.

Regarding other variables, size is important for stability in both specifications. However, credit growth seems to help bank stability in crisis period only in CEF specification. One has to be careful with this interpretation, since higher credit growth in crisis period could be result of some banks managing to find solid clients even when others can't or the result of banks protecting their own earnings by continuing to extant loans to lower quality clients to artificially preserve their earnings (*Zombie lending*). Relative cost efficiency is, as expected, positively connected with stability in most of the specifications as it increases earnings. Surprisingly, growth coefficients are mostly insignificant and have ambiguous signs indicating that the economic growth in current year is not important, providing that we already indicated whether we observe pre-crisis or crisis period.

Table 2: Competition – fragility test with Z-score and its components

	Lerner index				Competition efficiency frontier			
	Pre-crisis period		Crisis period		Pre-crisis period		Crisis period	
	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.
	Pre-crisis period		Crisi period		Pre-crisis period		Crisi period	
Dep: Z-score								
market power	0.0664	0.0003	1.3452 ***	1.2758 ***	0.5300	-0.3664	0.3948	-0.0904
x_efficiency	0.5239	1.4428	-0.1427	0.3875 ***	1.2314 *	2.4917 ***	-0.7326 *	0.0992
liquidity	-0.0010	0.0000	-0.0004	0.0008	-0.0024	-0.0020	0.0003	0.0067
credit growth	-0.0016	-0.0002	0.0018	0.0022 **	0.0031	0.0011	0.0146 ***	0.0130 ***
loan to deposit	-0.0027	0.0142 **	0.0065 **	0.0049 ***	0.0639	0.1067	-0.0363	0.0104
market share	0.5174	1.3581	0.4977	1.0262 ***	0.6606	2.4113 ***	0.6204	1.9749 *
growth	0.0079	-0.0142	-0.0538 ***	-0.0141	-0.0133	0.1785 *	-0.0590 ***	-0.0173
_cons	3.0604 ***	2.5610 ***	3.3727 ***	2.7080 ***	2.5994 ***	0.1427	3.9791 ***	3.2444 ***
N of obs	362	362	877	877	144	144	416	416
R-sq.	0.03	0.15	0.14	0.23	0.07	0.24	0.15	0.33
Dep: Portfolio stability								
market power	0.3358	0.1358	0.9169 ***	0.9914 ***	1.0914 *	0.5764	0.8790 **	0.6329 **
x_efficiency	0.9226 **	1.7096	-0.9859 ***	-0.2917 *	1.4520 *	2.8724 ***	-1.2379 **	-0.4574
liquidity	-0.0022	-0.0011	-0.0006	0.0005	-0.0075	-0.0060	0.0009	0.0042 **
credit growth	-0.0001	0.0008	0.0025	0.0036 **	0.0012	-0.0001	0.0130 ***	0.0134 ***
loan to deposit	-0.0706	-0.0441 *	0.0059 **	0.0035 **	0.2561	0.2635	-0.0427	-0.0085
market share	1.9167 ***	2.7897 ***	2.8264 ***	3.5118 ***	2.4634 ***	4.1865 ***	3.3898 ***	4.6903 ***
growth	0.0058	-0.0047	-0.0172	0.0094 ***	-0.0218	-0.1926	-0.0070	0.0057
_cons	0.4933 *	-0.1604	1.4421 ***	0.6547	-0.0774	-2.8986 **	1.3575 ***	0.7780
N of obs	334	334	699	699	133	133	333	333
R-sq.	0.14	0.25	0.09	0.20	0.22	0.33	0.14	0.26
Dep: Leverage stability								
market power	0.0047	-0.0673	1.0939 ***	1.0213 ***	0.4545	-0.4215	0.3622	-0.1446
x_efficiency	0.4123	1.3242 ***	-0.2584	0.2102	1.0956 *	2.3489 ***	-0.8031 *	-0.1091
liquidity	-0.0008	0.0001	-0.0001	0.0010	-0.0023	-0.0018	0.0004	0.0053
credit growth	-0.0015	-0.0002	0.0015	0.0018	0.0029	0.0012	0.0125 ***	0.0112 ***
loan to deposit	-0.0057	0.0126	0.0066 ***	0.0052 **	0.0628	0.0936	-0.0275	0.0150
market share	0.2930	1.1065 *	-0.0172	0.6061	0.4383	2.1085 **	0.0886	1.4450
growth	0.0067	-0.0176	-0.0450 ***	-0.0046	-0.0144	0.1635 *	-0.0481 ***	-0.0097
_cons	3.0844 ***	2.6400 ***	3.4141 ***	2.7362 ***	2.6695 ***	0.2828	3.9480 ***	3.3011 ***
N of obs	362	362	878	878	144	144	416	416
R-sq.	0.02	0.15	0.11	0.22	0.05	0.23	0.13	0.31

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

In the next step, we test the competition fragility relationship by employing other indicators of bank stability. In empirical literature, these are mainly focused on credit risk and could therefore be considered a robustness test for our portfolio stability. Even though credit risk is only one factor influencing bank total risk profile, in CEE countries it is clearly the most important one. Our results show that, banks with higher market power have lower non-performing loans ratio and lower capital burden of uncovered non-performing loans which is also consistent with competition - fragility view. On the other hand, we find only weak evidence of banks with more market power having lower value adjustment costs to asset ratio.

Table 3: Competition – fragility test with alternative stability specification

	Lerner index				Competition efficiency frontier			
	Pre-crisis period		Crisis period		Pre-crisis period		Crisis period	
	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.
Dep: Non-performing loans ratio								
market power	-18.0317 ***	-12.7258 ***	-4.5153 **	-4.4399 *	-0.4886	3.4927	-4.0049	-1.2801
x_efficiency	-7.0760	-5.1336	1.7871	-0.4509	-11.2652	-2.8821	2.7505	1.2332
liquidity	0.1215 ***	0.0610	0.0164	0.0122	0.0208	0.0478	0.0681	0.0257
credit growth	-0.0192	-0.0080	-0.0960 ***	-0.1002 ***	-0.0026	0.0659	-0.1865 ***	-0.1763 ***
loan to deposit	-2.5115 **	-3.1479 **	-0.0302	-0.0186	-5.6284 *	-9.6885 ***	0.5435	0.2804
market share	-10.1658 **	-9.3382 *	-7.2772	-10.2871	-13.0170 *	-20.0948 **	-12.7813	-16.6491 *
growth	-0.1536	-0.5138	0.3152 ***	0.2803 **	0.0644	-1.7882 **	0.2980 **	0.2076
_cons	19.1922 ***	23.9879 **	9.2808 ***	11.5884 ***	21.137483***	34.9644 ***	8.4822 **	11.5582 *
N of obs	183	183	697	697	83	83	363	363
R-sq.	0.36	0.53	0.11	0.19	0.34	0.53	0.17	0.21
Dep: Value adjustment cost to assets								
market power	0.0032	0.0043	-0.0106 ***	-0.0100 ***	-0.0046	-0.0034	0.0010	0.0073
x_efficiency	-0.0007	0.0016	0.0075 *	0.0040	-0.0116 *	-0.0110	0.0069	-0.0009
liquidity	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0002 *
credit growth	0.0000	0.0000	-0.0001 **	-0.0001 ***	0.0000	0.0000	-0.0002 **	-0.0002 **
loan to deposit	0.0003	0.0005	0.0000	0.0000	0.0038	0.0029	0.0009	-0.0007
market share	-0.0065 *	-0.0057	0.0075	0.0064	-0.0071	-0.0116	0.0002	0.0008
growth	0.0000	-0.0006 *	0.0002	-0.0002 ***	-0.0001	-0.0014	0.0003	-0.0002
_cons	0.0057 **	0.0144 *	0.0075 **	0.0134 ***	0.0167 **	0.0207 *	0.0069	0.0155
N of obs	362	362	878	878	144	144	416	416
R-sq.	0.03	0.11	0.05	0.15	0.07	0.10	0.04	0.20
Dep: Uncovered NPL to capital								
market power	-24.1938 **	-20.6140	-34.5503 **	-30.8292 *	-2.7344	1.7904	-9.0863	-55.4807 **
x_efficiency	-19.4364	-12.2615	8.8741	-12.7780	-18.9454	2.6125	-48.2088	3.2701
liquidity	0.1227	0.0265	0.0617	-0.1094	-0.1250	-0.2175	-71.4044	85.1658
credit growth	0.0627	0.1218	-0.3884 **	-0.3318 *	0.1350	0.2857 *	-0.1753	-0.2396
loan to deposit	-4.9082	-11.1552 *	-0.1003	-0.0684	-14.1863	-19.8690 *	-0.4222 **	-0.7351 ***
market share	-33.5443 **	-26.4419	-40.9499	-131.5645 **	-50.0636 *	-34.2509	-26.0085	16.2250
growth	-0.3184	-2.4589 *	1.7425 ***	0.1932	-0.5329	-4.2445	0.6635	0.0072
_cons	43.8576 ***	73.4969 **	38.6784 **	77.9273 **	60.7967 ***	74.2071 **	111.0944 ***	53.2549
N of obs	106	106	568	568	48	48	265	265
R-sq.	0.27	0.40	0.06	0.17	0.34	0.53	0.13	0.18

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

Our main equation and related robustness checks confirm competition fragility as we find evidence of market power being related to higher bank stability. However, we take this analysis a bit further and search for the relationship between market power and cost of funding that banks impose to their clients. However, in this test, using Lerner index could be unfeasible since it is a direct product of relative prices. Therefore it makes no surprise that our Lerner specification clearly shows that banks with higher (exercised) market power have higher implicit interest rates and higher net interest margins.

Using CEF indicator relieves us from of the problem of possible spurious relationship between market power and net interest margin as it is a relative measure not calculated directly from the prices. Unlike Maudos (2004), we find no evidence of net interest margin being higher in banks with higher relative market power. Going a bit further, we see implicit loan and implicit customer deposit rates lower for banks with more market power. This is probably the result of different portfolio structure but it leads us to believe that banks use their market power outside pricing strategy.

Regarding other factors influencing net interest margin, we see the positive influence of non-interest activity share as well as higher equity to assets on net interest margin. Non-interest income is usually connected with banks earnings on capital markets, commissions and fees and hedging activities. After the crisis all of these activities declined noticeably and banks that rely more on these activities tried to compensate this by increasing net interest margin. Similar was the effect of equity to capital ratio as banks with higher share of capital have balance sheet tendency to generate lower profitability.

Table 4: Bank competition and cost of funding

	Lerner index				Competition efficiency frontier			
	Pre-crisis period		Crisis period		Pre-crisis period		Crisis period	
	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.
Dep: Net interest margin								
market power	2.2239 **	1.3012 *	1.5765 ***	1.5656 ***	0.0525	0.0363	-1.3778 **	0.1294
x_efficiency	0.3747	0.7871	-1.0261 *	-0.7513 *	-0.0879	2.3918 *	-0.0766	0.8159
market share	1.8962 *	2.4341 **	-1.5430	-1.1254	0.9736	2.2734	-0.6137	0.5344
loan to deposit	-0.8480 ***	-0.9761 ***	-0.0072 *	-0.0043	-0.5954	-0.0912	-0.3152	-0.6885 **
loan to assets	3.7004 ***	3.7358 ***	2.5523 ***	2.6791 ***	4.0839 *	0.0052	1.8314	3.9902 ***
equity to assets	0.2749 ***	0.2675 ***	0.1015 ***	0.0449 ***	0.2455 ***	0.2241 ***	0.1428 ***	0.0267
non-interest revenue	0.5058 *	0.5917 **	1.1715 ***	0.7602 ***	0.7173	0.3721	0.8572 ***	0.3340 *
credit growth	0.0062	0.0023	0.0060 *	-0.0020	0.0048	0.0076	0.0135 *	0.0042
growth	-0.0591 *	-0.0451	-0.0217	-0.0152	-0.0742	-0.2277	-0.0394 *	-0.0222
nplr	0.0253	0.0249	0.0312 ***	0.0124 *	0.0419 *	0.0255	0.0048	0.0043
coverage	0.0004	0.0012	0.0076 ***	0.0048 ***	0.0014	0.0011	0.0052 **	0.0063 ***
_cons	-1.0887	1.4629	-0.1953	2.7163 ***	-0.6792	1.3516	1.1452	2.0102 **
N of obs	176	176	695	695	82	82	363	363
R-sq.	0.57	0.74	0.34	0.69	0.62	0.75	0.29	0.67
Dep: Implicit loan rate								
market power	11.2760 ***	10.7102 ***	5.2260 ***	5.3028 ***	-4.2742 *	-5.2876 *	-4.1945 ***	-2.3798 **
x_efficiency	-1.0541	-4.5839 **	-0.5076	-1.6072 *	-4.0620	-3.9235	-0.4982	-1.0851
market share	-1.2856	-6.2093 ***	-9.1552 ***	-9.6176 ***	-5.2144 *	-10.6039 **	-7.0715 **	-4.6611 *
loan to deposit	2.4374 ***	1.9867 ***	-0.0045	0.0054	1.0832	1.8326	0.2248	-0.7428
loan to assets	-8.4088 ***	-9.0160 ***	-3.3835 ***	-3.2349 ***	-11.9288 *	-17.8896 **	-8.6398 ***	-5.0073 **
equity to assets	0.2408 ***	0.2086 ***	0.0000	-0.0748 ***	0.1776	0.0802	0.1070 **	-0.0522
non-interest revenue	1.4280 **	1.2978 *	1.8564 ***	1.1460 ***	-0.0539	0.3116	1.6193 ***	0.8291 **
credit growth	0.0074	-0.0043	0.0076	-0.0027	-0.0025	0.0092	0.0017	-0.0084
growth	-0.1572 **	-0.5815 ***	-0.0062	-0.0585 **	-0.0323	-0.6339	-0.0338	-0.1139 ***
nplr	0.0638	0.0577	0.0358 **	-0.0047	0.0021	-0.0550	-0.0238	-0.0342 *
coverage	0.0025	0.0042 *	0.0088 ***	0.0036 *	0.0017	0.0029	0.0059	0.0065 *
_cons	6.5804 ***	23.7399 ***	7.3460 ***	13.0275 ***	18.5976 **	28.3134 ***	13.3402 ***	17.3241 ***
N of obs	176	176	695	695	82	82	363	363
R-sq.	0.64	0.75	0.31	0.59	0.38	0.50	0.26	0.55
Dep: Implicit deposit rate								
market power	-0.7308	0.0088	0.9176	1.3436	-3.5313 ***	-3.3751 ***	-3.3162 ***	-1.7436 ***
x_efficiency	-0.2815	-2.5405	-0.0001	-2.8174 *	0.5786	1.3100	-0.2552	-0.1635
market share	-2.9983 *	-7.4258 ***	-2.6878	-4.0140	-3.0304 **	-3.2111 *	-3.5056 **	-3.9155 **
loan to deposit	10.0592 ***	9.7043 ***	0.0554 ***	0.0610 ***	3.0114 ***	3.0548 ***	1.3697 ***	0.6270 *
loan to assets	-21.7247 ***	-22.1121 ***	-1.3029	-1.0911	-10.1376 ***	-10.9490 ***	-4.3794 ***	-1.7694
equity to assets	-0.0596	-0.0777	-0.0225	-0.0203	0.0608	0.0413	0.0425	0.0109
non-interest revenue	2.3746 ***	2.5438 ***	-0.2447	-0.5712	-0.0667	-0.1695	0.5611 **	-0.1257
credit growth	0.0122	0.0077	0.0112	0.0063	-0.0059	-0.0013	-0.0007	-0.0027
growth	-0.1175 *	-0.3644 *	-0.0309	-0.0378	-0.0050	-0.1258	-0.0276	-0.0302
nplr	0.0276	0.0298	0.0102	-0.0163	0.0785 **	0.0650 *	0.0046	-0.0068
coverage	-0.0010	0.0005	0.0002	-0.0036	0.0026	0.0032 *	-0.0013	-0.0016
_cons	6.9212 ***	16.8183 ***	5.0483 ***	7.7475 ***	7.0513 ***	9.0586 ***	5.9821 ***	6.0418 ***
N of obs	163	163	667	667	75	75	355	355
R-sq.	0.89	0.91	0.05	0.13	0.61	0.63	0.22	0.46

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

Having calculated market power and efficiency indicators we use the opportunity to test the quiet life hypothesis.[12] However, again we have to keep an eye on our market power indicators. With cost efficiency being a factor influencing bank profitability, using Lerner index to test quiet life hypothesis should be done with caution since banks with higher mark-ups are interested in profitability.[13] Our results provide some evidence of quiet life behaviour in CEE banks. By using Lerner index as market power indicator, we find no significant connection between market power and X-efficiency in pre-crisis period. However, we find evidence of higher X-efficiency in crisis period. This is probably due to the fact that managers of banks with higher mark-ups had little reason to worry about x-efficiency in good times; however, in crisis period they had to increase cost efficiency to boost earnings.

On the other hand, using CEF, we find evidence of classical quiet life behaviour in pre-crisis period as the market power has statistically and economically negative influence on bank cost efficiency (an increase of 1 percentage point in market power relative to the weakest bank would decrease x-efficiency by 0.15 percentage points compared with most efficient bank). In the crisis period, we find no statistically significant relationship between the two variables.

Table 5: Testing out the quiet life hypothesis

	Lerner index				Competition efficiency frontier			
	Pre-crisis period		Crisis period		Pre-crisis period		Crisis period	
	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.	OLS	Country f.e.
Dep: Bank efficiency								
lerner	0,0680	-0,0254	0,0629 *	0,0898 ***	-0,1522 ***	-0,1537 **	0,0524	-0,0461
market share	0,0601	-0,2678 **	-0,1359	-0,3587 ***	0,0967	0,1187	-0,3088	-0,1387
loan to deposit	0,0898 ***	0,0630 ***	0,0001	0,0005	-0,0011	0,0551 *	0,0273	-0,0051
regulation	-0,1359	-0,0097	-0,0002	-0,1792	0,0684	0,0778	-0,1190	-0,4571 **
Liquidity	-0,0016 ***	-0,0009 *	-0,0003	-0,0004 **	-0,0015 ***	-0,0016 *	-0,0013	-0,0012 **
credit growth	0,0000	-0,0004	0,0002	0,0002	0,0003	-0,0003	-0,0008	0,0001
equity to assets	0,0003	0,0029	0,0037 **	0,0042 ***	0,0033	0,0047 *	-0,0045	0,0040 *
_cons	0,6734 ***	0,8415 ***	0,6680 ***	0,7848 ***	0,7611 ***	0,7032 ***	0,7863 ***	0,7999 ***
N of obs	286	286	636	636	414	290	414	414
R-sq.	0,12	0,41	0,03	0,36	0,09	0,14	0,09	0,34

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

5. Conclusion

Before financial crisis, banking sector s of CEE countries enjoyed a period of tranquillity with high earnings, strong capital and low volatility. Consequently, the stability of banks was high with Z-scores reaching their maximum historical values. In the period of financial crisis, after 2008, stability of banks in CEE decreased noticeably, with loan quality and weak credit

[12] By claiming that *the best thing about monopoly is quiet life,* Hicks (1935) suggested that market power can have a negative influence on bank efficiency, but also that the market power can be used out-side the price strategy.

[13] It is surprising that literature rarely mentions this connection.

growth leading to significant earnings decrease. In the same time, competition between banks increased as the market started to shrink.

Using a relatively simple elasticity test, we show that market power contributes to the franchise value of banks making the franchise value channel possible. Results of our main equation and associated robustness tests are consistent with competition fragility hypothesis since that we find evidence of banks with higher market power being more stable in the period of crisis. Our competition – fragility results are in line with some of the recent research on this matter that used mostly Lerner index - Berger et al. (2009) and Turk –Arisis (2010), and Jimenez et al. (2010). Using two subsamples, two measures of bank specific market power and two panel regression specifications our results are robust.

Both of our market power indicators are associated with higher portfolio stability, while the leverage stability is only related to Lerner index (an indicator more associated with bank size). By keeping the differences between Lerner index and CEF in mind, we decide against using Lerner index for further testing of bank market power influence on cost of funding in economy. Using CEF, we find no evidence of banks with more market power having higher net interest margins which suggests that their stability is not a result of higher prices that increase profitability and thus portfolio stability. Even more, we actually find some evidence of banks with more market power having lower implicit interest rates (both passive and active) which could be under the influence of different client structure.

Consequently, our results suggest that banks in CEE use their market power outside the pricing strategy as they accomplish lower portfolio volatility through the higher quality of relationship with their clients. So instead of economic rents, banks with more market power use the advantage of informational rents as Allen and Gale (2004) suggest. This way, their clients benefit from stable funding and lower interest rates, while they benefit from lower reinvestment risk and higher asset quality. In that sense, growing differences in Z-score between CEE banks bare down to the quality issue. Results imply that banks with higher market power gain the advantage over weaker banks not through the aggressive interest rate policy, but through the acquiring better clients and investing in relationship with them. Results also imply that banks with less market power get stuck with clients of lower average quality which leads to decreasing interest revenue and higher value adjustment costs.

There are several ways how this research can be expanded. First, in future research, it could be beneficial to test the risk shifting paradigm on banks with less market power. Second, this research could benefit from employing dynamic panel analysis in form of GMM and Arlano Bover estimator to combine fixed effect and lagged dependent variable. Initial test suggest that our results hold, when we control for the endogeneity and when we include lag of depended variable into equation. However, as Beck and others (2011) suggest, pooling the data always hides cross-country variation and additional work on the technique could prove to be beneficial.

To conclude, bank franchise value seems to be a well functioning self disciplining mechanism within the CEE banks. As the theory suggests and our results confirm, stricter regulation and increasing competition are factors causing its decline which should be important information for policy makers. Increasing bank competition with the aim of increasing bank efficiency, according to our results is justified. However, its effect can be offset with some stability losses which make the net effect of such an increase uncertain from the social welfare point of view. Looking from the perspective of CEE banks, joining the banking union, which creates a

level playing field for members, could result in market power convergence to the somewhat lower level of older EU member states. Consistent with our findings of competition fragility relationship this could increase bank individual riskiness in the future.

Appendix

Measuring bank-specific market power

Measuring bank **market power** is technically demanding which becomes even more obvious when working on a sample of countries with lower quality data. This often results in different authors having different indicators of bank competition. This is one of the reasons why we use two measures of bank market power: a standard measure of market power, Lerner index (Lerner, 1934) and relatively new measure, Competition efficiency frontier (Bolt and Humphey, 2010). Besides robustness, using two measures can help us finding some additional information, as those two market power indicators do not show the exact same thing. While Lerner index is an indicator of exercised market power in form of setting prices above marginal cost, CEF is a relative measure of bank resistance towards competition.

Lerner index of market power (Lerner, 1934) is the most widely used index of bank market power. There are a couple of arguments for using this indicator. First of all, this indicator can be obtained on bank level for separate years, which makes it suitable for statistical testing as it allows time and cross section dimension. Further on, this indicator is directly derived from microeconomic theory and is intuitive as it can be connected with the social welfare loss (Harbergers` triangle) and monopolistic rents monitoring. Lerner index is calculated as a relative monopolistic mark-up:

$$L = \frac{P - MC}{P} \qquad (1)$$

With L - Lerner index, P - price (implicit interest rate) and MC - marginal cost. Consequently, Lerner index measures relative price mark-up against marginal cost. However, unlike easily available bank prices, calculating marginal cost is often technically challenging since it requires the use of bank total and marginal cost function.[14]

With our relatively restricted dataset we use a relatively simple total trans-log cost function[15]:

$$Ln(C_{it}) = a_{0i} + b_0 \ln(Q_{it}) + b_1 0.5(\ln(Q_{it}))^2 + a_1 \ln(W_{1it}) + a_2 \ln(W_{2it}) + a_3 \ln(W_{3it}) + b_2 0.5 \ln(Q_{it}) * \ln(W_{1it}) + b_3 0.5 \ln(Q_{it}) * \ln(W_{2it}) + b_4 0.5 \ln(Q_{it}) * \ln(W_{3it}) + a_4 \ln(W_{1it}) * \ln(W_{2it}) + a_5 \ln(W_{1it}) * \ln(W_{3it}) + a_6 \ln(W_{2it}) * \ln(W_{3it}) + a_7 0.5(\ln(W_{1it}))^2 + a_8 0.5(\ln(W_{2it}))^2 + a_9 0.5(\ln(W_{3it}))^2 + \mu_{it} \qquad (2)$$

Where, C, Q, w1, w2 and w3 represent: total costs, bank output, price of labour, price of physical assets and price of financial capital. The subscripts i and t are for bank and year respectively. By generating the first derivation of total cost for the Q, we generate the MC/TC equation:

---

[14] Given the specificities of this calculation, trans-logarithmic cost functions are often used in this research, since they allow for certain flexibility in calculation.

[15] In appendix we show a country level Lerner index calculation that serves as a robustness test.

$$(MC/TC)_{it} = b_0/Q_{it} + b_1 * \ln Q_{it}/Q_{it} + b_2 0.5 \ln w_{1it}/Q_{it} + b_3 0.5 \ln w_2/Q_{it} + b_4 0.5 \ln w_3/Q_{it} \quad (3)$$

The Competition efficiency (CEF) concept, recently developed by Bolt and Humprey (2010), is from the technical perspective, an efficiency measure. However, in this approach, the efficiency refers to the competition as a process: We are not searching for bank efficiency frontier; rather, we are searching for the bank or a group of banks that competition was most efficient in restraining the revenue. Therefore, the bank or a group of banks on the CE frontier is actually a bank or a group whose revenue was the most restrained by the competition. The further a bank (or a group of banks) is from the frontier the greater its market power. This means that while we still maintain that bank revenue reflects productivity, cost and competition, we actually reverse the story and claim that revenues of banks are restrained by productivity, cost and competition.[16]

Like Bolt and Humphrey (2010), we maintain that banks use spread revenue and non-interest revenue as their two main sources of revenue. However, since we lack the data to calculate the CEF for non-interest activities, we calculate only the CEF for spread business. Also, CEE banks mostly rely on spread revenue.

For estimation of spread revenue and non-interest revenue, we use the standard transcendental function in logs with two inputs (working and physical capital):

$$\ln(Y_i) = \theta_0 + \sum_{i=1}^{5} \theta_i \ln X_i + 1/2 \sum_{i=1}^{5}\sum_{i=1}^{5} \theta_{ij} \ln X_i \ln x_j + \sum_{i=1}^{5}\sum_{k=1}^{2} \lambda_k \ln X_i \ln P_k + \sum_{k=1}^{2} \pi_k P_k + 1/2 \sum_{k=1}^{2}\sum_{m=1}^{2} \pi_{km} \ln P_k \ln P_m$$

(4)

Where: Y – spread revenue to operating costs, Pk – productivity ratios: labor deposit ratio and tangible assets to deposit ratio, X – input costs: price of labor, price of physical capital, Pm – unit costs: processing cost, tangible assets unit cost and equity to assets. The subscripts i and t are for bank and year respectively.

The spread business is the traditional banking business and represents the core of bank revenue in CEE countries. For CEF purpose, we calculate spread revenue as the implicit rates mark-up multiplied with the deposit level. The labour-deposit ratio is our measure of labour productivity. We calculate it using the costs of labour to total deposits, since the number of employees is not available for most of our sample. The price of labour is calculated as the bank total personnel expenses to number of employees. We use tangible assets (net of amortization) to deposits to explain banks' reliance on physical capital. Since finding the interest rate that would describe the opportunity cost of investing in physical assets (market rate) in our sample is very complicated, we use the implicit rate on loans as an opportunity cost of investing in physical capital.

---

[16] Competition efficiency frontier measure is similar in concept to an indicator developed by Boone (2008). Boone relies on balance sheet data to compute the difference between reported total firm revenues and reported total variable costs, a spread that contains total fixed cost plus extra revenues associated with the degree of market competition. We are interested in revenues for particular subsets of banking services (which are reported, but not in as much detail as we would like) but rely on statistical cost analysis to identify the (unreported) associated variable and fixed costs, leaving the effect of competition on revenues as an average residual.

CEF measure is rather data consuming and in order to calculate it, some compromises had to be made compared with the data used by Bolt and Humphrey (2010). This refers mostly to the indicators of unit costs. With the data on payment statistics available for most of the CEE countries only after 2005, it is impossible to measure long-run technological progress using the number of ATMs a la Bolt and Humphrey. Also, apart from shorter period of available data, some CEE banks that did not engage in retail business did not have ATMs even after 2005. Using business units instead of ATMs would not help much since some banks still have only one business unit. Since this form of bank technological progress started later in CEE than in EU member countries, the available data (from 2005 onwards) shows constant increase of ATMs until 2010.

Unit cost for processing transactions is calculated as the ratio of banks non-interest bearing assets to interest bearing assets. Tangible assets unit cost is calculated as bank average depreciation cost to tangible assets.

In a composed error framework, equation (4) can be expressed as:

$$\ln(rev/oc) = R(\ln X_i, \ln X_j, \ln P_k) + \ln e + \ln u \tag{5}$$

Under the DFA approach (Berger, 1993) the total residual is made of random part and competition part ($\ln e$ and $\ln u$ respectively). Over long enough time period will average to close to zero, while will average to the competition effect. Afterwards, the series of residuals is averaged across banks and only then averaged bank residuals are averaged across bank groups (based on size, ownership, and strategy, survival). Only then was the CEF calculated using the following formula:

$$CE_i = \exp(\ln\overline{u}_i - \ln\overline{u}_{\min}) - 1 = (\overline{u}_i / \overline{u}_{\min}) - 1 \tag{6}$$

Where: CEF - competition efficiency for a bank or a group of banks, $\overline{u}_i$ - averaged residuals across time for a certain bank or a group of banks and $\overline{u}_{\min}$ the minimum $\overline{u}_i$ vector.

The term (5) is multiplicative to revenue/operating costs in the unlogged version of (6) equation:

$$(rev/oc) = R(X_i, X_j, P_k) + e + u \tag{7}$$

Thus the ratio is an estimate of the ratio of for the bank or a group of banks compared with the bank or bank group facing the greatest competition while having the same underlying cost and service productivity. Since the CEF measures competition inefficiency, the value of 0.00 means perfect efficiency of competition and a frontier position of a bank. A CE value of 0.05 means that the competition is 5% less efficient than on the frontier. Intuitively, higher CEF means higher market power.

Measuring bank stability

Market power indicators may be the most important indicators in our research; however, additional indicators are required for the complete picture as the standard banking data does not tell the complete story. This refers to the calculation of: stability, cost efficiency and franchise value.

Being a non-observable term, **banking stability** as a variable is rather specific. In bank-level research like ours, most of the authors use Z-score, an indicator that conveniently, combines risk, earnings and capitalisation which is in a way the core of banking business. However, as Kohler (2012) shows, the Z-score is actually a combination of two separate stabilities that can annul each other. This is the reason why, apart from the standard Z-score, we also look at its two components: portfolio stability and leverage stability.

$$Z = \frac{k + \mu}{\delta} = \frac{k}{\delta} + \frac{\mu}{\delta} = P + L \qquad (8)$$

Where: Z - Z-score, k - three year - average Return on average assets, μ - equity to assets, δ - three year standard deviation of Return on average assets, P - portfolio stability and L - leverage stability.

Measuring banks x-efficiency

For bank **cost efficiency**, we use X-efficiency (XE) concept that combines alocative and technical efficiencies (both under the influence of bank management) in unknown proportion (thus the X name). For the same reasons as with CEF, for the individual bank X-efficiency, we also apply DFA to dismantle residuals on efficiency and random parts. We follow Berger and Hannan (1998) who measure X-efficiency, or the closeness of the bank costs to the minimum costs for the bank's output that could be achieved on the efficient frontier. Bank efficiency calculated this way is generally very convenient for testing out the Quiet life hypothesis that states that banks with higher market power tend to enjoy the quiet and less efficient life since competitive pressures are unlikely force managers to reduce costs.[17]

To estimate efficiency Berger and Hannan (1998) assume that the cost function has a composite error term that includes both inefficiencies (deviations from the efficient frontier) and random error (luck, measurement error). The difficulty in estimating efficiency is in disentangling the two elements. This is exactly where DFA method proves its value. While most studies must impose distributions in order to separate them, DFA relieves us of the issue but requires a time series of data for each of our banks in return. The key assumption is that cost differences owing to inefficiency are relatively stable and should persist over time, while those owing to random error will average out over time.

For the XE calculation, we use standard trans-log cost function with three inputs (financial capital, labour and physical capital) and three outputs (investments, loans and fees):

[17] In other words, we believe that competitive pressures or the lack of it will influence only relative bank efficiency, while it will not influence technological progress or economy of scale which depends on the optimal size of the bank.

$$\ln TC_{it} = \alpha_i + \sum_{m}^{M} a_m \ln Y_{m,it} + \sum_{n}^{N} b_n \ln W_{m,it} + \frac{1}{2}\sum_{m}^{M}\sum_{n}^{N} a_{mn} \ln Y_{n,it} \ln Y_{m,it} + \frac{1}{2}\sum_{m}^{M}\sum_{n}^{N} b_{mn} \ln W_{n,it} \ln W_{m,it} + \sum_{m}^{M}\sum_{m}^{M} ab_{mn} \ln W_{n,it} \ln Y_{m,it} + \varepsilon_{it} \quad (9)$$

Where: TC indicates total operational costs of a bank i in the period t, W indicates input prices and Y indicates bank outputs (loans, investments and fees and commissions), with ε being the residual. The subscripts i and t are for bank and year respectively.

For the DFA method, a cost function is modified as:

$$\ln C_{ij} = \ln_t C(Y_{ij}, w_{ij}) + \ln x_i + \ln vi_t, \quad (10)$$

where ln indicates natural logarithms, t denotes time, C is operating costs, C(Y, w) is a cost function with output quantity vector Y and input price vector w as arguments, 1n x is an efficiency factor, and 1nv is a random error. All the components in equation (10) vary over time except for the efficiency factor xi, which is assumed to be constant for bank i.

To calculate efficiency, we average the residuals from equation (10) for each bank over the 5 years. This average residual, ln xˆi for each bank, is an estimate of ln xi , given that the random errors ln vit will tend to cancel each other out for each firm separately in the averaging. We transform ln xˆi into a normalized measure of efficiency:

$$EFF_i = \exp(\ln x_{\min} - \ln x_i) - 1 = x_{\min} / x_i, \quad (11)$$

Where, min indicates the minimum for all i. This is an estimate of the ratio of costs for the most efficient bank in the sample to bank i's costs for bank i's combination of outputs and input prices. This corresponds with the conventional notion of efficiency as the ratio of the minimum resources needed for production to the resources actually used, and ranges over (0, 1), with higher values indicating greater efficiency.

Measuring bank franchise vale

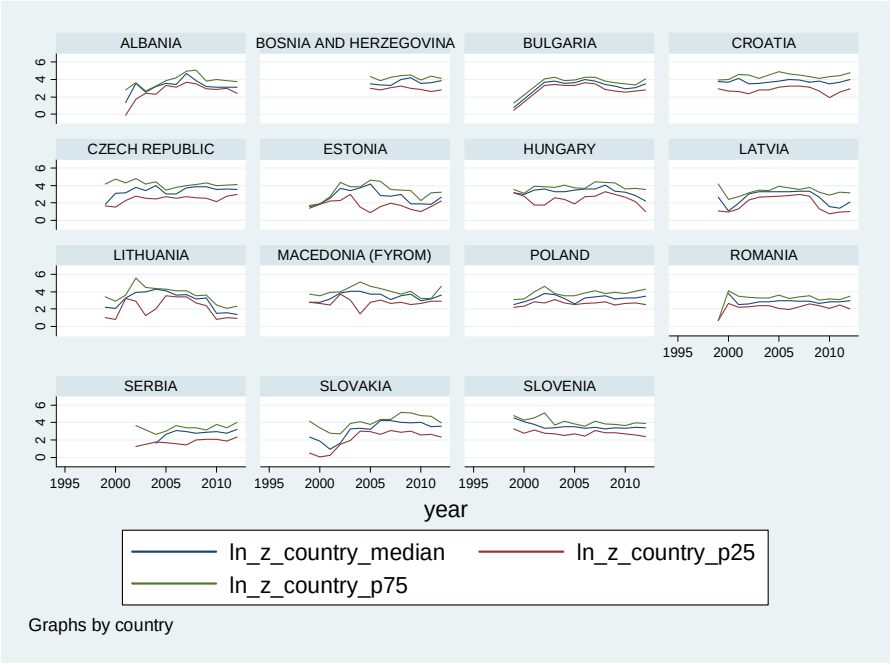
By including the franchise value in our research, we show the true micro nature of our research since we have to use a simple technique from corporate finance. Franchise value is a ratio of market and book value of a bank. With book value being relatively easy to calculate form the balance sheet, the market value is not easily available since CEE banks rarely trade on the stock exchange. Therefore in order to calculate bank market value we discount the operating profit with banks` the cost of capital in a model of eternal rent and this way calculate imputed market value. This relatively simple way of calculating franchise value allows us to generate enough observations for CEE countries.[18]

[18] One could argue that there is no evidence of someone being willing to pay for the bank the amount equal to discounted cash flow. However, average cost of capital reflects creditors` and deponents` value assessment of a bank.

$$FV_{ij} = \frac{MVA_{ij}}{BVA_{ij}}, MVAL_{ij} = \frac{OP_{ij}}{WACC_{ij}}, BVA_{ij} = EQ_{ij}, \tag{12}$$

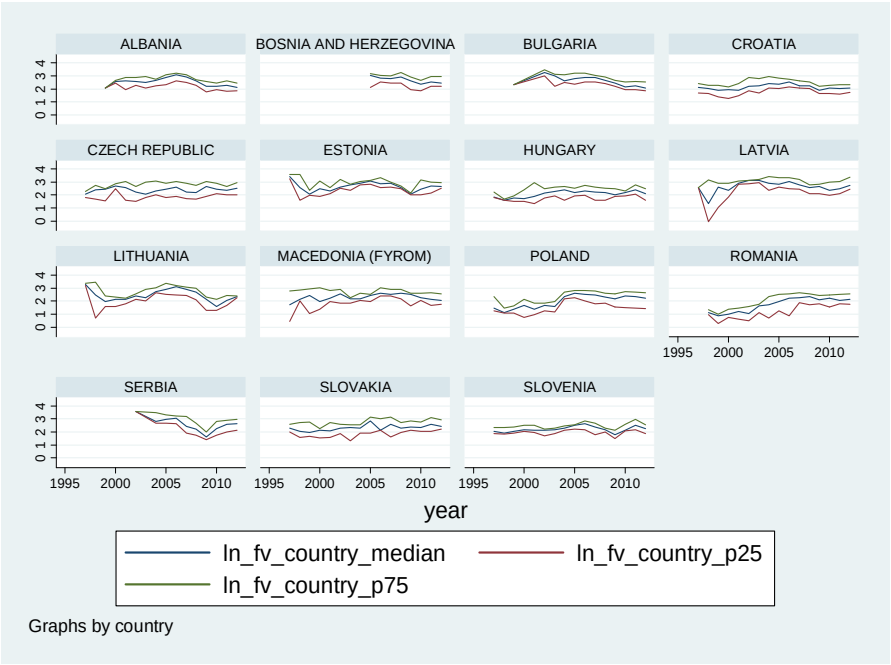
with FV - franchise value, MVA - market value, BVA - book value, OP - operating profit, WACC - weighted average cost of capital, EQ - balance sheet equity. The subscripts i and t are for bank and year respectively.

Figure A1: Bank-specific Z-score index percentiles



Source: Own calculation based on Bankscope data

Figure A2: Bank-specific franchise value percentiles



Source: Own calculation based on Bankscope data

Table A1: Trans-log functions results

Lerner index		Competition_efficiency frontier		X_efficiency	
ln_q	1,09 ***	ln_lab_dep	-1,77 ***	ln_y1	0,36 ***
ln_q_ln_q_2	0,00	ln_fix_dep	0,03	ln_y2	0,08
ln_w1	-0,17 ***	ln_ea	1,34 ***	ln_y3	0,32 ***
ln_w2	1,12 ***	ln_pc	-0,29 *	ln_w1	0,01
ln_w3	0,07	ln_fixc	-0,22	ln_w2	0,70 ***
ln_q_w1_2	0,04 ***	ln_lab_dep_ln_fix_~p	-0,02	ln_w3	0,51 ***
ln_q_w2_2	0,01	ln_lab_dep_ln_ea	0,17 ***	ln_y1_y1	0,06 ***
ln_q_w3_2	0,00	ln_lab_dep_ln_pc	0,14 ***	ln_y2_y2	0,11 ***
ln_w1_w2_	-0,03 ***	ln_lab_dep_ln_fixc	0,15 ***	ln_y3_y3	0,11 ***
ln_w1_w3_	-0,03 ***	ln_fix_dep_ln_ea	-0,03	ln_w1_w1	-0,02 *
ln_w2_w3_	0,03 ***	ln_fix_dep_ln_pc	-0,15 ***	ln_w2_w2	0,11 ***
ln_w1_w1_2	-0,06 ***	ln_fix_dep_ln_fixc	-0,02	ln_w3_w3	0,00
ln_w2_w2_2	0,18 ***	ln_ea_ln_pc	0,05 **	ln_y1_y2	-0,07 ***
ln_w3_w3_2	0,00	ln_ea_ln_fixc	-0,04	ln_y1_y3	-0,09 ***
_cons	0,57 **	ln_pc_ln_fixc	-0,09 ***	ln_y2_y3	-0,10 ***
		ln_lab_dep_ln_pl	-0,23 ***	ln_w1_w2	0,17 ***
N	**2833**	ln_lab_dep_ln_pk	0,00	ln_w1_w3	0,04 *
R_sq.	**0,98**	ln_fix_dep_ln_pl	0,16 ***	ln_w2_w3	0,09 ***
		ln_fix_dep_ln_pk	0,01	ln_y1_w1	0,03 **
		ln_ea_ln_pl	-0,03	ln_y1_w2	0,02
		ln_ea_ln_pk	-0,18 ***	ln_y1_w3	0,03 ***
		ln_pc_ln_pl	-0,07 ***	ln_y2_w1	0,00
		ln_pc_ln_pk	0,05	ln_y2_w2	0,14 ***
		ln_fixc_ln_pl	-0,01	ln_y2_w3	-0,05 ***
		ln_fixc_ln_pk	0,00	ln_y3_w1	0,04 **
		ln_pl	1,37 ***	ln_y3_w2	-0,08 ***
		ln_pk	1,08 ***	ln_y3_w3	0,00
		ln_pl_ln_pk	-0,10 **	_cons	4,09 ***
		ln_lab_dep22	0,07		
		ln_fix_dep22	0,07	**N**	**2992**
		ln_ea22	-0,14 *	**R_sq.**	**0,93**
		ln_pc22	0,10 ***		
		ln_fixc22	-0,11 ***		
		ln_pl22	0,25 ***		
		ln_pk22	0,08 **		
		_cons	-6,45 ***		
		N	**1999**		
		R_sq.	**0,80**		

*Note: *,** and *** - significant at 10%, 5% and 1%*

Source: Own calculation based on Bankscope data

Lerner index robustness check

Besides a bank specific Lerner index, as a robustness test, we also calculate a country specific Lerner index. For this purpose we use Angelini i Cetorelli (2003) approach, already applied to Croatia by Kraft (2006). The methodology relies on rather simple behaviour model to measure competition level in a country with sufficient data availability. The model assumes that banks generally set prices (that contain two components: marginal cost and market power based mark-up) to maximize their profits. In this case the price equation has the following form: $p_i = C'_j(q_j, w_j) + \lambda,$

with C' being the derivative of cost function C, and represents the marginal cost. Total cost is the function of output quantity q, a price of input is represented by vector w. Consequently, λ is the indicator of market power in a certain industry. Divided with average price in an industry, this indicators allows us to calculate Lerner index, L= λ /p, that shows relative monopolistic mark-up. Angelini and Cetorelli suggest the following translog cost function:

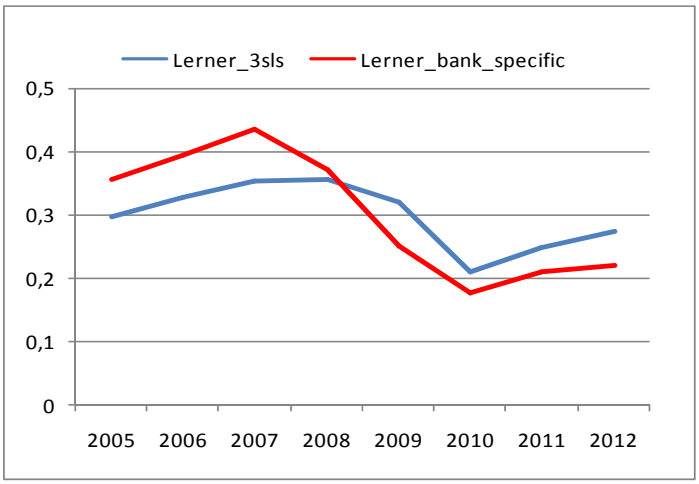
$$Ln(C_j) = C_0 + s_0 \ln q_j + (s_1/2)(\ln q_j)^2 + \sum c\ w_{ij} + \ln q_j \sum s_{i+1} \ln w_{ij} + c4 \ln w_{1j} \ln w_{3j} +$$
$$c5 \ln w_{1j} \ln w_{2j} + c6 \ln w_{2j} \ln w_{3j} + \sum c_{i+6} \ln(w_i)^2,$$

Using the translog function derivative, one can easily calculate marginal cost, C' and return it in function of price, explained earlier which results with the following equation, on which we apply Three-stage Least Squares (3SLS) Method to generate more consistent estimators:

$$p_i = C_j / q_j (s_0 + s_1 \ln q_j + \sum s_{i+1} + \ln w_{ij)} + \lambda.$$

Although this methodology requires a relative rich dataset for each country, after 2005, when our Bankscope data coverage increases (on average to 98% of the banking sector) we generate a relatively similar level and trend of average bank market power for medial CEE country.

Figure A3: Comparison of Lerner index for medial country



Source: Own calculation based on Bankscope data

Country bank competition rank comparison

Although we aware of the fact that bank market power rarely produces statistically significant rank correlation, we conduct additional robustness test by comparing the ranks of countries regarding aggregate bank market power.

Boone indicator and Lerner_WB are publically available country level bank competition indicators. Boone indicator measures competition while other indicators measure market power including Panzar-Rosse test that was modified by generating a (1-PRH original). Panzar-rosse is the sum of elasticity of interest revenue on input price changes. Our bank specific Lerner index ranks are significantly and positively correlated with our country-level Lerner index (3sls) ranks and with World Bank country-level Lerner index ranks. Although not significantly, our bank-specific Lerner index ranks is negatively related with Boone indicator. Our CEF measure is positively related to all Lerner indices (significantly with World Bank Lerner index) with unexpected relation with Boone indicator. However, it has to be kept in mind that CEF is a relative measure.

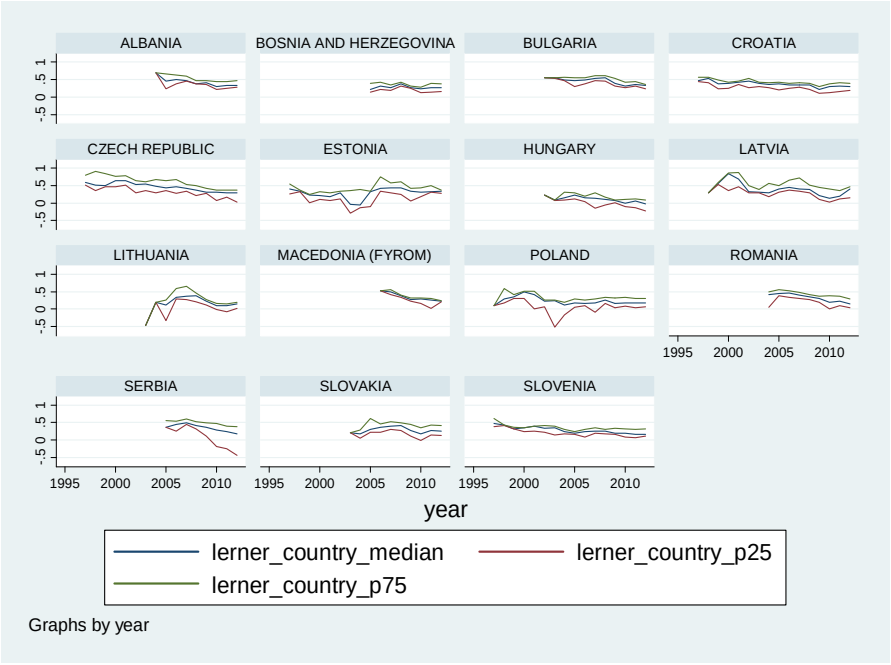
Table A2: Spearman rank correlation matrix

	Lerner 3sls	Lerner_bank_spec	CEF	PRH	Boone_WB	Ler_WB
Lerner 3sls	1					
Lerner_bank_spec	0.4536 0.0895	1				
CEF	0.1393 0.6205	0.3286 0.2318	1			
PRH	0.4679 0.0786	0.1643 0.5585	0.2750 0.3212	1		
Boone_WB	-0.5571 0.0310	-0.0393 0.8894	0.0643 0.8199	-0.2179 0.4354	1	
Ler_WB	-0.0857 0.7613	0.4643 0.0813	0.7393 0.0016	-0.1393 0.6205	0.1286 0.6479	1

Note: upper number represents correlation, lower number significance level

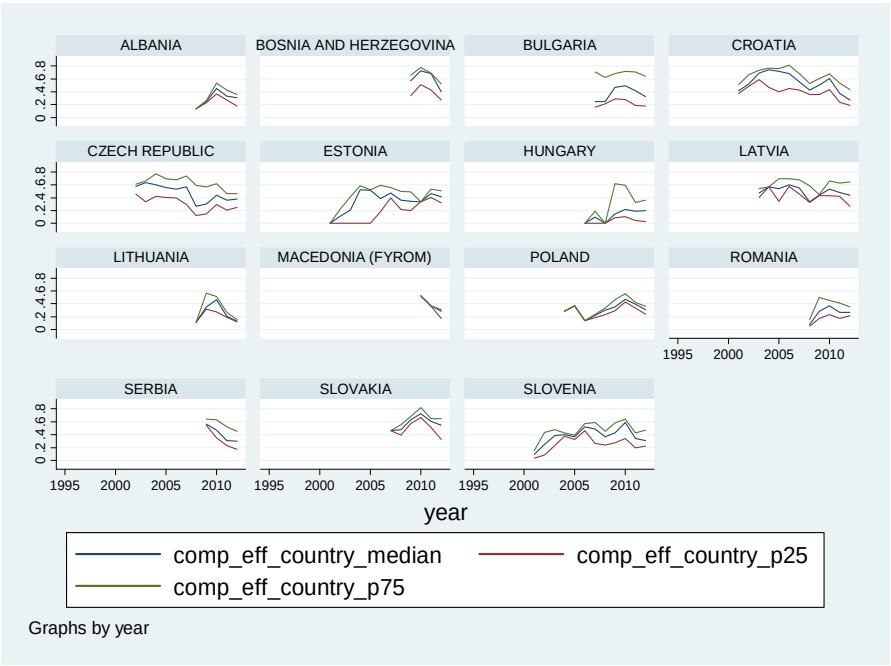
Source: Own calculation based on Bankscope data and World Bank

Figure A4: Average bank-specific Lerner index and percentiles



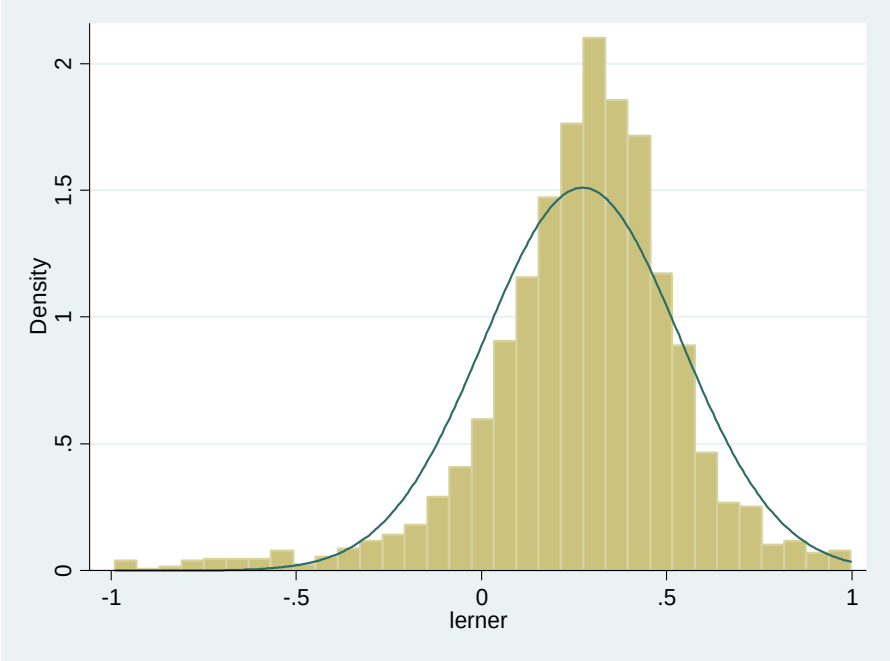
Source: Own calculation based on Bankscope data

Figure A5: Bank-specific CEF indicator percentiles



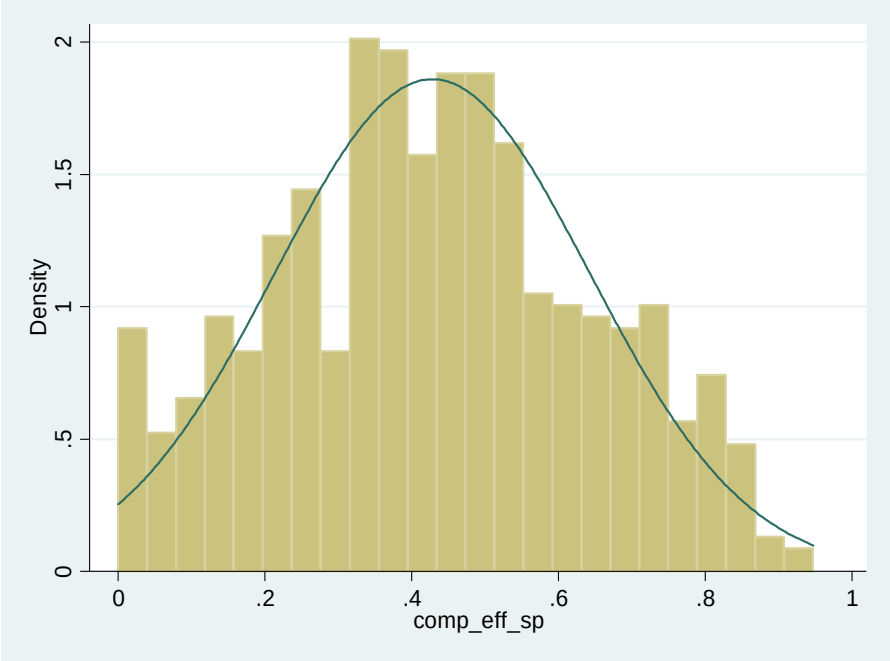
Source: Own calculation based on Bankscope data

Figure A6: Bank-specific Lerner index histogram



Source: Own calculation based on Bankscope data

Figure A7: Competition efficiency frontier histogram



Source: Own calculation based on Bankscope data

References

Edwards, F.R. and Mishkin, F.S. (1995), **The decline of traditional banking: implications for financial stability and regulatory policy**, Economic Policy Review, Federal Reserve Bank of New York, July, 27-45

Agoraki, M, Delis, M. and Pasiouras, F., (2011), **Regulations, competition and bank risk-taking in transition countries,** Journal of Financial Stability 7 (1), 38-48.

Allen, F. and Gale, D. (2004), **Competition and financial stability**, Journal of Money, Credit, and banking 36:3, 433-480

Angelini, P., Cetorelli N. (2003), **The effects of regulatory reform on competition in the banking industry**, Journal of Money, Credit, and Banking 35, 663-684

Ariss R. T. (2010), **On the implications of market power in banking: Evidence from developing countries**, Journal of banking & Finance, 34, 765-775

Beck, T, Demirguc-Kunt, A. and Levine, R. (2006), **Bank concentration, competition, and crises: First results,** Journal of Banking & Finance, 30(5), 1581-1603.

Beck, T. (2008), **Bank Competition and Financial Stability: Friends or Foes,** World Bank Policy Research Working Paper, 4656

Beck T., De Jonghe, O. and Schepens, G. (2011), **Bank Competition and Stability: Cross-country Heterogeneity**, Universitet Gent, working paper, 2011/732

Berger, Alan (1993.), **Distribution-free estimates of banking efficiency in the US Banking Industry and Tests of the Statistical Distribution Assumptions,** Journal of Productivity Analysis, 261-92

Berger, A.N. and Hannan T.H. (1998), **The efficiency cost of market power in the banking industry: a test of the „quiet life" and related hypotheses**, Review of Economics and Statistics 8(3), 454-465

Berger, A. N., Demirgüç-Kunt, A., Levine, R., Haubrich, J. G. (2004), **Bank Concentration and Competition: An Evolution in the Making,** Journal of Money, Credit and Banking, 36 (3), 433-451.

Berger A.N., Klapper L.F. and Ariss R.T. (2008), **Bank Competition and financial stability**, The World Bank Policy Research Working Paper 4696

Besanko, D. and Thakor, A.V. (1993), **Relationship banking, deposit insurance and bank portfolio**, In: Mayer, C. and Vives, X. (eds), Capital markets and Financial intermediation, Cambrige, 292-318

Bolt, W. and Humphrey, D. (2010), **Bank competition efficiency in Europe: A frontier approach,** Journal of Banking & Finance 34 (2010) 1808–1817

Boone, J. (2008), **A New Way to Measure Competition**, Economic Journal, Royal Economic Society, vol. 118(531), 1245-1261

Boyd, J. H. and De Nicolo G., (2005), **The Theory of Bank Risk Taking and Competition Revisited,** Journal of Finance, 60 (3), 1329-1343.

Boyd, J. and others (2006), **Bank Risk-taking and Competition Revisited: New Theory and New Evidence**, IMF Working Paper WP/06/2 97

Caminal, R. and Matutes, C., (2002.), **Market power and banking failures,** International Journal of Industrial Organization, vol. 20(9), 1341-1361,

Carletti, E. and Hartman, P. (2003), **Competition and stability: What`s special about banking?** In: Mizen, P. (ed), Monetary history, exchange rates and financial markets: Essays in honor of Charles Goodhart, Edwart Elgar.

Carbo S., Humphrey D., Maudos J. and Molyneux P. (2009), **Cross-country comparison of competition and pricing power in European banking**, Journal of International Money and Finance Volume 28, 115-134

Chen et al 1986Coccorese, P. and Pellecchia, A., (2010), **Testing the 'Quiet Life' Hypothesis in the Italian Banking Industry**, Economic Notes, Banca Monte dei Paschi di Siena SpA, vol. 39(3), 173-202

Coccorese, P. and Pellechia, A. (2010), **Testing the quiet life hypothesis in the Italian Banking industry**, Economic Notes, 39/3,173-202

Demsetz R., Saidenberg, M. and Strahan, P (1986), **Banks with Something to Lose: The Disciplinary Role of Franchise Value**, federal Reserve Bank of New York, working paper, http://www.nyfedeconomists.org/research/epr/96v02n2/9610dems.pdf

Dermine, J. (1986), **Deposit rates, credit rates and bank capital : The Klein-Monti Model Revisited**, Journal of Banking & Finance, 10(1), 99-114

De Jonghe, O. and Vennet, R. V. (2008), **Competition versus efficiency: What drives franchise values in European banking?**, Journal of Banking & Finance, 32(9), 1820-1835

De Young, R. (1997), **A Diagnostic Test for the Distribution-Free Efficiency Estimator: An Example Using U.S. Commercial Bank Data**, European Journal of Operational Research, 98, 243-249

Dumičić, M. and Ridzak, T. (2012), **Determinants of Banks' Net Interest Margins in the CEE**, The Eighteen Dubrovnik Economic Conference, Croatian National Bank, Dubrovnik, June 2012, http://www.hnb.hr/dub-konf/18-konferencija/dumicic-ridzak.pdf

Furlong, F. and Kwan S., (2006), **Sources of Bank Charter Value**, federal Reserve Bank of San francisco, working paper, http://www.fdic.gov/bank/analytical/cfr/2006/sept/FFurlong.pdf

Gaganis, C. and others (2010), **Modelling banking sector stability with multicriteria approaches**, Optimization Letters November 2010, Volume 4, Issue 4, pp 543-558

Greene, W. (2008), **Econometric Analysis** (6th ed, 2008), Prentice Hall Reference Books

Gropp, R., Hakenes, H. and Schnabel, I. (2011), **Competition, Risk-shifting, and Public Bail-out Policies**, Review of Financial Studies, Society for Financial Studies, 24(6), 2084-2120

Group of four (2008), **Results of the Fifth CNB Bank Survey**, Croatian National Bank Survey, S-15

Harberger A.C. (1954.), **Monopoly and Resource Allocation**, The American Economic Review, Papers and Proceedings of the Sixty-sixth Annual Meeting of the American Economic Association, 44(2): 77-87

Hellman, T., Murdock, K. and Stiglitz, J. (2000), **Liberalization, moral hazard in banking and prudential regulation: Are capital controls enaugh?**, American Economic Review 90:1, 147-165

Hicks J.R. (1935), **Annual Survey of Economic Theory: The Theory of Monopoly**, Econometrica, 3(1), 1-20. "The best thing about monopoly is quiet life"

Honohan i Klingebiel (2000): Controlling Fiscal Costs of Banking Crises, World Bank http://www1.worldbank.org/finance/assets/images/depins02.pdf

Jahn, N. and Kick, T. (2012), **Determinants of Banking System Stability: A Macro-Prudential Analysis**, Banken-Workshop; BCBS, CEPR and JFI, http://www.bis.org/bcbs/events/bhbibe/jahn.pdf

Kasman, A. and others (2010), **Consolidation and commercial bank net interest margins: Evidence from the old European Union members and candidate countries**, Economic Modelling 27, 648-655

Keeley, M.C., (1990), **Deposit insurance, risk and market power in banking,** American Economic Review 80, 1183-1200.

Kraft, E. i Huljak, I. (2011.), **A frontier approach for measuring bank competition efficiency in Croatia**, Conference preceding "Challenges of Europe: growth and competitiveness – reversing the trends", Faculty of economics, Split

Kraft, E. i Tirtiroglu, D. (1998.), **Bank Efficiency in Croatia: A Stochastic-Frontier Analysis**, Journal of Comparative Economics, 26/2, 286-300

Kraft, E., Payne, J. i Hofler, R. (2006.), **Privatization, Foreign Bank Entry, and Bank Efficiency in Croatia: A Fourier-Flexible Stochastic Frontier Analysis**, Applied Economics, 38: 2075-2088

Kraft and others, (2004.), **Privatization, Foreign Bank Entry and Bank Efficiency in Croatia: A Fourier-Flexible Function Stochastic Cost Frontier Analysis**, Croatian national bank working paper, W-9

Kraft, E. (2006.), **How much is the competition in Croatian banking sector?** Croatian National Bank working paper, W-14

Kohler, M. (2012.): **Which banks are more risky? The impact of loan growth and business model on bank risk-taking**, Deutsche Bundesbank Discussion Paper, 33/2012

Kumbhakar, S. and others, (2007.), **Nonparametric stochastic frontiers: A local maximum likelihood approach**, Journal of Econometrics, 137(1), 1-27

Koskela, E. and Stenbacka, R. (2000), **Agency Cost of Debt and Lending Market Competition: A Re-Examination,** Bank of Finland Discussion Papers, 12/2000,

Leaven, L. and Valencia, F., (2012), **Systemic Banking Crisis database: An Update**, IMF working paper, WP/12/163

Lerner, A. (1934.), **The Concept of Monopoly and the Measurement of Monopoly Power**, The Review of Economic Studies, 1/3, 157–175.

Martinez-Miera, D. And Repullo, R. (2010), **Does competition reduce the risk of bank failure?**, Review of Financial Studioes, 23/10, 3638-3664

Jimenez, G., J. A. Lopez and J. Saurina Sala, **How does competition impact bank risk-taking?**, Banco de Espana Working paper, no. 1005

Marcus, A.J. (1984), **Deregulation and bank financial policy**, Journal of Banking and Finance 8, 557-565

Maudos, J. and de Guevara, J. (2004), **Factors explaining the interest margin in the banking sectors of the European Union**, Journal of Banking & Finance, 28(9), 2259-2281

Mishkin, F. (1999), **International experiences with different monetary policy regimes**, Journal of Monetary Economics, 43(3), 579-605

Saez, L. and Shi, X., (2004), **Liquidity pools, risk sharing and financial contagion**, Journal of Financial Services research 25, 5-23.

Suarez, J. (1994), **Closure rules, market power and risk-taking in a dynamic model of bank behavio**ur, LSE Financial Markets Group DP 196/1994

Tobin, J., (1969.), **A general equilibrium approach to monetary theory**, Journal of Money Credit and Banking 1 (1): 15–29

Tirole J. (1988.), **The theory of industrial organization**, MIT Press, Cambridge, MA.

Robinson J. (1969.), **The Economics of imperfect competition' with a comparable theme of distinguishing perfect from imperfect competition**, London, Macmillan

Schaeck K., Cihak, M. and Wolfe, S., (2009), **Are Competitive Banking Systems More Stable?,** Journal of Money, Credit and banking, 41, 4, 711-734

Stiglitz, J. and Weiss, A. (1981), **Credit Rationing in Markets with Imperfect Information**, The American Economic Review, 71/3

Tabak, B., Rodrigues M. and Da Silva M. (2012), **The impact of market power at bank level in risk-taking: The Brazilian case**, Banco Central De Brasil, Working paper 283, http://www.bcb.gov.br/pec/wps/ingl/wps283.pdf

Whish, R. (2005), **Competition Law**, Oxford University Press Inc., New York.