Changes in the Structure of the Banking Sectors in Europe—The Role of Competition between Banks

Małgorzata Pawłowska[1]

April 2015

Abstract

The aim of this paper is to present the changes in the banking sectors of European Union (EU) countries both before the last global financial crisis and during the crisis, with particular emphasis on the change in concentration and competition, in an attempt to determine the relationship between competition, concentration, and risk-taking by banks. This paper also addresses the current problems in the banking sector of the EU (i.e., banks are too-big-to-fail (TBTF)), and attempts to solving these problems within the framework of regulatory initiatives.

The empirical results based on panel data analysis find that increasing the concentration and size of the banking sectors within EU from the period 2006–2010 had a negative impact on financial stability. The results for competition are unambiguous, as competition had a positive impact on financial stability, mainly within the EU-12 banking sectors.

Keywords: banking and finance, market structure, competition, European Union (EU), banking regulations, panel data analysis, financial stability.

JEL classification: F36; G2; G21; G34; L1.

[1] Warsaw School of Economics, mpawlo1@sgh.waw.pl, Narodowy Bank Polski, Economic Institute. This paper *presents* the personal opinions of the author and does *not* necessarily reflect the official position of Narodowy Bank Polski.

Introduction

The last two decades have witnessed dynamic growth within banking assets. The value of the assets of the entire banking sector of EU-27 is equivalent to 350% of the EU GDP. Additionally, before the last global financial crisis we observed a sharp increase in lending, which caused a mounting imbalance between development within the financial market and economic development, highlighting the fact that potentially excessive credit expansion leads to both macroeconomic and financial gaps. Credit booms cause banks to shift their focus toward increasing profits while ceasing to monitor and properly assess risk, which leads to an increase in non-performing loans and problems within the banking sector as a whole. The problem of banks being too-big-to-fail (TBTF) has also emerged, as rescuing such banks carries enormous social costs. At the same time, regulatory work concerning the new supervisory architecture within EU-27 shows progress in minimizing the effects of future crises.

The macroeconomic imbalances revealed by the recent financial crisis prompt us to ponder the question of proper size within the financial sector under the present circumstances and whether the current regulatory changes can minimize the TBTF problem and reduce the size of banks, the rescue of which is carried out with taxpayers' money and carries huge social costs.

Changes within the banking sector of the EU have a huge impact on the level of concentration and competition between banks. Therefore, the financial crisis has highlighted once again the role of competition between banks, its impact on financial stability, and the relationship between concentration and the level of competition.

The aim of this paper is to present the changes within the structure of the banking sectors of EU countries both before the financial crisis and during the crisis, with particular emphasis on changes in concentration and competition. The paper also addresses the current problem concerning banks becoming too-big-to-fail (TBTF) and attempts to solve those problems within the framework of regulatory initiatives in the EU. Finally, this paper attempts to determine the relationship between competition, concentration, and financial stability as well as determining the role of competition between banks.

The empirical results based on the panel data analysis show that the increasing size of the banking sector has had a negative impact of risk-taking within EU banks. This paper will therefore attempt to determine the role of competition in both large (EU-15) and small (EU-12) European banking sectors from 2006–2010.

The structure of this paper is as follows. The first section outlines the changes that have taken place in the structure of the individual banking sectors of the EU. The second section attempts to determine the right size of the banking sector, and the third section discusses the problem of TBTF banks along with the measures taken post-crisis with respect to this. Finally, the fourth section presents a literature review about the role of competition between banks and the empirical model based on panel data analysis concerning the impact of competition and concentration on the financial stability of EU banking sectors. The paper concludes with a summary.

1. Changes in the size and structure of banking sectors of the EU

The past fifty years have seen systemic shifts in the structure, size, and composition of financial systems, both globally as well as in the EU. These changes have given rise to the TBTF problem. In 2011 the assets of the banking sector of EU-27 countries grew nearly two-and-a-half times in comparison with 1998. At the same time, due to the mergers and acquisitions (M&A) process, there has been a decrease in the number of monetary financial institutions (MFIs), which means that the individual banks in EU-27 countries are getting bigger. In 2012 the assets of the banking sector of EU-27 countries decreased slightly (cf., Figure 1 in the appendix 1).

It should be noted that the banking sectors of EU-27 countries are not homogeneous. We can see a clear difference in the value of assets of the so-called old and new EU member states EU-12 (i.e., Cyprus, Czech Republic, Estonia, Lithuania, Latvia, Malta, Poland, Slovakia, Slovenia, Hungary, Bulgaria, Rumania) (cf., Figure 2 in the appendix 1). The Polish banking sector has the largest assets of the entire group of the so-called new member states of EU-12. Among the countries of the so-called old union, EU-15 (Austria, Belgium, Denmark, Finland, France, Greece, Spain, the Netherlands, Ireland, Luxembourg, Germany, Portugal, Sweden, United Kingdom, and Italy), the banking sector of the United Kingdom (UK) has the largest assets. The lack of homogeneity of the banking sectors is also reflected in the share of assets of the individual banking sectors in the overall GDP. The assets of the banking sector of the UK amount to more than 500% and the banking sector, and those in Ireland amount to more than 800% of their respective GDP[2] (cf., Figure 3 in the appendix 1). The average for EU-27 countries is about 400%.

[2] The figure for Luxembourg was approx. 2,000% in 2011 and approx. 3,000% in 2002. See also Bijlsma et al. (2013).

The assets of the banking sector are mainly found in loans. Bank loans in the EU are the most important source of external funding not only for households but also for businesses, and they play a significant role in shaping the changes in business activity and in transmitting monetary policy impulses to the real economy.

The main factors that have contributed to the dynamic growth of credit in the EU include the creation of the euro area, was saw an increase in cross-border credit and credit booms in the property market. Loans to the private sector are predominantly loans to businesses and households, which mainly include housing loans and consumer loans (cf., Figure 4 Panel A in the appendix 1).

Before the financial crisis there was a robust growth of credit to the private sector within EU-15 countries, mainly in the euro zone. However, the structure and growth of the credit to the private sector also varies between the euro area countries (e.g., the rapid increase of housing loans in Spain and Ireland led to the bursting of the speculative bubble in that market and a banking crisis in those country). Before the financial crisis a robust growth of credit to the private sector, associated with the so-called catching-up process, was also observed in EU-12 countries. This increase was seen both in loans to households and to businesses. This growth was particularly strong in the Baltic states (i.e., Lithuania, Latvia and Estonia) whereas this growth was significantly weaker in Poland, especially in terms of corporate credit. The main reason for the slow growth in credit to businesses in Poland was the fact that its own funds continued to be the primary source of financing (i.e., internal financing) (cf., Figure 4 Panel B in the appendix 1).

The banking crisis was reflected in the value of the non-performing loans ratio (NPL). The value of this ratio in the banking sectors of the EU increased significantly from 2006–2012 (cf., Figure 5 in the appendix 1).

2. The optimum size of the banking sector, the economies of scale, and the scope of the product

The global financial crisis has shown that credit growth caused a deepening of the imbalances present between development of the financial market and economic development, thus showing that countries where home-loan booms occurred the consequences of the crisis were more pronounced.

However, prior to the financial crisis, the excessive growth of assets in the banking sector did not raise objections among many economists and researchers. The crisis actually resulted in the emergence of new studies attempting to identify the optimal size of the banking

sector, with very different conclusions than those preceding the financial crisis. It should be noted that prior to the crisis there were many studies pointing to the positive effects of the so-called *financial deepening* of economic growth. Many studies from the early 1990s demonstrated a positive correlation between the development of the financial sector and growth (i.e., Rajan & Zingales, 1998; Beck & Levine, 2004; Levine, 2004). However, there were also studies demonstrating that this influence is ambiguous and depends on institutional factors, macroeconomic conditions, or the size of the economy (Demetriades & Hussein, 1996; Demetriades & Hook, 2006).

The financial crisis brought renewed interest to the issue of the optimum size of the financial sector. As a result, studies began to appear where the optimum level of financial development was identified. The paper by Arcand et al. (2012) demonstrated that there is a ceiling for the size of the financial sector above which further financial development hurts economic development. The authors found that when the credit-to-GDP ratio exceeded 100% there was an adverse effect on economic growth, which was confirmed by Cecchetti et al. (2011).

Studies concerning *economies of scale* are particularly interesting in this context. As a result of mergers between large banks, new banks are created that are even larger than the existing ones, with the result that they TBTF institutions. Banks that are too big to be allowed to collapse pose moral hazard for managers who receive public aid for the bankrupting banks and are inefficient. The existence of economies of scale (or a lack thereof) should affect the development of the structure and the optimum size of banks. The model of economies of scale for a bank describes the relationship between the size of the bank (measured by various metrics such as the size of assets and the number of products and services offered) and the average total cost of the bank. Positive or negative economies of scale are an indication of how close the tested bank is to the optimum size.

Prior to the global financial crisis, a study by Pulley and Braunstein (1992) found that the boundary above which an increase in the volume of assets no longer causes positive economies of scale is 100 million USD. A paper published before the crisis stated that this ceiling was 10 billion USD (Mester, 2005, 2008). Subsequent studies published after the crisis (Wheelock & Wilson, 2012; Hughes & Mester, 2012) pointed to an even higher threshold—over 100 billion USD. However, critics of these studies emerged, stating that the proposal of such a large volume of assets (i.e., 100 billion USD) is based upon inaccurate estimates of the costs of bank financing, which do not include the grants and subsidies related to banks that are too big to fail (cf., Haldane, 2012).

When comparing the volume of assets of commercial banks operating in individual countries and the limits above which an increase in the volume of assets no longer causes positive economies of scale, there are several factors to account for including the size of individual countries, their population, and the business model. Therefore the results from the U.S. banking sector cannot be applied directly to the EU-27 banking sectors. The results of the assessments also depend on the construction of the bank model, which is usually a simplification of a much more complex reality.

Also in terms of *the economies of scope*, no negative effects of diversification of banking products were noted before the global financial crisis. Studies published after the financial crisis, however, clearly suggest that diversification of products has harmful consequences for the banks. This applies both to the investment activities of banks as well as financial conglomerates. Fiordelisi and Marques-Ibanez (2013) demonstrated that a diversification in the scope of products causes a significant increase in risk. Positive aspects apply only to the geographic diversification of banking activities (cf., Gambacorta & Van Rixtel, 2013). Therefore, the current activities of regulators relate mainly to the separation of traditional loan and deposit banking from investment banking.

3. The too-big-to-fail (TBTF) problem—Actions taken

The increase in the assets of the EU banking sector led to the problem of banks that were too-big-to-fail (TBTF). An increase in the assets of the banking sector accompanied by a decrease in the number of financial institutions caused an increase of the CR5[3] and HHI[4] concentration ratios. The introduction of a single currency meant that the banking institutions operating in the monetary union willingly engaged in mergers and acquisitions, in particular cross-border mergers and acquisitions, in order to increase their own efficiency and profitability. However, the greatest surge in mergers was recorded in the period before the adoption of the euro in 1999, while in the subsequent period the rate of consolidation of the financial system declined. In many EU countries consolidation of the banking sector occurred once again during the financial crisis, but its cause in this case was different from those occurring in the first phase of functioning in the euro area. The current M&A are mostly the result of acquisitions of banks facing bankruptcy by other banks or government institutions. The consolidation processes were also reflected in the concentration ratios, which exhibited

[3] The CR5 ratio represents the market share of the five largest banks.
[4] The Herfindahl-Hirschman Index (HHI) is calculated as the sum of the squares of the market share of individual commercial banks (e.g., in the net assets). The index can range from 0–1, with higher values of the index denoting a greater the concentration of the market.

an upward trend in monetary union countries (cf., Figure 6 in the appendix 1). The banking sectors with the highest concentration include Estonia, the Netherlands, and Finland, whereas the banking sectors with the lowest concentrations are Germany, Luxembourg, and Italy.

The increase in the volume of assets of individual banks, the increase in concentration within the banking sectors, and cross-border links between large banks means that we can now talk about the policy of international organizations in relation to TBTF institutions. On the 4th of November 2011 the Financial Stability Board published a list of the largest cross-border banking corporations (G-SIFIs)[5]. Table 1 presents a list of the largest European cross-border banking corporations (G-SIFIs). On the 1st of November 2012, the BBVA from Spain and Standard Chartered from the United Kingdom were added to the list while Commerzbank and Lloyds Banking Group were removed.

The list of G-SIFIs[6] is updated and published by the Financial Stability Board in November of each year. The fact that some of these banks are parent-banks of banks operating in EU-12 countries is of significance for these banking sectors (e.g., Unicredit Group and Crédit Agricole Group are parent banks in the Polish banking sector).

The financial crisis and the increase in systemic risk associated with cross-border links between large banks gave rise to activities aimed at reforming the post-crisis national and international institutional system in an effort to improve the supervision of banks, including the systemically important banks. Among these post-crisis measures, the new European institutional supervisory architecture is worth noting. This system consists of two pillars: macro-prudential supervision and micro-prudential supervision. The European Systemic Risk Board was established and put in charge of macro-prudential supervision, which is a process of monitoring and evaluating the potential systemic risks to the stability of the financial system in the European Union. Thanks to the macro-prudential supervision, credit growth and ratios are now monitored on an ongoing basis to identify any threats to the stability of the system. New EU micro-prudential supervisory institutions have also been created that function within the framework of the general European System of Financial Supervision (ESFS), but with a sectoral focus. These institutions include the European Banking Authority (EBA), the European Insurance and Occupational Pensions Authority (EIOPA) and the European Securities and Markets Authority (ESMA).

[5] Criteria for the designation of G-SIFI's: size and international links of the bank, lack of readily available substitutes for services provided or adequate infrastructure for services, global activity (i.e., activity in many legal jurisdictions), and complexity of the activity (i.e., its impact on the financial system and the economy).
[6] FSB, 4.11.2011. The group of G-SIFIs will be updated annually and published by the FSB each November.

Also, regulations on liquidity and capital management have been adopted (Capital Requirements Regulation and Directive—CRDIV/CRR)[7] as part of the implementation of the Basel III legislation.

A major step in combating the crisis is the project of a banking union—however, this still lacks a complete and final shape. The current project assumes a successive transfer of competences from the national to the EU level. In the first place, the creation of a Single Supervision Mechanism (SSM) is envisaged, utilizing funds from the European Stability Mechanism (ESM) and the creation of a Single Resolution Mechanism (SRM). Th Single Supervision Mechanism (SSM) was started in 2014. At the present stage, the centralized deposit insurance systems are being abandoned, and common banking supervision will first cover systemically important banks in the euro area. Countries outside of the euro area, including Poland, may enter the common supervisory system under the framework of a close co-operation or association. The aim of the project is to reduce the involvement of taxpayers' money in bank bailouts. However, at this stage it is difficult to determine whether this objective will be achieved and whether a banking union will help to solve the problems faced by the biggest banks.

Possible solutions to the problem TBTF banks were discussed in many reports (i.e., reports by de Larosière, Vickers, Volcker, and Liikanen) and presented concepts for reforming the banking system. In the United States, Volcker attempted to solve the problem of TBTF banks by defining the necessary reforms, which were introduced in the Dodd-Frank Act in 2010. The Vickers report (Vickers 2010), concerning the reforms of the banking sector in the UK, highlights the role of competition in the banking sector, which increases the efficiency of banks and may help in solving the problem of TBTF banks. The Liikanen report (Liikanen, 2012) formulated conclusions concerning appropriate business models and the separation of deposit activities from investment activities.

4. The role of competition between banks

4.1 Competition between banks—A literature review

The global financial crisis reignited the interest of policy makers and academics concerning the impact of market competition within the banking industry as well as the role

[7] Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC2006/49/WE, and Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012.

of the state in shaping competition policies. In contrast to non-financial companies, banks were previously regarded as public trust organizations resistant to market forces due to the influence of monetary and financial policies of central banks and supervisory authorities.

While the positive role of competition in the commodity markets was unquestioned, historically the banking market was seen as an area where the strong external effects necessitated regulating the level of competition. The situation has changed substantially in the last decades, due to the progressive deregulation and liberalization of markets and the dynamic development of product innovations. As a result, the banking sector became the banking industry, which resulted in a general increase in competition.

Competition and concentration were identified in the classic model based on the structure-conduct-performance paradigm (SCP), which dominated until the late 1970s. The SCP model assumed that in a more concentrated system there is less competition, which means that the probability of price fixing is higher. This in turn leads to higher profits and a positive relationship between concentration and profitability (Bain, 1951). However, subsequent results of analyses based on the SCP paradigm have shown that the relationship between the structure of the market and conduct is more complex. Similar to SCP is the theory based on the efficiency structure hypothesis (ESH) that was developed by Demsetz (1973). According to the ESH, concentrated markets are those where highly effective firms (banks) operate. Hicks (1935) developed a theory opposite to the ESH, and it is known in literature as the quiet life hypothesis (QLH). According to the QLH, firms with superior market strength and thus a privileged position suffer a lower cost efficiency due to the quiet life of their managers.

The modern theory is based on the New Empirical Industrial Organization (NEIO) literature, which provided empirically applicable tests based on either aggregate industry data or individual firm data. Methods based on NEIO do not take into account the direction of the change in the level of concentration and they presume that the degree of competition does not always depend on concentration measures, as other market characteristics including dynamic barriers to entry and exit are more important. In this theory, the intensity of competition should be assessed jointly: the degree of concentration and the range of possibilities of entering into a given industry are determined by the dynamic barriers to entry.

Changes in competition within the banking sector are taking place mainly through two channels: mergers and acquisitions (M&A) and regulations stimulating barriers to entry and to exit. The Industrial Organization Approach to Banking (IOAB) is a theory concerned with the issue of measuring competition in the banking sector and defines the following measures

of competition: the Lerner index,[8] the H-statistic,[9] and the Boone-indicator[10] (cf., Degryse et al., 2009; Van Hoose, 2010, Bikker & Leuvensteijn, 2014).

Specific to the financial sector is the link between competition and stability, long recognized in theoretical and empirical research and, most importantly, in the actual conduct of prudential policy towards banks (Schaeck et al., 2006; Vives, 2010). It should be noted that there is no scientific consensus on whether bank competition leads to greater or lesser stability in the banking sector (cf., Schaeck et al., 2006; Schaeck & Čihák, 2008; Vives, 2010; Guevara & Maudos, 2011). On the one hand, competition may enhance financial stability by pushing unstable banks out of the market. On the other hand, competition can encourage banks to take greater risks in order to become more profitable (Bikker & Leuvenstein, 2014), and this excessive level competition in the financial market caused the financial crisis.

Before the financial crisis, Cetorelli (2004) and others confirmed that an increase in competition is generally positive for economic development—however, there are possible channels through which it can have a negative impact. Greater competition may lead to greater amounts of credit in the market and an increase in the share of non-performing loans. During the financial crisis, Vievs (2010) and others found that competition may increase financial instability on the part of both depositors and borrowers by increasing the risk incurred. That is why it is important to determine the optimal level of competition. Moreover, Vievs (2010) demonstrated that some aspects of competition in the banking sector (e.g., low barriers to entry and openness to international capital) are positively correlated with the level of stability.

An issue addressed in the literature is the relationship between the consolidation of the banking system and increasing concentration and competition. Although it seems that the general relationship here is obvious (i.e., a larger share in the market determines increased market power and decreased competition), many empirical studies found that there is no clear relationship between an increase in the concentration of a system and the level of its competition (cf., Claessens & Laeven, 2003).

A number of studies have attempted to determine trends in competitive behaviour over time. Most studies before the crisis were based on the Lerner index (e.g., de Guevara & Maudos, 2004, 2007; de Guevara et al., 2007; Carbó & Rodrıguez, 2007; Maudos et al., 2007)

[8] The Lerner Index measures the so-called monopoly mark-up. According to the Lerner index, the market power of a monopoly depends on the price elasticity of market demand. The increasing value of the Lerner Index indicates a decrease in competition.

[9] Panzar and Rosse defined the measure of competition as the value of the sum of revenue elasticities, known in the literature as the H-statistic. The increasing value of the H-statistic indicates an increase in competition.

[10] The Boone method is based on the so-called efficient structure (i.e., hypothesis ESH) (cf., Pawłowska (2011).

and found a reduction of competition during the 1990s in EMU countries. However, de Guevara et al. (2004) and Angelini and Cetorelli (2003) demonstrated an increase in competition despite increased concentration. Finally, Carbó et al. (2009) found that when using different measures of competition (i.e., the Lerner index, the H-statistic, and net interest margin) different conclusions are obtained concerning competitive behaviour due to that fact that the competition indicators measure different things. Bolt and Humphrey (2012) formulated a similar conclusion.

The results of the empirical studies concerning the direction of the changes in concentration and competition between banks in the EU both before and during the financial crisis generally demonstrated that concentration in the EU banking sectors continued to grow both before the crisis and during the crisis—banks were continuing to increase in size. However, the results concerning the direction of the changes in competition between banks within EU-15 countries are ambiguous (cf., Bikker et al., 2012; Weill, 2013). These results demonstrated a decreasing trend in competition after the crisis and convergence in the measure of competition before the crisis between EU-15 and EU-12 countries. EU-12 countries experienced an increase in competition before the crisis and a slight decrease during the crisis (cf., Pawłowska, 2012; Clerides et al., 2013; Efthyvoulou and Yildrim, 2013). It is worth knowing, however, that before the financial crisis the level of competition in many EU countries, estimated using the H-statistic, was described as a monopolistic competition. However, after a proper re-estimation of the model, it turns out that these were oligopolistic structures, which contradict the conclusion that the creation of the euro area contributed to an increase in competition (cf., Bikker et al., 2012; Pawłowska, 2012).

After the Lehman Brothers collapse there are a lot of questions concerning the role of the state in shaping competition policies, resulting in an intensification of research on the relationship between the degree of competition on the banking market, the level of concentration, and the efficiency of banks, including research testing the impact of competition in the banking sector on economic growth (i.e., Chortareas et al., 2013). Ratnovski (2013) stressed that banks in advanced economies have high incentives to take risk. In such an environment, traditional policies that seek to affect the degree of competition by focusing on market structure (i.e., concentration) may have a limited effect. Ratnovski argued that a bank's competition policy should be reoriented to deal with the TBTF problem. It should also focus on the permissible scope of activities rather than on the market structure of the banks. The World Bank report entitled Rethinking the Role of the State in Finance (2013) concluded that competition can help increase efficiency if there are good regulations and good

supervision. Also, Vives (2010) emphasized the role of competition in the banking sector and the coordination of regulatory and competition policies. Currently, the general principles of the competition policy apply to the banking sector with regard for the specific nature of the sector and its institutional framework.

4.2 Empirical Method and Regression Results concerning the Relationship between Competition, Concentration, and Financial Stability in EU-27 Countries

This section includes an empirical analysis based on panel data in order to investigate the role of competition in the EU banking sectors during the crisis. A quantitative assessment is performed to determine the impact of competition in the EU-27 banking sectors on financial stability, using regressions of annual panel data for the period of 2006–2010. The following three types of estimators are used: GMM,[11] FE,[12] and pooled OLS[13]. Table 1 presents the estimated results for GMM and additional estimations are presented in Table A3 and A4 in the statistical appendix 2.

The research is divided into three levels of investigation: Panel A includes the smallest banking sectors with regard to their total assets (i.e., EU-12), Panel B includes the largest banking sectors (i.e., EU-15), and Panel C includes EU-27. The annual banking statistics data for this research are taken from the World Bank (competition measures)[14], IMF (Global Financial Soundness Indicators), Eurostat, and ECB (Statistical Data Warehouse). In case to determine the measure of risk within the EU banking sectors the ratio of non-performing loans to total gross loans (NPL) was taken in this model. NPL data was retrieved from the IMF database. Table A1 in the appendix 2 presents the descriptive statistics of the variables used in the empirical analysis and table A2 in the appendix 2 presents correlation coefficients.

The following regressions with the ratio of non-performing loans to total gross loans (NPL) as the dependent variable were calculated as follows:

$$NPL_{it} = \alpha + a_1 * market\ structure_{it} + a_2 * size\ of\ banking\ sectors_{it} + a_3 * ROA_{it} + \sum_{j=1}^{N} b_j * tj + \varepsilon_{it} \quad (1)$$

[11] Dynamic panel data model, based on the first difference.
[12] Fixed-effects panel data estimations.
[13] Pooled OLS estimations. The pooled OLS estimator ignores the panel structure of the data.
[14] http://www.worldbank.org/en/research, and the St. Louis Fed's Economic Research web site.

where NPL_{it} denotes the ratio of non-performing loans to total gross loans for each banking sectors in the EU *i* and for each year *t*.

Market structure measures were determined by taking the competition measure from the Lerner index (L_{it}) and H-satistics (H_{it}) for each banking sector *i* in the EU for each year *t*. The regression also estimated the variable indicating concentration ratios (i.e., the share of the five largest banks' total assets) ($CR5_{it}$) for each banking sector *i* for each year *t*, and the Herfindahl-Hirschman index for assets (HHI_{it}) for each banking sector *i* for each year *t*.

The model also tests the impact of the size of the banking sector on risk taking. The regression is also estimated with the independent variable indicating the size of the banking sector, which is defined as the share of banking sector assets in the GDP for each banking sector *i* for each year *t* ($size_{it}$). The control explanatory variable is the profitability ratio return of assets (ROA_{it}) for each banking sector *i* for each year *t*. The variable α is a constant term, ε_{it} denotes the error, and a_1, a_2, a_3 are the regression coefficients. Due that fact that external factors during the global financial crisis had an impact on the risk taken in the banking sector, the time effect (tj) for each year of the analyses is also tests, and bj, are the time effect regression coefficients.

To determine the robustness, additional estimations were calculated with the growth of loans (GL_{it}) for each banking sector *i* for each year *t*, as a dependent variable. For this model we also consider the profitability ratio and the core capital Tier 1 for each of the banking sectors *i* for each year *t* ($Tier1_{it}$). The following regressions were calculated with the growth of loans (CG_{it}) as the dependent variable[15] :

$$CG_{it} = \alpha + a_1 * market\ structure_{it} + a_2 * size\ of\ banking\ sectors_{it} + a_3 * ROA_{it} + \sum_{j=1}^{N} b_j * tj + \varepsilon_{it} \quad (2)$$

The variable α is a constant term, ε_{it} denotes the error, a_1, a_2, a_3 are the regression coefficients, and b_j is the time effect regression coefficient.

The results of above regressions are presented in Table A5 in statistical appendix 2.

[15] Due to a lack of IMF data concerning credit within the private sector, the regression was calculated for all EU-27.

Table 1. Competition and Risk - Regression results

Dependent Variable NPL				
Panel A: EU-15				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	**-0.8880724**	-	-	-
H-statistic	-	**1.62338**	-	-
CR5	-	-	**0.0866505*** **	-
HHI	-	-	-	**10.3186**
Size	0.380012**	0.0474902	0.3408047**	0.3150635***
ROA	-0.31077***	-0.22878**	-2.854936***	-0.2559276***
Time effects	Yes	Yes	Yes	Yes
Arellano-Bond	(0.1946)	(0.2223)	(0.2122)	(0.2116)
test	(0.4348)	(0.2284)	(0.4833)	(0.4818)
Saragan test *(p value)*	(0.1975)	(0.2429)	(0.3839)	(0.3000)
number of observations			53	
number of groups			15	
Panel B: EU - 12				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	**35.83953*** **	-	-	-
H-statistic	-	**-9.58968*** **	-	-
CR5	-	-	**0.066623*** **	-
HHI	-	-	-	**49.12614*** **
Size	-1.435035**	-2.151416	0.5098954***	0.4171463***
ROA	-3.9175***	-1.169409***	-3.516799***	-3.361353***
Time effects	Yes	Yes	Yes	Yes
Arellano-Bond	(0.1988)	(0.5949)	(0.1434)	(0.2177)
test	(0.3508)	(0.4751)	(0.1070)	(0.2375)
Saragan test *(p value)*	(0.4925)	(0.3202)	(0.5069)	(0.3660)
number of observations			47	
number of groups			12	
Panel C: EU-27				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	**0.4487165**	-	-	-
H-statistic	-	**-7.36056*** **	-	-
CR5	-	-	**-0.0758288**	-
HHI	-	-	-	**-20.20315**
Size	0.448716***	0.4105249**	0.6392259***	0.6160789***
ROA	-1.99121***	-1.027465***	-3.516799***	-3.361353***
Time effects	Yes	Yes	Yes	Yes
Arellano-Bond	(0.1988)	(0.5949)	(0.1434)	(0.2177)
test	(0.3508)	(0.4751)	(0.1070)	(0.2375)
Saragan test *(p value)*	(0.4925)	(0.3202)	(0.5069)	(0.3660)
number of observations			100	
number of groups			27	

Source: author's calculations. ***/**/* indicate significance at the 1/5/10% level respectively.

The insignificant coefficient (a_1) from Table 1 in Panel A is determined by regression 1 and 2. This means that competition had an insignificant impact on risk taking within EU-15

banks. By contrast, a positive and significant coefficient (a_1) is determined by regression 3. This means that concentration had a positive impact on risk taking within EU-15 banks and that growing concentration leads to instability within EU-15 banks. In Panel A, the positive coefficient (a_2) is determined by regressions 1, 3, 4. This means that the size of the banking sector leads to an increase in risk taking within EU-15 banks. Generally, a positive coefficient (a_2) also is found also for the estimators FE and pooled OLS (see Table A3 and A4 in statistical appendix). The negative coefficient (a_3) for the three types of estimators (GMM, FE, and pooled OLS) means that the increase in profitability had a positive impact on financial stability within EU-15 banks.

Table 1 in Panel B presents slightly different results in comparison with Panel A. A positive and significant coefficient (a_1) is determined by regression 1 and a negative and significant coefficient (a_1) is found by regression 2. This means that competition had a negative impact on risk taking within EU-12 banks and had a positive impact on financial stability. A positive and significant coefficient (a_1) is determined by regressions 3 and 4 for the estimator GMM. This means that concentration had a positive impact on risk taking within EU–12 banks. The positive coefficient (a_2) from Table 1 in Panel B is determined by regressions 3 and 4. This means that size also had a positive influence on risk taking within EU-12 banks. However, those effects are stronger within EU-15 banks. The negative coefficient (a_3) means that an increase in profitability had a positive impact on financial stability within EU-12 banks.

For Panel C (i.e., for all EU-27 banks) a significant coefficient (a_1) is found only in regression 2. It seems that competition might have a positive impact on financial stability in the period of analysis. The positive coefficient (a_2) is found in all regressions 1–4, meaning that the increasing size of the banking sectors leads to an increase in risk taking within EU-27 banks. The positive coefficient (a_2) was found for the three types of estimators (GMM, FE, and pooled OLS) (see Table A3 and A4 in statistical appendix 2).

Results presented in Table A5 of the statistical appendix are unambiguous. However, a positive and significant coefficient (a_1) is found in regressions 3-4 for the two estimations. This may mean that growing concentration leads to larger credit growth and instability within EU-27 banks. In addition to all these estimation results, we find that increasing concentration and size within EU-27 banks leads to an increase in risk within the period of analysis. In contrast, competition generally did not have a negative impact on financial stability within EU-15 banks and thus competition was insignificant, whereas within EU-12 banks positive impact on financial stability was found.

5. Summary

In resent years the EU banking sectors have witnessed dynamic growth in banking assets mainly due to a sharp increase in lending, which leads to the TBTF problem. Also, there has been an increase in the concentration and competition between banks in the EU sector.

This paper describes the important role of competition between EU banks. As a result of the panel data analysis of the banking sectors in the EU, we can determine that the sectors with EU-27 are not homogeneous. In fact, we have obtained different results concerning the impact of competition on financial stability for EU-15 banks (i.e., large banking sectors) and for EU-12 (i.e., small banking sectors). Competition had a positive impact on financial stability, mainly in the small EU-12 banking sectors from 2006-2010. Generally, size had a positive influence on risk taking within EU-27 banks. However, those effects are stronger within EU-15 banks.

The ratio of banking sector assets to GDP is relatively lower in EU-12 (excluding Malta and Cyprus) than in EU–15, indicating high potential for growth. In addition, banks within EU-12 are relatively small in comparison with banks in EU-15. Therefore, within the EU-12 banking sectors, the barriers to entry are lower than in the EU-15 banking sectors. For example, there has been no entry in retail banking for the past 100 years in the UK (cf., Haldane, 2012). However, in the Polish banking sectors there was a successful entry of the Alior Bank. For this purpose, appropriate regulatory policies concerning competition must be conducted, including developing optimal policies concerning barriers to entry and exit from the banking market. Regulations concerning exit from the banking market are to be defined in a common resolution regime, as the general issues in the banking sector is the entry of new banks. The entry of new players in the banking market could potentially take away a part of the market from existing banks, which would allow for a reduction in concentration and inhibit the growth of existing banks. However, due to the fact that European financial institutions are the largest foreign investors in EU-12, the situation of parent-banks and regulatory changes concerning new bank supervision, including the implementation of the banking union project, will undoubtedly have an impact on the EU-12 banking sectors.

Of course, banks have their competitors among the other players on the financial market (e.g., shadow banking institutions, investment funds, venture capital-private equity funds, brokerage houses). However, the important thing to strive for is a policy determining the appropriate amount of competition within the EU financial market.

References

Bain J.P. [1951], *Relation of profit rate to industry concentration: American manufacturing 1936–40*, Quarterly Journal of Economics, 65, pp. 293–324.

Arcand J.-L., Berkes E., Panizza U. [2012], *Too Much Finance?* IMF Working Paper WP/12/161.

Andrés J., Arce O. [2012], *Banking Competition, Housing Prices and Macroeconomic Stability*, Economic Journal, Royal Economic Society, vol. 122(565), pp. 1346-1372, December.

Angelini P., N. Cetorelli, [2003], *The effects of regulatory reform on competition in the banking industry*, Journal of Money, Credit and Banking, 35, p. 663–684.

Beck T., A. Demirguc-Kunt, R. Levine [2003], *Bank Concentration and Crises*, World Bank, January 2003

Beck, T., De Jonghe, O., Shepens, G., [2011], *Bank competition and stability: Cross-country heterogeneity*, Working Paper 2011-080, CentER.

Beck T., Levine R. [2004], *Stock markets, banks, and growth: Panel evidence*, Journal of Banking and Finance, 28[3], pp. 423–442.

Bijlsma M. J., Gijsbert T., Zwart J., [2013], *The changing landscape of financial markets in Europe, the United States and Japan*, CPB Discussion Paper, 238.

Bikker J.A., L. Spierdijk, P. Finnie, [2007], *The impact of market structure, contestability and institutional environment on banking competition*, DNB Working Paper, No. 156/November.

Bikker J.A., L. Spierdijk, [2008], *How Banking Competition Changed over Time*, DNB Working Paper, No. 167/February.

Bikker J.A, Leuvensteijn M., [2014], *A New measure of competition in the financial industry*, Routledge, London.

Bikker J.A., Shaffer S., Spierdijk L. [2012], *Assessing Competition with the Panzar-Rosse Model: The Role of Scale, Costs, and Equilibrium*, The Review of Economics and Statistics, MIT Press, vol. 94(4) November, pp. 1025-1044.

Gambacorta L. A. van Rixtel [2013], *Structural bank regulation initiatives: approaches and implications*, BIS Working Papers No. 412, Bank for International Settlements.

Cecchetti, S, Mohanty, M. Zampolli, F. [2011], *The real effects of debt*, BIS Working Papers No. 352, Bank for International Settlements.

Carbó S., D. Humphrey, J. Maudos, P. Molyneux, [2009], *Cross-Country Comparisons of Competition and Pricing Power in European Banking*, Journal of International Money and Finance, 28, pp. 115-134.

Chortareas G. E., Girardone, C. Ventouri A. [2013], *Financial freedom and bank efficiency: Evidence from the European Union*, Journal of Banking & Finance, 37, pp. 1223–1231.

Coccorese P. [2004], *Banking competition and macroeconomic conditions: a disaggregate analysis*, Journal of International Financial Markets, Institutions & Money 14, pp. 203-219.

Cetorelli N. [2004], *Real Effects of Bank Competition, Journal of Money*, Credit, and Banking, Vol. 36, No. 3 (June 2004, Part 2), The Ohio State University Press, pp. 544-558.

Claessens P., L. Laeven, [2004], *What drives bank competition? Some international evidence*, Journal of Money, Credit, and Banking, Vol. 36, No. 3 (June 2004, Part 2), The Ohio State University Press, pp. 564-583.

Clerides S., Manthos D. Delis, Kokas S. [2013], *A new data set on bank competition in national banking markets*, Working Paper 08-2013, University of Cyprus.

De Guevara F.J., Maudos J. [2011], *Banking competition and economic growth: cross-country evidence*, The European Journal of Finance, vol. 17, Issue 8.

De Guevara F.J., Maudos J., Pérez F. [2005], *Market Power in European Banking Sectors*, Journal of Financial Services Research, Springer, vol. 27(2), pp. 109-137.

Degryse H., Kim M., Ongena S. [2009], *Microeconometrics of Banking: Methods, Applications and Results*, Oxford University Press.

Demetriades P.O., Hook S.L. [2006], *FINANCE, INSTITUTIONS AND ECONOMIC DEVELOPMENT*, International Journal of Finance & Economics, Volumes, pp.245–260, July 2006.

Demetriades P.O., Hussein A.K. [1996], *Does Financial Development Cause Economic Growth? Time-Series Evidence from 16 Countries*, Keele Journal of Development Economics, Department of Economics 51/2, pp. 387-411.

Demsetz H. [1973], *Industry structure, market rivalry, and public policy*, Journal of Law and Economics 16, pp. 1-9.

Efthyvoulou i Yildrim [2013], *Market Power in CEE Banking Sectors and the Impact of the Global Financial Cries*, Case Network Studies & Analysis, No 452.

Fiordelisi, F., D. Marques-Ibanez [2013], *Is default risk systematic?* Journal of Banking and Finance, 37, pp. 2000-2010.

Gambacorta L., van Rixtel A. [2013], *Structural bank regulation initiatives: approaches and implications*, BIS Working Papers, 412.

Haldane A. G., [2012], *On being the right size*, Bank of England, 25 October.

Hempell H., [2002], *Testing for Competition among German Banks*. Economic Research Centre, Deutsche Bundesbank, Discussion Paper 04/02.

Hicks J., [1935], *The Theory of Monopoly*, Econometrica, 3, pp. 1-20.

Hughes, J, Mester, L [2011], *Who said large banks don't experience scale economies? Evidence froma risk-return-driven cost function*, Working Papers 11-27, Federal Reserve Bank of Philadelphia.

Lamfalussy A. [2011], Keynote Speech, *The Future of Central Banking under Post Crisis Mandates*, Ninth BIS Annual Conference, BIS Papers, Bank for International Settlements, No. 55.

Levine, R [2004], *Finance and Growth: Theory and Evidence*, NBER Working Papers 10766, National Bureau of Economic Research, Inc.

Liikanen, E. [2012]. *Final Report of the High-level Expert Group on Reforming the Structure of the EU Banking Sector*, Brussels.

Leuvensteijn M., Bikker J.A., Rixtel A., Sørensen C.K. [2007], *A new Approach to measuring competition in the loan markets of the euro area*, EBC Working Paper Series, 768, June.

Koutsomanoli-Fillipaki N., Staikouras K.Ch. [2006], *Competition and concentration in the New European banking Landscape, European Financial Management*, European Financial Management Association, vol. 12(3), pp. 443-482.

Maudos J., F. de Guevara, J. [2007], *The cost of market power in banking: social welfare loss vs. inefficiency cost*, Journal of Banking and Finance, 31 (7), pp. 2103–2125.

Mester L.J. [2005], *Optimal industrial structure in banking*, Working Papers 08-2, Federal Reserve Bank of Philadelphia.

Mester L.J. [2008], *Optimal industrial structure in banking*, in Thakor A. & A. Boot, eds., Handbook of Financial Intermediation and Banking, Amsterdam: Elsevier, pp. 133–162.

Pawłowska M. [2012], *Competition, concentration and foreign capital in the Polish banking sector (prior and during the financial crisis)*, National Bank of Poland Working Papers – 2012, 130, Warszawa.

Pawłowska M., [2014] Konkurencja w sektorze bankowym: teoria i wyniki empiryczne, Wydawnictwo C.H. Beck, Warszawa.

Pulley L.B., Braunstein Y.M. [1992], *A composite cost function for multiproduct firms with an application to economies of scope in banking*, Review of Economics and Statistics, 74[2], pp. 221-230.

Rajan R., Zingales L. [1998], *Financial Dependence and Growth*, The American Economic Review, Vol. 88, No. 3 (June 1998), pp. 559-589.

Ratnovski L. (2013), *Competition Policy for Modern Banks*, IMF Working Paper, WP/13/126.

Schaeck K., Čihák M., Wolfe S. [2006], *Are More Competitive Banking Systems More Stable*, "Working Paper", No. 143, IMF, Washington, D.C.

Schaeck K., Čihák, M. [2008], *How Does Competition Affect Efficiency and Soundness in Banking?* ECB Working Paper, No. 932.

Schoenmaker., Wagner W. [2011], *The Impact of Cross-Border Banking on Financial Stability, Discussion Paper*, TI 11-054 / DSF 18, Duisenberg School of Finance, Tinbergen Institute.

World Bank [2013], *Rethinking the Role of the State in Finance*, Global Financial Development Report 2013, Washington, D.C.

Yildirim H.P., G. C. Philippatos, [2007], *Competition and Contestability in Central and Eastern European Banking Markets*, Managerial Finance, Vol. 33, No. 3, pp. 195-209.

Wheelock, D.C., Wilson P.W. [2012], *Do Large Banks have Lower Costs? New Estimates of Returns to Scale for U.S. Banks*, Journal of Money, Credit, and Banking, 44(1), pp. 171 – 199.

Weill L. [2013], *Bank competition in the EU: How has it evolved?* Journal of International Financial Markets, 26, pp. 100-112.

www.knf.gov.pl.

Van Hoose D. [2010], *The Industrial Organization of Banking, Bank Behavior*, Market Structure, and Regulation, Springer-Verlag, Berlin Heidelberg.

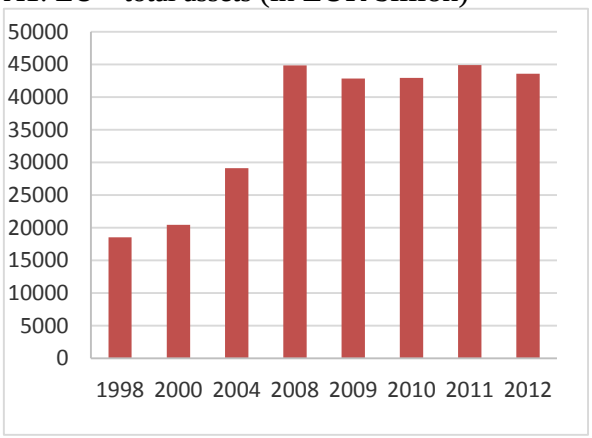
Vickers J. [2012], *Some economics of banking reform*, University of Oxford, Department of Economics, Discussion Paper Series, 632

Vives, X., [2010], *Competition and Stability in Banking*, Policy Insight No. 50.

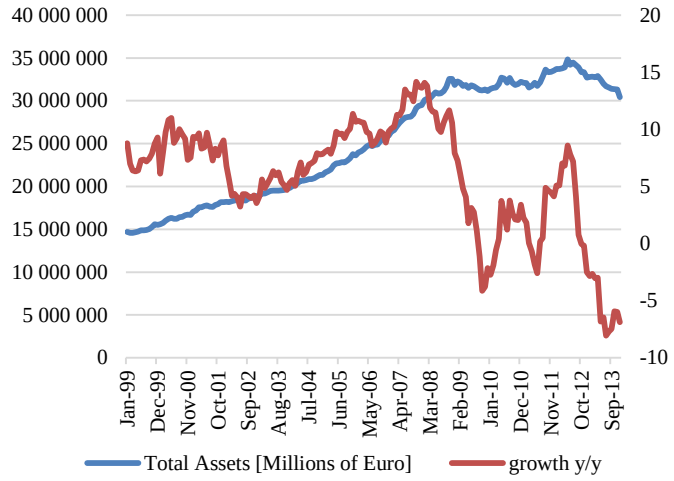
Appendix 1

Figure 1: Assets of the banking sectors in the EU

A1: EU – total assets (in EUR billion)



B1: EMU – total assets and assets growth y/y

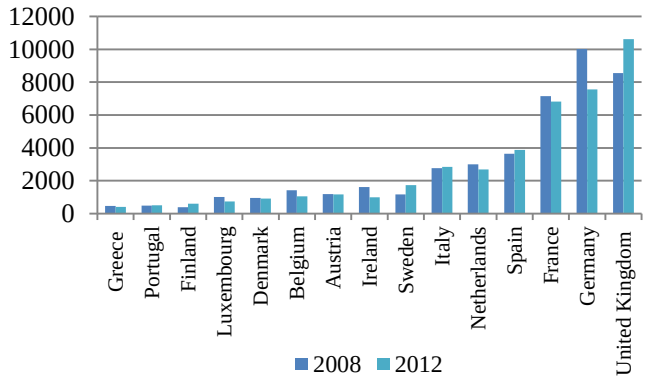


Source: own calculations on the basis of ECB data.

Figure 2: Assets of the banking sectors in the years 2008-2012 (in EUR billion)

A2: EU - 12

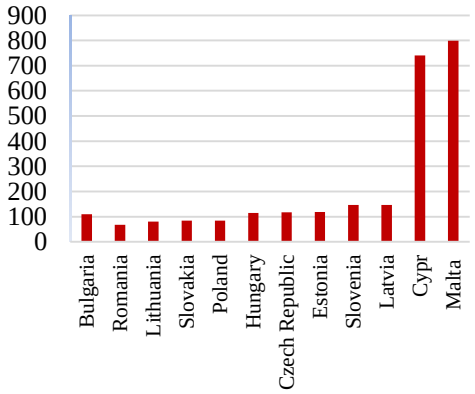
B2: EU - 15



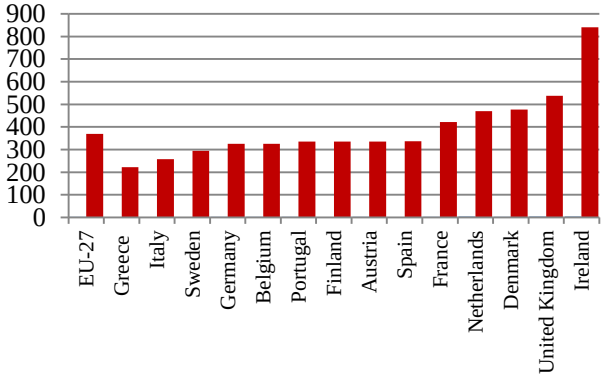
Source: ECB.

Figure 3: Size of the EU banking sector in relation to GDP [%]

A3: EU - 12



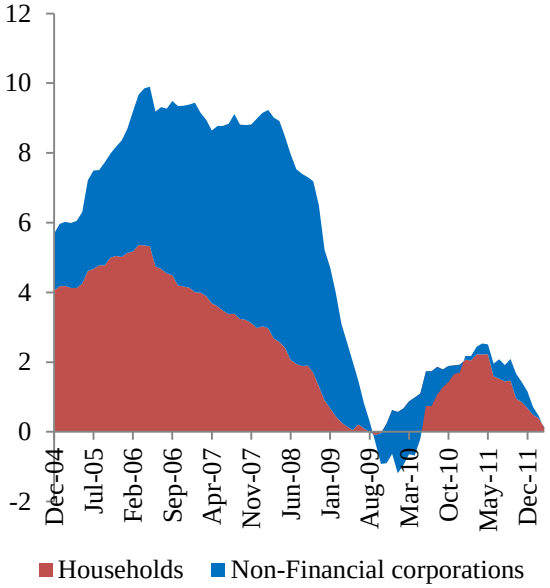
B3: EU – 15



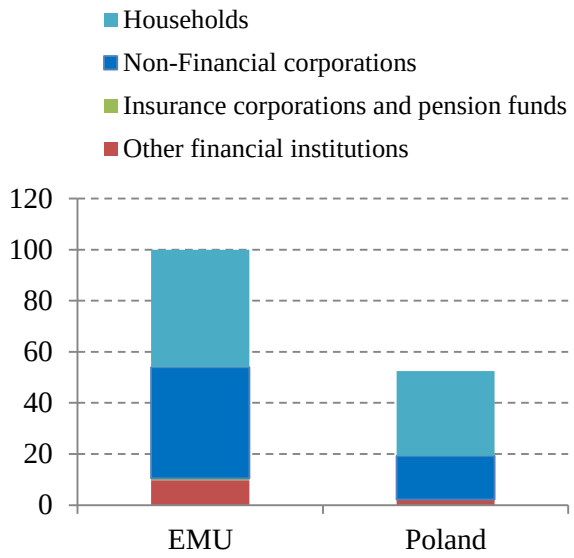
Source: ECB, Eurostat and own calculation. Note: In both panels the graphs present values of the ratio of the share of banking sectors assets in GDP. B3: presents average for EU-27.

Figure 4: Growth of Bank Loans to Non-Financial Sector before and during the crisis

Panel A Growth of Bank Loans to Private Sector before and during the crisis (y/y, structure in %): EMU

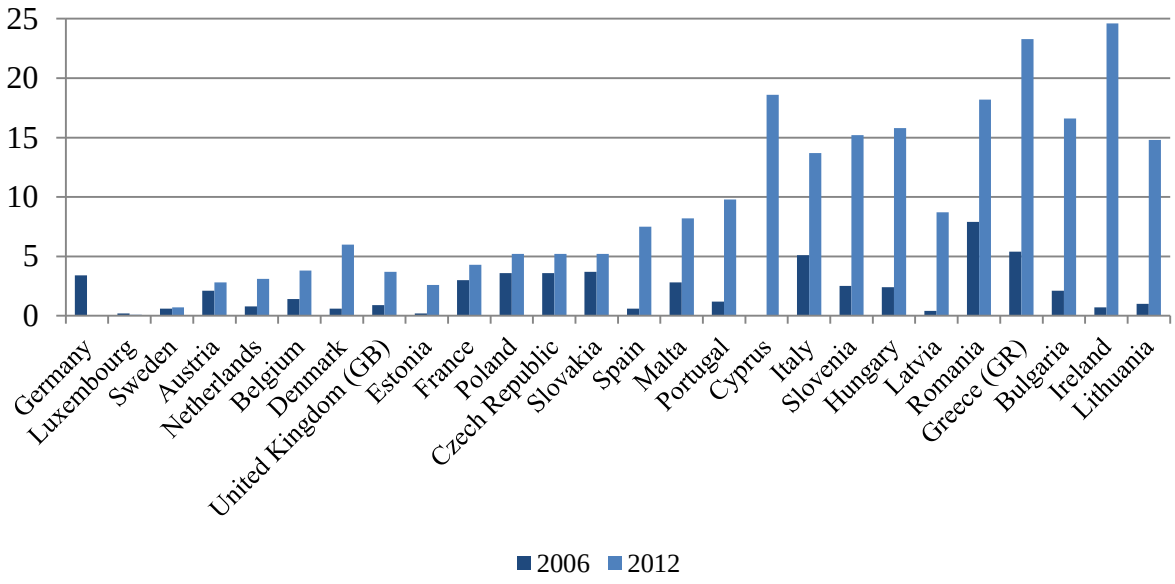


Panel B. The structure of Bank Loans to Private Sector in GDP in 2011 (structure in %): EMU and Poland



Source: own calculations on the basis of ECB data.

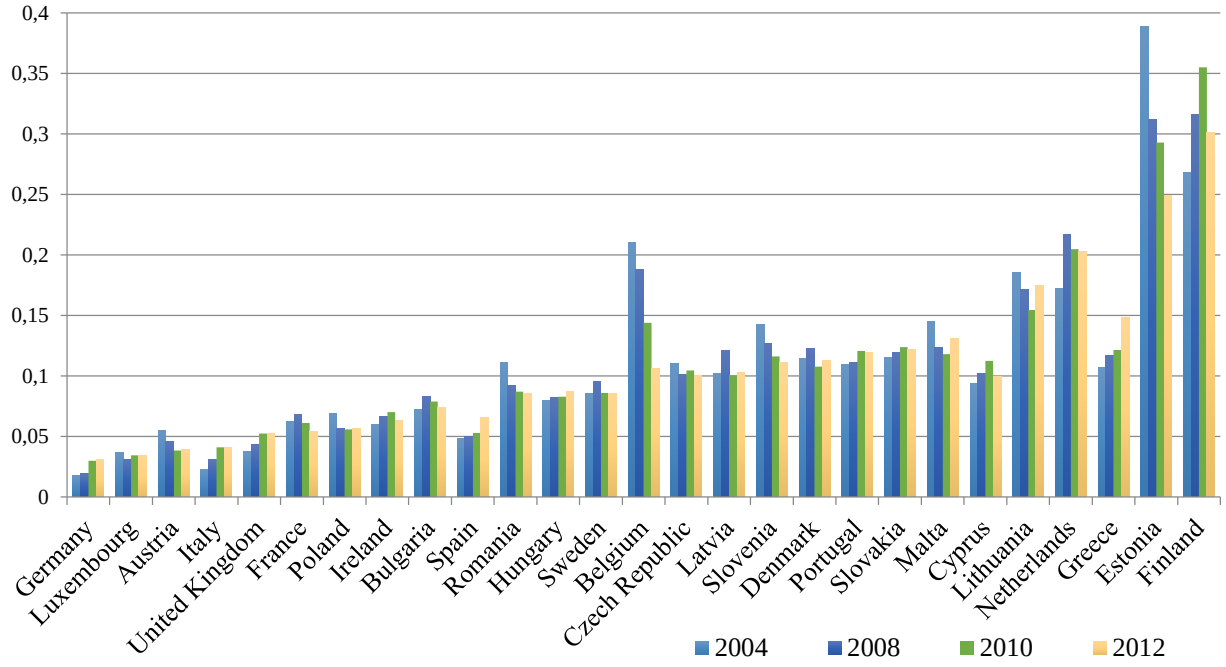
Figure 5: Non-performing Loans to Total Gross Loans [%]



Source: IMF. Note: There is no data for Germany in 2012.

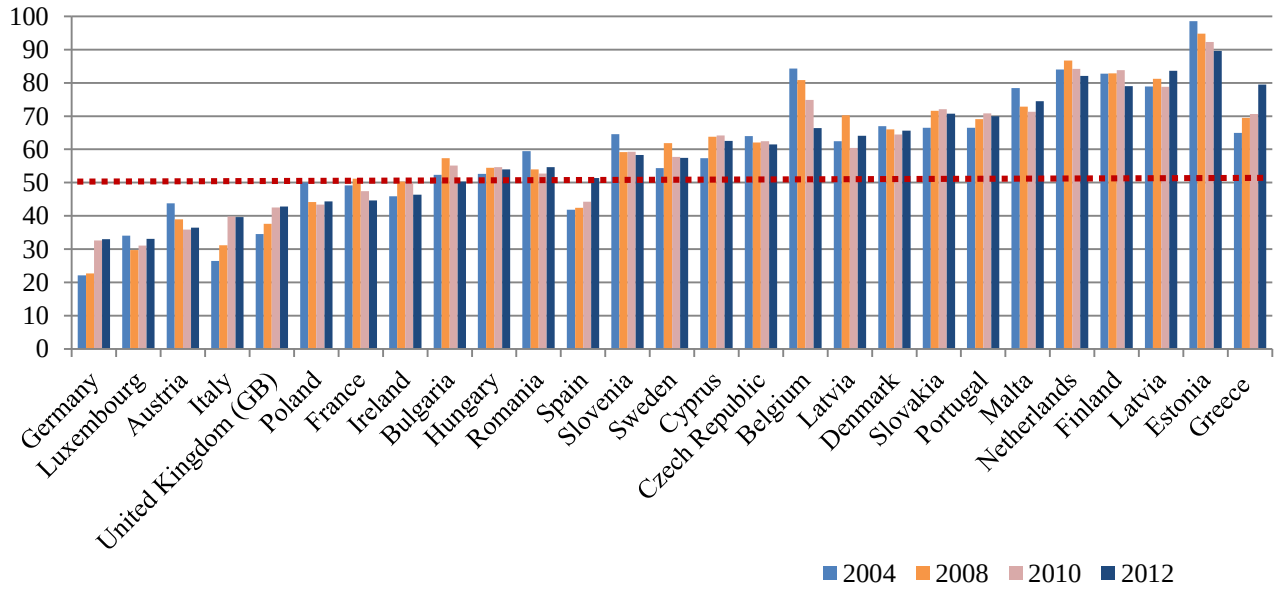
Figure 6: Concentrations in banking sectors in EU-27

Panel A: HHI



Source: ECB data.

Panel B: CR5 [%]



Source: ECB data and own calculations on the basis of ECB data. Note: red line signs he EU average.

Appendix 2

Table A1: Summary Statistics on the Characteristics of EU banking sectors structure and balance sheet data.
This table provides summary statistics (mean and standard deviation (SD)) for all variables in the model. Data are observed yearly from 2006-2010 for EU banking sectors.

	All EU Banking sectors (n=27)		EU-15 (n=15)		EU-12 (n=12)	
Variables	Mean	SD	Mean	SD	Mean	SD
Balance sheet data (for each banking sector *i* and year *t*)						
Observations	135		75		60	
ROE Ratio(%)	1.952025	22.21166	-2.23954	27.9291	6.715173	11.5978
Tier1 Ratio(%)	11.93747	4.221742	10.22592	2.570898	13.80461	4.863843
Total Assets	1.55e+09	2.55e+09	2.72e+09	2.94e+09	7.96e+07	6.65e+07
ROA Ratio(%)	0.540564	1.108772	0.231989	1.091764	0.9262833	1.01233
Observations	128		72		56	
NPL Ratio(%)	4.624898	4.417878	3.755708	4.028817	5.742429	4.67485
Observations	77		59		18	
Loans	2.38e+12	3.13e+12	2.66e+12	2.34e+12	1.44e+12	4.88e+12
Log(Loans)	27.5485	1.656389	28.10504	1.108466	25.72431	1.864192
Competition measure and concentration ratio (for each banking sector *i* and year *t*)						
	All EU Banking Sectors (n=27)		EU - 15 (n=15)		EU - 12 (n=12)	
Variables	Mean	SD	Mean	SD	Mean	SD
Observations	133		75		58	
Index Lerner	0.163684	0.074614	0.155467	0.072624	0.174308	0.0764309
H statistics	0.540047	0.209936	0.556814	0.188295	0.517584	0.2358466
Observations	135		75		60	
HHI	0.110328	0.073011	0.097432	0.07616	0.126448	0.0660001
CR5 (%)	59.33941	17.62031	54.68066	19.46034	65.16286	12.96472
Total Banking Assets in GDP Ratio (for each banking sector *i* and year *t*)						
	All EU Banking sectors (n=27)		EU -15 (n=15)		EU-12 (n=12)	
Variables	Mean	SD	Mean	SD	Mean	SD
Observations	135		75		60	
Size (%)	398.2	5.572364	552.66	6.837354	205.5	2.254734

Source: own calculations on the basis of ECB, IMF, World Bank, Eurostat data.

Table A2: Spearman's rank correlation coefficients for all variables in the model.

Panel A: EU - 15

	Lerner	H-statistic	HHI	CR5	Tier1	Total Assets	ROA	Size	NPL	Loans
Lerner	1									
H-statistic	-0.5041	1								
HHI	0.1656	-0.0214	1							
CR5	0.1579	-0.0558	0.9921	1						
Tier1	0.5186	-0.4258	0.2851	0.259	1					
Total Assets	0.0787	-0.2313	-0.3884	-0.3426	-0.2079	1				
ROA	0.3125	-0.2072	0.0521	0.0548	-0.2306	-0.0896	1			
Size	0.133	-0.2479	0.0187	-0.0069	0.4778	0.0159	-0.3539	1		
NPL	-0.1078	-0.2168	-0.0069	0.0154	-0.0445	0.2432	-0.0608	-0.1615	1	
Loans	-0.0266	-0.1554	-0.2189	-0.1989	-0.1033	0.5795	-0.1394	0.0415	0.1213	1

Panel B: EU - 12

	Lerner	H-statistic	HHI	CR5	Tier1	Total Assets	ROA	Size	NPL	Loans
Lerner	1									
H-statistic	-0.5394	1								
HHI	-0.5758	0.2848	1							
CR5	-0.3697	0.0303	0.8545	1						
Tier1	-0.3212	0.5758	0.2606	0.3818	1					
Total Assets	0.1879	0.3697	-0.3939	-0.7212	-0.1758	1				
ROA	0.3212	0.2364	-0.3818	-0.3212	0.4667	0.2848	1			
Size	0.0552	-0.7547	0.2516	0.497	-0.4233	-0.7178	-0.5338	1		
NPL	-0.2121	-0.4424	0.1152	0.3455	-0.1273	-0.7697	-0.4788	0.5951	1	
Loans	0.2727	0.1273	-0.8061	-0.9636	-0.2	0.8061	0.4303	-0.6197	-0.4667	1

Panel C: EU-27

	Lerner	H-statistic	HHI	CR5	Tier1	Total Assets	ROA	Size	NPL	Loans
Lerner	1									
H-statistic	-0.4202	1								
HHI	0.0756	-0.0336	1							
CR5	0.0813	-0.0577	0.984	1						
Tier1	0.2934	-0.3389	0.3134	0.2995	1					
Total Assets	0.0797	0.1256	-0.4227	-0.3698	-0.458	1				
ROA	0.1724	-0.2126	0.0278	0.0217	0.2658	-0.3596	1			
Size	0.1175	0.0755	-0.1452	-0.1129	-0.1024	0.5342	-0.551	1		
NPL	-0.1225	-0.3994	0.0739	0.0828	0.1714	-0.2944	0.1484	-0.4672	1	
Loans	0.0513	0.0998	-0.3437	-0.2976	-0.3727	0.7798	-0.307	0.4744	-0.2934	1

Source: author's calculations.

Table A3: Competition between banks and the risk taking – (FE)

Dependent Variable NPL				
Panel A: EU-15				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	-0.6818058	-	-	-
H-statistic	-	3.712427**	-	-
CR5	-	-	0.1845157***	-
HHI	-	-	-	21.25299
Size	0.743239***	0.282296**	0.6775217**	0.0162474
ROA	-1.067712**	0.6930408	-1.048261***	-2.805297***
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
R-squared	0.5475	0.5789	0.6059	0.7822
Time fixed effects	Yes	Yes	Yes	Yes
number of observations	72			
number of groups	15			
Panel B: EU-12				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	-7.333795	-	-	-
H-statistic	-	-8.669578***	-	-
CR5	-	-	-0.0523759	-
HHI	-	-	-	27.52099
Size	2.562153*	1.277659*	0.10340	0.5899209
ROA	-0.68309***	-1.841856***	-3.519738***	-1.536642***
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
R-squared	0.7847	0.7954		
Time fixed effects	Yes	Yes	Yes	Yes
number of observations	56			
number of groups	12			
Panel C: EU-27				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	-5.878293	-	-	-
H-statistic	-	-6.533731***	-	-
CR5	-	-	0.0497454	-
HHI	-	-	-	-18.94348
Size	0.5559344*	0.6960884***	0.6552796*	0.691721*
ROA	-2.43566***	-1.94763***	-2.408876***	-2.371141***
R-squared	0.5769			
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
Time fixed effects	Yes	Yes	Yes	Yes
number of observations	128			
number of groups	27			

Source: author's calculations. ***/**/* indicate significance at the 1/5/10% level respectively.

Table A4: Competition between banks and the risk taking – (Pooled OLS)

Dependent Variable NPL				
Panel A: EU-15				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	-1.6132	-	-	-
H-statistic	-	0.3295403	-	-
CR5	-	-	0.0121795	-
HHI	-	-	-	20.5978
Size	0.657342***	0.3050965*	0.5316977*	0.103663*
ROA	-1.118406**	-2.10293***	-1.109945***	-0.244204***
R-squared	0.9064	0.9214	0.9063	0.9078
Adj R-squared	0.8679	0.8862	0.8678	0.8698
Time effects	Yes	Yes	Yes	Yes
Countries effects	Yes	Yes	Yes	Yes
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
number of observations	128			
Panel B: EU-12				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	12.98448	-	-	-
H-statistic	-	-0.2378525***	-	-
CR5	-	-	0.1540373	-
HHI	-	-	-	82.48954***
Size	1.616911*	4.45948***	0.0924337	0.5269034
ROA	-2.10293***	-1.340022**	-2.85033***	-0.244204***
R-squared	0.9060	0.9210	0.9325	0.9260
Adj R-squared	0.8590	0.8751	0.9005	0.8909
Time effects	Yes	Yes	Yes	Yes
Countries effects	Yes	Yes	Yes	Yes
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
number of observations	128			
Panel C: EU-27				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	-9.03748***	-	-	-
H-statistic	-	-0.6894623	-	-
CR5	-	-	0.009742*	-
HHI	-	-	-	20.5978*
Size	0.859954***	0.8731622***	0.604452***	0.6378202***
ROA	-1.73744***	-2.061711***	-0.25098***	-0.244204***
R-squared	0.9086	0.9161	0.9025	0.9024
Adj R-squared	0.8762	0.8832	0.8686	0.8686
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
Time effects	Yes	Yes	Yes	Yes
Countries effects	Yes	Yes	Yes	Yes
number of observations	128			

Source: author's calculations. ***/**/* indicate significance at the 1/5/10% level respectively.

Table A5: Competition between banks and the risk taking – the credit growth as dependent variable in the model

Dependent Variable CG				
EU-27				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	0.8578659*	-	-	-
H-statistic	-	1.316557***	-	-
CR5	-	-	0.0023706***	-
HHI	-	-	-	0.9372746***
Size	0.380012	0.0347013**	-0.0364456	-0.0370303
ROA	0.31077*	0.22878*	0.0186231*	0.0590162**
Time effects	Yes	Yes	Yes	Yes
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
Arellano-Bond test	(0.1946) (0.4348)	(0.2539) (0.2254)	(0.2122) (0.4833)	(0.2116) (0.4818)
Saragan test *(p value)*	(0.1975)	(0.2053)	(0.3839)	(0.3000)
number of observations	77			
number of groups	20			
Dependent Variable CG				
EU – 27				
Independent Variables	Estimate (1)	Estimate (2)	Estimate (3)	Estimate (4)
Lerner	1.094593**	-	-	-
H-statistic	-	1.947691***	-	-
CR5	-	-	0.0073067***	-
HHI	-	-	-	-2.50264
Size	-1.435035	0.0279896*	-0.0312787	-0.01247
Tier1	-3.9175***	-0.094466***	-0.0323816***	-0.0254148***
Time effects	Yes	Yes	Yes	Yes
Time Period	2006-2010	2006-2010	2006-2010	2006-2010
Arellano-Bond test	(0.1988) (0.3508)	(0.5949) (0.4751)	(0.1434) (0.1070)	(0.2177) (0.2375)
Saragan test *(p value)*	(0.4925)	(0.3202)	(0.5069)	(0.3660)
number of observations	77			
number of groups	20			

Source: author's calculations. ***/**/* indicate significance at the 1/5/10% level respectively.