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ASSESSING COMPETITION IN THE EUROPEAN UNION BANKING SECTOR

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Abstract. The current paper provides new insights on competition degree among 2,024 commercial, cooperative and savings banks from the 28 European Union states during 2005-2015. Bank-level Lerner index, its efficiency-adjusted form and Boone indicator are the computed indices, with total output consisting in loans, customer deposits and securities. The estimates of marginal costs result from solving a Fourier flexible form of translog cost function. The banks included in the sample remain very competitive over time with the commercial and cooperative ones displaying the highest competitiveness. Non-OECD, upper-middle income and Eurozone states have a more competitive banking sector comparing to their counterparts.

1. Introduction

The present paper estimates and analyses the degree of competition among European commercial, cooperative and savings banks covering 2005-2015.

This topic is relevant for both researchers and practitioners. The banking system generally represents one of the most important sectors of the economy since it generates substantial share of gross income (i.e. 50% in the case of EU) and herewith it determines the overall competitiveness, economic growth and prosperity. During the last twenty years, banking markets have been subject to structural adjustments due to changes in external environment, caused mainly by deregulation, technological development, financial liberalization and innovations. All these variations have had impact on the competition level, as large financial institutions operating at low margins in developed states, have extended their activities into the potentially more profitable markets of developing countries, have accelerated the consolidation process in both groups of countries, and have caused concerns about increased concentration in the banking sector. Therefore, the market conditions for banks are of particular interest because higher concentration leads to undesirable exercise of market power by banks and the changes in competition and concentration degree influence the financial stability and soundness.

Competition plays an essential role in the economy since it fosters efficiency through better allocation of resources, improves the quality of goods and services (Cetorelli, 2001), stimulates innovations and boosts international competitiveness. In the banking sector, higher efficiency translates into decreasing costs passed to bank customers, in the form of lower charges, higher deposit rates and reduced lending costs.

The deregulation of financial services in the European Union and the establishment of the Economic and Monetary Union, have created a level playing field in the provision of banking

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products and services across the EU. These steps have removed the entry barriers and enticed competition and efficiency in national banking markets. However, the regulatory changes have come with a trend towards consolidation, resulting in the recent wave of mergers and acquisitions. The pro-competitive deregulation process has increased the level of competition (Cetorelli, 2004), particularly in non-traditional and non-interest-bearing areas of banking activity (Goddard et al., 2001). It was expected that increased competition would in turn foster efficiency by providing incentives to managers to cut costs in order to remain profitable. However, recent researches have indicated that the relationship between competition and banking system performance is more complex and the view that competition is unambiguously good is more naïve in banking than in other industries (Claessens & Leaven, 2004). To date, one of the effects of the regulatory changes was to spur a trend towards consolidation, resulting in the recent wave of mergers and acquisitions (M&As). Increased cross-border capital flows, greater market contestability, as well as the on-going process of privatisations of financial institutions have fostered an increase in market concentration.

From a policy point of view, it is difficult to know what impact these structural developments are likely to have on the competitive environment and how they may influence the efficiency and stability of banking markets. On the one hand, higher concentration is expected to intensify market power and therefore hinder both competition and efficiency. On the other hand, if bank mergers and acquisitions are driven by economies of scale, then more concentration may foster efficiency improvements.

Several empirical works have investigated the link between bank competition and credit allocation effectiveness (Cetorelli & Strahan, 2006; Bonnacorsi & Dell'Aricca, 2004), focused on the competition-stability trade-off (Keeley, 1990; Boyd & De Nicoló, 2005) or identified the macroeconomic outputs of banking competition (Cetorelli, 2004). At the same time, policymakers have implemented measures on bank competition at European Union level in an attempt to achieve a primary target of ensuring an effective market competition, given the system's central function in credit and capital funds allocation processes and access to finance. Moreover, a sustainable financial and economic development is only the direct outcome of financial intermediation activities that facilitate the flow of money and capital among the market participants. However, there is a trade-off between promoting competition and ensuring financial stability on the same time.

This paper marks its contribution to the literature in three ways. First, competition is measured at bank-level considering the total output as the sum of the main products of financial institutions: loans, customer deposits and securities. In most of the current papers on European competition, total bank output consists in : total assets (Andrieş & Căpraru, 2012; Bikker et al.,2012; Fiordelisi & Salvatore Mare, 2014), total real earning assets (Clerides et al., 2015), off-balance sheet items (Bikker et al., 2012; Clerides et al., 2015), business and consumer loans and securities (Berger & Mester, 1997; Bolt & Humphrey, 2015), total loans and securities (Casu & Girardone, 2006), loans and advances to banks, loans, other securities and off-balance sheet items (Andrieş & Căpraru, 2014). In this paper, "production approach" is followed. Therefore, banks produce loans, customer deposits and securities using labour, fixed assets and borrowed funds, except customer deposits. The bank-level competition indicator offers insights on different conditions the financial institutions operating in the same environment may face. A simple average value delivers little information on the competitive position of each bank. Besides, the indicators are computed for commercial, cooperative and savings banks. Even if few studies have investigated separately (Clerides et al., 2015) or altogether (Van Leuvensteijn et al., 2011) the behaviour of this kind of credit institutions, the present research sheds light on the strategy each financial entity aims to implement in the long-run (i.e. eleven-year period), whether there are differences in terms of competition based on the bank type and supports regulatory authorities come with more effective policies.

Moreover, the second contribution of the current research to the extant literature consists in the usage of adjusted Lerner index and Boone indicator, that represent the most recent indices

on the market power and competition of financial entities from Europe and offer different perspectives on the degree of competitiveness in the markets and for the banks under observation. At the same time, these indexes are more flexible and make possible the estimations depending on the bank specialisation and outputs.

Lastly, the extended sample and period facilitate several more in-depth analyses. As European states are part of various groups like Eurozone and non-Eurozone, OECD and non-OECD and high and middle-income, several comparisons are available and provide insights on the disparities in terms of integration level, economic development and economic policies. To our knowledge, there is no previous research on all 28 state members of European Union. The time window allows for investigation of various macroeconomic and financial conditions such as boom, financial crisis and recession.

The main findings of the current paper show that the market power improves lately and it follows the business cycles. Commercial and cooperative banks are involved more in designing and implementing strategies on competition as they have similar products and services and should find different ways to gain market shares. Financial crisis has determined banks be more competitive and reshape their business strategy. When it comes to differentiating among being or not a systemically important bank, the other systemically important institutions (O-SIIs) prefer being involved in a fiercer competition, in an attempt to extend their market share and get higher profits. Non-OECD members and Eurozone countries have banking systems that are more competitive in comparison to their counter-parties.

The paper consists in several parts. Section 2 reviews the extant literature on bank competition. The next section presents the data and the methodology followed. Afterwards, come the main results and several conclusions.

2. Literature review

There is a long tradition in measuring competition. At the beginning, the focus has been on market structure-performance linkages starting from the structure-conduct-performance paradigm (SCP) and Chicago Revisionist School.

Mason (1939, 1949) and Bain (1951, 1956, and 1959) propose the Structural-Conduct-Performance model that quantifies the structure-performance links among several industries and reflects the meaning of these connections for the company's behaviour. The decisions and overall performance of firms depend on the structural characteristics of the industries and markets (i.e. number of business entities along with their absolute and relative sizes, extent of product differentiation and barriers to entry), where they are active. The market structure shapes the businesses' conduct in terms of setting the prices, R&D and advertising expenditures, whereas the profit, growth, technological progress and efficiency measure the firms' performance. The main take-away of this paradigm is that a fewer number of firms allows for increasing the market power and the profitability.

Hannah and Kay (1977) develop *n-firm concentration ratio*, a measure that refers to the market share of the top n firms in a certain industry. The market share considers either total assets or total deposits, while the number of firms chosen can be three, five or ten.

Hirschman (1945) and Herfindahl (1950) make use of all the points from the firm size distribution and calculate the sum of the squares of the market shares of all entities to obtain another competition measure called Herfindahl- Hirschman index.

Though, all the measures previously mentioned have been contested by a more recent trend in the literature, the New Empirical Industrial Organization (NEIO). The researchers belonging to NEIO claim that a lower market power does not imply fiercer competition on the market and propose new measures such as: *Lerner index (Lerner,1934), Iwata index (Iwata, 1974), H-statistic (Panzar &Rosse,1977), Bresnahan index (Bresnahan, 1982 and Lau, 1982).*

The extant papers that deal with bank competition take into account United States, few European and Asian states, as summarized in table I.

Table I: Short overview of papers on banking competition	
Country name	Paper
Europe	
Austria	Schaeck et al. (2009); Berger et al. (2008); Carbó et al. (2009);
Belgium	Schaeck et al. (2009); Berger et al. (2008); Carbó et al. (2009); Bolt and Humphrey (2010)
Denmark	Schaeck et al. (2009); Berger et al. (2008); Carbó et al. (2009); Bolt and Humphrey (2010)
France	Schaeck et al. (2009); Van Leuvensteijn et al. (2011); Berger et al. (2008); Carbó et al. (2009);
	Bolt and Humphrey (2010); Huang et al. (2016);
Germany	Schaeck et al. (2009); van Leuvensteijn et al. (2007); Berger et al. (2008); Carbó et al. (2009);
	Bolt and Humphrey (2010); Huang et al. (2016);
Ireland	Berger et al. (2008); Carbó et al. (2009)
Italy	Schaeck et al. (2009); Van Leuvensteijn et al. (2011); Berger et al. (2008); Carbó et al. (2009);
	Bolt and Humphrey (2010); Huang et al. (2016);
Luxembourg	Schaeck et al. (2009); Berger et al. (2008); Carbó et al. (2009); Huang et al. (2016);
the Netherlands	Schaeck et al. (2009); Van Leuvensteijn et al. (2011); Berger et al. (2008); Carbó et al. (2009);
	Bolt and Humphrey (2010);
Portugal	Schaeck et al. (2009); Carbó et al. (2009);
Norway	Schaeck et al. (2009); Berger et al. (2008);
Spain	Schaeck et al. (2009); Van Leuvensteijn et al. (2011); Carbó et al. (2009); Bolt and Humphrey (2010);
Sweden	Berger et al. (2008); Carbó et al. (2009); Bolt and Humphrey (2010);
Switzerland	Schaeck et al. (2009); Berger et al. (2008); Coccorese (2014); Huang et al. (2016);
United Kingdom	Schaeck et al. (2009); Van Leuvensteijn et al. (2011); Berger et al. (2008); Carbó et al. (2009);
	Bolt and Humphrey (2010); Coccorese (2014);
Asia	
Indonesia	Schaeck et al. (2009); Liu et al. (2014);
Malaysia	Schaeck et al. (2009); Fu et al. (2014); Liu et al. (2014);
Thailand	Leightner and Lovell (1998); Okuda and Rungsomboon (2006); Lapteacru and Lahet (2014);
	Coccorese (2014); Fu et al. (2014);
China	Schaeck et al. (2009); Xu et al. (2013); Fu et al. (2014);
India	Schaeck et al. (2009); Fu et al. (2014);
Hong Kong	Schaeck et al. (2009); Fu et al. (2014);
Pakistan	Schaeck et al. (2009); Coccorese (2014); Fu et al. (2014);
Philippines	Schaeck et al. (2009); Coccorese (2014); Fu et al. (2014); Liu et al.(2014);
Sri Lanka	Coccorese (2014); Fu et al. (2014);
Vietnam	Coccorese (2014); Liu et al. (2014);

Several empirical researches have investigated the bank competition across specific groups of European countries like members of EU15, EU27 or CEE. Carbo´ et al. (2009) have compared the results on competition degree based on five different indicators (i.e. net interest margin, Lerner index, return on assets, H-statistic and HHI) for the banking sectors from Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom during 1995-2001. The main takeaway is that the value of competition depends entirely on the indicator chosen to estimate it. Net interest margin is suitable for the investigation of the bank competition in a single country since it better reflects the traditional activities: taking deposits and granting loans. Lerner index and return on assets are able to express the competition level for a broader range of banking activities. Therefore, based on this recommendation our paper includes, among others, Lerner index.

Based on a sample of commercial banks from France, Germany, Italy, Spain and the United Kingdom for the period 2000-2005, Casu and Girardone (2009) have claimed that there is a negative causation between efficiency and competition, while competition impacts efficiency in a positive, but weak way. Compared to this study, the present research focuses on assessing bank competition only in more European banking systems and for a longer period.

Van Leuvensteijn et al. (2011) are among the first that apply the Boone indicator to assess the competition on loan market in five Eurozone states (i.e. Spain, Germany, France, Netherlands and Italy), UK, US and Japan during 1994-2004. The sample includes commercial, cooperative and savings banks. US loan market is the most competitive, followed by Germany and Spain. In terms of bank specialisation, commercial banks face a fiercer competition, in comparison to their counter-parties that activate mainly on local markets. Competition intensity varies across the states under investigation depending on the importance of each type of financial institution and changes in the banking regulatory and institutional frameworks. However, the paper of Van Leuvensteijn et al. (2007) focuses mainly on loan competition at banking sector level in five European states. The current research comes with several improvements. The Boone indicator estimates competition at bank level for each financial entity from all 28 countries that are member of the European Union over the period 2005-2015. Moreover, this study assesses deposit and securities competition as well.

Andrieş and Căpraru (2012) have analysed the competition in the banking systems of the EU 27 states using Lerner index and H-statistic over 2001-2009. During the period under scrutiny, the competition level has an upward trend. Most states display a monopolistic competition, with new EU members behaving more competitively. In a later study, Andrieş and Cãpraru (2014) have concluded, based on the H-statistic estimates for the commercial banks from the states of EU 27 during 2004-2010, that there is a stronger competition in the old members of the European Union, except for the years 2008 and 2009. In Eurozone countries, competition has an ascending trend. In our paper, we are using Lerner index, adjusted Lerner and Boone indicator since Panzar-Rosse H-statistic is estimated using a static model and has a weak prediction power. In addition, this measure requires overall market equilibrium, condition that is difficult to comply with due to frequent entries and exits as Claessens and Laeven (2004) have noticed.

Lapteacru (2014) has stated that HH index, Panzar and Rosse H-statistic and Lerner index provide different outlooks on the competition in banking systems of ten CEE states. Overall, there is an increase in market power, whereas H-statistic remains stable. Competition and market power are positively correlated in all countries under analysis except for Romania and Estonia. Hence, on average the competition is low and stable, while the market power has an upward trend. Our study proposes the usage of the improved Lerner index and a more recent competition measure, Boone indicator, for a more extensive sample of European countries and bank types.

Clerides et al. (2015) have used three competition indicators (i.e. Lerner index, adjusted Lerner index and Boone indicator) to account for the competition level among the commercial, cooperative and savings banks of 148 states worldwide from 1997 to 2010. The outcomes for the three competition measures are similar in terms of changes over time and confirm that the movements in competition intensity follow the global business cycle. The present research estimates the same measures of competition for commercial, cooperative and savings banks from the EU28 state members, but at bank level since financial entities might react differently to the changes occurred on the market and an overall indicator does not account for this fact.

Apergis et al. (2016) analyse the competition within three main groups of European Union countries (EU-17, EMU-17 and the rest of the 27 EU states) using H-statistic. According to the estimates for the entire sample, the banking sector is characterized by monopolistic competition. EU-27 countries are more competitive relative to EMU-17, due to continuous integration reforms and mergers and acquisitions. In our paper, there are different bank competition measures that are more flexible than Panzar-Rosse indicator since they can be applied on various categories of banks. Moreover, the focus of this research is on cooperative banks as well and not limited to commercial and savings banks. Our investigation deals with the time span 2005-2015 that is more recent than the one used by Apergis et al. (2016) (i.e. 1996-2011).

3. Data and methodology

The period under analysis is 2005-2015 and the estimations of competition indicators are done with annual bank level data. The sample consists in commercial, cooperative and savings banks from the 28 countries of European since these financial entities have similar business strategies as they primarily involve in traditional activities such as providing loans and taking deposits. The data source for the computation of competition measures is Bankscope-Bureau van Dijk. Country classification by income follows the guidelines from World Bank.

Several steps ensure the high accuracy and relevance of the dataset. First, the sample includes the banks with available financial statements for the last five years and positive values for inputs and outputs. Secondly, taking into account the consolidation code available in Bankscope, each financial institution is separately analysed in an attempt not to include double entries between parent banks and subsidiaries (Clerides et al., 2015). An additional investigation refers to mergers and acquisitions. All the banks under scrutiny are checked in order to see if they have been involved in an M&A process and afterwards only the merged entity or the acquiring bank is part of the sample after this event.

Table II: Number of banks by country and by type

Country	Commercial banks	Cooperative banks	Savings banks	Total
Austria	21	24	21	66
Belgium	10	1	3	14
Cyprus	4	-	-	4
Germany	55	784	371	1,210
Estonia	3	-	-	3
Spain	11	23	3	37
Finland	3	1	-	4
France	44	38	11	93
Greece	6	-	-	6
Ireland	3	-	-	3
Italy	37	270	21	328
Lithuania	4	-	-	4
Luxembourg	22	2	-	24
Latvia	6	-	-	6
Malta	3	-	-	3
Netherlands	8	1	-	9
Portugal	6	-	1	7
Slovenia	6	-	-	6
Slovakia	5	-	1	6
Bulgaria	9	-	1	10
Czech Republic	12	1	-	13
Denmark	23	2	12	37
United Kingdom	30	-	-	30
Croatia	15	1	1	17
Hungary	9	-	-	9
Poland	13	1	1	15
Romania	10	1	1	12
Sweden	7	-	41	48
Total	385	1,150	489	2,024

The figures have been winsorized at 1% and 99%. The final sample consists in 20,264 observations, meaning 2,024 banks. Out of them, there are 1,150 cooperatives, 489 savings and 385 commercial banks. Germany with 1,210 financial institutions and Italy with 328 banking entities dominate the sample, as table II depicts. In terms of total assets, the best-represented

states are Denmark, France and Czech Republic (table III). To provide more valuable insights for regulators and bank practitioners, the entire sample is split in several subgroups. The promoters of a better and faster integration and convergence among the European countries consider relevant to compare the bank competition between new and old state members, Eurozone vs. non-Eurozone areas or OECD and non-OECD countries. Besides, the income level of the country (i.e. high income and upper-middle), bank specialisation and systemically importance may affect the level of competitiveness among banks and generate different results.

Table III: Sample coverage by selected countries

Country	Total assets (th USD)	% total assets
Austria	764,025,760.62	59%
Belgium	996,619,472.48	67%
Cyprus	81,643,492.47	59%
Germany	4,053,861,696.76	40%
Estonia	27,357,795.12	76%
Spain	3,095,591,839.24	73%
Finland	198,335,689.73	35%
France	8,005,402,762.90	85%
Greece	392,881,209.96	72%
Ireland	463,280,550.55	34%
Italy	3,382,073,344.93	71%
Lithuania	14,855,533.16	47%
Luxembourg	272,052,703.03	26%
Latvia	14,941,052.19	39%
Malta	17,102,697.48	28%
Netherlands	2,166,361,089.54	75%
Portugal	188,105,191.74	30%
Slovenia	39,046,846.50	65%
Slovakia	46,921,990.19	58%
Bulgaria	25,435,283.02	51%
Czech Republic	176,601,672.12	84%
Denmark	1,033,941,586.48	86%
United Kingdom	8,879,842,071.29	69%
Croatia	52,755,681.50	70%
Hungary	110,700,197.23	71%
Poland	231,663,222.85	60%
Romania	69,053,234.14	69%
Sweden	577,086,239.00	31%
Total	35,377,539,906.20	

The competition indexes estimated are Lerner index, adjusted Lerner index and Boone indicator that attempt to proof the validity of the results and offer different perspectives. All of them are part of previous studies such as Clerides et al. (2015), Van Leuvensteijn et al. (2011) or Carbó et al. (2009). Nevertheless, in the present paper, they are computed based on the different bank total output of the financial institutions, namely the sum of loans, customer deposits and securities and using a Fourier flexible form for translog cost function, a method previously applied in a small number of researches like Bolt and Humphrey (2015).

The first competition indicator, the Lerner index, is widely applied in extant literature since it is based on easily available data and it is simple to estimate and interpret. Lerner (1934) defines this measure as an "index of the degree of monopoly power". The form of Lerner index is:

$$Lerner_i = \frac{P_i - mc_i}{P_i} \tag{3.1}$$

where P_i represents firm i's price whereas mc_i refers to marginal cost. The values of this index range between zero (i.e. perfect competition) and unity (i.e. monopoly).

In order to estimate the marginal costs (MC), we make use of a Fourier flexible form of the translog cost function, as suggested by Mitchell and Onvural (1997), Berger and Mester (1997) and Bolt and Humphrey (2015). Usually, in the literature, translog is the most frequently used method to estimate MC. Though, this function fails to fit an extensive range of bank sizes. The solution would be to add Fourier trigonometric terms to the traditional cost function and get the below first expression:

$$\begin{aligned}
\ln TC \quad = \quad & \alpha_0 + \sum_{i=1}^{3} \alpha_1 * \ln Q_i + 1/2 * \sum_{i=1}^{3} \alpha_i * \ln(Q_i)^2 + 1/2 * \sum_{i \neq j}^{3} \alpha_{i,j} * \ln Q_i * \ln Q_j + \\
& + \sum_{i=1}^{3} \sum_{k=1}^{3} \delta_{i,k} (\ln Q_i * \ln P_k) + \sum_{i=1}^{3} \beta_1 * \ln P_k + 1/2 * \sum_{k=1}^{3} \sum_{m=1}^{3} \beta_{k,m} (\ln P_k * \ln P_m) + \\
& + \theta_i * \ln T + 1/2 * \ln(T)^2 + \cos(\sum_{i=1}^{3} \alpha_1 * \ln Q_i) + \cos(1/2 * \sum_{i=1}^{3} \alpha_i * \ln(Q_i)^2) + \\
& + \cos(1/2 * \sum_{i \neq j}^{3} \alpha_{i,j} * \ln Q_i * \ln Q_j) + \sin(\sum_{i=1}^{3} \alpha_1 * \ln Q_i) + \\
& + \sin(1/2 * \sum_{i=1}^{3} \alpha_i * \ln(Q_i)^2) + \sin(1/2 * \sum_{i \neq j}^{3} \alpha_{i,j} * \ln Q_i * \ln Q_j)
\end{aligned} \tag{3.2}$$

$$S_k = \beta_k + \sum_{m=1}^{3} \beta_{k,m} * \ln P_k + \sum_{i=k}^{3} \delta_{i,k} * \ln Q_i \tag{3.3}$$

where $TC = LCOST + KCOST + FCOST$;

$Q_{i,j}$ = *the value of the three output variables(loans,securities and customer deposits);*

$P_{k,m}$ = *three input prices (price of labour, physical capital and funding without customer deposits);*

T = *time trend;*

S_k = *cost shares of funding and labour inputs.*

There are three input prices: price of labour, price of physical capital and price of funding, excluding customer deposits. The price of labour is equal to the ratio between the personnel expenditures and total assets of the banks, since the number of employees and branches is most of the time unavailable. The division of the costs with premises by the value of fixed assets reflects the price of physical capital. The ratio between the interest rate on total funds, except customer deposits and total borrowed funds, without customer deposits represents the cost of funds, without customer deposits. Table IV summarizes in percentages the three prices along with the loans, securities and customer deposits as share of total assets. Total costs are equal to the sum of interest expense, personnel expense and overheads. Costs, loans, securities and customer deposits represent 4%, 58%, 32% and 60% of total assets, respectively. In the current sample, the mean of wage rates is 1.1% of total assets. The price of physical capital is on average 619% of fixed assets, whereas the interest rate costs are around 2.5%. All these are real values and provide a brief description of the variables used in the estimations of competition indexes.

Table IV: Mean values of key variables by country for the period 2005-2015 (in %)

Country	TotalCosts/ TotalAssets	Loans/ TA	Scurities/ TA	Customer Deposits/ TA	Overheads/ TA	Wages/ TA	InterestExpenses/ TotalFunding (witout CustomerDeposits)
Austria	3.82	59	26	59	582	1.19	2.04
Belgium	3.96	46	47	57	1035	0.70	2.85
Bulgaria	5.39	64	22	68	215	1.04	3.15
Croatia	5.68	60	21	66	506	1.35	3.02
Cyprus	6.61	54	35	73	196	1.50	3.36
Czech Republic	3.19	54	43	67	457	0.65	1.98
Denmark	4.49	60	27	66	1088	1.63	1.75
Estonia	3.26	67	18	64	391	0.99	1.69
Finland	5.57	44	46	41	1139	1.57	3.14
France	4.08	65	29	46	804	1.10	2.43
Germany	3.98	58	29	73	284	1.35	1.88
Greece	4.63	66	29	58	291	1.13	2.95
Hungary	8.51	68	31	53	567	1.59	4.01
Ireland	3.25	68	32	48	362	0.65	2.33
Italy	3.73	64	27	51	329	1.31	1.64
Latvia	3.71	48	31	67	449	1.03	1.67
Lithuania	4.36	69	20	61	367	1.18	2.35
Luxembourg	3.56	31	55	63	919	0.85	2.33
Malta	3.13	53	45	81	118	0.82	1.85
Netherlands	4.42	57	34	58	694	0.75	3.47
Poland	4.83	59	39	54	891	1.15	2.71
Portugal	5.62	55	30	28	602	0.88	4.75
Romania	7.37	59	29	60	201	1.87	3.82
Slovakia	4.06	62	29	73	189	1.03	1.71
Slovenia	4.22	64	31	57	187	1.07	2.35
Spain	3.25	66	23	66	2833	0.89	1.79
Sweden	3.14	73	15	80	537	1.08	1.35
United Kingdom	3.14	41	47	47	1110	0.75	1.94
Total	4.46	58	32	60	619	1.11	2.51

The prices of the three inputs and the share of the loans, customer deposits and securities vary depending on the type of the credit institution (table V). Commercial and cooperative banks register greater overall costs as they provide a greater variety of products and services in a higher volume, comparative to savings banks that are locally oriented. Savings banks focus their operations on customer deposits (70%), whereas the portfolios of the other two categories of financial institutions include equal shares of loans and customer deposits. Commercial banks pay the highest prices for physical capital and funds, as their operations are more capital intensive. These outcomes are in line with the conclusions of the study by Van Leuvensteijn et al. (2011).

Koetter et al. (2012) conclude that Lerner index suffers from several flaws as banks may "enjoy a quiet life" and not be efficient in terms of costs and profits. Therefore, Lerner index is altered for efficiency and turns into adjusted Lerner index:

$$adjustedLerner_i = \frac{\pi_i + tc_i - mc_i * q_i}{\pi_i + tc_i} \tag{3.4}$$

with the bank profit being π_i, total cost tc_i, marginal cost mc_i and total output q_i. The adjusted Lerner index can take values between zero and one, higher results reflecting stronger market power.

Table V: Mean values of key variables by bank specialization for the period 2005-2015 (in %)

Bank specialization	TotalCosts/ TotalAssets	Loans/ TA	Scurities/ TA	Customer Deposits/ TA	Overheads/ TA	Wages/ TA	InterestExpenses/ TotalFunding (witout CustomerDeposits)
Commercial banks	4.35	55	34	56	1198	1.14	2.36
Cooperative banks	3.90	60	27	68	246	1.36	1.79
Savings banks	3.87	61	30	70	264	1.23	1.96

The cost function used to estimate the efficiency-adjusted Lerner index has the same form as for the regular Lerner indicator, but instead the OLS estimation method we apply the Distribution Free Approach (DFA). DFA is preferable to the Stochastic Frontier Approach since it does not impose constraining assumptions on the distribution of the error components. The main assumption for SFA is the half-normal distribution of inefficiency that does not hold in the absence of any restriction on inefficiency distribution as Berger (1993) and Bauer (1990) state.

Boone indicator is the newest technique to commensurate competition and replaces *relative profit differences* that is a theoretical construct difficult to be implemented in practice and proposed by Boone (2008). Actually, Boone et al. (2005) recommend *profit elasticity (PE)* or Boone indicator as empirical analogue of *relative profit differences (RPD)*. Boone indicator expresses the elasticity of profits to marginal costs:

$$profitelasticity_i = \frac{\partial \ln \pi_i}{\partial \ln mc_i} \tag{3.5}$$

where π_i shows the firm i's total profits and mc_i equals the marginal costs. Profit elasticity is expected to take negative values due to the inverse relationship between profits and marginal costs.

Banks that are more efficient should have a lower Boone indicator, in absolute terms, since their returns should be not seriously impacted by incremental expenditures. A large absolute value of Boone indicator shows that the financial institution is less capable to manage its losses as a direct result of increasing competition. Therefore, profit elasticity is the connection between the overall performance of a bank and different levels of efficiency. It can have any value and represents consequently a continuous measure of market power.

The major advantages of the profit elasticity index consist in no differentiation between small and large states and no separate investigation of the competitive nature of the total of all banking activities.

To estimate the Boone indicator, we utilize General Method of Moments (GMM) with one-, two-, and three-lagged values of marginal costs as proposed by Van Leuvensteijn et al. (2011). The only major difference is that, in the current model, market shares are replaced by profits before taxes.

In this paper, the three competition measures have been chosen based on several reasons. Lerner index is a market power measure that can be estimated at bank level, across time and by taking into account different geographic and product markets. Its efficiency-adjusted form helps dealing with profit and cost inefficiencies. Boone indicator comes with the benefit of assessing competition for different bank outputs and types of financial institutions.

4. Results

The average value of Lerner index in the current sample equals 0.069 with a standard deviation of 0.211, as table VI shows. Hence, overall, the twenty-eight countries under scrutiny possess very competitive financial systems and they are similar in terms of competition. The smallest value of Lerner index equals -0.319 and belongs to *Capital Bank - Grawe Gruppe AG*, an Austrian commercial bank, in 2005. The lowest level of competition occurs for *Sparkasse Pottenstein N.OE.* in 2005, as this savings bank has a score of 0.379.

Table VI: Measures of competition (2005-2015) for the entire sample

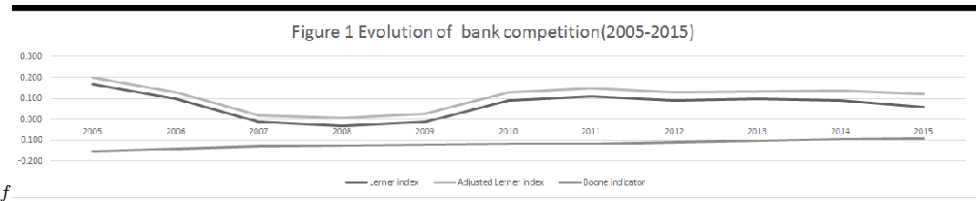
Variable	No.Obs.	Mean	Std.Dev.	Min	Max
Lerner index	20,264	0.069	0.211	-0.319	0.379
Adjusted Lerner index	20,264	0.110	0.201	-0.263	0.404
Boone indicator	20,264	-0.118	0.038	-1.192	-0.068

Adjusted Lerner index confirms the competitiveness of the banks included in the sample under observation as it is on average 0.110 and does not vary significantly (i.e. standard deviation of 0.201). The lowest value for this indicator occurs in 2011 for *Caja Rural San Roque de Almenara S Coop de Credito* (-0.263), a Spanish cooperative bank, whereas *Icbc Standard Bank Plc*, a commercial bank from U.K., is the less competitive bank with efficiency-adjusted Lerner index equal to 0.404, in 2014.

Boone indicator highlights the high level of competition present at bank-level as well. The last index takes a mean of -0.118 and reflects no important discrepancies across countries (standard deviation of 0.038). The most competitive banking entity is *Bpost Banque SA-Bpost Bank*, a commercial bank from Belgium with a Boone score of -1.192, while the French savings bank *Caisse d'Epargne et de Prévoyance de Loire-Drôme-Ardèche* displays the lowest interest in competition (-0.068).

Starting with 2005, market power decreases for the next three years according to all three competition measures (figure 1). After 2008, Lerner index and adjusted Lerner index get higher until 2011, while the decrease of Boone indicator drops by the end of 2008 and is followed by improvements in market power for 2009-2011. During years 2011 and 2012, Lerner index and its adjusted form reflect that the market power increases. Slower increases in Lerner index and efficiency adjusted-Lerner index occur in 2013 and 2014, followed by a drop in 2015. For 2011-2015, Boone indicator fluctuates. The movements of the three indicators coincide with the conclusions of Beck et al. (2012), Anginer et al. (2012), and Clerides et al. (2015) and follow the global business cycle. Bank efficiency is higher during the upward phase of the business cycles due to better information availability and decreasing adjustment expenses. Since the resulting cost savings are not fully transferred to the prices charged for banking products, the market power gets up. At the same time, the higher competition before 2008 is due to financial globalization, mergers and acquisitions that have improved the efficiency of banking activities and processes. The financial crisis has brought lower market power since it has caused significant capital losses and higher volumes of non-performing loans.

1



1.tif

According to table VII, on average, Lerner index indicates that Czech Republic, Lithuania, Malta, Bulgaria, Greece, Netherlands and Slovakia have the most competitive banking sectors. In fact, these states possess attractive markets for the financial institutions that want to expand their operations abroad. In Luxembourg, Austria, United Kingdom, Hungary and France,

banks are the least competitive, since there are several big banking entities that control the market. According to adjusted Lerner index, the highest competition in banking sector is present in Slovenia, followed by Sweden, Bulgaria, Czech Republic, Lithuania, Malta and Slovakia. United Kingdom, Luxembourg, Hungary, Finland and Portugal possess the least competitive banking systems. Boone indicator suggests that Sweden promotes the highest level of banking competition. On the next places, one finds Bulgaria, Czech Republic, Malta, Latvia and Slovakia. The least competitive banking sectors are in Ireland, Finland, United Kingdom, France and Hungary. Similar mixed results, depending on the measures used, have been obtained by Carbó et al. (2009), Andrieş and Căpraru (2012) and Clerides et al. (2015).

Table VII: Average values for competition (2005-2015), by country

Country	Lerner index	Adjusted Lerner index	Boone indicator
AUSTRIA	-0.030	0.020	-0.100
BELGIUM	0.120	0.160	-0.120
BULGARIA	0.230	0.260	-0.170
CROATIA	0.130	0.170	-0.160
CYPRUS	-0.020	0.030	-0.150
CZECH REPUBLIC	0.200	0.240	-0.120
DENMARK	0.150	0.190	-0.150
ESTONIA	0.110	0.170	-0.110
FINLAND	-0.170	-0.110	-0.090
FRANCE	-0.060	0.000	-0.100
GERMANY	0.060	0.100	-0.120
GREECE	0.120	0.170	-0.140
HUNGARY	-0.090	-0.040	-0.140
IRELAND	-0.060	0.020	-0.080
ITALY	0.120	0.160	-0.120
LATVIA	0.160	0.200	-0.130
LITHUANIA	0.170	0.220	-0.130
LUXEMBOURG	-0.110	-0.060	-0.090
MALTA	0.160	0.200	-0.110
NETHERLANDS	0.120	0.170	-0.130
POLAND	0.100	0.140	-0.140
PORTUGAL	0.000	0.040	-0.130
ROMANIA	0.050	0.090	-0.160
SLOVAKIA	0.160	0.210	-0.130
SLOVENIA	-0.010	0.040	-0.110
SPAIN	0.100	0.140	-0.110
SWEDEN	0.240	0.280	-0.130
UNITED KINGDOM	-0.090	-0.030	-0.090

The non-OECD members are slightly more competitive that the states belonging to OECD, as all three competition measures from table VIII indicate. This might be explained by the fact that Bulgaria, Croatia, Cyprus, Lithuania, Malta and Romania have good profit perspectives for new entrants. At the same time, local companies take loans in order to finance their ongoing activities (Caminal and Matutes, 2002). However, the OECD states have more concentrated markets in which it is difficult to rap the profits from the leader. These results are similar to those from the study by Clerides et al. (2015). The differences between the two groups of countries are significant at least 10%, according to the outcomes of the t-test included in table VIII.

Table VIII: Average values for competition (2005-2015), by subsample			
Country group	Lerner index	Adjusted Lerner index	Boone indicator
OECD vs Non-OECD countries			
OECD	0.123	0.161	-0.154
Non-OECD	0.067	0.108	-0.117
Difference	0.056***	0.053***	-0.036*
Eurozone vs Non-Eurozone states			
Eurozone	0.063	0.104	-0.117
Non-Eurozone	0.092	0.134	-0.125
Difference	-0.028***	-0.030***	0.008***
High vs Upper middle income countries			
High income	0.068	0.109	-0.118
Upper middle income	0.131	0.168	-0.163
Difference	-0.063***	-0.059***	0.045***
Commercial vs Cooperative banks			
Commercial bank	0.030	0.079	-0.116
Cooperative bank	0.114	0.148	-0.124
Difference	-0.084***	-0.069***	0.008***
Commercial vs Savings banks			
Commercial bank	0.030	0.079	-0.116
Savings bank	0.060	0.043	-0.106
Difference	-0.030***	0.036***	-0.010***
Cooperative vs Savings banks			
Cooperative bank	0.114	0.148	-0.124
Savings bank	0.060	0.043	-0.106
Difference	0.054***	0.105***	-0.018***
G-SIIs vs O-SIIs			
G-SIIs	0.211	0.200	-0.100
O-SIIs	0.150	0.181	-0.120
Difference	0.061***	0.019***	0.020***
G-SIIs vs N-SIIs			
G-SIIs	0.211	0.200	-0.100
N-SIIs	0.190	0.168	-0.150
Difference	0.021***	0.032***	0.050***
O-SIIs vs N-SIIs			
O-SIIs	0.150	0.181	-0.120
N-SIIs	0.190	0.168	-0.150
Difference	-0.040***	0.013***	0.030***

As for OECD states, the three competition measures fluctuate across time as figure 2 suggests. Market power increases before 2009 and lowers during the next two years. In 2012, competition level decreases, whereas in 2013 slightly recovers. During year 2014, market power increases. These movements are in line with those of the Lerner index, adjusted Lerner index and Boone indicator computed for the entire sample on a yearly basis.

Similar outcomes characterize the non-OECD countries as well. The only differences are higher market power in 2009 and decreasing values for Lerner index during 2012-2014, along with more variability in Boone indicator and more stable adjusted Lerner index. The results are accounted by the fact that these states are later impacted by the global financial crisis and they need more time to fully recover. Based on the values presented by Clerides et al. (2015), the same conclusions can be drawn.

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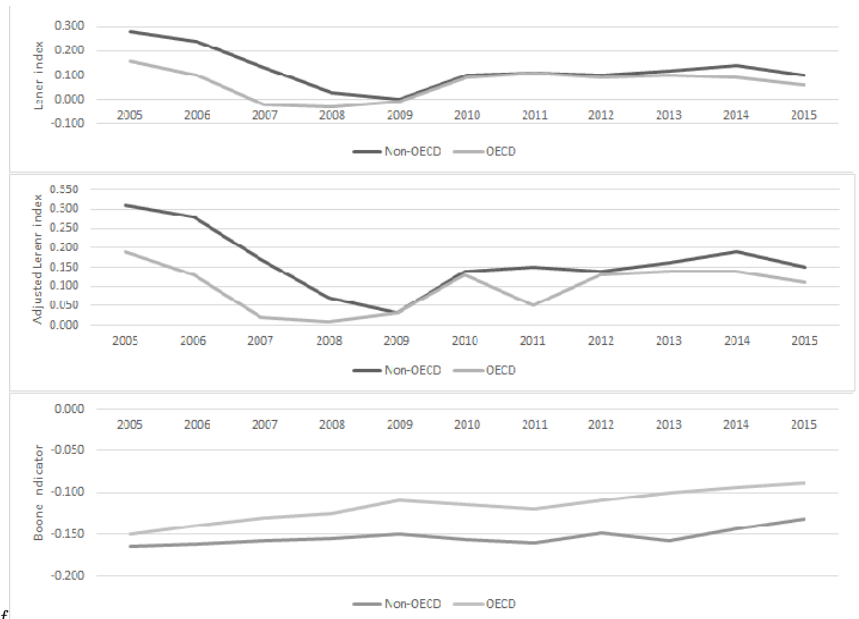

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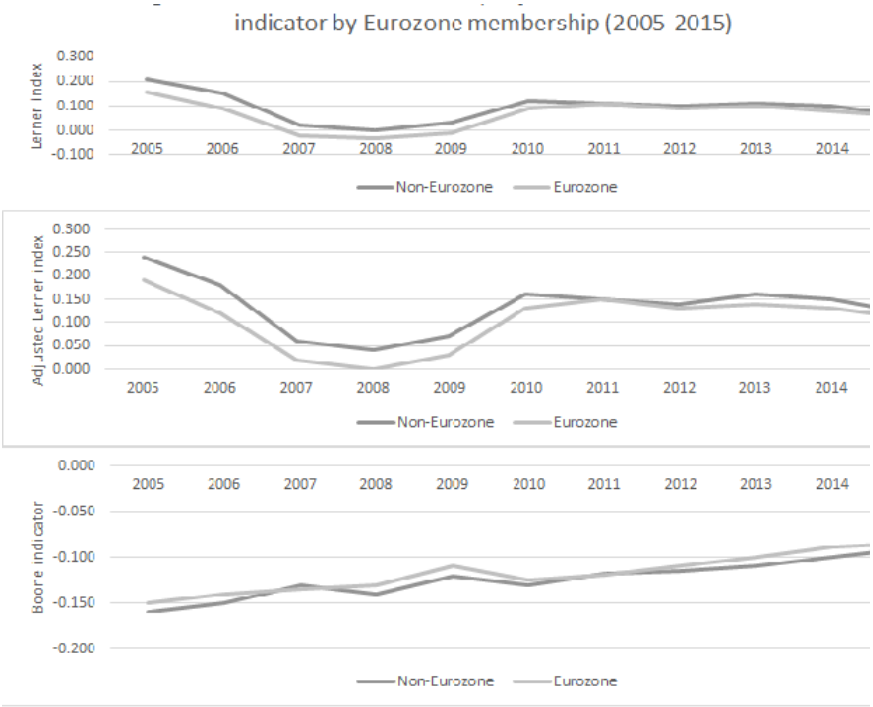
Being part of the European Economic and Monetary Union brings gains on competition level, as this organization facilitates comparability in terms of costs and prices within European Union, which in turn helps consumers, enhances intra-Union trade and eases business transactions (table VIII). The differences between the two subgroups are significant. These findings are similar to those from Weill (2013) and Andrieş and Cãpraru (2014).

During 2005-2008, there is a decreasing competitive behaviour in Eurozone countries (figure 3). By the end of year 2011, market power declines and starting with 2012 until 2014, competition level gets higher. These changes are normal given the macroeconomic conditions.

3



3.tif

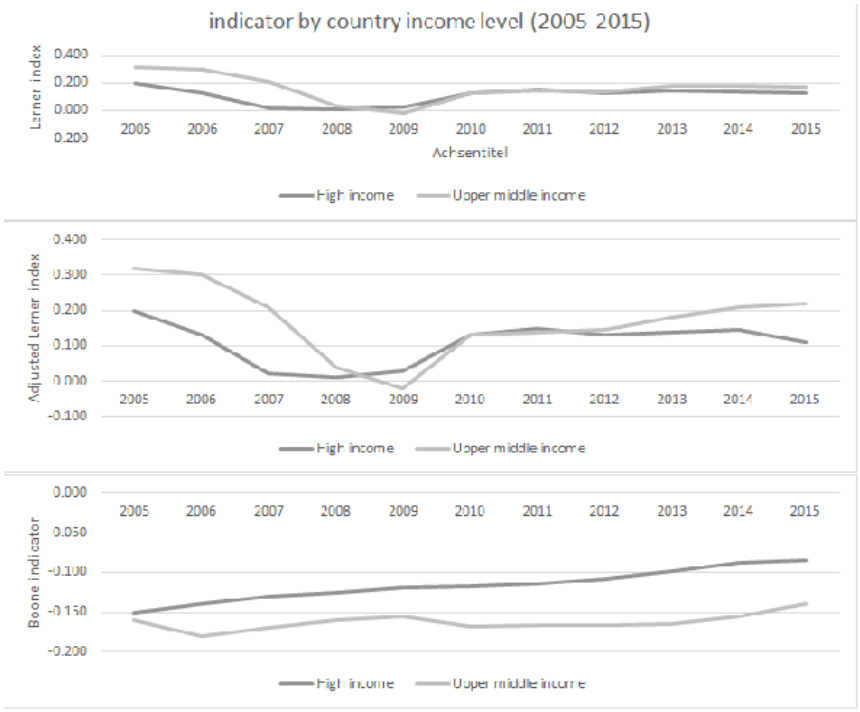
The same fluctuations are present in the states with their own currency. Overall, the variations in competitiveness level exist no matter of national currency. Yet, Euro countries prove to be more competitive as their counter-parties. The result comes naturally since in Eurozone area there are always challenges that make banks act more willingly to attract new customers. Similar variations have been identified by Weill (2013) and Andrieş and Căpraru (2014), for shorter periods included in the present time window.

Taking into account the OECD classification of states according to their income level, the upper middle-income states (i.e. Romania and Bulgaria) have more competitive banking sectors as their counter parties (table VIII). The differences between the two subgroups are significant. Similar results for the same country subgroups can be obtained based on the outcomes of the assessment made by Clerides et al. (2015).

The analysis of yearly changes based on figure 4 proves that market power increases in states with high-income from 2005 until 2008. Afterwards, competition improves for the next four years. In 2013 and 2015, there is a drop in the degree of competitiveness. The trend follows somehow the business cycle and has been noticed by Clerides et al. (2015).

As for Romania and Bulgaria, the variations during 2005-2015 are close to the changes that occur in high-income countries, the only exceptions being increasing competition in year 2006 and lower market power starting with 2010 until the end of the period under scrutiny.

4



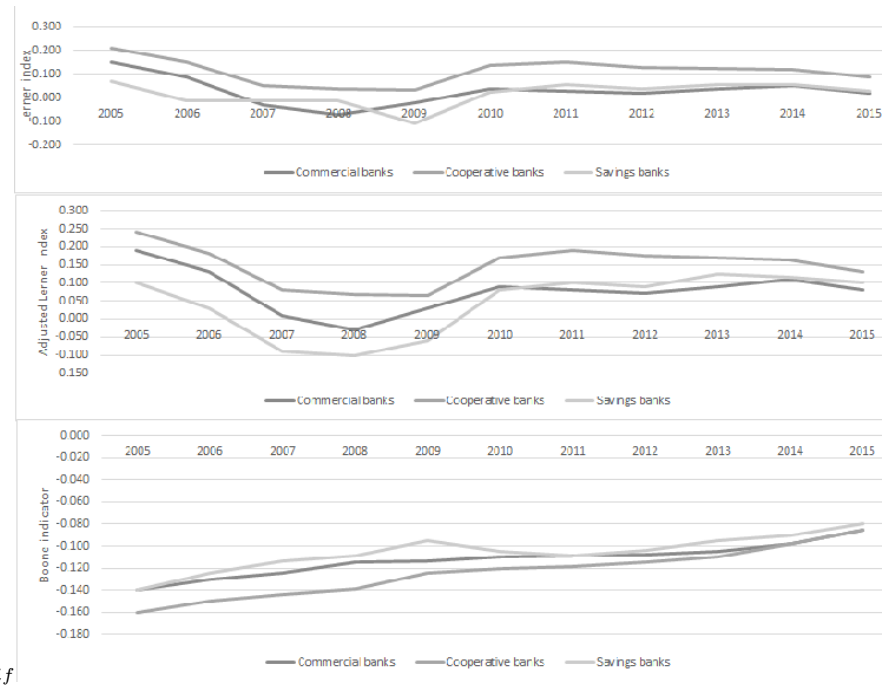
4.*tif*

The three indices vary across banks, given their specialization as table VIII shows. The most competitive financial institutions are the commercial banks (given the Lerner index and adjusted Lerner index scores), which is expected given the variety of products and services they provide to their clients and the fierce competition they are exposed to. Moreover, these banking entities are the most numerous as they are present in each country. Boone indicator shows that the highest competition level characterizes cooperative banks. Van Leuvensteijn et al. (2011) have reported similar results.

Until 2009, the market power of the commercial banks increases continuously (figure 5). Starting with 2009 until 2011, these financial institutions become more competitive. The period 2012-2015 is characterized by a decline in competition degree. All these changes account for the

adjusted banking behaviour considering the overall economic conditions. Similar fluctuations define cooperative banks, as well. The differences refer to years 2009, 2012 and 2014 that mark the beginning of a more competitive behaviour for the banks.

5



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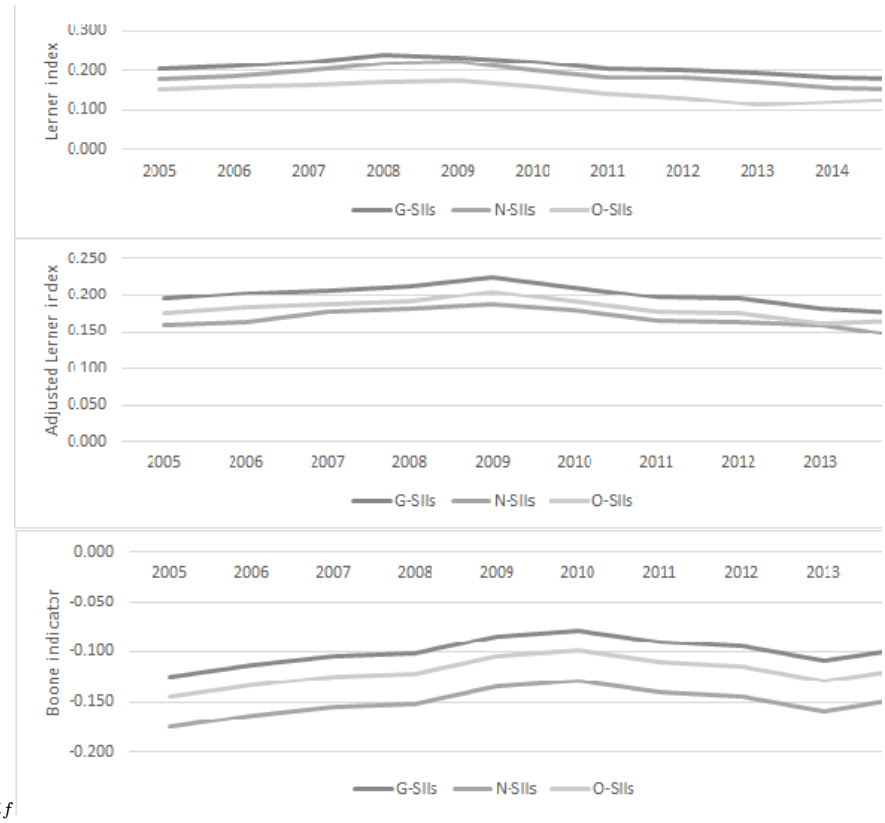
As for savings banks, they display a trend similar with the one of commercial banks during 2005-2009, and with cooperative banks afterwards. This behaviour comes as expected since these financial institutions are less competitive as they serve a market niche and offer personalized products and services. Therefore, these banking entities do not have any interest in involving in fierce competition. They are always having their customers based on the output they create. All these findings are similar to the conclusions of Van Leuvensteijn et al. (2011).

Given the values of Lerner index, the other systemically important institutions (O-SIIs) are more competitive than the global systemically (G-SIIs) and non-systemically ones (N-SIIs), as depicted in table VIII. O-SIIs consists in medium banks or subsidiaries of banking groups that have to be active and acquire a significant share of the market in a specific country. These banks offer a wide variety of products and services as most of them are commercial banks. Consequently, their involvement in designing and implementing competitive strategies is normal. As for G-SIIs, they follow O-SIIs in terms of competitiveness since they are well-established banking entities that have a secured market share due to their reputational advantages and size. In the last place come N-SIIs that are represented mainly by savings banks and small local commercial banks that are not focused on being competitive, since they differentiate from their counter-parties through their specialized products and services. Adjusted Lerner index and Boone indicator show that N-SIIs remain the most competitive, seconded closely by O-SIIs and followed by G-SIIs. The differences among these three categories of financial institutions are significant as shown in table VIII.

Table IX: Correlation matrix competition			
	1	2	3
LernerIndex	1.000		
AdjustedLernerIndex	0.956*	1.000	
	(0.000)		
BooneIndicator	0.735*	0.839*	1.000
	(0.000)	(0.000)	
The p-values are listed in the parentheses.			
*shows statistical significance at the 1% level.			

On a yearly basis, the changes in the competition level of global systemically important banks follow the business cycle since these financial entities must permanently adjust their behaviour to macroeconomic conditions (figures 6). A similar behaviour is displayed by non-systemically and other systemically important financial entities. To our knowledge there has been no previous study done on the competition level depending on the systemic importance of the banks.

6



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All the three competition measures (i.e. Lerner index, adjusted Lerner index and Boone indicator) are positively and significantly correlated at 1% level as table IX depicts. This consequence comes natural since they are strongly interrelated and their computations are connected to each other. These outcomes are in line with the findings of Clerides et al. (2015).

5. Conclusion

The current research has investigated the evolution of competition among 2,024 commercial, cooperative and savings banks from Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia,

Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom during 2005-2015.

Lerner index, adjusted Lerner index and Boone indicator provide different perspectives on the market power that characterizes each bank. The Fourier flexible form of translog cost function with total assets consisting in the sum of three main bank outputs (i.e. loans, securities and customer deposits) and three input prices (labour, physical capital and funds, excluding customer deposits). World Bank and European Central Bank make the necessary input available. Overall, the banks included in the sample display high level of competition that varies given the changes in the macroeconomic conditions. This outcome is similar to the findings in previous literature on overall competition level. Euro area, OECD and upper middle-income states are more competitive that their counter-parties, whereas in terms of bank specialization, commercial and cooperative banks are the most interested in improving their market shares.

Further studies should be done in this area maybe using different datasets that refer to either other countries or groups of states. The existing methodologies and estimates can be improved and developed so they enable the analysis of competition by each bank product for individual financial institutions. One way of doing so is by using a meta-frontier in approximating the marginal costs.

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References

[1] Andrieş, A.M. & Căpraru, B. (2012). Competition and efficiency in EU27 banking systems. Baltic Journal of Economics, 12, 41-60.
[2] Andrieş, A.M. & Căpraru, B. (2014). The nexus between competition and efficiency: the European banking industries experience. International Business Review, 23, 566-579.
[3] Apergis, N., Fafaliou, I., & Polemis, M.L. (2016). New evidence on assessing the level of competition in the European Union banking sector: a panel data approach. International Business Review, 25, 395-407.
[4] Bain, J.S. (1951). Relation of profit rate to industry concentration: American manufacturing, 1936-1940. The Quarterly Journal of Economics, 65, 293-324.
[5] Bain, J.S. (1956). Barriers to new competition: their character and consequences in manufacturing industries. Cambridge: Harvard University Press.
[6] Bain, J.S. (1959). Industrial Organization. New York: Wiley.
[7] Bauer, P. (1990). Recent developments in the econometric estimation of frontiers. Journal of Econometrics, 46, 39-56.
[8] Berger, A.N., (1993). "Distribution free" estimates of efficiency in the US banking industry and tests of the standard distributional assumptions. Journal of Productivity Analysis, 4, 261–292.
[9] Berger, A. N., Klapper, L.F., & Turk-Ariss, R. (2009). Bank competition and financial stability. Journal of Financial Services Research, 21, 99-118.
[10] Berger, A.N. & Mester, L. (1997). Inside the black box: What explains differences in the efficiencies of financial institutions? Journal of Banking and Finance, 21, 895-947.
[11] Bikker, J.A., Schaffer, S., & Spierdijk, L. (2012). Assessing competition with the Panzar-Rosse model: the role of scale, costs and equilibrium. The Review of Economics and Statistics, 94, 1025-1044.
[12] Bolt, W. & Humphrey, D. (2010). Bank competition efficiency in Europe: a frontier approach. Journal of Banking and Finance, 34, 1808-1817.
[13] Bolt, W. & Humphrey, D. (2015). Assessing bank competition for consumer loans. Journal of Banking and Finance, 61, 127-141.
[14] Bonaccorsi Di Patta, E., & Dell'Aricca, G. (2004). Bank competition and firm creation. Journal of Money, Credit and Banking, 36, 225–252.
[15] Boone, J. (2008). A new way to measure competition. The Economic Journal, 118, 1245-1261.
[16] Boone, J., Griffith, R., & Harrison, R. (2005). Measuring competition. AIM Research Working Paper Series.
[17] Bresnahan, T. (1982). The oligopoly solution concept is identified. Economics Letters, 10, 87-92.
[18] Carbó, S., Humphrey, D., Maudos, J., & Molyneux, P. (2009). Cross-country comparisons of competition and pricing power in European banking. Journal of International Money and Finance, 28, 115-134.
[19] Casu, B., & Girardone, C. (2009). Competition issues in European banking. Journal of Financial Regulation and Compliance, 17, 119-133.
[20] Cetorelli, N. (2001). Competition among banks: good or bad? Economic Perspectives, 25, 38-48.

[21] Cetorelli, N. (2004). Real effects of bank competition. Journal of Money, Credit and Banking, 36, 543-558.
[22] Cetorelli, N., & Strahan, P.E. (2006). Finance as a barrier to entry: bank competition and industry structure in local US banking markets. Journal of Finance, 61, 437–461.
[23] Claessens, S., & Laeven, L. (2004). What drives bank competition? Some international evidence. Journal of Money, Credit and Banking, 36, 563-583.
[24] Clerides, S., Delis, M. D., & Kokas, S. (2015). A new dataset on competition in national banking markets. Financial Markets, Institutions and Instruments, 24, 267-311.
[25] Coccorese, P. (2014). Estimating the Lerner index for the banking industry: a stochastic frontier approach. Applied Financial Economics, 24, 73-88.
[26] Fiordelisi, F. & Salvatore Mare, D. (2014). Competition and financial stability in European cooperative banks. Journal of International Money and Finance, 45, 1-16.
[27] Fu, X., Lin, Y. & Molyneux, P. (2014). Bank competition and financial stability in Asia Pacific. Journal of Banking and Finance, 38, 64–77.
[28] Goddard, J., Molyneux, P., & Wilson, J.O. (2001). European banking: efficiency, technology and growth. New York: Wiley.
[29] Hannah, L. & Kay, J.A. (1977). Concentration in modern industry: theory, measurement and the U.K. experience. London: Palgrave Macmillan UK.
[30] Herfindahl, O. (1950). Concentration in the U.S. steel industry, Dissertation. New York: Columbia University.
[31] Hirschman, A.O. (1945). National power and the structure of foreign trade. California: University of California Press.
[32] Huang, T.H., Chiang D.L., & Chao, S.W. (2017). A new approach to jointly estimating the Lerner index and cost efficiency for multi-output banks under a stochastic meta-frontier framework. The Quarterly Review of Economics and Finance, 65, 212-226.
[33] Iwata, G. (1974). Measurement of conjectural variations in oligopoly. Econometrica, 42, 947-966.
[34] Keeley, M.C. (1990). Deposit insurance, risk and market power in banking. American Economic Review, 80, 1183-1200.
[35] Lapteacru, I. (2014). Do more competitive banks have less market power? The evidence from Central and Eastern Europe. Journal of International Money and Finance, 46, 41-60.
[36] Lapteacru, I. & Lahet, D. (2014). Efficience et pouvoir de marché des banques en Thaïlande suite aux crises financières. Revue économique, 65, 675-698.
[37] Lau, L. (1982). On identifying the degree of competitiveness from industry price and output data. Economics Letters, 10, 93–99.
[38] Leightner, J.E. & Lovell, C.K. (1998). The impact of financial liberalization on the performance of Thai banks. Journal of Economics and Business, 17, 115-131.
[39] Lerner, A. P. (1934). The concept of monopoly and the measurement of monopoly. Review of Economic Studies, 1, 157-175.
[40] Liu, G., Mirzaei, A., & Vandoros, S. (2014). The impact of bank competition and concentration on industrial growth. Economic Letters, 124, 60-63.
[41] Mason, E. S. (1939). Price and production policies of large-scale enterprise. American Economic Review, 29, 61-74.
[42] Mason, E. S. (1949). The current status of the monopoly power in the United States. Harvard Law Review, 62, 1265-1285.
[43] Mitchell, K., & Onvural, N.M. (1996). Economies of scale and scope at large commercial banks: evidence from the Fourier flexible functional form, Journal of Money, Credit and Banking, 28, 178-199.
[44] Okuda, H., & Rungsomboon, S. 2006. Comparative cost study of foreign and Thai domestic banks in 1990–2002: its policy implications for a desirable banking industry structure. Journal of Asian Economics, 17, 714-737.
[45] Panzar, J., & Rosse, J. (1987). Testing for "monopoly" equilibrium. Journal of Industrial Economic, 35, 443-456.
[46] Schaeck, K., Čihák, M. & Wolfe, S. (2009). Are competitive banking systems more stable? The Journal of Money, Credit and Banking, 41,711-734.
[47] Van Leuvensteijn, M., Bikker, J.A., van Rixtel, A.R., & Sørensen, C.K. (2011). A new approach to measuring competition in the loan markets of the euro area. Applied Economics, 43, 3155-3167.
[48] Xu, B., Van Rixtel, A., & Van Leuvensteijn, M. (2013). Measuring bank competition in China: a comparison of new versus conventional approaches applied to loan markets. BIS Working Papers, 422, 1–68

List of figures

Figure 3 Evolution of Lerner index, adjusted Lerner index and Boone indicator by Eurozone membership (2005-2015)

Figure 4 Evolution of Lerner index, adjusted Lerner index and Boone indicator by country income level (2005-2015)

Figure 5 Evolution of Lerner index, adjusted Lerner index and Boone indicator by bank specialisation (2005-2015)

Figure 6 Evolution of Lerner index, adjusted Lerner index and Boone indicator by bank systemically importance (2005-2015)