

Relationship between Concentration, Competition and Efficiency in the Banking Sector

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ABSTRACT

The goal of the paper is to investigate the relationship between concentration, competition and efficiency in the Baltic banking market.

For the research purposes the authors use financial data of commercial banks operating in three Baltic countries extracted from BankScope database and statistics on structural indicators from the European Central Bank data warehouse. Period of seven years – from 2007 till 2013 – is analyzed.

To check the consistency between concentration and competition measures, the authors perform a simple correlation analysis in SPSS environment. To determine the causal link between competition in the banking market and efficiency of banks, the express regression analysis is performed.

Market concentration is proxied by Herfindahl-Hirschman Index (HHI). To measure competition in the banking sector, Lerner index is estimated for individual banks and aggregated into the mean value. Efficiency of banking sector is based on estimated efficiency scores of individual banks. In turn, efficiency of banks is calculated, applying Data Envelopment Analysis (DEA) in DEA Frontier software.

The stated research hypotheses are rejected. There is no statistically significant relationship between concentration and competition in the Baltic banking market. Besides, there is no empirical evidence that competition level has an impact on overall efficiency of the banking sector.

Keywords: Competition, concentration, efficiency, Baltic banks.

1. INTRODUCTION

Competition in the banking sector can bring significant benefits to the market players, national economy and society, but also

can be a source of a potential instability due to the fact that competition forces banks to take more risk.

Recent studies, in turn, support the positive relationship between the level of competition and overall stability in the banking sector [1][2][3][4]. OECD experts in the report “Bank competition and stability” examine the interrelationship between banking competition and financial stability, considering the experience from the recent global crisis. They conclude that “that competition can be both good and bad for stability.” [5]

Unambiguous conclusion can be made about the positive effect of competition. Among the benefits are increased efficiency of production of financial services, the higher quality of financial products and the degree of innovation in the sector.[6]

The banking sector of the Baltic States, especially since joining the European Union in 2004, has experienced an increased competitive pressure from foreign financial institutions. Thus, it is crucially important to understand the impact of the competition level on the situation in the Baltic banking market.

The current research continues the series of studies aimed to measure efficiency of banks in the Baltic banking sector and identify the factors affecting the efficiency level. [7][8][9]

This paper focuses on the relationship between competition and concentration in the banking sector. Competition is frequently measured by concentration ratios. However, many researchers argue that concentration ratios are not good proxies for competition. This paper investigates the consistency of concentration measure - Herfindahl-Hirschman Index (HHI) - and Lerner index of competition. Besides, the competition-efficiency link is analyzed.

The goal of the paper is to investigate the relationship between concentration, competition and efficiency in the Baltic banking market.

The following hypotheses are tested in the current study:

Table 1.

H1: There is a statistically significant relationship between market concentration and competition level in the Baltic banking sector.

H2: Efficiency of the banking sector in the Baltic States is influenced by the level of market competition.

Sample data are extracted from BankScope data basis, covering the period of 2007-2013. As of 2013, Latvian sample (LV) includes 16 commercial banks, Lithuanian and Estonian sample – 8 and 9 banks, respectively.

Bank efficiency scores, estimated by means of Data Envelopment Analysis (DEA), are aggregated into mean scores for banking sector of each separate country. Statistics on Herfindahl-Hirschman Index (HHI) is extracted from the data warehouse of the European Central Bank (ECB). [10]

The authors did not find any empirical data on Lerner index of competition measured for the Baltic banking market. The present paper is aimed to reduce this gap in the literature. The investigation of the competition-stability link is one of possible directions for further studies.

2. COMPETITION, CONCENTRATION AND EFFICIENCY IN BANKING

Competition in the banking sector is frequently measured by concentration ratios, such as market share of the largest banks (CR3, CR5, CR10) or Herfindahl-Hirschman Index (HHI). However, many researchers insist on distinguishing between concentration and competition. In 2010, the OECD Competition Committee organized a roundtable discussion on competition, concentration and stability in the banking sector. One of the conclusions made through discussion was that “concentration, among other structural indicators, is not a good proxy for competition.” A set of other factors should be taken in consideration – for instance, market contestability, switching costs, size of competitors and customers and etc. [11]

The relationship between concentration and competition in the banking market has been investigated in the wide range of studies. [11][12][13][14][15] There is empirical evidence of the existence [15][16][17] and non-existence [13][18] of the relationship between bank competition and concentration.

The results of studies can be largely influenced by the kind of measures used by the researchers. The comprehensive overview of different ratios employed in measuring bank competition is provided by Bikker and Haaf. [19]

Measuring of competition level is based on the structural and non-structural approaches. In structural models concentration ratios (CR5 ad HHI) are used to describe the relationship between competitive performance and market structure. [14] Non-structural measures of competition are estimated, applying Iwata model [20], Bresnahan model [21] and Panzar and Rosse (PR) model [22]. Besides, the researchers use such competition measures, as Lerner index [23] and Boone indicator [24].

Table 1 summarizes the information about the competition measures used in recent studies.

Measures of competition used in recent studies

Source	Measures of competition
Casu, Girardone 2006 [13]	PR H-statistics
Schaek <i>et al.</i> 2006 [1]	Lerner index, Boone indicator
Abbasoğlu <i>et al.</i> 2007 [18]	H-statistics
Maudos, Guevara 2007 [25]	Lerner index
Liu <i>et al.</i> 2010 [26]	Lerner index, PR H-statistics
Andries, Capraru 2012 [27]	Lerner index, PR H-statistics
Pawlowska 2012 [14]	Lerner index, PR H-statistics
Repkova 2012 [28]	Lerner index
Castellanos, Garza-García 2013 [29]	Boone indicator
Park 2013 [15]	PR H-statistics, Boone indicator
Amidu, Wolfe 2013 [3]	Lerner index
Ningaye <i>et al.</i> 2014 [30]	Lerner index

The relationship between market structure, competition level, bank efficiency and profitability in the banking industry has been tested empirically in different regions and applying a wide range of different approaches and measures. [29][27][31][32][33][34][35]

The earliest contributors to the exploration of the efficiency concept were Debreu with his coefficient of resource utilization [36], Koopmans with his definition of an efficient point [37] and Farrell with his work “The Measurement of Productive Efficiency” [38].

The most frequently applied methods to measure bank efficiency are Stochastic Frontier Approach (SFA) [39][40][27][41][42][43] and Data Envelopment Analysis (DEA) [44][7][8][45][46]. These methods incorporate multiple inputs and outputs specific for banking business. Studies on application both methods [47][48] yielded significantly different efficiency scores of banks. Thus, the question about the consistency of results from different papers still remains open.

Another important question that is frequently discussed while measuring bank efficiency is variables selection. Combinations of inputs and outputs differ widely [44][45][46] depending on one of three conceptual approaches to the core of banking business. Intermediation approach emphasizes the intermediary role of banks and treats loans and securities as outputs, but deposits, labour and capital as inputs [49]. Production approach assumes that banks use capital and labour to produce different kinds of banking products [50]. Profitability approach uses profit-oriented measures as bank outputs [46].

The wide range of methods and underlying measures used to test competition-efficiency link in banking explains the diversity of the outcomes and made conclusions. It means, in turn, that the researchers should refer to the previously received results with caution. The analysis of data performed for local markets should be comprehensive and multidimensional.

3. RESEARCH METHODOLOGY

For the research purposes the authors use financial data of commercial banks operating in three Baltic countries extracted from BankScope database and statistics on structural indicators from the European Central Bank data warehouse.

Period of seven years – from 2007 till 2013 – is analyzed. Research sample data is limited by the information available in BankScope. For instance, Latvian sample is represented by 16 banks, while the real number of banks operating in the Latvian banking sector in 2013 was 19. Besides, Central Banks of the countries are removed from the sample. The analysis is performed for each country separately.

To test the first hypothesis about the relationship between concentration level and competition and, consequently, to check the consistency between concentration and competition measures, the authors perform a simple correlation analysis in SPSS environment.

Concentration is measured with Herfindahl-Hirschman Index (HHI). The HHI is calculated by summing up the squared market shares of all companies competing in the market. The value of HHI can range between 0 and 10000 (0 and 1). The closer value is to 0, the closer market situation to perfect competition. Value equal to 10000 indicates a monopolistic market.

To measure competition in the banking sector, Lerner index is estimated for individual bank and aggregated into the mean value. Lerner index is estimated, using the formula (1):

$$L_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \quad (1)$$

where P_{it} is the price of banking outputs for bank i at time t ,
 MC_{it} is the marginal costs for bank i at time t .

In turn, MC_{it} is calculated from translog cost function (see formula 2).

$$\ln TC = a_0 + a_1 \ln Y + 0.5a_2 (\ln Y)^2 + \sum_{j=1}^3 \beta_j \ln w_j + \sum_{j=1}^3 \sum_{k=1}^3 \beta_{jk} \ln w_j \ln w_k + \sum_{j=1}^3 \gamma_j \ln Y \ln w_j + \varepsilon \quad (2)$$

where TC – total costs,

Y (output) – total assets,

w1 (input 1) – labour price,

w2 (input 2) – price of borrowed funds,

w3 (input 3) – capital price;

$k > j$.

The coefficients estimated from the cost function (formula 2) are used to calculate marginal costs (MC), applying the formula (3).

$$MC = \frac{TC}{Y} (\alpha_1 + \alpha_2 \ln Y + \sum_{j=1}^3 \gamma_j \ln w_j) \quad (3)$$

Following the experience of other researchers [25][28], the measures needed for the calculation purposes are estimated with the formulas from the Table 2.

Table 2.

Lerner index calculation: procedure and measures

Measure	Calculation
P_{it}	Total revenues (TR) / Total assets
TR	Interest revenues + non-interest revenues
TC	Interest expenses + Non-interest expenses
w1	Personnel expenses / Total assets
w2	Interest expenses / Deposits and short-term funding
w3	Other operating expenses / fixed assets

All the financials summarized in the Table 2 can be directly extracted from BankScope data base.

Lerner index estimated for each individual bank denotes its pricing power. Based on the theory, Lerner can range between 0 and 1. However, in the real market situation its value can exceed 1 (in case of positive marginal costs) or it can be negative. [51]

As for bank efficiency, Data Envelopment Analysis, firstly introduced by Charnes *et al.* [52], was applied. The most efficient companies form the efficient production frontier, and relative inefficiency of other companies within the reference is assessed in comparison with efficient ones. Efficiency score is estimated as the ratio of weighted outputs to weighted inputs. To find the weights, optimization task is solved for each company in order to maximize its efficiency score (see formulas 4 and 5).

$$\max h_0 = \frac{\sum_{r=1}^s u_r y_{r0}}{\sum_{i=1}^m v_i x_{i0}} \quad (4)$$

subject to:

$$\frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1; \quad (5)$$

The maximal efficiency score is equal to 1, and the lower values indicate relative inefficiency of analyzed banks.

To test the second hypothesis about the causal link between competition in the banking market and efficiency of banks, the express regression analysis is performed. Competition is proxied by the average value of Lerner index. In turn, the efficiency of banking sector is based on estimated DEA scores of individual banks.

Input-oriented DEA model under the assumption of Variable Returns to Scale VRS) is used. Variables selection for the model is based on the intermediation approach. Total deposits are treated as a single input, and total loans represent a single

output. The calculations are made by means of DEA Frontier software.

4. RESULTS

DEA scores for individual banks in the Baltic banking sector for the period 2007-2013 are calculated and the average values are summarized in the Table 3.

Table 3.

DEA efficiency in the Baltic banking sector

Year	LV	LT	EE
2007	0,525	0,899	0,812
2008	0,638	0,876	0,835
2009	0,747	0,877	0,791
2010	0,673	0,862	0,758
2011	0,659	0,917	0,704
2012	0,602	0,950	0,553
2013	0,537	0,925	0,611

The Lithuanian banks demonstrate higher average efficiency, compared with Latvia and Estonia. Besides, there is a significant decreasing trend observed in the Estonian sample data.

Statistics on market concentration in the Baltic banking market [10] is presented in the Fig. 1.

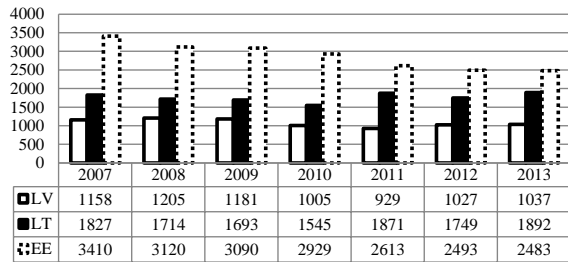


Figure 1. Concentration in the Baltic banking market (HHI)

The most concentrated is the Estonian banking market, and the less concentrated is the Latvian banking market. According to the criteria of the U.S. Department of Justice and the Federal Trade Commission [53], the market with HHI above 2500 points is considered to be a highly concentrated. However, it is difficult to compare banking sector in the Baltic States with the banking sector of larger countries. The high value of HHI is obvious without any calculation, because of small number of banks operating in the market.

The estimated values of Lerner index for the period of 2007-2013 are presented in the Table 4.

Table 4.

Average Lerner index in the Baltic banking sector

Year	LV	LT	EE
2007	0,6381	0,5813	0,6653
2008	0,7456	0,5380	0,6848
2009	0,6096	0,6635	0,8776
2010	0,2611	0,2837	0,3755
2011	0,3557	0,2595	0,6254
2012	0,6041	0,3788	0,5413
2013	0,8671	0,3898	0,7298

The larger is the Lerner value, the higher market power has an individual bank. Consequently, the closer Lerner is to 1, the closer is the market to a monopoly. Based on the calculation results, the Latvian banking sector demonstrates the highest values of Lerner index.

To determine the relationship between values of HHI and Lerner index in the Baltic banking sector, a simple correlation analysis is performed. The results of the analysis for three Baltic States are, as follows:

- Latvia: no statistically significant correlation (Pearson $\rho = 0,550$, Sig. = 0,200);
- Lithuania: no statistically significant correlation (Pearson $\rho = -0,021$, Sig. = 0,965);
- Estonia: no statistically significant correlation (Pearson $\rho = 0,202$, Sig. = 0,664).

The results of the express regression analysis to determine the relationship between competition in the market, expressed by Lerner index, and the efficiency of the banking sector are presented graphically in the Figures 2, 3 and 4.

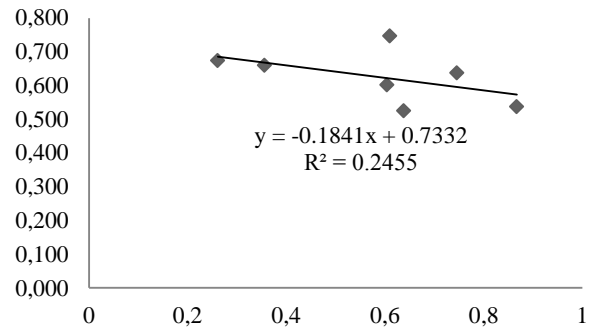


Figure 2. Relationship between competition and efficiency (Latvian banking data)

R-squared of the model is equal to 0.2455, indicating that 25 per cent of the variability in the banking sector efficiency is explained by this model.

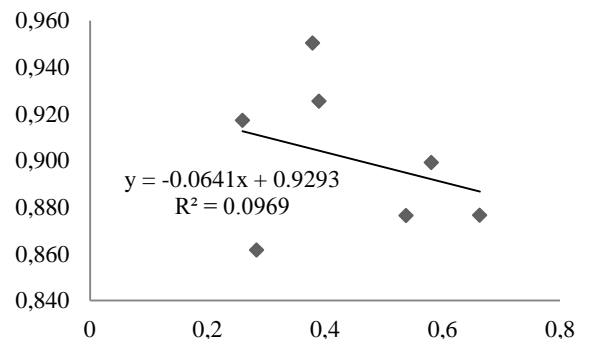


Figure 3. Relationship between competition and efficiency (Lithuanian banking data)

This model explains only 9 per cent of the variability in the banking sector efficiency ($R^2 = 0.0969$).

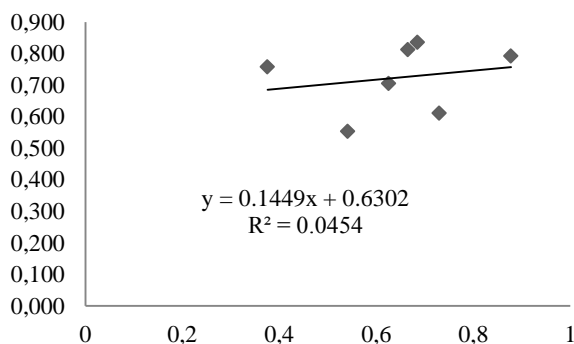


Figure 3. Relationship between competition and efficiency (Estonian banking data)

Model based on the Estonian sample data explains only 4 per cent of the variability in the efficiency of the Estonian banking sector.

The received results allow making an unambiguous conclusion that there is no causal relationship between Lerner index and DEA efficiency in the banking sector of the Baltic States. It means, in turn, that the second research hypothesis is rejected.

5. CONCLUSIONS

The present paper continues the series of studies performed with the sample data of the Baltic banking sector. The overall goal of these studies is to fill the information gap in the literature, considering the small number of papers on bank performance, efficiency and banking market structure, published by the local researchers.

The authors of the current research focus their attention on the relationship between market structure and bank efficiency, in particular on the consistency between concentration and competition measures.

Two research hypotheses are tested and the results are, as follows:

H1: There is a statistically significant relationship between market concentration and competition level in the Baltic banking sector. – Rejected

H2: Efficiency of the banking sector in the Baltic States is influenced by the level of market competition. – Rejected

It should be mentioned that the results of the present research are preliminary, and the further investigation is needed to investigate the problem. First of all, the analysis at the level of individual banks should be performed. Besides, the authors used DEA model with only two variables to measure efficiency of Baltic banks. The research with application of more complicated models can yield significantly different results from the present ones. It would be interesting also to test the consistency of market concentration and competition measures, using CR5 as a proxy of market concentration.

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