

## Exploring banking competition in Croatia by using the Panzar-Rosse model

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### ABSTRACT

The performance commercial banks in the Croatia have been widely studied, but there is little known about the examination of the nature of competition. For these reasons, it is important to investigate whether the banking sector in Croatia exerts monopoly or monopolistic behavior. This research empirically explores the nature of competition in the Croatian banking sector by covering 24 commercial banks between 2008 and 2018. In this vein, the panel data analysis was used along with H-Statistics. This study for Croatia and its findings confirms early findings of the existence of monopolistic competition in the most transition and developing countries. In fact, the findings obtained from this study reveals that the commercial banks in Croatia operate under monopolistic structure. Moreover, the results reveal that variable of RIETD, RLTA, RETA, and RDTA are statically significant. It indicates that banks operated in Croatia are focus more on traditional loans than other activities.

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**Keywords:** Banking competition, the Croatian banking sector, Panzar-Rosse model, panel data.

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### 1. Introduction

In the new post-crisis market environment national financial markets become increasingly integrated into one global system, while a new wave of bank consolidation put regional banks to be focused on building new capabilities. For instance, the global financial crisis in the US affected worldwide banking sectors followed by rise of merger and acquisition transactions and decline the number of banks. With decline of the number of banks, the structure competition and banking concentration experienced many changes as well [1]. The Structure-Conduct-Performance (SCP) and Efficiency Performance (EP) approaches predict a one-way causation relationship between market structure and performance. It might be arguable in the contemporary literature. The SCP and the EP approaches were also tested during the investigation of relationship between concentration and competition, profitability and efficiency are being investigated.

Numerous empirical studies have focused on explaining or examining the nature of competition in the banking sector. Although some empirical studies used the both structural and non-structural approach in their research, in this direction our study used Panzer- Rosse H statistic method from three reasons. Firstly, provides broader market structure, secondly, it enables estimation of econometric model with regression and lastly, using cross-section as a form of competition among commercial banks.

The Croatia banking sector has been the most dominant part of the financial industry controlled by foreign banking groups from Austria and Italy and highly concentrated similar like in B&H, Montenegro and Serbia. The banking sector has strong banking linkages with high income EU countries [2].

The research aims to explore competitive environment in the Croatian banking sector by assessing the impact of changes in factor prices with using the Panzar-Rosse approach. So, the research may provide benefit to the existing literature by exploring the nature competition in Croatia. Financial data were sourced from unconsolidated annual financial reports by individual commercial banks in Croatia between 2008 and 2018.

As part of this effort, the model inspired by the Panzar and Rosse model (1987) will be tested on newer database for the Croatian banking sector. This research will help to further research and better planning some measures of the Croatia regulatory authority.

## 2. Literature review

In recent years, banking has proven to be undoubtedly a highly profitable business. It is confirmed by interests of foreign investors, who in the process of transition have invested significantly in expanding their business either by taking over or opening their branches in host countries. Today, the oligopolistic structure prevails in most of transition countries, with dominations a market of 4-5 banks, which often control (depending on the country) over 75% of the banking sector's assets. Although there has been a decline in bank concentration in almost all the Western Balkan countries, some available banking indicators reveal difference across the region. For example, the level of bank concentration in Croatia was high with 65.26% (2017), while the least concentrated banking sector in the region was found in B&H with 38.43% [3]. As shown in Table 1, some recent empirical studies reveal that the banking sector in most countries operate under monopolistic competition.

In the 1970s and 1980s, three models have developed (the Iwata model, the Bresnahan model and the Panzar-Rosse model) on the side of non-structural models to measure competitive behavior banks and companies in a market.

New empirical approaches focus on the analysis of firm behavior in markets and uses industry and firm-specific details when modelling competition. These non-structural approaches have created models for measuring competition in the market in empirical studies, such as the Iwata model (1974), the Bresnahan model [4], and the Panzar and Rosse model [5], while the Boone model (2004, 2008) was developed in the 2000s.

In empirical studies, the Panzar-Rosse model is one of the most widely used to measure a level of competition. The summary of the existing empirical studies is shown in Table 1.

Table 1. The summary of the existing empirical studies – Panzar – Rosse model

Researchers	Countries	Years	Conclusion
de Bandt & Davis (2000)	15 EU countries	1992-1996	Monopolistic behavior
Bikker & Haff (2002)	23 European and non European countries	1988-1998	Monopolistic behavior
Yeyati & Micco (2003)	8 countries from Latin America	1996-2002	Monopolistic behavior
Claessens & Leaven (2004)	50 developing and developed countries	1994-2001	Monopolistic behavior
Casu & Girardone (2006)	EU 15 countries	1997-2003	Monopolistic competition (exception Greece and Finland)
Habte (2013)	Sweeden	2003-2010	Monopolistic competition
Memic (2015)	Bosnia and Herzegovina	2008-2012	Between monopoly and oligopoly structure
Mustafa & Toçi (2017)	CEE (Central and Eastern Europe) countries	1999-2009	Monopoly behavior

Source: (Authors' compilation, 2022)

Shaffer [6] is one of pioneering researchers used the Panzar Rosse test to evaluate the market structure of banks in the New York. In his study, he examined the level of competition and took total revenues as an independent variable. His study confirmed a monopolistic competitive structure bank. Similarly, the Canadian banking sector was examined by two authors: Nathan and Neave [7] between 1982 and 1984. As a result of the model's prediction, they found that the Canadian banking market was fully competitive in 1982 and monopolistic competition in 1983 and 1984.

Using the Panzar Rosse model [8] measured a level of competition and market structure in nine developing countries. They estimated the model using data from 126 Argentine banks, 189 Brazilian banks, 37 Chilean banks, 33 Czech Republic banks, 72 Mexican banks, 55 Hungarian banks, 55 Polish banks and 69 Turkish banks between 1994 and 2000. As a result of the study, it was seen that the countries included in the study had a monopolistic competition structure at different levels of competition.

One more study done by [9] explored a level of competition in the Latin American banking sector between 1996 and 2002. To determine the level of competition, the authors used the ratio of sum of total income to total assets as a dependent variable. The study finds that in all countries under consideration the banking sector operates under monopolistic competition. In countries other than Mexico and El Salvador, the degree of competition increases over time. One other similar study done by [10] for eleven South American countries explored a level of competition among 843 banks between 1993 and 2000 showing that all countries had a monopolistic competitive structure.

[11] focused on exploring determinants of banking competition in 50 countries across the world between 1994 and 2000. The Panzar Rosse model was preferred as a method to determine the level of competition of the countries in the study. The authors used the H-statistics calculated separately for each country. As a result of the prediction in the regression model they found that commercial banks operate under Monopolistic behavior. Additionally, [12] explored market concentration and the level of competition in the Nepalese between 2001 and 2009. The study finds that the Nepalese banking system operates under a monopolistic competitive structure.

Like the previous study, [13], investigated the level of competition in Sweden between 2003-2010. The author applied the H-statistic for assessment of market competitiveness. The findings indicate that the banking sector in Sweden operate under monopolistic environment.

[14] explored a structure of competition in Bosnia and Herzegovina between 2008 and 2012 by using set concentration ratios and Panzar-Rosse H statistic. The author finds that commercial banks acting between monopoly or perfectly collusive oligopoly.

In the same vein, [15], assessed the nature of banking competition in Iran between 2005 and 2010 with the H statistic. The authors revealing that the banking sector acting under monopolistic competition.

On the contrary, by using the GMM model [16], investigated the sample of 300 banks in CEE countries between 1999 and 2009. The findings of study indicate that banks in CEE countries exert monopoly behavior.

### 3. Methodology

Having in mind some the earlier studies, the purpose of this study is to empirically explore the structure of competition in the Croatian banking sector by covering 24 commercial banks operating between 2008 and 2018. The data is derived from the unconsolidated balance sheets and income statements of 24 banks from Croatia that represent 98% of total banking assets. In this vein, the panel data analysis was used along with H-Statistic following the techniques to measure the degree of competition in the literature.

Panzar Rosse model (1987) entered to the literature with studies to explore determinants of market structure and measurement of competitiveness in an industry. It is often used in the measurement of the bank sector's competition, especially after the 1990s. According to the Panzar Rosse model, banks are in balance over the long term. The price flexibility of demand is bigger than 1, and the homogeneous cost structure prevails.

The study uses as a proxy variable the ratio of interest income to total assets (RIITA) for revenue and includes in the model. One of the reasons is that some previous studies done by as [8], [17], [11], [18] and [12] used the same variable.

First explanatory variable, the non-interest expenses to fixed assets (RNIEFE) is included in the model to measure the cost of capital. Similarly, in the earlier studies, [19] and [10] used the similar variable. It is expected to have a negative relationship with dependent variable because higher cost of capital leads fall of revenues.

Second explanatory variable, the ratio of interest expenses to total deposits (RIETD) is employed in the model to control the unit price of funds. In their research, [8], [11], [13], [14], and [16] also used the same proxy variable for control the unit price of funds. It is anticipated that this variable has a positive relationship with dependence variable because that more collected deposits increase loans portfolio and consecutively generates more revenues.

To control for differences in the capital structure. the ratio of equity to total assets (RETA) is used in the model. [17], [11], [18], [12], [13], [14], [16], and [20] used the same variable in their researches. It is expected to have an inverse relation to the revenue.

To control differences in asset structure among commercial banks in Croatia, forth explanatory variable (the ratio of loans to total assets-RLTA) is employed. [17], [8], [11], [18], [13], and [14], found this variable interesting and included in their models. A positive relationship is expected to have RLTA with the dependent variable.

To test the long-run equilibrium, the study uses a model like done by [17], [8], and [12]. In fact, the thesis measures a level of competition by examining how changes in the input prices affect the revenue.

The model is set up as follows:

$$\ln RIITA = \alpha_0 + \beta_1 \ln RNIEFE + \beta_2 \ln RIETD + \beta_3 \ln RETA + \delta_1 RLTA \ln + \gamma_1 \ln RDTA + u \quad (1)$$

The explanations of the dependent and independent variables used in the model are structured as follows:

For the dependent variable, we follow studies done by [19] and [21] based on interest revenue in the estimation of H-statistics. As a proxy variable for revenue to be the dependent variable in our model we use the ratio of interest income to total assets (RIITA), while  $\alpha_0, \beta_1, \beta_2, \beta_3, \delta_1$  and  $\gamma_1$  are coefficients to be estimated while  $u$  is a stochastic error term.

H statistic is the sum of  $\beta_1, +\beta_2 +\beta_3$ . The value of  $H \leq 0$  implies that increase of input prices leads to decrease of bank profitability. It means that level of competition of the banking system is in line with monopoly or opposite if value of  $0 < H < 1$ .

Factors input prices are proxied with three independent variables as follows: RNIEFE represents a proxy for the cost of capital, a variable of RETA controls for differences in the capital structure, while RIETD is used to control the unit price of funds. These first three variables represent the price of units. Next, a variable of RLTA is employed to control differences in asset structure and a variable of RDTA to control risks.

#### 4. Empirical findings

The summary statistics for the Croatian banking sector are shown in Table 2. The dependent variable of RIITA, in terms of natural logarithm was found 0.68. The minimum value of RIITA is 0.19 and the Standard deviation from RIITA in the mean equals 0.12 percent. The mean value of RNIEFE is 1.11 and the standard deviation is equal to 0.30. The maximum and minimum ratio of non-interest expenses value in terms of natural logarithm is 1.91 and 0.11, respectively. Pertaining to the ratio of RIETD, the Table 2 indicates that the mean value in terms of natural logarithm is 0.68, and the standard deviation in terms of natural logarithm is 0.41.

The maximum and minimum values of RIETD are shown in Table 2 in terms of the natural logarithm to be 1.74 and -0.72 respectively. Moreover, the ratio of loans to total assets has the highest value. The variables RNIEFE and RIITA have the highest values of standard deviation (1.11 and 0.68, respectively) which represents the volatility of the observation values. In addition, the variable RDTA has the lowest value of standard deviation (0.049).

Except for the standard deviation of 0.08. The mean of the RETA in Table 2 is 1.76, and the maximum and minimum values are found in terms of the natural logarithm as 1.95 and 1.18. Regarding the RLTA, the mean of it in the table was found 1.06, and the standard deviation in terms of natural logarithm was 0.15. Besides that, the maximum and minimum values in terms of natural logarithm were 1.97 and 0.62. Lastly, the highest values in Table 8 are obtained by the ratio of deposits to total assets. The highest mean among all values belongs to RDTA with 1.88. In addition, to the mean, the standard deviation is also the lowest value in table 12 with 0.05. when it comes to maximum and minimum values, the maximum value of 1.97 and the minimum value of 1.66.

Table 2. Output of Descriptive statistics

Variable	Obs	Mean	St.dev	Min	Max
RIITA	259	0.19	.6887	.12039	.98
RNIEFA	251	.11	1.1153	.30367	1.91
RLTA	249	1.0636	.15694	.62	1.97
RIETD	250	.68876	.41639	-.72	1.74
RDTA	257	1.88167	.04977	1.66	1.97
RETA	251	1.76422	.08022	1.18	1.95

Source: (Authors' compilation, 2022)

Furthermore, the correlation matrix of variables used in Panzar-Rosse model is shown in Table 3. The study finds that correlation among the variables is low and acceptable. The explanatory variable RIITA has a negative correlation coefficient value of -0.1620, -0.0119, and -0.3178 with RNIEFA, RLTA, and RDTA, respectively. The variable RNIEFA is negatively associated with RIITA, while the variable RIETD is negative with RNIEFA. For instance, the correlation coefficients between the independent variables have the value of 0.0162 to -0.4143 indicating a low to moderate degree of collinearity between the variables. Thus, it indicates that multicollinearity cannot create a problem.

Table 3. Correlation matrix

\	RIITA	RNIEFA	RIETD	RLTA	RETA	RDTA
RIITA	1.0000					
RNIEFA	-0.1620	1.0000				
RIETD	0.4026	-0.1297	1.0000			
RETA	0.3333	-0.0089	0.1324	1.0000		
RLTA	-0.0119	-0.0605	0.2428	0.1105	1.0000	
RDTA	-0.3178	0.0162	-0.2805	-0.2657	-0.4143	1.0000

Source: (Authors' compilation, 2022)

Additionally, as shown in Table 4 multicollinearity problem was examined by using the VIF test. The results of VIF test reveal that, the VIF value is 1.16. It indicates that there is no serious multicollinearity problem.

Table 4. VIF Test

Variable	VIF	1/VIF
RLTA	1.02	0.981065
RIETD	1.24	0.809545
RDTA	1.13	0.884734
RETA	1.33	0.752263
RNIEFA	1.08	0.925681
Mean VIF		1.16

Source: (Authors' compilation, 2022)

Furthermore, F-test, Breusch Pagan and Hausman tests are used to decide which model the best represent our data. According to data shown in Table 5, Random effect model is more appropriate for this model. After testing multicollinearity, the study tested whether unobservable effect and unobservable time impact into model.

Table 5. Selection of model

Pooled vs Fixed model	F test that all $u_i = 0$	F(5, 217)= 20.61	Prob>F= 0.0000
Pooled vs Random model	Breusch and pagan Lagrangian multiplier test	chibar2(01)= 55.62	Prob>chibar2 =0.0000
Random vs Fixed model	Hausman Test	chi2(5) 55.62	Prob>chi22 =0.2070

Source: (Authors' compilation, 2022)

Accordingly, Breusch-pagan LM and F test are examined [24]. In the Table 6, the correlation among residual is examined by Breusch Pagan LM test. Result of Breusch Pagan LM test states that the null hypothesis is rejected and concludes that presence of heteroscedasticity in the model. Additionally, heteroscedasticity is examined by using Modified Wald and Wooldridge test for group heteroscedasticity in random effect regression model where the null hypothesis is rejected and the presence of heteroscedasticity is detected.

Table 6. Diagnostic tests

Breusch Pagan LM Test for Random effect	Chi2: 55.62	Prob: 0.0000
Modified Wald Test	Chi2: 335.65	Prob: 0.0000
Wooldridge Test	F(1,23): 65.379	Prob>chi2: 0.0000

Source: (Authors' compilation, 2022)

Wooldridge test is used for examination of autocorrelation in the model. Having the Prob>F equal to 0.0000 it means that the null hypothesis of no correlation is strongly rejected with a 5% level of significance. It implies the presence of autocorrelation in the model as shown in the Table 6.

Next, the problem of heteroscedasticity and problem of autocorrelation is controlled by using a robust option to adjust standard errors (Table 7).

The result of the random effects (robust) model indicates that  $P > |z|$  values and the independent variables: RIETD, RDTA and RETA have statistical significance at 1% on the dependent variable RIITA, while the variable RLTA has a statistical significance at 10%. However, the variable of RNIEFA is not shown as a statistically significant variable in our model. The overall R squared is found to be 0.303. It indicates that changes in RIITA can be explained by 30.3% by changes in the variables included in our model.

Coefficients of independent variables in tables show different values. RLTA and RDTA imply that a negative correlation between interest incomes to total assets exists. A negative sign for the variable RLTA means that a bank with a higher liquidity ratio uses less earning assets to generate more income [22], [12], and. [13]. Also, a negative sign for variable RDTA means that banks operated in Croatia used some other funds than deposits for the funding loan portfolio.

In contrast to the previous two variables, the RIETD and RETA show that there is a positive correlation between both variables and interest rate. A variable RLTA indicates that banks operating in Croatia are focused more on traditional loans than other activities and tend to earn more many from loan portfolios than other banking services. In fact, it means the positive effect of lending activities on the revenue of the bank [23].

And lastly, the value of H statistics is shown in Table 7. The results of Wald test indicates that the hypothesis of monopolistic market structure ( $H=0$ ) is rejected. The estimation of the H statistic value of 0.526 as the sum of the price of units (RNIEFA+ RIEDT+ RETA) indicates that the Croatian banking industry running out under monopolistic competition.

Table 7. Random Effect Model Robust

	Coeff.	Std. Err.	Z	$P >  z $	[95% Conf. Interval]	
RNIEFA	-.0416519	.0278887	-1.49	0.135	-.0963127	.0130088
RIEDT	.0999533	.0219321	4.56	0.000	.0569671	.1429394
RETA	.4671938	.0928048	5.03	0.000	.2852998	.6490879
RLTA	-.1214807	.0659278	-1.84	0.065	-.2506967	.0077354
RDTA	-.8914413	.2386716	-3.74	0.000	-1.359229	-.4236535
Cons	1.644043	.4850256	3.39	0.001	.6934109	2.594676

	Coeff.	Std. Err.	Z	P> z	[95% Conf. Interval]
Sigma u			.0480746		
Sigma e			.07682524		
rho			.28139379		
Overall R-squared R-sq			0.3031		
Wald Chi2			216.43		
Prob > chi2			0.0000		
H= -.0416519+ .0999533+.40.526 (sum of price of units (RNIEFA+ RIEDT+ RETA))			0.526		

Source: (Authors' compilation, 2022)

## 5. Conclusion

The examination of the nature of competition in any industry has been at the centre of many empirical studies. Similarly, as in other industries, the nature of competition is usually considered a prerequisite for an efficient banking sector. However, theoretical, and empirical studies differ in many ways, for example in their regional or country level.

In recent years, the Croatian banking sector experienced a decline in the number of banks over the years, at least for two reasons. The first one is the rise in the number of bank failures in the 1990s and the second one is a process of bank consolidation through M&A. In addition to the change in the number of banks, the ownership structure also was changed. With the entry of foreign banks into the local market, the ownership structure was changed, including a rise of new banking products and services. In comparison across the range of transition economies, it can be concluded that the Croatian banking sector does not differ significantly as do other banking sectors in the region.

The study for Croatia and its findings confirms early findings of the existence of monopolistic competition in most transition and developing countries. In fact, the findings obtained from the Panzar-Rosse model indicate that commercial banks in Croatia operate under monopolistic competition. A lower competition among banks causes owning to five largest banks to possess 80% of overall assets in the sector. Thus, the national government examiner can develop its strategies accordingly and improve the competitive market behavior in the Croatian banking sector.

## References

- [1] M. Gamic, *Međunarodna regulacija u bankarstvu*, Sarjevo: International University of Sarajevo, 2012.
- [2] M. Ganić, "An empirical analysis of factors affecting bank interest margins: Evidence from the Southeast European (SEE) Countries," *Comparative Economic Research. Central and Eastern Europe*, vol. 21, no. 2, p. 81-98, 2013.
- [3] M. Ganić, "Road to success: Balkans banking in transition." *Financial Globalization in the Emerging Balkans: Exploring Financial Trends during the Eve of EU Membership*, M. Ganić, Germany: Springer International Publishing, 2021.
- [4] T.F. Bresnahan, "The oligopoly solution concept is identified," *Economics Letters*, vol. 10, no. 1-2, p. 87-92, 1982.
- [5] J.C. Panzar, and J.N. Rosse, "Testing for "monopoly" equilibrium", *Journal of Industrial Economics*, vol. 35, no. 4, p. 443-456, 1987.
- [6] S. Shaffer, "Competition in the U.S. banking industry," *Economics Letters*, vol. 29. no. 4, pp. 321-323., 1989.
- [7] A. Nathan, and E.H. Neave, "Competition and contestability in Canada's financial system: Empirical results," *Canadian Journal of Economics*, vol. 22. no. 3, p. 576-594, 1989.
- [8] R. G. Gelos, and J. Roldós, "Consolidation and market structure in emerging markets banking systems," *Emerg. Mark. Rev.*, vol. 2002, no. 186, p. 39-59, 2004.

- [9] E. L. Yeyati, and A. Micco, "Concentration and foreign penetration in latin american banking sectors: Impact on competition and risk," *SSRN Electron. J.*, 2003.
- [10] H. S. Yildirim, and G. C. Philippatos, "Efficiency of Banks: Recent Evidence from the Transition Economies of Europe, 1993–2000", *The European Journal of Finance*, vol. 13, no. 2, p. 123–143, 2007.
- [11] S. Claessens, and L. Laeven, "What drives bank competition? Some international evidence," *Journal of Money, Credit and Banking*, vol. 36, no. 3, p. 563–583, 2004.
- [12] D. P. Gajurel, and R. S. Pradhan, "Concentration and competition in Nepalese banking," *Journal of Business, Economics & Finance*, vol. 1, no. 1, p. 5-16, 2012.
- [13] O. Habte, Competitive conditions in the Swedish banking system, Konkurrensverket research, global assets, 2013.
- [14] D. Memić, "Banking competition and efficiency: Empirical analysis on the bosnia and herzegovina using panzar-rosse model," *International Journal of the Society for Advancing Innovation and Research in Economy*, vol. 6, no. 1, p. 72–92, 2015.
- [15] J. Zarein, F.K. Kashi, and Y. Mosavi, "Competition in Iran's banking sector: Panzar-Rosse approach," *qjerp*, vol. 19, no. 1, p. 29-39, 2015.
- [16] A. Mustafa, and V. Toçi, "Estimation of the banking sector competition in the CEE countries: The Panzar-Rosse approach," *Zb. rad. Ekon. fakultet Rijeka*, vol. 35, no. 2, p. 459-485, 2017.
- [17] J.A. Bikker, and K. Haaf, "Measures of competition and concentration in the banking industry: A review of the literature," *Economic & Financial Modelling*. p. 1-46, 2002.
- [18] B. Casu, and C. Girardone, "Bank competition, concentration and efficiency in the single European market," *The Manchester school*, vol. 74, no. 4, 2006.
- [19] J. Bikker, and J. M. Groeneveld, "Competition and concentration in the EU banking industry," *Credit and Capital Markets*, vol. 33, no. 8, p. 62-98, 2000
- [20] H. C. Le, and T. L. Vo, "Concentration and performance in Vietnamese commercial banks," *Accounting*, vol. 6, no. 2, p. 161–168, 2020.
- [21] A. Mkrtchyan, "The evolution of competition in banking in a transition economy: An application of the Panzar-Rosse model to Armenia," *European Journal of Comparative Economics*, vol. 2, no. 1, p. 67-82, 2005.
- [22] P. Molyneux, D. M. Lloyd-Williams and J. Thornton, "Competitive conditions in European banking," *Journal of Banking & Finance*, vol.18, no. 3, p. 445-459, 1994.
- [23] L.G. de Rozas, "Testing for competition in the Spanish banking industry: The Panzar-Rosse approach revisited," August 2007, *Documentos de Trabajo N.º 0726, Banco de Espana*.
- [24] B. H. Baltagi, *Econometric Analysis of Panel Data*, 5<sup>th</sup> ed. Nashville, TN: John Wiley and Sons Ltd., 2013.