Banking Sector Competition in the Panzar-Rosse Framework and Net Interest Margins: An Empirical Analysis Using the General Method of Moments

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Abstract

This paper provides empirical evidence on the determinants of net interest margins in Central, Eastern, and Southeastern European countries (CESEE) during the period 1999–2009, with a particular focus on the relationship between banking sector competition and net interest margins. Using country-level Panzar-Rosse H-statistic estimates as a measure of competition, and the General Method of Moments, it has been determined that banking sector competition had a negative impact on net interest margins. In order to check for consistency, alternative measures of competition, such as the Lerner index and the Herfindahl-Hirschman index, have also been used. The results appear consistent and suggest that higher market power is associated with higher interest margins.

A number of interactions have been used to check for the impact of competition when interacted with other variables. The study also provides evidence on the impact of other bank-specific, macroeconomic, and institutional variables on net interest margins.

Keywords: bank competition, net interest margins, Panzar-Rosse H-statistic, General Method of Moments

JEL classification: D4, E43, G21, P2

1 Introduction

One of the key objectives of the transition process in the Central, Eastern, and Southeastern European countries (CESEE) was the establishment of sound and efficient banking sectors.[1] After a decade of substantial reforms which, among others, included the privatization of state-owned banks and the "opening-up" to foreign bank entry, the banking sectors of the CESEE countries were able to achieve stability and improve the financial intermediation efficiency. The entry of the foreign banks was associated with the adoption of modern commercial banking practices, which led to a more prudent and efficient banking sector in all the countries. One of the standard measures of efficiency in the banking sector is the net interest margin (Claeys & Vennet, 2008; Demirgüç-Kunt & Huizinga, 1999). During the second decade of the transition process, net interest margins pursued a declining trend, but still remained at a higher level compared to the average of the euro area.

High interest margins, despite the potential positive effects for the profitability and sustainability of the banks, are viewed as signals of financial intermediation inefficiency and, as such, are considered to have a negative impact on the overall economic activity (Chortareas, Garza-García, & Girardone, 2012). When interest margins are high, potential savers are discouraged by the low deposit

1 Countries included in the analysis are: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovenia, and Slovakia.

rates, and credit expansion is impeded by high lending rates, thus negatively affecting investments. This is particularly important for the CESEE and other countries that lack well-functioning equity markets. In the absence of developed equity and bond markets, financing options for the enterprises are much more limited, so the economy is more dependent on the financing from the banking sector and more sensitive to banks' net interest margins.

The theoretical and empirical literature emphasizes a number of factors that are considered to have an important role in determining the level of interest margins. One of the factors most frequently "blamed" for the high level of interest margins is the lack of competition which provides banks with price-inelastic demand and supply functions that enable them to exert market power and set higher interest margins (Ho & Saunders, 1981). The relationship between competition and interest margins can also be viewed from the perspective of efficiency theories. Inefficient banks are predicted to set higher interest margins in order to compensate for the additional costs that arise from their cost inefficiencies. However, banks may be able to set higher interest margins to compensate for their inefficiencies only if banking markets operate under imperfect competition, otherwise the inefficient banks would not be able to survive in competitive markets.[2] When competition increases, banks are likely to compete through their interest rates, with those applying lower interest margins being more likely to increase their market shares and survive in the market. However, banks may not necessarily be able to reduce their interest margins without enhancing their efficiency. Therefore, the increase of competition may induce banks to enhance their efficiency in order to be able to set more competitive interest margins. The discussion on the relationship between competition and efficiency was initiated by Hicks (1935) who came up with the "quiet life" hypothesis, which suggests that monopoly firms are less efficient compared to firms operating in more competitive markets. According to this hypothesis, monopoly banks' managers live a "quiet life", given that market power enables them to charge higher prices

2 The hypothesis that banking systems operate in uncompetitive markets has been confirmed by many empirical studies, including De Bandt and Davis (2000), and Bikker, Spierdijk, and Finnie (2007).

and, consequently, realize satisfactory profits without taking effort to cut their expenditures. The impact of banking sector competition on interest rate margins has also been treated in the literature addressing the link between competition and banks' risk-taking. Most of the studies in this field focus on the competition for deposits, arguing that as banks face more competition they tend to attract additional deposits by offering higher deposit interest rates in order then to be able to seize larger shares in the loans market (Keeley, 1990; Hellman, Murdock, & Stiglitz, 2000; Repullo, 2004). Under competitive conditions, banks will not be able to compensate higher deposit rates by increasing loan rates. Instead, banks are more likely to reduce the loan interest rates when competition increases in order to maintain/increase their shares in the loans market. As a result, the increase of competition is expected to result in lower interest rate margins. However, some authors argue that the increase of competition does not necessarily lead to higher deposit rates. According to Cordella and Yeyati (1998), and Shy and Stenbacka (2004), when the bank risk is observable, depositors are ready to accept even lower interest rates on their deposits from the banks that are viewed as safer in terms of asset quality. Hence, instead of competing through interest rates, banks may decide to use the quality of their assets as a strategic instrument to compete in the market for deposits.

The investigation of the determinants of interest margins, including the impact of competition, has been subject of a broad range of empirical studies. One stream of the literature has used a two-stage model which is in line with the original "dealership model" of Ho and Saunders (1981)[3], while the other stream of studies uses a single-stage model, which explains actual interest margins by various variables.

The empirical studies investigating the determinants of interest margins, some of which have been reviewed below, have mostly found a negative relationship between banking sector competition and interest margins, suggesting that

3 The first step involves the estimation of a "pure interest spread" by regressing observed margins on a number of bank-specific variables. In the second step, the estimated pure spreads are regressed on macroeconomic and market structure variables.

higher competition leads to lower interest margins. Saunders and Schumacher (2000) investigated the determinants of interest rate margins in six selected EU countries and the USA for the period 1988–1995 and found that banks operating in markets that are more restricted in terms of geographic distribution in branching and universality of banking services appear to have higher interest rate spreads due to the higher monopoly power that banks may have.

Studies have mostly used market concentration indices (mainly the Herfindahl-Hirschman index) as a measure of competition and found a positive relationship with interest margin, suggesting that a higher degree of market concentration provides banks with a higher degree of market power which, in turn, enables them to set higher interest margins (Corvoisier & Gropp, 2001; Demirgüç-Kunt, Leaven, & Levine, 2003; Peria & Mody, 2004; Gelos, 2006; Claeys & Vennet, 2008). The use of market concentration indices as a measure of competition is based on the structure-conduct-performance paradigm which claims that a higher degree of concentration grants market power to incumbent firms and enables them to behave in particular ways, such as colluding with each other, which results in higher profits (Bain, 1951). Even though largely used in the literature, market concentration indices may not represent an adequate measure of competition. Based on the *efficiency structure hypothesis*, developed by Demsetz (1973), and the *contestability theory*, which was developed by Baumol (1982), and Baumol, Panzar, and Willig (1982), a higher degree of market concentration does not necessarily imply a less competitive market.[4] Hence, the relationship between market concentration and interest margins, found in the empirical studies using the market concentration as a measure of competition, may not necessarily reflect the relationship between competition and interest margins.

Few studies have used more direct measures of market power/competition, which are known as non-structural measures of competition. In this regard, Chortareas et al. (2012), in a study covering nine Latin American countries for the period

4 The *efficiency structure hypothesis* claims that higher profits realized by firms operating in concentrated markets are a result of the superior efficiency of larger firms, which derives from the economies of scale (Demsetz, 1973). According to the *contestability theory*, firms behave competitively also in a concentrated industry or even in a monopoly if the market is contestable (Baumol, 1982, and Baumol, Panzar & Willig, 1982).

1999–2006 used the Panzar-Rosse H-statistic as a measure of competition and found a significantly negative relationship between the H-statistic and the net interest margin, suggesting that higher banking sector competition leads to lower interest margins. The Panzar-Rosse H-statistic was used also by Gelos (2006), but its relationship with the interest margin appeared statistically insignificant. Few studies have investigated this relationship for different samples of the CESEE region and, using market concentration indices as a measure of competition, suggested that competition reduces interest margins (Claeys & Vennet, 2008; Schwaiger & Liebeg, 2007; Kasman, Gokce, Vardar, & Okan, 2010).

In order to estimate the relationship between banking sector competition and interest margins in CESEE countries, this paper uses the Panzar-Rosse H-statistic which we have estimated for each country and year. The Panzar-Rosse H-statistic is estimated using the Panzar and Rosse (1987) model (P-R model), which is a non-structural approach that measures competition by directly quantifying the conduct of firms and not taking into account the market structure. In assessing competition, the focus of the P-R model is on the competitive behavior of firms rather than on market structure. To best of our knowledge, this is the first study to use the Panzar-Rosse H-statistic in estimating the relationship between banking sector competition and interest margins for CESEE countries. In addition, the study employs the Lerner index, which is an alternative non-structural measure of market power. In order to make our results comparable to other studies, we run an additional regression using the market concentration index (i.e. the Herfindahl-Hirschman index) instead of the competition measure. The regression controls also for the impact of other variables, including bank-specific variables, macroeconomic variables, and institutional variables. For the dependent variable, we follow the majority of the studies in this field that use the net interest margin, which is the difference between lending and deposit rates expressed as a ratio of total earning assets. The estimation is dynamic, conducted on panel data, and uses the General Method of Moments.

This paper is organized as follows. Section two presents an overview of the macroeconomic conditions and banking sector development in CESEE countries. Section three describes the model. The data and methodology are presented in sections four and five, respectively. Section six presents the estimation results and section seven the conclusions.

2 Macroeconomic Conditions and Banking Sector Development in CESEE Countries

The poor macroeconomic environment at the beginning of the transition process that was characterized by a sharp decline of output and excessively high inflation rates represented a serious impediment to the efficient functioning of the banking system. However, the stabilization programs during the first decade of transition, which included sound monetary and fiscal policies, resulted in macroeconomic stability. The economic activity in the old unproductive sectors gradually declined while the new sectors that were able to compete in an open market economy started to grow (Fischer & Sahay, 2000). As a result, by 1999 almost all CESEE countries recorded positive real GDP growth rates which generally remained quite steady until 2009 when the global crisis resulted in most CESEE countries recording negative growth rates (Table 1). Despite the similarities in growth rates, a wide gap remains when CESEE countries' GDPs per capita are compared with each other. The more advanced CESEE countries, namely the EU member countries, have considerably higher GDP per capita compared to other countries of the region, thus reflecting substantial divergences in terms of the degree of economic development. The country with the lowest GDP per capita is Kosovo (USD 1,814), while the country with the highest GDP per capita is Slovenia (USD 16,486).

CESEE countries were also successful in bringing down their inflation rates, which had represented a serious macroeconomic problem at the beginning of the transition. All countries except Serbia and Romania were successful in reducing

the inflation to one-digit rates by 1999. By 2007, inflation rates had dropped to one-digit rates in Serbia and Romania too.

Table 1: *Selected Macroeconomic Indicators, Average Values for the Period 1999–2009*

	Real GDP growth rates (in %)	GDP per capita (in USD)	Annual average inflation rates (in %)
Albania	6.5	2,367	2.4
Bosnia and Herzegovina	4.7	2,960	1.7
Bulgaria	4.7	3,581	6.2
Croatia	2.8	9,266	3.3
The Czech Republic	3.4	11,705	3.3
Estonia	4.5	9,404	4.2
Hungary	2.4	9,430	6.5
Kosovo	4.5	1,814	1.6
Latvia	4.6	7,191	5.7
Lithuania	4.3	7,197	2.8
Macedonia	2.9	2,830	2.4
Montenegro	3.8	3,736	21.2
Poland	4.0	7,683	3.9
Romania	4.1	4,441	19.1
Serbia	4.0	3,438	27.3
Slovakia	4.2	10,389	5.9
Slovenia	3.3	16,486	5.0

Sources: European Commission (2010), International Monetary Fund (IMF, 2010), and the European Bank for Reconstruction and Development (EBRD, 2009).

The second decade of the transition process was also characterized by substantial reforms in the banking system. More specifically, this period marked a reduction in the role of the state in the banking system, the privatization of state-owned banks progressed rapidly, and the market opened up to the entry of foreign-owned banks. This is the period when the banking system stability, in the sense of the banking sector being capable of withstanding the shocks and allocating the savings into profitable investment projects (European Central Bank's definition of financial stability), was more clearly achieved.

The competitive conditions in the banking sectors of the region were difficult at the beginning of the transition process. With the break-up of the mono-bank system, the banking system experienced the creation of oligopolistic market structures in most of transition economies (Papi & Revoltella, 1999). However, the privatization process and the entry of foreign banks led to the increase of banking sector competition in these markets.

The interest rate spreads were initially high, potentially reflecting the high market power and operational inefficiencies and the other deficiencies of the operating environment. However, as the transition progressed, the interest rates followed a declining trend in all the CESEE countries (Table 2). The decline is consistent with the increasing presence of foreign banks in the region which seems to have increased the degree of banking efficiency and banking system competition. Moreover, this period was also characterized by a more favorable macroeconomic performance. The improvements in the banks' operating environment and enhanced "know-how" on the side of banks led to a reduction of non-performing loans, thus leading to lower risk premiums embedded in the interest rates.

As Table 2 shows, there are significant differences between the spreads in EU member states and other countries, with the latter having higher interest rate spreads during the whole period. However, the differences between the EU and non-EU countries appear to have narrowed in the last years.

Table 2: *Interest Rate Spread Developments in CESEE Countries*

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	8.7	13.8	11.9	6.8	5.9	5.2	8.0	7.7	8.4	6.2	5.9
Bosnia and Herzegovina	15.2	15.8	-	8.2	6.8	6.6	6.0	4.3	3.6	3.5	4.3
Bulgaria	10.3	8.2	8.2	6.4	5.6	5.8	5.6	5.7	6.3	6.4	5.2
Croatia	10.6	8.3	6.3	11.0	10.1	9.9	9.5	8.2	7.0	7.2	8.4
The Czech Republic	4.2	3.7	4.3	4.7	4.6	4.7	4.6	4.4	4.5	4.6	4.7
Estonia	6.9	3.7	3.7	4.0	3.1	3.5	2.8	2.2	2.1	2.8	4.6
Hungary	4.4	3.1	3.7	2.8	-1.4	3.7	3.4	0.6	2.3	0.3	5.2
Kosovo	-	-	-	-	-	12.4	11.4	11.6	10.1	9.4	10.1
Latvia	9.2	7.5	5.9	4.7	2.4	4.2	3.3	3.8	4.8	5.5	8.2
Lithuania	8.1	8.3	6.6	5.1	4.6	4.5	2.9	2.1	1.5	0.8	3.6
Macedonia	9.1	7.7	9.4	8.8	8.0	5.9	6.9	6.6	5.4	3.8	3.0
Montenegro	-	-	-	-	-	-	-	6.1	4.1	5.4	5.5
Poland	5.7	5.8	6.6	5.8	3.6	3.8	4.0	3.3	-	-	3.9
Romania	19.8	20.7	18.5	16.2	14.4	14.1	13.2	9.2	6.6	5.5	5.3
Serbia	42.7	-72.4	30.4	17.1	12.7	11.9	13.1	11.5	7.1	8.8	6.7
Slovakia	6.7	6.4	4.8	3.6	3.1	4.9	4.2	4.1	4.3	2.0	-
Slovenia	5.1	5.7	5.2	4.9	4.8	4.8	4.6	4.6	2.3	2.6	4.5
euro area	-	-	-	-	3.2	3.2	3.0	2.7	2.3	2.3	3.5

Sources: World Bank (WB, 2010), European Central Bank (ECB, 2010), and the Central Bank of the Republic Kosovo (CBK, 2010).

3 Model Description

For the estimation of the determinants of interest margins, we follow the single-stage dealership model. The explanatory variables in our model consist of bank-specific variables as well as country-specific macroeconomic and institutional variables that are included to capture the impact of interest margins stemming from differences in the general environment where banks operate. The model takes the following form[5]:

$$nim_{it} = \alpha_0 + \beta_1 lagnim_{it-1} + \beta_2 Hstat_{it} + \beta_3 equity\_ta_{it-1} + \beta_4 non\,int\,inc\_ta_{it-1} + \beta_5 \log grossloans_{it-1} + \beta_6 prov\_loans_{it-1} + \beta_7 lqdassets\_custstfunding_{it} + \beta_8 non\,int\,exp\_ta_{it-1} + \beta_9 earningassets\_ta_{it} + \beta_{10} bankdep\_custdep_{it} + \beta_{11} ebrd\_bankref_{it} + \beta_{12} economic\_freedom_{it} + \beta_{13} rgdpgrowth_{it} + \beta_{14} gdp\_percap_{it} + \beta_{15} cpi\_ebrd_{it} + \beta_{16} dv\_foreign_{it} + \beta_{17} dv\_norigin_{it} + \beta_{18} dv\_year_{it} + \beta_{19} dv\_country_{it} + \varepsilon_{it}\ ,$$

where i (1,...n) indexes the banks and t (1,..,T) the years. The description of variables is presented in Table 3.

Table 3: *Description of Variables*

Variables	Description
Nim	Net interest margin: (interest income – interest expenses) / average earning assets
Lagnim	First lag of the net interest margin
h-stat	Panzar Rosse H-statistic
equity_ta	Equity / total assets
nonintinc_ta	Total non-interest operating income / total assets
loggross_loans	Logarithm of gross loans
prov_loans	Loan-loss provisions / total loans
lqdassets_custstfunding	Liquid assets / customer deposits and short-term funding
nonintexp_ta	Total non-interest expenses / total assets
earningassets_ta	Total earning assets / total assets
bankdep_custdep	Bank deposits / customer deposits
ebrd_bankref	EBRD index of banking reform
economic_freedom_hrt	Economic Freedom index (Heritage Foundation)
rgdpgrowth	Real GDP growth rate

Source: Authors' construction.

5 Because of the suspected endogenous relationship with the dependent variable, a number of variables are included in lags.

For the dependent variable we follow the majority of studies that investigate the determinants of interest margins by using the Net Interest Margin (NIM), which is calculated as total interest income minus total interest expenditures divided by total earning assets. Most of the studies investigating the determinants of net interest margins, based on the structure-conduct-performance (SCP) paradigm, use the market concentration indices to control for banking sector competition. However, given that the SCP paradigm has been heavily criticized by other theories such as the efficient structure hypothesis and the contestability theory, which claim that more concentrated markets do not necessarily reveal a higher degree of market power, it may be considered that market concentration may not represent an adequate measure of banking sector competition. Taking into account these criticisms, we consider that inferences on the relationship between competition and net interest margins derived from studies that use the degree of market concentration as a proxy for competition might be questionable. Therefore, to control for the impact of banking sector competition on net interest margins, we use the H-statistic (*h_stat1*) that is produced by using the Panzar-Rosse approach, which directly quantifies the competitive behavior of a bank.[6] This is the first study to use the H-statistic as a measure of competition within the literature investigating the determinants of bank interest margins in CESEE countries, and one of the few in the literature in this field. The H-statistic has been obtained by running cross-section estimations for each of the countries and years included in our sample.[7] Unlike other studies that use H-statistic as a measure of competition (Gelos, 2006; Chortareas et al., 2012), we acknowledge that the H-statistic is an estimated variable and therefore apply the bootstrapping technique to correct its standard errors. Since the literature applying the Panzar-Rosse approach has not come to a general conclusion on the choice of dependent variable in such a regression, for comparative purposes, we apply separately two

6 The P-R model produces the so-called H-statistic, which measures the sum of elasticities of bank's revenues with respect to input prices. The H-statistic indicates how bank's revenues respond to an increase of input prices and takes values from below 0 to 1. An $H \leq 0$ implies that banks' competitive behavior is consistent with monopoly; $0 < H < 1$ implies that banks' behavior is consistent with monopolistic competition; and $H = 1$ implies perfect competition.

7 The H-statistic estimates for each sample country and year are available upon request.

alternatives of H-statistic as a measure of competition.[8] In line with Vesala (1995), and Claessens and Laeven (2004), the H-statistic is interpreted as a continuous variable.

In order to verify our inferences on the impact of competition on the net interest margin, we run a separate model using the Lerner index (*lerner_index*) as a measure of market power.[9] The Lerner index is obtained from the study of Efthyvoulou and Yildirim (2014) who have estimated this index for individual CESEE countries for each year in the period 2002–2010.[10] The Lerner index is considered to be inversely related to the H-statistic, with higher values of the Lerner index implying higher market power. For comparison with other studies, we also run a regression that controls for the impact of the Herfindahl-Hirschman index (*hhi_dep*), which is a measure of market concentration. The three measures of competition considered in this paper have been used separately in other studies. We use the three of them in this paper. By doing this, we wish to derive more reliable inferences on the relationship between banking sector competition and interest rate margins, but also provide evidence that can be used to validate the consistency of the three measures of competition.

Even though the original dealership model does not consider bank's ownership to be among the determinants of interest margins, some authors argue that foreign ownership may have an important role in the determination of interest margins through channels like efficiency and loan portfolio quality (Lehner & Schnitzer, 2008; Claeys & Hainz, 2007). Given that the readily available Bankscope database provides information only on the current ownership of the bank, we utilize the shareholders' history from this database through which we identify the bank's ownership for the available years. Based on this information, we construct

8 The dependent variable in a Panzar-Rosse model may be the bank's interest income or the total income. Since there is no conclusive argument on which is more appropriate, in order to test for robustness, we have run separate cross-section estimations using both the interest income as the dependent variable and the total income. The *h_stat1* variable was estimated using interest income as the dependent variable; and the *h_stat3* was estimated using total income as the dependent variable.

9 The Lerner index measures the mark-up of price over the marginal costs. Higher values of the index indicate a higher degree of market power.

10 The Lerner index estimates are not available for Estonia and Lithuania.

a dummy variable (*dv_foreign*) which takes the value of 1 when the bank is more than 51 percent foreign-owned and 0 when the bank is domestically owned. In addition, unlike other studies, we distinguish also between the countries of origin of the foreign banks included in the sample. According to Haselmann (2006), the activity of foreign banks in the transition economies is mostly determined by the strategic considerations of the parent banks, where the country of origin may play an important role with regard to the strategy and business culture of the bank. Therefore, we construct a dummy variable (*dv_origin*) which takes the value of 1 if the bank is an EU-12[11] country or the USA and 0 if the bank's origin is some other country. The model also controls for other bank-specific variables, institutional variables, and macroeconomic variables.

4 Data Description

This section presents the descriptive statistics of the variables used in the model discussed in section two and the data used for the estimation. As Table 4 shows, all the variables are continuous apart from two dummies, which stand for the ownership of the bank (i.e. foreign vs. domestic) and the origin country of the banks. From the summary statistics, it can be observed that there is sufficient variability in the data.

The bank-level data that are used in our estimation are sourced from the Bankscope database. Bankscope is a comprehensive global database that contains banks' financial statements and other bank data. The study includes data on 285 banks from 15 CESEE countries over the period 1999–2009. Nevertheless, it must be emphasized that the initial years suffer from a pronounced rate of missing data. The data on the real GDP growth rate have been obtained from the European Commission (the AMECO database) and the International Monetary Fund (IMF), whereas the GDP per capita and inflation data were obtained from the European Bank for Reconstruction and Development (EBRD). The banking

11 EU-12 includes the signatories of the Maastricht Treaty in 1992: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and the United Kingdom.

reform index is obtained from the EBRD, whereas the Economic Freedom index is obtained from the Heritage Foundation.

Table 4: *Summary Statistics*

Variable	Obs	Mean	St. Dev.	Min	Max
nim	2915	5.0	3.8	-16.9	38.8
Lagnim	2470	5.1	3.9	-12.1	38.8
h_stat1	2650	-1.2	2.1	-11.7	5.2
equity_ta	2926	15.4	13.3	-12.4	98.7
nonintinc_ta	2912	2.9	4.9	-5.4	85.7
loggross_loans	2908	12.3	1.9	4.8	17.2
prov_loans	2628	1.9	4.9	-48.2	49.7
lqdassets_custstfunding	2894	46.8	39.3	0.0	586.2
nonintexp_ta	2908	4.6	4.5	-1.0	75.8
earningassets_ta	2919	85.0	12.3	0.5	99.9
bankdep_custdep	2626	2.4	19.4	0.0	478.0
ebrd_bankref1	2914	3.3	0.6	1.0	4.0
economic_freedom_hrt	2676	59.8	7.5	29.4	78.0
rgdpgrowth	2909	4.0	4.2	-17.7	13.5
gdp_percap	2925	7709.1	5039.1	933.4	27128.5
cpi_ebrd	2926	6.6	9.6	-2.7	97.1
dv_foreign	2155	0.6	0.5	0.0	1.0
dv_origin	2155	0.5	0.5	0.0	1.0

Source: Authors' calculations.

5 Methodology

The estimation of the determinants of net interest margins for our sample of data is conducted using the system General Method of Moments (GMM) dynamic panel estimator, which was initially developed by Arellano and Bond (1991), extended by Arellano and Bover (1995), and Blundell and Bond (1998). The "system" GMM estimates the model by creating a system of two equations for each time period, where one is a first-order differenced model instrumented by lagged levels as in Arellano and Bond (1991), and the other is an equation where variables are held in their original levels and instrumented with lags of their own first differences.

The reasons to use the system GMM approach include:

First, the Wooldridge test for autocorrelation in static, fixed effects estimation of our panel data rejects the hypothesis of no autocorrelation, hence suggesting that our model should be estimated with a dynamic approach. In order to avoid the potential endogeneity problems between the lagged dependent variable and the error term in a fixed effect model, we use the system GMM approach which overcomes this problem by using instrumental variables from within the dataset.

Second, it enables the consideration of both the time and cross-sectional variation in the model.

Third, the error term in the GMM model allows for bank-specific unobserved heterogeneity.

Fourth, it is suitable for data sets with a large number of cross-section observations (N) and short time-series (T), which is the case with our sample.

Fifth, apart from the statistical reasons, there is also an economic rationale for using a dynamic model. The dynamic model enables us to capture the persistence of the dependent variable when there is at least some degree of continuity in the banking environment and banking behavior. The underlying reason why this is possible with a dynamic model is that the lagged dependent variable captures the entire time-path (or history) of the dependent variable. In other words, history is accounted for in a dynamic model, while it remains excluded in a static model.

In order to ensure that our model does not suffer from misspecification issues, we have run a number of diagnostic tests, including the test for the validity of instruments, the test for the cross-sectional dependence and we have also checked the size of the lagged dependent variable coefficient. All the above-mentioned diagnostic tests suggest that our model is well specified.[12]

12 The results of the diagnostic tests are available upon request.

6 Estimation Results

Table 5 presents a number of different model specifications, where the first column (specification 1) presents the main specification and the rest are alternative specifications, which are mainly included to test for robustness.

The lagged dependent variable (*Lagnim*) is highly significant in all model specifications, thus confirming the dynamic nature of our model and showing that net interest margins are persistent over time and follow a gradual adjustment toward new conditions. The coefficient of 0.628 (specification 1) shows a moderate persistence of the lagged net interest margin, suggesting that interest margins in the current year reflect to some extent interest margins from the previous year.

As expected, our results show a statistically significant negative impact of the H-statistic on the net interest margin, suggesting that competition has contributed to the decline of net interest margins of banks in CESEE countries. The negative relationship between banking sector competition and interest margins was also found by a number of authors examining this relationship for different samples of developed countries, such as Ho and Saunders (1981), Demirgüç-Kunt and Huizinga (1999), and Saunders and Schumacher (2000).

The coefficient of the H-statistic (*h_stat1*) in our estimation is statistically significant at the 10 percent confidence level. Since we use a dynamic model to estimate the impact of competition on net interest margins, we are also able to estimate the long-run impact of competition. In the long run, the H-statistic has a coefficient of -0.66, which suggests that in the long run the impact of competition on net interest margins remains negative and the impact is larger than in the short run. The reduction of interest margins in the face of increased competition reflects the strategy of banks for increasing/maintaining their market share. In order to do so, banks may reduce their interest margins by offering higher interest rates on deposits in order to become more attractive in the deposits market and apply lower interest rates on loans in order to increase their competitiveness in the credit market.

Table 5: *Estimation Results, Dependent Variable: Net Interest Margin*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES							
Lagnim	0.628***	0.638***	0.639***	0.612***	0.647***	0.666***	0.592***
	(0.086)	(0.082)	(0.088)	(0.106)	(0.083)	(0.070)	(0.081)
h_stat1	-0.029*	-0.016				-0.033*	0.178**
	(0.016)	(0.017)				(0.018)	(0.086)
hstat1_dvnoneu		-0.069					
		(0.055)					
h_stat3			-0.030*				
			(0.016)				
lerner_index				0.012***			
				(0.004)			
hhi_dep					0.0003**		
					(0.0001)		
equity_ta	0.036**	0.041**	0.031*	0.038*	0.041**	0.034*	-0.007
	(0.018)	(0.020)	(0.018)	(0.021)	(0.020)	(0.018)	(0.021)
nonintinc_ta	-0.108	-0.142	-0.078	-0.100	-0.112	-0.171*	-0.239**
	(0.099)	(0.106)	(0.084)	(0.104)	(0.106)	(0.089)	(0.113)
loggross_loans	0.190*	0.190*	0.149	0.170*	0.214**	0.237**	0.035
	(0.098)	(0.101)	(0.100)	(0.102)	(0.084)	(0.101)	(0.063)
prov_loans	0.076	0.093	0.072	0.086	0.097**	0.075	0.022
	(0.050)	(0.072)	(0.066)	(0.060)	(0.049)	(0.072)	(0.050)
lqdassets_custstfunding	-0.003	-0.003	-0.003	-0.004	-0.002	-0.002	-0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
nonintexp_ta	0.132	0.120	0.098	0.136	0.171*	0.179**	0.271***
	(0.101)	(0.119)	(0.101)	(0.113)	(0.097)	(0.083)	(0.091)
earningsassets_ta	-0.035***	-0.035***	-0.030***	-0.036***	-0.031***	-0.029***	-0.025***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
bankdep_custdep	0.004	0.003	0.002	0.004	0.004	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
ebrd_bankref1	-0.005	0.093	-0.035	0.239	0.211	-0.156	0.186
	(0.230)	(0.269)	(0.242)	(0.264)	(0.238)	(0.205)	(0.240)
economic_freedom_hrt	-0.028**	-0.023	-0.027**	-0.022	-0.021	-0.019	-0.032*
	(0.014)	(0.015)	(0.014)	(0.014)	(0.013)	(0.016)	(0.017)
rgdpgrowth	0.048***	0.054***	0.045***	0.050***	0.058***	0.051***	0.055***
	(0.015)	(0.020)	(0.015)	(0.016)	(0.014)	(0.017)	(0.012)
gdp_percap	0.00005**	0.00005**	0.00004**	0.00003	0.00004*	0.00002	0.00006**
	(0.00002)	(0.0002)	(0.00002)	(0.0002)	(0.0002)	(0.00002)	(0.00002)
cpi_ebrd	0.010	0.014	0.013	0.007	0.001	0.011	0.015
	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.024)	(0.015)

dv_foreign	-0.133	-0.158	-0.090	-0.122	-0.165*		
	(0.089)	(0.104)	(0.094)	(0.100)	(0.097)		
dv_origin	-0.013	0.010	-0.005	0.015	0.005		
	(0.099)	(0.106)	(0.099)	(0.108)	(0.117)		
dv_noneu		1.856***					
		(0.493)					
hstat1_nonintexpta							-0.067*
							(0.034)
dv_year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
dv_country	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.320	0.954	3.463	2.458	0.598	1.860	4.161**
	(2.127)	(2.481)	(2.287)	(2.184)	(1.988)	(2.239)	(1.972)
Observations	1,498	1,498	1,498	1,380	1,530	1,822	1,498
Number of banks	285	285	285	265	285	347	285

Notes: Standard errors in parentheses; *** p < 0.01; ** p < 0.05; * p < 0.1; a) specification (1) includes the *h_stat1* as a measure of competition; specification (2) includes the interaction term between the *h_stat1* and the dummy variable for the non-EU countries (*hstat1_dvnoneu*); specification (3) includes the *h_stat3* as a measure of competition; specification (4) includes the Lerner index (*lerner_index*) as a measure of market power; specification (5) replaces the measure of competition with the degree of market concentration (i.e. the Herfindahl-Hirschman index, *hhi_dep*); specification (6) excludes the foreign ownership variables; specification (7) includes the interaction term between operating expenses (*nonintexp_ta*) and the degree of competition (*h_stat1*).

Source: Authors' calculations.

Since the H-statistic is an estimated variable from a first-stage regression, when used in the second-stage regression it may carry over imprecisions from the first stage. Hence, we apply the bootstrapping technique in order to correct the standard errors of the H-statistic (Table 6). This is a conservative approach to inference with bootstrapping typically yielding standard errors on our estimate of the H-statistic (*h_stat1*) that are somewhat larger than the default cluster-robust standard errors.

Table 6: *Bootstrapped Standard Errors of h_stat1*

	Observed	**Bootstrap**			**Normal-based**	
	Coef.	***Std. Err.***	***z***	***P > z***	***[95% conf. interval]***	
_bs_1	-0.029	0.017	-1.73	0.084	-0.061	0.004

Source: Authors' calculations.

The bootstrapped standard errors confirm our results in that the banking sector competition has a significantly negative impact on the net interest margin. Apart from estimating the average impact of competition on the net interest margin for the overall sample, we run an additional estimation where we check whether competition in non-EU countries of our sample affects banks' net interest margins differently compared to the EU countries of our sample. Our variable of competition *h_stat1* interacted with the dummy variable for the non-EU countries (*dv_noneu*) that takes the value of 1 when the country is not an EU member country. The interaction term between the *h_stat1* and the *dv_noneu* is denoted as *hstat1_dvnoneu*.[13] However, the coefficient of the interaction term appears statistically insignificant, suggesting that the relationship between competition and interest margins in non-EU countries of our sample does not differ significantly from the relationship in the EU countries of our sample (Table 5, specification 2).

Apart from the Panzar-Rosse H-statistic (*h_stat1*), we also include a number of alternative measures of competition/market power in order to check for consistency between different measures of competition.

In specification 3, as a measure of competition, we use an alternative H-statistic variable (*h_stat3*), which differs from *h_stat1* based on the model specification that was used when this variable was estimated.[14] The estimation results appear robust, with *h_stat3* having a negative and statistically significant coefficient at the 10 percent confidence level, which has a similar size to the *h_stat1*. This might also be an important contribution to the literature using the Panzar-Rosse approach since it shows that regardless of whether the Panzar-Rosse H-statistic is estimated with interest income or total income as the dependent variable,

13 The inclusion of the interaction term is done in line with Brambor, Clark, and Golder (2006), who suggest that in case of multiplicative interaction models, the regression should include all the constitutive terms of the interaction term and the interaction term itself. The authors suggest that the coefficients of the constitutive terms should not be interpreted as average effects. The coefficient of one component term can be interpreted only under the assumption that the other component of the interaction term equals zero.

14 The *h_stat3* variable was obtained by estimating the Panzar-Rosse model for each country/year using total income as the dependent variable.

the inferences on the relationship between banking sector competition and net interest margins remain similar.

Another model specification replaces the H-statistic with the Lerner index (*lerner_index*), which is a measure of market power (Table 5, specification 4). The coefficient on the *lerner_index* is positive and highly significant, suggesting that higher market power leads to higher net interest margins. This finding is consistent with our results which suggest that higher competition (i.e. lower market power) leads to lower interest margins. The robustness of our results is shown also by other control variables that retain the same sign and mostly the same level of statistical significance when using the H-statistic for the measure of competition and when using the Lerner index.

In specification 5, we replace the H-statistic with the market concentration index (*hhi_dep*) which is, despite many critiques in the literature, broadly used as a measure of market power. The estimation results suggest that market concentration has a positive and statistically significant impact on the net interest margin. As it can be seen from the results, the three different measures of competition, i.e. the Panzar-Rosse H-statistic, the Lerner index, and the market concentration index (the Herfindahl-Hirschman index) have produced consistent results, which might serve as evidence in favor of the use of these variables to measure the banking sector competition.

As shown in Table 5, the estimation results for the control variables are quite robust across different model specifications, so in the interpretation of results we will focus on our main model specification (specification 1).

The risk-aversion variable, proxied by the equity to total assets ratio (*equity_ta*), has a positive coefficient which is statistically significant at the 5 percent confidence level, suggesting that bank's equity ratio plays an important role in the determination of the net interest margin.[15] According to this result, banks that maintain higher equity ratio tend to have higher net interest margins.

15 Banks holding higher equity ratios are considered to be more risk-averse because the costs associated with a potential bankruptcy would imply the loss of their equity.

Since equity financing is considered to be more expensive than other forms of financing and bears a higher opportunity cost, banks tend to compensate this cost by charging higher loan interest rates (Ho & Saunders, 1981). In addition, since more capitalized banks are considered to be safer, a higher equity ratio may enable the bank to attract deposits at a lower interest rate, which will lead to a higher net interest margin (Claeys & Vennet, 2008).

The diversification of bank's activity, measured by the non-interest income to total assets ratio (*nonintinc_ta*) has the expected negative coefficient, but is statistically insignificant. This suggests that the diversification of banks' activity toward the non-interest generating assets did not have a significant impact on net interest margins in CESEE countries. This may be related to the fact that the share of non-interest generating assets in the banking sectors of CESEE countries is still low and, as such, banks may not significantly rely on this source of income to compensate potential reductions in the income from the interest-generating assets.

Similar to Maudos & Fernández de Guevara (2004), we have included the *loggross_loans* variable to proxy for the average size of bank's transactions. This variable has a positive and statistically significant coefficient at the 10 percent confidence level, suggesting that banks with larger loans in their portfolios tend to apply higher interest rate margins. Banks may apply higher risk premiums on larger loans given that the potential default on larger loans is expected to incur larger losses. The use of this variable as a proxy for the average size of bank's transactions is done based on the assumption that larger banks tend to conduct larger size transactions compared to smaller banks.

The variable controlling for the quality of the loan portfolio, i.e. the credit risk (*prov_loans*), has the expected positive sign but its coefficient is statistically insignificant. Nevertheless, since its *p-value* is 0.133, this variable might be considered as borderline at the 10 percent confidence level. A positive coefficient of this variable suggests that banks with lower-quality loan portfolios tend to

charge higher loan interest rates in order to compensate for the potential losses occurring from the defaulted loans. In addition, since potential loan repayment problems usually start to take place in a later stage after the loan has been disbursed, banks facing higher credit risk tend to charge higher loan interest rates in order to collect a higher amount of interest during the period that the loan is performing which, to some extent, would compensate the losses from a potential default in the future.

The variable consisting of liquid assets expressed as a percentage of customer deposits and short-term funding (*lqdassets_custstfunding*), which is included in the regression to control for the opportunity cost of holding reserves, has a statistically insignificant impact.[16] This suggests that the opportunity cost of holding reserves was not significantly incorporated in banks' interest rates. However, even though the reserves may compose a considerable part of liquid assets, the total amount of liquid assets may still not be an appropriate proxy for the reserves. Hence, this variable might not properly account for the true impact of banks' reserves on net interest margins.

The coefficient on the non-interest operating expenditures to total assets ratio (*nonintexp_ta*), which may serve as a proxy for the cost-inefficiency of the banks, has the expected positive sign but is statistically insignificant. Banks with higher non-interest expenses (i.e. overhead costs) would be expected to set higher interest margins in order to compensate for the higher level of their operating expenses. However, the statistically insignificant impact of this variable might be attributed to the fact that our regression controls for bank's foreign ownership whose impact on net interest margins might be to a degree channeled through the bank's cost efficiency. In order to test for this, we have run a separate regression (specification 6), in which we exclude the foreign ownership variables. After excluding the ownership variables, the coefficient of the *nonintexp_ta* variable becomes statistically significant and retains a positive sign, suggesting that more inefficient banks tend to set higher net interest margins in order to compensate

16 The use of liquid assets as a proxy for bank reserves has also been done by Poghosyan (2010), and Männasoo (2012).

for higher operating expenses. This finding may serve as supporting evidence to the view expressed by Poghosyan (2010), who suggests that the control for foreign ownership may not be necessary in a dealership model, given that the channels through which foreign ownership may affect interest margins (such as efficiency and competition) are already controlled for in such models.

Supposing that the degree to which banks can compensate their cost inefficiencies by setting higher interest margins may depend on how competitive the market is, we run an alternative model specification in which we include the interaction term between the operating expenses (*nonintexp_ta*) and the competition variable H-statistic (specification 7).[17] The interaction term is denoted as *hstat1_nonintexpta*. The higher the degree of competition, the lower the expected ability of banks to transfer their cost inefficiencies into higher interest margins. The estimation results from this model specification show that the interaction term *hstat1_nonintexpta* has a statistically significant negative coefficient, which suggests that the increasing impact of the operating expenditures on the net interest margin is reduced when competition increases. In other words, this finding suggests that inefficient banks are less able to charge higher interest rates when the market is competitive and, consequently, less likely to survive in a competitive market.

The model also controls for the impact of the quality of management on the net interest margin. The quality of management is proxied by the earning assets to total assets ratio (*earningsassets_ta*), with a higher ratio implying a better quality of management. The coefficient on the *earningsassets_ta* is negative and highly significant, suggesting that banks with better management quality tend to operate with lower net interest margins. The share of the deposits from banks to total customer deposits (*bankdep_custdep*), which is included in the regression to control for the composition of deposits, is statistically insignificant showing that the composition of deposits does not appear to be relevant for the determination of net interest margins.

17 This specification does not control for foreign ownership (*dv_foreign* and *dv_origin*) because when these variables are included, the non-interest expenditures to total assets ratio (*nonintexp_ta*) turned statistically insignificant.

The Economic Freedom index (*economic_freedom_hrt*), which is included in the regression to control for the overall institutional environment in each country, is statistically significant at the 5 percent confidence level with a negative coefficient. This suggests that countries with a higher Economic Freedom index which, among others, implies better protection of property rights and lower corruption are characterized by lower interest rate margins. A higher Economic Freedom index indicates a less uncertain operating environment for the banks, which might be reflected in lower risk premiums on the loan interest rates. The EBRD banking reform index (*ebrd_bankref*) has a statistically insignificant coefficient.

Regarding the macroeconomic variables, the results suggest that the real GDP growth rate (*rgdpgrowth*) has a positive and highly significant impact on the net interest margin (statistically significant at the 1 percent confidence level). This may be reflecting the positive impact of GDP growth on the demand for loans, which makes upward pressure on loan interest rates. A positive coefficient is also found for the GDP per capita (*gdp_percap*), which is included in the regression to control for the overall level of economic development in each country. Its impact on the net interest margin in principle is expected to be negative, assuming that banks operating in more developed countries face lower levels of risk and, as such, apply lower risk premiums on their loan interest rates.

The variable on the inflation rate (*cpi_ebrd*) turned out to be statistically insignificant, suggesting that banks' net interest margins in CESEE countries have not been significantly responsive to the change of inflation rates. Statistically insignificant appear also the dummy variables on foreign ownership (*dv_foreign*) and on the banks' countries of origin (*dv_origin*), suggesting that net interest margins of the foreign-owned banks are not significantly different from the net interest margins of the domestically-owned banks.

7 Conclusions

Both the theoretical and empirical literature generally agrees that competition leads to lower interest margins. However, the vast majority of empirical studies that have investigated this relationship have used the market concentration index as a measure of competition, which may make the inferences derived by these studies on the relationship between competition and net interest margins questionable.

Therefore, in order to provide a more reliable picture regarding this relationship, we have used the Panzar-Rosse H-statistic to estimate the impact of banking sector competition on net interest margins in CESEE countries during the period 1999–2009. To our knowledge, this is the first study to use the H-statistic as a measure of banking sector competition when investigating the determinants of net interest margins in CESEE countries. The estimation is performed on panel data with a dynamic model, using the General Method of Moments approach.

Our estimation results suggest that the banking sector competition has had a significantly negative impact on net interest margins in CESEE countries. This implies that the decline of the interest rate spreads that took place in CESEE countries during the period 1999–2009 was significantly driven by the increase of banking sector competition. The results suggest that the relationship between competition and interest margins in non-EU countries of the sample is not statistically different from the relationship in the EU countries of the sample.

In order to make our inferences on the relationship between the banking sector competition and the net interest margin more credible, we have also used some alternative measures of banking sector competition. First, we estimated an alternative Panzar-Rosse H-statistic, by using the total income instead of the interest income when estimating the H-statistic. The results remain similar, suggesting that both versions of the H-statistic produce consistent results. Second, we used the Lerner index as a measure of market power and the results show a significantly positive impact, thus confirming our finding that market power

leads to higher net interest margins. Third, we included the market concentration index (the Herfindahl-Hirschman index), which has a significantly positive coefficient, suggesting that banks operating in more concentrated markets have higher net interest margins. These findings suggest that the three different measures of competition, albeit differing substantially in the way they measure competition, produce consistent results.

Regarding the impact of the control variables, the estimation results suggest that banks holding higher capitalization ratios tend to have higher net interest margins. Similarly, the average size of the loan transactions appears to be associated with higher interest rates, possibly reflecting higher potential risks that are associated with larger transactions. Operating costs appear to have a positive impact on net interest margins, but the ability of banks to translate higher operating costs into higher net interest margins appears to decline as competition increases. Better management quality appears to be associated with lower interest margins. The degree of economic freedom has a significantly negative effect, which may be reflecting the fact that more reformed countries are viewed as less uncertain by the banks and, hence, lower risk premiums are applied. Regarding the macroeconomic indicators, both the real GDP growth rate and the GDP per capita appear to have a significantly positive impact on net interest margins.

Acknowledging the importance of lower net interest margins for a more efficient financial intermediation and, consequently, better financing conditions for the economy, the findings of this paper may be considered as a suggestion directed at the authorities with hopes of enhancing the conditions for the development of healthy competition in the baking system. In addition, special attention should be given to the improvement of the different aspects of the overall operating environment, some of which have been covered in this paper. Even though our findings may suggest that the negative relationship between competition and net interest margins may serve as evidence in support of a positive link between competition and financial intermediation, further research in this

area is desirable. In order to have a more complete picture regarding the effects associated with higher competition, it would be desirable to also investigate the impact of competition on other indicators such as the access of firms to bank financing and the general financial inclusion rate.

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