Competitive conditions in the Central and Eastern European banking systems

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Abstract

The aim of this study is to conduct a large-scale empirical analysis of the competitive conditions in the banking systems of Central and Eastern European countries. The well-known model of Panzar and Rosse (1987) is implemented on bank-level data over the period 1999-2006. The estimates based on the separate country panels suggest a wide variation in the competitive conditions of the banking systems examined, with some being characterized as (monopolistically) competitive and other as non-competitive. Finally, the results from the full sample indicate that bank revenue is substantially influenced by structural and macroeconomic conditions.

JEL codes: G21, L10, C23
Keywords: Market power, Central and Eastern European banks, Panzar-Rosse model

1. Introduction

The purpose of this study is to provide a large scale analysis of the competitive conditions in the banking sectors of Central and Eastern European (CEE) countries, in light of the reforms implemented in these countries and the immense changes in their banking systems. Besides the decisive shifts in the political regime, the transition in these countries occurred as a consequence of the increasing monetary and financial integration, as well as deregulation of the domestic financial system and liberalization of capital flows. The vital role of banks in these economies encompasses their participation in the payment system, the transmission of monetary policy, and the provision of credit. Thus, any market failure, inefficiency, or anticompetitive conduct among banks, is likely to impose more severe costs throughout the economy – in terms of both allocative efficiency and distributional fairness – than would similar defects in many other industries.

In the academic literature of the banking industry, several authors have assessed the level of competition in banking markets, at different levels of aggregation. Some consider the whole of submarkets in which banks operate, while others concentrate on one (or more) specific submarket(s) (for a recent review of the literature, see Delis et al., 2008). This literature can be divided into two major streams that employ either structural or non-structural models. The structural approach embraces the structure-conduct-performance and the efficiency hypotheses, as well as a number of formal approaches with roots in industrial organization theory. The two hypotheses examine, respectively, whether a highly concentrated market causes collusive behavior among the larger banks (thus resulting in superior market performance), or whether it is the efficiency of larger banks that enhances their performance. Although lacking formal back-up in microeconomic theory, these hypotheses have frequently been tested in the banking industry

and provide policy makers with measures of market structure and performance as well as their interrelationship.

However, due to several deficiencies arising from the application of the structural approach, the ongoing developments in the industrial organization literature, and the recognition of the need to endogenize the market structure, many empirical studies followed a new course.[1] The non-structural approach to the evaluation of competitive conditions has emerged under the impulse of the New Empirical Industrial Organisation (NEIO) literature. This approach, pioneered by Iwata (1974) and strongly enhanced by Appelbaum (1982), Bresnahan (1982, 1989), Lau (1982) and Panzar and Rosse (1987), tests for the presence of market power by stressing the analysis of banks' competitive conduct. Specifically, the NEIO literature attempts to measure the competitive conduct of firms at the industry level by estimating deviations from competitive pricing (without explicitly using information on the structure of the market). A major advantage of this approach is its formal grounding in explicit optimization models and equilibrium conditions.[2]

The Panzar and Rosse (1987) approach (PR hereafter) offers an appropriate framework for testing for market power by relying on the premise that banks will employ different pricing strategies in response to a change in input costs, depending on the market structure in which they operate. In other words, market power is measured by the extent to which changes in factor prices are reflected in revenue. PR define a measure of competition, the 'H-statistic', which represents the percentage variation from the equilibrium revenue derived from an infinitesimal

[1] For a thorough critique of the structural approach, see Bresnahan (1989).
[2] There has also been some critique of the NEIO literature, especially as regards the models of Appelbaum (1982) and Bresnahan (1982) and Lau (1982). The main elements of critique are the use of a single functional form to describe all firms and the failure of these models to incorporate dynamics (see e.g. Genesove and Mullin, 1998; Corts, 1999; Delis et al., 2008). The fact that the Panzar and Rosse (1987) approach offers a long-run equilibrium test, probably makes it more suitable in the context of the present study.

percent increase in the price of all factors used by the firm. In this vein, the H-statistic may indicate the existence of monopolistic, monopolistically competitive or perfectly competitive structures.

The PR methodology has been extensively applied to the European banking sector, both on regional and single-country studies (see e.g. Molyneux et al., 1994; De Bandt and Davis, 2000; Bikker and Haaf, 2002; Coccorese, 2004). In addition, a growing body of recent literature has focused on emerging economies. Among these studies, Yildirim and Philippatos (2007) analyzed the competitive conditions in the banking industries of fourteen CEE countries for the period 1993-2000. Their results suggest that most of the banking sectors examined are characterized by monopolistic competition (notable exceptions are FYROM and Slovenia). Similar findings are reported by Gelos and Roldos (2004). Finally, Mamatzakis et al. (2005) measure the degree of competition in the banking sector of the South Eastern European region over the period 1998-2002, and reach the conclusion that banks also earn their interest and total revenue under conditions of monopolistic competition.

In this paper, I extend the scale of the analysis to 22 CEE countries for the last eight years of available data (1999-2006). Therefore, this paper augments previous studies by using (i) the entire set of CEE countries covered by the European Bank for Reconstruction and Development (EBRD) and (ii) very recent data. This may be quite important if one considers the fact that in many CEE countries the deregulation and liberalization process has been completed during the 2000s, while in other this process is still underway. In a second step, the full sample is used to examine the impact of the significant structural and macroeconomic developments that took place during the sample period on bank revenue, which is an important element of the identification of market power in the PR framework.

The rest of the paper is organized as follows. Section 2 presents some characteristics of the banking systems and macroeconomic environments of the CEE countries. Section 3 discusses the PR methodology and the estimation procedure. Section 4 presents and analyzes the empirical results. Finally, Section 5 concludes the paper.

2. The CEE banking industry

Since the mid-1990s, the CEE financial and banking landscape has changed rapidly. The environment that emerged gave impetus to the establishment and operation of new credit institutions, either domestic ones or branches of foreign banks. A specific structural feature of the status quo ante of the CEE financial system, characterizing in particular the old banking regime, was the significant level of state intervention, which for a long time hindered competition and created a distorted market environment (see EBRD, 2006). Indeed, in 1999 the state commercial banks controlled around 31 per cent of total commercial banking assets, which is a low portion compared to that of the early 1990s. During the early 2000s, privatization of several banks controlled by the state was further enhanced and, as a result, the percentage of directly or indirectly state-controlled banks was reduced significantly to only 12 per cent in 2006 (see Table 1).

In addition, a number of new, mainly foreign, commercial banks opened during the 1999-2006 period and a series of mergers and acquisitions were undertaken, altering the level of bank concentration and substantially changing the structure of the CEE banking systems. These mergers and acquisitions have reversed the downward trend in bank concentration observed in many CEE banking systems during the 1990s. Note, however, that differences in concentration between countries are significant, with countries like Azerbaijan and Lithuania presenting the

most concentrated banking systems and Bulgaria and Ukraine being at the opposite end (see Table 1).

[Please insert Table 1 about here]

To compete in the new financial landscape and strengthen their position in the market, CEE commercial banks have been transforming themselves into financial groups mainly by adding subsidiaries – such as insurance companies, brokerages, credit card companies, mutual fund firms, factoring companies and finance houses – so as to offer additional services. These developments resulted in significant modifications in the balance sheet and profit and loss accounts of banks. Most notably, the ratio of equity to total assets (*ea*) fell significantly from an average of 19 per cent in 1999 to an average of 14 per cent in 2006 (see Table 2), being much closer to EMU standards. In addition, the proportion of loans to total assets (*la*) reached 59 per cent in 2006 (compared to 43 per cent in 1999), also catching up with the average European levels.[3]

[Please insert Table 2 about here]

Last but not least, the CEE credit institutions took important steps towards improving their efficiency by deploying modern information technology systems, cutting down on their operating costs and improving their organizational structure (see Brissimis et al., 2008), while extending their scope of business by offering new products and services. Taking into account these developments, the indications of an upward trend in profitability towards the last years of our sample (see Table 2) are not surprising, a fact that may have important implications for the market power of CEE commercial banks.

[3] Several factors have been responsible for the high rates of growth of bank lending, including the relatively-high rate of growth of the CEE economies, the gradual convergence of CEE lending rates to those of the rest of the euro area and the release of commercial bank funds from the national central banks due to the harmonization of reserve requirements with the EMU. For detailed information on EU banking structures, see ECB (2007).

The progress of the CEE banking systems in areas such as i) the adoption of regulations according to international standards and practices, ii) the implementation of higher and more efficient supervision, iii) the privatization of state-owned banks and iv) the write-off of non-performing loans and the closure of insolvent banks, is reflected in the EBRD index of banking sector reform (*ebrd*). This index provides a ranking of progress for liberalization and institutional reform of the banking sector, on a scale of 1 to 4+. A score of 1 represents little change from a socialist banking system apart from the separation of the central bank and commercial banks, while a score of 4+ represents a level of reform that approximates the institutional standards and norms of an industrialized market economy (EBRD, 2006). On the basis of this index, CEE countries get an average score around 3.3 in 2006, most of them coming up from much lower levels observed in 1999 (see Table 1). Overall, these scores imply that, despite the improvement that took place recently in the banking system of the CEE countries, still some countries have not reached the level of EU practice.

Finally, macroeconomic factors, such as fiscal and monetary discipline, the gradual reduction of interest rates and risk premiums, the rise of expected lifetime income in the region and an increasing money demand have all positively contributed to the development of financial markets (EBRD, 2006). These developments enhanced the ongoing rise and broadening of intermediation in the CEE region. Yet, differences among the CEE countries in the average value of the macroeconomic variables remain quite significant (see Table 1). For example certain countries like Belarus and Romania were still facing hyperinflation, while Moldova, Georgia and Armenia are still considered among the poorest countries in the world. Such characteristics of the CEE countries may have important implications for the estimation and the sources of market power.

3. The Panzar-Rosse model

The PR model for measuring market power relies on the premise that each bank will employ a different pricing strategy in response to a change in input costs, depending on the market structure in which this bank operates (Panzar and Rosse, 1987). Phrased differently, market power is measured by the extent to which changes in factor prices are reflected in revenue. The authors define a measure of competition, the H-statistic, as the sum of the elasticities of the reduced-form revenue function with respect to factor prices. Thus, the H-statistic represents the percentage variation from the equilibrium revenue derived from an infinitesimal percent increase in the price of all factors used by the firm.

PR assert that the H-statistic is negative when the competitive structure is a monopoly, a perfectly colluding oligopoly, or a conjectural variations short-run oligopoly; an increase in input prices will increase marginal costs, reduce equilibrium output, and subsequently reduce revenue.[4] Under perfect competition, where banks' products are regarded as perfect substitutes of one another, the Chamberlinian model, based on free entry of banks and determining not only the output level but also the equilibrium number of banks, produces the perfectly competitive solution (as demand elasticity approaches infinity). Thus, in this case, the H-statistic is equal to unity. Shaffer (1982) shows that the H-statistic is also unity for a natural monopoly operating in a perfectly contestable market and also for a sales-maximizing firm that is subject to breakeven constraints. Consequently, an increase in input prices raises both marginal and average costs without altering the optimal output of a bank. Exit from the market will evenly increase the

[4] In the case where the monopolist faces a demand curve with constant price elasticity (i.e. $e > 1$) and where a constant returns to scale Cobb–Douglas technology is employed, Panzar and Rosse proved that the H-statistic is equal to e-1. Hence, apart from the sign, the magnitude of the H-statistic may also be of importance, as the H-statistic yields an estimate of the Lerner index of monopoly power $L = (e-1)/e = H/(H-1)$ (Shaffer, 1983).

demand faced by each of the remaining banks, thereby leading to an increase in prices and total revenue by the same amount as the rise in costs (i.e. demand is perfectly elastic). Finally, if the H-statistic is between zero (inclusive) and unity (exclusive), the market structure is characterized by monopolistic competition. Under monopolistic competition, potential entry leads to contestable market equilibrium, and income increases less than proportionally to the input prices, as the demand for banking products facing individual banks is inelastic.

This method is a valuable tool for assessing market conditions, mainly owing to its simplicity and transparency, without lacking efficiency. Moreover, data availability becomes much less of a constraint, since bank revenue is more likely to be observable (as opposed to output prices). Also, by utilizing bank-level data, this approach allows for bank-specific differences in the production function. In addition, the non-necessity to define the location of the market a priori implies that the potential bias caused by the misspecification of market boundaries is avoided; hence for a bank that operates in more than one market, the H-statistic will reflect the average of the bank's conduct in each market.

The H-statistic is derived using the following specification of the reduced-form revenue equation for a panel dataset:

$$\ln rtr_{it} = \beta_0 + \beta_1 \ln w_{1,it} + \beta_2 \ln w_{2,it} + \beta_3 \ln w_{3,it} + \beta_4 \ln ea_{it} + \varepsilon_{it} \qquad (1)$$

where the subscript *it* indicates bank *i* at time *t*, *rtr* stands for a bank's real total revenue, w_1, w_2 and w_3 are the three input prices and *ea* stands for the ratio of equity to assets.[5] As discussed above, the H-statistic is equal to the sum of the elasticities of total revenue with respect to the three input prices, i.e. $H = \beta_1 + \beta_2 + \beta_3$. The log specification is used to improve the regression's

[5] Some authors also add the logarithm of total assets to control for bank size. However, the addition of total assets in the revenue equation makes it de facto a price equation, which may lead to a systematic bias in the estimation of the price parameters, and therefore the H-statistic (see Vesala, 1995). The dependent and independent variables chosen for estimating this basic model are the ones most widely employed in the literature (see Delis et al., 2008). Several other variables will be used to examine the sensitivity of the results (see Section 4.2 below).

goodness of fit and to reduce possible simultaneity bias (see De Bandt and Davis, 2000). Also, Molyneux et al. (1996) found that a log-linear revenue equation gives results similar to those of a more flexible translog equation. The three input prices are generated by dividing (i) interest expenses by total deposits (w_1), (ii) depreciation and other capital expenses by fixed assets (w_2) and (iii) personnel expenses by total assets (w_3). Table 2 provides country-specific average values for all the variables included in Eq. (1). Furthermore, the Baltagi-Wu test-statistic reveals that the error term should be treated as first order autoregressive. Therefore, to estimate Eq. (1) we use a panel-data, random-effects (RE) estimator with a first-order autoregressive disturbance term (see Baltagi, 2005).[6]

Finally, a critical feature of the H-statistic is that the test must be undertaken on observations that are in long-run equilibrium (not subject to severe dynamics). The empirical test for equilibrium is justified on the grounds that competitive capital markets will equalize the risk-adjusted rate of return across banks, so that (in equilibrium) the rate of return should not be statistically correlated with input prices. Therefore, to test for equilibrium, one can calculate the H-statistic (H_n) using the rate of return, instead of total revenue, as the dependent variable in the regression equation. The largest body of the existing literature uses a regression that relates the return on assets (*roa*) with input prices. In this framework, $H_n=0$ indicates that banking systems are in equilibrium. However, the argument also holds if the return on equity is used as the dependent variable instead (see Molyneux et al., 1996; Yildirim and Philippatos, 2007; Bikker and Haaf, 2002 for a thorough discussion of these issues).

[6] The suitability of a RE model was tested against a fixed effects (FE) model, using a Hausman test. The results showed that the difference in coefficients is not systematic, thus providing evidence against FE.

4. Estimation results

4.1 Basic results

As discussed above, the dataset of the present study consists of bank- and country-level variables. All bank-level data are obtained from BankScope and include 3087 observations from 529 commercial banks[7] (therefore the panel is unbalanced). These banks operated during the period 1999-2006 in the 22 CEE countries reported in Tables 1, 2 and 3. Some banks have been excluded from the empirical analysis, given that their figures were unreasonable (very high input prices) or some of the required data were missing. Averages of the bank-level variables, along with the number of banks and observations by country are provided in Table 2. Moreover, the structural and macroeconomic variables included in the empirical analysis are the EBRD index of banking sector reform, *ebrd*; the 3-bank concentration ratio, *conc3* (obtained form the World Bank); the share of majority state-owned banks' assets in total banking sector assets, *state* (obtained from the EBRD); the share of total banking sector assets in banks with foreign ownership exceeding 50 per cent, *foreign* (obtained from the EBRD); the GDP per capita in US dollars, *gdpcap* (obtained from the EBRD); and the inflation rate, *inf* (obtained from the EBRD).

Table 3 reports the estimates obtained from applying the methodology described in Section 3 to the individual banking sectors. Most of the input prices and the capital ratios reported in Table 3 are statistically significant at conventional levels, which implies good fit of the revenue equations. However, contrary to the findings of previous studies (see e.g. Claessens and Laeven, 2004; Gelos and Roldos, 2004), the H-statistic varies widely between countries, with Kazakhstan presenting the lowest score (-0.6) and Poland the highest (0.85). Besides Kazakhstan, the banking systems of Bosnia, Estonia and FYROM are characterized by anti-

[7] I have decided to restrict the analysis to commercial banks only so as to avoid comparing banks with different products, clientele and objectives.

competitive (monopolistic) practices. For countries like Bulgaria, Croatia, Hungary, Lithuania, Slovenia and Ukraine the H=0 hypothesis is not rejected at conventional levels of statistical significance. The banking systems of these countries are characterized by monopolistic competition, but they are on the edge of presenting some anti-competitive conduct. Indeed, if one considers the extension of the PR model of Bikker and Haaf (2002), where the H-statistic is opted as a continuous measure of the level of competition, then it holds that countries with values close to zero are characterized by less competition, whereas countries with values closer to unity are characterized by relatively competitive practices.[8] For the rest of the countries the dominant market structure is monopolistic competition, as their H-statistics differ significantly from both zero and unity.[9] Finally, I test for long-run equilibrium using *roa* as the dependent variable as discussed above. The results (not reported but available upon request) suggest that the hypothesis of equilibrium (i.e. H_n=0) is confirmed for all the banking systems, but Bosnia (p-value of t-test=0.001) and Estonia (p-value=0.000).[10]

[Please insert Table 3 about here]

[Please insert Table 4 about here]

Apart from the aforementioned country-specific estimates, we use the full sample to re-estimate the PR model, also including a number of structural and macroeconomic characteristics for the countries examined. These characteristics are reported in Table 4, along with their correlation statistics. Note that *ebrd* presents relatively high correlations with some of the rest of the variables and, therefore, we do not use this variable along with the other control variables to

[8] However, this approach has been criticized by Shaffer (2004a,b), who suggests that the H-statistic does not map as robustly as the estimates obtained from the Bresnahan-Lau method into a range of conduct solutions.

T[9] Note that any grouping of countries based on the relationship of the H-statistic with structural or macroeconomic conditions is not possible. For example the Pearson correlation of H with *ebrd* and *conc3* is as low as -0.02 and 0.02, respectively.

[10] Notably, these two countries faced a very unstable economic and political environment during the sample period, which may be an important reason for the observed disequilibrium.

avoid problems of multicollinearity. The estimation results are presented in Table 5. The H-statistic ranges between 0.110 and 0.205 among the different specifications, reflecting monopolistically competitive conditions (as the hypotheses H=0 and H=1 are rejected at conventional levels of statistical significance). Given the country-specific estimates provided above, this result is certainly of not particular importance. The main element of interest here is the impact of the structural and macroeconomic variables on revenue, which is found to be quite significant in all specifications.[11] The variable *ebrd* presents a positive and highly significant coefficient, which implies that as banking sectors are reformed, revenues substantially increase. Another quite appealing result is the negative impact of state ownership and the positive impact of foreign ownership on bank revenue. This certainly implies that penetration of foreign banks and the observed reduction of state ownership will eventually result in improved competition as foreign entry will continue. As regards the macroeconomic variables, the results meet our expectations, with both *gdpcap* and *inf* presenting a positive and significant effect on bank revenue. On the one hand, higher economic prosperity leads to enhanced investments and therefore lending and bank revenue rises. On the other hand, higher inflation usually implies higher interest margins, which are naturally associated with increased bank revenue. In addition, the positive nexus between inflation and bank revenue may suggest that banks are better able to form expectations for the future level of inflation than their customers, which in turn implies that interest rates have been appropriately adjusted to achieve higher revenues (see Athanasoglou et

[11] Some of the previous literature suggested regressing the country-specific H-statistics on a similar set of structural and macroeconomic variables (see e.g. Claessens and Laeven, 2004). However, regressing estimates for the H-statistic (obtained from OLS or similar estimation methods) against some control variables is almost certain to result in problems of statistical consistency. This is because the covariates in the second-stage regression are correlated with the error terms from the first stage regression; otherwise there would be no need for the second stage regression (this holds regardless of whether the H-statistic maps robustly into a range of solutions as discussed in footnote 8 above). To overcome this problem, the second-stage regressors should be made functions of either the H-statistic (and hence of the input prices) or of the error term in a single stage approach. As this procedure is beyond the scope of the present paper, I will leave it to future research.

al., 2008). Note that the positive relationship between inflation and bank revenue holds regardless of the fact that inflation has been decreasing throughout the sample period (see Table 1).[12] Finally, concentration has a significant impact on bank revenue, only when the macroeconomic variables are not included in the estimated equations (specifications II and III).[13] This outcome is in accordance with Berger (1995) who claims that concentration is usually an insignificant determinants of bank revenues and profits once other effects, external to the bank management, are controlled for.

[Please insert Table 5 about here]

4.2. Sensitivity analysis

In this section I inquire into the robustness of the results in three ways. First, I use two alternative dependent variables, second I employ two more bank-specific control variables and third I re-estimate the model using a dynamic panel data method. The alternative dependent variables employed (in place of real total bank revenue) are real gross interest revenue (used to isolate competitive conditions in revenue generated by lending) and the ratio of total bank revenue over total assets.[14] Use of both variables suggests very similar results with those reported in Table 3 (see columns H1 and H2 of Table 6).

[Please insert Table 6 about here]

Besides *ea*, other bank-specific factors were used as additional control variables to reflect differences in credit risk (the ratio of loan loss provisions to assets) and the asset mix (the ratio of

[12] Alternatively to the inflation rate, the one-year interest rate has been employed as a proxy for the monetary conditions. The results were very similar to those of the inflation rate and hence they are not reported.
[13] Note that this holds despite the fact that the Pearson correlation of *conc3* with the macroeconomic control variables is low.
[14] These variables are used by a number of papers that employ the PR methodology, including Claessens and Laeven (2004) and Bikker and Haaf (2002).

loans to assets). Once again, these variables even though they were found to be statistically significant determinants of bank revenue in almost all country panels, they possessed no impact on the H-statistic (see column H3 of Table 6). Therefore, I decided to limit the basic analysis to the use of capital adequacy, so as to simplify both the strategy and the main results of the paper.

Finally, and probably more notably, I check for the existence of dynamics in the data by fitting a dynamic panel data model, which includes lags of both the dependent and the independent variables. Dynamics have been examined in this fashion by Delis et al. (2008), who report that the dynamic method reveals increased market power of banks compared to its static counterpart. Also, Shaffer (2004b) suggests that the potential existence of monopsony power could be mitigated if lagged input prices are fitted in the revenue equation. This argument is based on the recognition that an upward-sloping supply curve for banks will have the effect of driving up input prices as a function of contemporaneous quantities of bank outputs, whereas the revenue levels predicted by PR may respond to input prices only with a lag (particularly in the case of long-run competition). To this end, an autoregressive-distributed lag model is specified, as follows:[15]

$$\ln TR_{it} = \beta_0^{'} + \beta_{l0} \ln TR_{i,t-1} + \beta_1^{'} \ln w_{1,it}^{'} + \beta_{l1}^{'} \ln w_{1,it-1} + \beta_2^{'} \ln w_{2,it}^{'} + \beta_{l2}^{'} \ln w_{2,it-1} + \beta_3^{'} \ln w_{3,it}^{'} + \beta_{l3}^{'} \ln w_{3,it-1} + \beta_4^{'} \ln EA_{it} + \beta_{l4}^{'} \ln EA_{it-1} + \eta_i + u_{it} \quad (2)$$

where t-1 is the one-period time lag, η are the individual effects, u is the idiosyncratic disturbance and, as in the static case, the H-statistic is obtained by $H^{'} = \beta_1^{'} + \beta_2^{'} + \beta_3^{'}$. Eq (2) is

[15] This model has been proposed by Delis et al. (2008). Note that the model assumes $E(u_{it} \mid x_{it}, \eta_i) = 0$, where x is the set of explanatory variables. This assumption implies that for all t and s $E[x_{is}(\Delta \ln TR_{it} - \beta_{l0} \Delta \ln TR_{it} - \Delta x_{it}^{'} \beta^{'})] = 0$, where s is the number of instrumented lags. Essentially, this rules out the possibility of feedback from lagged revenue to current x_s (see Arellano, 2003).

estimated using the dynamic panel data estimation method proposed by Blundell and Bond (1998).[16]

The results (see column H4 of Table 6) indicate that for some countries – especially those ones still in the transition phase – the dynamic model produces somewhat lower H-statistics (see e.g. the values for Belarus, Bulgaria, Kazakhstan, Ukraine). In contrast, countries with relatively stable economies and higher *ebrd* values do not seem to be significantly affected by the dynamics in the data. Nonetheless, this may be a rather interesting issue for future research.

5. Conclusions

This paper has described the competitive conditions in the CEE banking sectors over the period 1999-2006, using an empirical framework that is based on the seminal work of Panzar and Rosse (1987). The empirical findings suggest a wide variation of the competitive conditions between the banking systems examined, with some being characterized by significant market power, while others are closer to monopolistically competitive practices. In addition, the structural and macroeconomic environment is highly important in shaping bank revenues, which is a critical feature in the identification of market power under the PR approach. The extent that factors like increased foreign ownership, financial reform, deregulation and institutional characteristics are in a constant state of flux in the CEE countries, may have important implications for the conditions prevailing in the banking sector and the associated policies of the monetary and fiscal authorities.

[16] The instruments used are $\ln TR_{i,t-2}, \ln TR_{i,t-3}, ..., \ln TR_{i,1}; \ln EA_{i,t-2}, \ln EA_{i,t-3}, ..., \ln EA_{i,1}; \ln w_{ji,t-2}$, $\ln w_{ji,t-3}, ..., \ln w_{ji,1}$ and $\Delta \ln TR_{i,t-2}, \Delta \ln EA_{i,t-2}$. For more details on this method, see Delis et al., 2008).

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Table 1a
Evolution of banking-system and macroeconomic characteristics in CEE countries over the period 1999-2006

Year	ebrd	conc3	state	foreign	gdpcap	inf	gdpgr
1	2.706	64.894	30.691	32.948	2868.2	21.456	2.895
2	2.767	65.114	22.678	46.729	2964.0	18.825	5.315
3	2.848	66.687	18.796	49.962	3049.4	10.254	6.058
4	2.983	62.600	17.484	51.228	3195.2	5.793	5.676
5	3.004	59.992	15.538	55.073	3379.0	5.105	7.013
6	3.118	59.930	12.136	52.298	3605.5	6.391	7.942
7	3.250	58.949	12.399	55.502	3857.5	6.066	7.416
8	3.288	61.148	11.934	59.970	4182.5	5.429	9.119
Average	2.996	62.664	17.703	50.469	3387.8	9.912	6.430

Table 1b
Banking-system and macroeconomic characteristics of CEE countries (country averages)

Country	ebrd	conc3	state	foreign	gdpcap	inf	gdpgr
Albania	2.413	76.806	40.688	58.000	1391.8	2.375	6.175
Armenia	2.400	62.257	0.913	50.575	895.4	2.400	10.500
Azerbaijan	2.225	83.392	60.238	5.150	1007.1	3.325	13.513
Belarus	1.438	77.362	66.713	11.763	1928.7	78.713	7.063
Bosnia	2.450	54.331	21.363	64.113	1510.6	2.550	5.525
Bulgaria	3.300	53.882	14.075	73.113	1879.5	5.863	4.825
Croatia	3.625	57.384	8.575	82.925	5336.9	3.188	3.750
Czech Republic	3.675	64.813	11.000	77.375	6598.8	2.463	3.663
Estonia	3.813	98.140	0.988	97.038	5739.5	3.675	7.988
FYROM	2.700	78.018	1.725	44.850	1925.5	2.263	20.950
Georgia	2.450	67.293	0.000	39.463	678.9	7.675	6.338
Hungary	4.000	62.102	7.963	74.103	5706.1	6.636	4.363
Kazakhstan	2.750	66.396	5.550	20.975	1928.0	8.150	9.375
Latvia	3.475	54.593	3.688	59.850	4303.7	4.000	8.000
Lithuania	3.250	82.227	11.625	79.500	4032.4	1.238	6.100
Moldova	2.450	69.848	13.625	32.138	336.8	16.825	4.763
Poland	3.400	55.214	23.738	69.525	4750.3	4.050	3.700
Romania	2.813	67.253	31.225	56.875	2112.3	23.913	4.638
Serbia	1.913	54.602	47.475	32.738	2286.6	37.425	2.200
Slovakia	3.338	77.480	13.950	77.063	4104.2	7.063	4.013
Slovenia	3.300	64.288	24.613	17.925	10474.2	5.638	4.000
Ukraine	2.325	49.770	10.538	15.813	912.0	12.563	6.450
Average	2.996	63.664	17.703	50.469	3387.8	9.912	6.430

Note
The variables displayed on the table are as follows. ebrd: the EBRD index of banking sector reform; conc3: the 3-bank concentration ratio obtained from the World Bank; state: share of majority state-owned banks' assets in total banking sector assets (obtained from EBRD); foreign: share of total banking sector assets in banks with foreign ownership exceeding 50 per cent (obtained from EBRD); gdpcap: GDP per capita in US dollars (obtained from EBRD); inf: the inflation rate (obtained from EBRD); gdpgr: annual GDP growth (obtained from EBRD).

Table 2a
Evolution of bank-level variables over the period 1999-2006

Year	rtr	roa	w1	w2	w3	ea	la
1	47027.6	0.015	0.084	1.475	0.025	0.187	0.429
2	45790.2	0.015	0.079	2.306	0.024	0.186	0.436
3	41493.8	0.011	0.074	2.336	0.022	0.183	0.442
4	41270.9	0.010	0.053	2.064	0.022	0.192	0.483
5	43909.5	0.013	0.048	1.864	0.021	0.181	0.513
6	52569.4	0.015	0.054	1.843	0.022	0.172	0.515
7	55941.1	0.017	0.053	1.866	0.020	0.155	0.543
8	67968.6	0.018	0.052	1.872	0.018	0.141	0.558
Average	49504.9	0.014	0.123	2.183	0.021	0.167	0.491

Table 2b
Number of banks, observations and averages of the bank-level variables by country

Country	No of banks	No of observations	rtr	roa	w1	w2	w3	ea
Albania	11	57	12642.4	0.016	0.030	1.048	0.011	0.126
Armenia	15	71	3260.6	0.018	0.050	1.304	0.032	0.217
Azerbaijan	21	102	4795.6	0.022	0.081	1.098	0.025	0.270
Belarus	17	92	1195.8	0.024	0.120	1.224	0.040	0.222
Bosnia	28	138	13165.3	0.005	0.025	1.216	0.024	0.208
Bulgaria	26	181	824.8	0.013	0.044	1.605	0.016	0.172
Croatia	38	235	45577.8	0.013	0.043	1.007	0.018	0.158
Czech Republic	24	169	167943.5	0.008	0.109	2.896	0.010	0.103
Estonia	10	55	72537.3	0.011	0.029	4.150	0.018	0.173
FYROM	15	84	12838.8	0.011	0.036	0.964	0.022	0.303
Georgia	11	66	5431.5	0.036	0.060	0.795	0.031	0.256
Hungary	30	180	102191.4	0.015	0.070	4.101	0.018	0.123
Kazakhstan	24	140	24168.7	0.026	0.190	1.437	0.022	0.205
Latvia	24	168	20547.0	0.012	0.023	1.441	0.017	0.123
Lithuania	9	68	35020.6	0.005	0.028	0.756	0.021	0.128
Moldova	16	92	2516.3	0.039	0.059	0.764	0.032	0.260
Poland	53	289	134323.2	0.012	0.067	4.419	0.019	0.145
Romania	27	180	7609.9	0.006	0.090	1.328	0.033	0.180
Serbia	36	181	17357.3	0.003	0.029	2.111	0.034	0.267
Slovakia	16	112	82663.3	0.007	0.046	9.302	0.011	0.096
Slovenia	21	129	87437.3	0.012	1.218	0.871	0.014	0.108
Ukraine	57	298	10899.8	0.018	0.078	1.157	0.024	0.166
Average	529	3087	49504.9	0.014	0.123	2.183	0.021	0.167

Note
The variables displayed on the table are as follows. rtr: total revenue of banks in real terms; roa: return on assets (total profits before tax/total assets); w1: price of funds (interest expenses/total deposits); w2: price of physical capital [(overheads-personnel expenses)/fixed assets]; w3: price of labor (personnel expenses/total assets); ea: capital ratio (equity/total assets). All bank-level variables are obtained from BankScope.

Table 3
Input price coefficients and H-statistics for CEE banking systems

Country	lnw1	lnw2	lnw3	lnea	H
Albania	0.640 [a]	0.027	-0.336 [b]	-1.649 [a]	0.331
Armenia	-0.174 [b]	0.309 [b]	0.245 [b]	-0.316 [b]	0.379
Azerbaijan	0.126	0.293 [b]	0.171 [b]	-0.903 [a]	0.591
Belarus	0.356 [b]	0.263 [b]	-0.176 [b]	-0.571 [a]	0.443
Bosnia	0.789 [a]	-0.099	-0.802 [a]	-0.785 [a]	-0.112*
Bulgaria	0.314 [b]	0.114	-0.364 [b]	-0.298 [b]	0.064**
Croatia	0.246 [b]	0.096	-0.409 [a]	-0.137 [b]	-0.067**
Czech Republic	0.401 [b]	0.085	-0.128	-0.166 [b]	0.357
Estonia	0.109	-0.279 [b]	-0.372 [b]	-0.070	-0.542*
FYROM	-0.465 [b]	0.238 [b]	0.060	-0.881 [a]	-0.166*
Georgia	0.438 [b]	0.030	-0.059	-0.340 [b]	0.410
Hungary	0.321 [b]	0.056	-0.432 [b]	-0.186 [b]	-0.055**
Kazakhstan	0.198 [b]	-0.028	-0.775 [a]	-0.083	-0.604*
Latvia	0.407 [b]	0.198 [b]	0.043	0.317 [b]	0.647
Lithuania	0.283 [b]	0.172 [b]	-0.524 [a]	-0.218	-0.069**
Moldova	0.269 [b]	0.052	0.185 [b]	-0.451 [a]	0.505
Poland	0.406 [b]	0.190 [b]	0.255 [b]	-0.373 [b]	0.851
Romania	0.664 [a]	0.073	-0.491 [a]	-0.538 [a]	0.246
Serbia	0.738 [a]	0.241 [b]	-0.317 [b]	-0.236 [b]	0.743
Slovakia	0.210 [b]	0.363 [b]	-0.158	1.537 [a]	0.415
Slovenia	0.014	0.199 [b]	-0.205 [b]	-0.502 [a]	0.008**
Ukraine	0.397 [b]	-0.068	-0.263 [b]	-0.382 [b]	0.066**

Note
The table displays the estimated coefficients of the input prices (lnw1, lnw2, lnw3) and the H-statistic (H) for each country in the sample using the Panzar and Rosse (1987) method. * denotes that H is statistically less than zero (at the 5 per cent level); ** denote that the H=0 hypothesis is not rejected at the 5 per cent level. Also, [a] and [b] denote that the input prices are statistically significant at the 1 per cent and at the 5 per cent level, respectively.

Table 4
Correlations between structural and macroeconomic variables

	ebrd	conc3	state	foreign	gdpcap	inf
ebrd	1.000					
conc3	-0.075	1.000				
state	-0.567	0.198	1.000			
foreign	0.717	-0.015	-0.530	1.000		
gdpcap	0.699	0.024	-0.167	0.387	1.000	
inf	-0.491	0.080	0.421	-0.319	-0.192	1.000

Note
The variables displayed on the table are as follows. ebrd: the EBRD index of banking sector reform; conc3: the 3-bank concentration ratio obtained from the World Bank; state: share of majority state-owned banks' assets in total banking sector assets (obtained from EBRD); foreign: share of total banking sector assets in banks with foreign ownership exceeding 50 per cent (obtained from EBRD); gdpcap: GDP per capita in US dollars (obtained from the EBRD); inf: the inflation rate (obtained from the EBRD).

Table 5
Estimation results from the full sample (dependent variable: lnrtr)

	I		II		III		IV		V	
lnrtr	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
lnw1	0.304	15.44	0.282	14.04	0.282	13.98	0.278	15.17	0.276	15.04
lnw2	0.085	4.64	0.085	4.58	0.090	4.83	0.056	3.31	0.060	3.52
lnw3	-0.205	-5.78	-0.251	-6.94	-0.262	-7.23	-0.129	-3.90	-0.138	-4.14
lnea	-0.367	-12.45	-0.376	-12.48	-0.376	-12.43	-0.361	-13.20	-0.361	-13.15
ebrd	0.752	16.68								
conc3			0.004	3.42	0.003	2.88	0.000	0.26	0.000	-0.08
state			-0.007	-7.40			-0.005	-5.36		
foreign					0.005	6.44			0.002	3.54
gdpcap							0.000	23.07	0.000	22.99
inf							0.009	12.01	0.009	11.90
constant	6.010	33.17	7.900	46.28	7.534	44.50	7.058	44.98	6.831	44.23
H	0.183		0.116		0.110		0.205		0.199	
H=0	18.710	0.000	7.360	0.007	6.590	0.100	27.160	0.000	25.470	0.000
H=1	370.930	0.000	424.960	0.000	427.050	0.000	408.760	0.000	413.380	0.000

Note
The table presents coefficients and t-statistics of regressions on the whole sample (3087 observations). The variables displayed on the table are as follows. rtr: total revenue of banks in real terms; w1: price of funds (interest expenses/total deposits); w2: price of physical capital [(overheads-personnel expenses)/fixed assets]; w3: price of labor (personnel expenses/total assets); ea: capital ratio (equity/total assets). ebrd: the EBRD index of banking sector reform; conc3: the 3-bank concentration ratio obtained from the World Bank; state: share of majority state-owned banks' assets in total banking sector assets (obtained from EBRD); foreign: share of total banking sector assets in banks with foreign ownership exceeding 50 per cent (obtained from EBRD); gdpcap: GDP per capita in US dollars (obtained from the EBRD); inf: the inflation rate (obtained from the EBRD). All bank-level variables are in logarithms and are obtained from BankScope. H represents the H-statistic of the equation (i.e. lnw1+lnw2+lnw3), H=0 and H=1 represent the *x*-squared values of the respective null hypotheses (along with their p-values).

Table 6
Sensitivity analysis

Country	H1	H2	H3	H4
Albania	0.305	0.311	0.240	0.197
Armenia	0.366	0.358	0.370	0.302
Azerbaijan	0.515	0.523	0.508	0.405
Belarus	0.467	0.408	0.414	0.278
Bosnia	-0.110*	-0.089*	-0.091*	-0.107*
Bulgaria	0.114	0.123	0.070**	-0.296*
Croatia	-0.009**	-0.108*	-0.111*	-0.288*
Czech Republic	0.323	0.348	0.360	0.301
Estonia	-0.587*	-0.508*	-0.515*	-0.509*
FYROM	-0.168*	-0.089*	-0.104*	-0.113*
Georgia	0.479	0.471	0.448	0.459
Hungary	-0.007**	0.010**	0.013**	-0.006**
Kazakhstan	-0.588*	-0.507*	-0.540*	-0.780*
Latvia	0.629	0.653	0.622	0.601
Lithuania	0.043**	0.057**	0.002**	-0.106*
Moldova	0.554	0.508	0.516	0.563
Poland	0.808	0.789	0.705	0.780
Romania	0.304	0.209	0.286	0.305
Slovakia	0.453	0.417	0.422	0.421
Slovenia	0.003**	-0.010**	-0.031**	0.017**
Ukraine	0.006**	-0.104*	-0.071**	-0.129*

Note
The table presents H-statistics derived from alternative specifications. H1 is obtained from the estimation of Eq. (1) using real interest revenue as the dependent variable. H2 is obtained from the same equation with total revenue over assets as the dependent variable. H3 corresponds to the estimation of Eq. (1) when including the ratio of loan loss provisions to loans and the ratio of loans to assets as additional bank-specific control variables. H4 is obtained from the estimation of Eq. (1) using the dynamic panel data method. * denotes that the H-statistic is statistically less than zero (at the 5 per cent level of significance); ** denote that the H=0 hypothesis is not rejected at the 5 per cent level.