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ASSESSING COMPETITION WITH THE PANZAR-ROSSE MODEL: An empirical analysis of European Union banking industry

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DISSERTATION: Assessing Competition With the Panzar-Rosse Model: An empirical analysis of European Union banking industry

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Abstract

The purpose of the present article is to assess the degree of competition within the enlarged European Union (EU) commercial banking system during the period ranging from 2004 to 2011 using the non-structural test developed by Panzar and Rosse (1987). Their procedure measures the competitive environment in which financial intermediaries operate employing the sum of the elasticities of the reduced-form interest revenue with respect to factor prices.

The main conclusion to retain from this study is that banking industry in the region does not seem to have operated either under perfect competition or under perfect monopoly, but rather consistently with long-run monopolistic competition. Further, we also find empirical evidence of efficiency hypothesis posted by Demestz (1973) and Peltzman (1977), as opposed to conventional view that concentration impairs price competitiveness. Finally, we underline the importance of trade off between the costs and benefits of competition to support financial stability objectives.

JEL Classification: G21, G28

Keywords: Competition, Concentration, Banking industry, Panzar and Rosse Model.

CONTENT

1 Introduction

Banks play a prominent role in the allocation of economic resources. Furthermore, they exert a fundamental influence on asset transformation, payment system, transmission of monetary policy, maintenance of financial stability, and thereby are a key determinant to economic growth and development. The vital role of banks in the economy makes the issue of banking competition largely important. In this context, the evaluation of the competitive environment in which financial intermediaries operate appears to be broadly justified.

The present article seeks to assess competitive conditions in the new enlarged EU commercial banking landscape over the period 2004-2011. Therefore, this paper augments previous studies by using contemporaneous banking data from 2000s.

In the empirical part, we focus on the non-structural model stated originally in Panzar and Rosse (1987). This approach estimates a reduced-form equation relating banking revenues to a vector of input prices and other control variables. The associated measure of competition, the so-called H-statistic, is obtained as the sum of elasticities of income with respect to unit prices of input.

The database employed in this paper is the bank-level information contained in balance sheets as well as income statements reported by relevant commercial banks to the BankScope over the period beginning in 2004 and ending in 2011.

The main conclusion to retain from this study is that banking industry in the region does not seem to have operated either under perfect competition or under perfect monopoly, but rather consistently with long-run monopolistic competition. Generally speaking, our finding is in keeping with comparable studies in the literature, which also point to monopolistic competition in EU countries. Second, we also find empirical evidence of efficiency hypothesis (EH) posted by Demestz (1973) and Peltzman (1977), as opposed to conventional view that increase in concentration should be linked to a decrease in competition. Last, but no least, we underline the importance of role played by banking regulators and supervisors to reach a desirable degree of competition in bank system.

The remainder of this paper is structured as follows. Section 2 provides a brief literature review on the subject, whereas Section 3 presents the methodology and data employed. Afterwards, estimations results are reported in Section 4. Finally, Section 5 offers some concluding remarks.

2 Literature Review

Theory suggests that banking competition can be inferred directly from the markup of prices over marginal costs (Lerner, 1934). In practice, however, this measure is often hard or even impossible to implement due to a lack of detailed information on the cost and prices of bank products.

The literature has proposed various indirect techniques to assess the competitive environment in which financial intermediaries operate. These methods can be divided into two main streams: structural and non-structural approaches.

Structural measures may, in turn, be divided into two major schools of thought: the formal and non-formal frameworks. The structure-conduct-performance (SCP) paradigm and the EH are the two most common non-formal structural approaches. The former hypothesis, originally due to Bain (1951), predicts that more concentrated markets are more collusive, while the latter, which stems from Demsetz (1973) and Peltzman (1977), supposes that the overall concentration level faced by banks depends positively on the degree of market competition.

Although lacking formal back up in micro-economic theory, they have frequently been applied to the banking industry and provide policy makers measures of market structure and performance, as well as their interrelationship. For example, Bikker and Groeneveld (1998) present empirical evidence of concentration impact on competitive structure in the EU as a whole as well as in individual EU countries during the period 1989-1996. Their results support the widespread view that concentration impairs competitiveness. A few years later, Bikker and Haaf (2002a) also provide support for the SCP paradigm employing a panel data of 23 industrialized countries inside and outside Europe over approximately 10 years. In the same vein, Corvoisier (2002) extend the analysis to banking sector of euro area countries during the period ranging from 1993 to 1999. This paper suggests that the ongoing process of banking consolidation in the euro area countries may substantially reduce competition, especially in segments where geographic proximity or informational asymmetries are important (loans, demand deposit) while efficiency structure has substantially increased in others (savings and time deposits). More recently, Rozas (2007) also find evidence for EH focused on a sample of Spanish commercial and savings banks.

In reaction to the theoretical and empirical shortcomings attributed to the structural stream, three non-structural models of banking competitive behavior have been developed within the emerging New Empirical Industrial Organization framework. This new category comprises the models developed by Iwata, Bresnahan and Panzar-Rosse (hereinafter PR).

The latter approach estimates a reduced-form equation relating banking revenues to a vector of input prices and other control variables. The associated measure of competition, the so-called H-statistic, is obtained as the sum of elasticities of income with respect to unit costs of input. Given an estimate of the H, different situations may arise. If H is negative the bank is neoclassical monopolist or collusive oligopolistic, between 0 and 1 is a monopolistic competitor and equal to unity is a competitive price-taking bank in long-run competitive equilibrium. This way, the approach heavily relies 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.

This technique has been much more widely used in empirical bank studies mainly due to its simplicity and transparency, without lacking efficiency. Moreover, data availability becomes much less of a constraint, since revenues are more likely to be observable than output prices necessary in other models. Finally, 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.

In this context, we provide a review of the studies that have applied the PR methodology in the banking industry, both in regional and single-country level.

The first category (multi-country approach) includes works presented by Bikker and Groeneveld (1998), Bikker and Haaf (2000a, b), Mamatzakis, Staikouras and Koutsomanoli-Fillipaki (2005), Al-Muharrami, Matthews and Khabari (2006), Bikker, Shaffer and Spierdijk (2009), Kasman (2010) and Delis (2010). Particularly, Bikker and Haaf (2002a) assess competitive conditions in the banking markets of as many as 23 industrialized countries inside and outside Europe over approximately 10 years. Their estimated PR model provides strong evidence that the banking markets in the industrial world are characterized by monopolistic competition, but perfect competition cannot be ruled out in some cases. Staikouras and Koutsomanoli-Fillipaki (2005) test a sample of banks from Albania, Bosnia, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Romania as well as Serbia for the period 1998-2002. Their empirical study also suggests that banks in the South Eastern European region earn interest and total revenue under condition of monopolistic. Bikker and Haaf (2000b), Bikker and Groeneveld (1998), Al-Muharrami, Matthews and Khabari (2006), Kasman (2010) as well as Delis (2010) document the same empirical results. Indeed, this conclusion is most plausible for characterizing the interaction between banks, as it recognizes the existence of product differentiation and is consistent with the observation that banks tend to differ with respect to product quality variables and advertising, although their core business is fairly homogeneous. For example, Bikker and Haaf (2000b) find that monopolistic competition is the prevailing outcome in the studies applying the PR method to European countries.

The second category of studies includes the investigation of competitive conditions in individual countries (Yuan, 2006; Deltuvaite, Vaskelaitis and Pranckeviciute, 2007; Gischer and Stiele, 2008; Boucinha and Ribeiro, 2009; Daley and Matthews, 2011; Shin and Kim, 2013). For example, Yuan (2006) presents an empirical assessment of the competitiveness of the Chinese banking industry during the period ranging from 1996 to 2000 and observes high competition even before its accession to the World Trade Organization. Gischer and Stiele (2008) examine the German banking system (more than 400 savings banks) over the period 1993-2002. The empirical results indicate that banks revenues appear to be earned in conditions of monopolistic competition. Furthermore, they find that small banks seem to enjoy even more market power than larger institutions. These results are supported by a study by Boucinha and Ribeiro (2009) as well as Mlambo and Ncube (2011) for the Portuguese and the South African banking groups, respectively. Daley and Matthews (2011) as well as Shin and Kim (2013) also find evidence of monopolistic competition. However, according the last study, monopolistic competition in the Korean banking industry exists but the degree of competition has improved after bank restructuring and consolidation conducted by Korean government during Asian Financial Crisis of 1997-1998. Therefore, even with increased concentration through bank consolidation and a reduction in the number of banks, competition is found to be higher, as banks are maximizing their interest revenues.

Finally, a growing body of the banking competition literature has focused on emerging economies. Among these studies, Yildrim and Philippatos (2007) analyze the evolution of competitive conditions in the banking industries of 14 Central and Eastern European countries for the period 1993-2000. The empirical results suggest that the banking markets of these countries cannot be characterized by the bipolar cases of either perfect competition or monopoly except for Former Yugoslav Republic of Macedonia and the Slovak Republic. Similar findings are reported by Gelos and Roldos (2004) as well as Suleyman sah University (2012). Finally, Mamatzakis et al. (2005) measure the degree of competition in the banking sector of the South Eastern European region over the period ranging from 1998 to 2002, and reach the conclusion that banks also earn their interest and total revenue under conditions of monopolistic competition.

3 Methodology and Data

Panzar and Rosse (1987) developed an indicator to discriminate between oligopolistic, monopolistically competitive and perfectly competitive markets on the basis of the comparative static properties of reduced-form revenue equations. This indicator measures the extent to which a change in factor input prices is reflected in the equilibrium revenues earned by banks. Under certain restrictive assumptions, it can be interpreted as a measure of the overall level of competition prevailing in a particular landscape. In other words, this methodology relies heavily on the premise that banks will employ different pricing strategies in response to changes in factor input prices depending on the competitive behavior of market participants.

Following Bikker and Haaf (2002a), let´s consider the log-linear marginal cost (MC) function of representative bank i during year t (dropping subscripts referring to bank i over year t):

$$\log \mathrm{MC} = \epsilon_0 + \epsilon_1 \log \mathrm{OUT} + \sum_{\mathrm{i}=1}^{\mathrm{m}} \omega_{\mathrm{i}} \log \mathrm{FIP_i} + \sum_{\mathrm{j}=1}^{\mathrm{p}} \rho_j \log \mathrm{EX_{COST_j}} \qquad (1)$$

where OUT is output of the bank, FIP are the factor input prices and $\mathrm{EX_{COST}}$ are other exogenous variables to the cost function. Equally, the underlying marginal revenue (MR) function has been assumed to be log-linear of the form:

$$\log \mathrm{MR} = \delta_0 + \delta_1 \log \mathrm{OUT} + \sum_{\mathrm{k}=1}^{\mathrm{q}} \sigma_{\mathrm{k}} \log \mathrm{EX_{REV_k}} \qquad (2)$$

where $\mathrm{EX_{REV}}$ are variables related to the bank-specific demand function.

For a profit-maximizing bank, marginal costs equal marginal revenues in equilibrium, yielding the following equilibrium value for output (denoted by an asterisk):

$$\log \mathrm{OUT}^* = \frac{\epsilon_0 - \delta_0 + \sum_{\mathrm{i}=1}^{\mathrm{m}} \omega_{\mathrm{i}} \log \mathrm{FIP_i} + \sum_{\mathrm{j}=1}^{\mathrm{p}} \rho_{\mathrm{j}} \log \mathrm{EX_{COST_j}} - \sum_{\mathrm{k}=1}^{\mathrm{q}} \sigma_{\mathrm{k}} \log \mathrm{EX_{REV_k}}}{\delta_1 - \epsilon_1} \qquad (3)$$

The reduced-form equation for revenues of the representative bank i during year t is the product of the output equilibrium value and the common price level (p), provided by the inverse-demand equation,

$$\log \mathrm{p} = \varepsilon + \tau \log(\textstyle\sum_{\mathrm{i}} \mathrm{OUT^*_i}).$$

In empirical analysis, the following operationalization of the reduced-form revenue equation is used:

$$\log \mathrm{IR} = \alpha_0 + \alpha_1 \log \mathrm{AFR} + \alpha_2 \log \mathrm{PCE} + \alpha_3 \log \mathrm{PPE} + \sum_{j=1}^{r} \beta_j \log \mathrm{BSF_j} + \varepsilon \qquad (4)$$

The dependent variable, IR, is the ratio of total interest revenue to the total balance sheet. The decision to consider only the interest income is consistent with the underlying notion in the PR model that financial intermediation is core business of most banks.

AFR (Average Funding Rate), PCE (Price of Capital Expenditure) and PPE (Price of Personnel Expenses) are the unit prices of the considered banking inputs: funds, labour and capital. The three costs are generated by

dividing interest expenses by total deposits, depreciation and other capital expenses to fixed assets and personnel expenses by total assets, respectively.

Input prices are followed by a set of bank-specific factors which, basically, are intended to catch differences in risk, business mix and size. Specifically, these control variables include: L (Loans to Total Assets), NPL (Non-performing Loans to Total Assets), DB (Deposits from Banks to Deposits and Short-term Funding), DDC (Demand Deposits from Customers to Deposits and Short-term Funding) and OI (Other Income to Total Assets). Finally, ε is the disturbance term. A positive parameter for L is expected, because more loans reflect more potential interest income. The coefficient for OI is probably negative as the generation of other income may be at the expense of interest revenue. Regarding the signs of the coefficients of the other explanatory variables, there are no strong a priori expectations.

Table VI contains the correlation matrix of aforementioned set of variables involved in the empirical analysis. As expected, the dependent variable exhibits a positive association with the total loans scaled by total assets. Further, the correlation between the interest revenue and non-interest income is negative. Noticeably, low values are reported for other bank-specific variables in the first column (IR). These figures suggest the finding of insignificant coefficients in the next step of the analysis, which is devoted to the estimation of the econometric model presented in equation (4).

As discussed above, the H-statistic is given by the following expression:

$$H = \sum_{i=1}^{3} \alpha_i \qquad (5)$$

This indicator determines the banking competitive behavior evaluating the elasticities of the reduced-form revenues with respect to changes in unit prices of factor.

The estimated value of the H-statistic ranges from minus infinity to unity. A negative H arises when the competitive structure is a monopoly or a perfect colluding oligopoly. In both cases, an increase in input prices will translate into higher marginal costs, a reduction of equilibrium output and, subsequently, a fall in total revenues. Under perfect competition, the H-statistic equals to unity. In this particular situation, an increase in input prices rise both marginal and average costs without distorting the optimal output of any individual banks. Exit from the market will evenly increase the demand faced by each of the remaining banks, thereby leading to an increase in prices and total revenue by same amount as the rise in costs. Finally, if the H is between zero and unit, the market structure is characterized by monopolistic competition. In this case, 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.

Since PR is a static approach, a critical feature of H is that the test must be undertaken on observations that are in long-run equilibrium. An equilibrium test relies on the premise that in competitive capital markets, risk-adjusted rates of return will be equalized across banks. In such a case, the rates of return will not be correlated with input prices. In practice, an equilibrium test is provided by PR model, after replacement of the dependent variable by rate of return on total assets or equity. The resulting statistic is supposed to be significantly equal to zero in equilibrium and significantly negative in opposite case. In addition, the model also assumes a price elasticity of demand greater than unity and a homogeneous cost structure. Finally, the performance of banks needs to be influenced by the actions of the other market participants.

The simplicity and transparency of this methodology explains its popularity in the study of competition in banking markets. For instance, it does not require price and quantity data on the services provided by banks, an issue that can often be problematic in the estimation of empirical structural equations of banks´ behavior, either

because they are not available to researchers or due to the fluidity of these services in what concerns establishing a measure of their quantity. Another appealing property of this methodology is the fact that it allows for the inference of the interaction between inputs price shocks to the cost function and revenue function, without requiring the estimation of output demand or cost 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.

Last, but no least, the applicability of the PR model is much broader and not confirmed to banks only. For example, Panzar and Rosse (1987) assess the competitive climate in the newspaper industry.

The PR model has been applied to banks from 26 EU countries, as listed in Table I. Only Luxembourg has been excluded, since some of the relevant observations are lacking.

The database employed in this study is the information contained in balance sheets and income statements reported by EU commercial banks to the BankScope, a privately owned financial database maintained by Bureau van Dijk, over the period beginning 2004 and ending in 2011. We have restricted the analysis to commercial banks only to avoid comparing institutions with different products, clientele as well as objectives. Further, for each country, we have considered just information of two largest banks, ranked by assets, because of high concentration.

For each country, Table I also contains the number of commercial banks as well as share of the two largest commercial banks in total assets (CR2 %) during year 2011. CRn is the percentage market share of the n largest depositary institutions, ranked according to assets, in the sum of the assets of all banks in a particular observation date.

Remarkably, concentration degree prevailing in enlarged EU commercial banking system is extremely high during year 2011, namely in main economies (France, Germany, Italy, Spain and United Kingdom).

Table 1: Banking Indicators

Country	Number of commercial banks	CR_2
Austria	69	52,13%
Belgium	97	39,28%
Bulgaria	28	29,50%
Cyprus	24	58,51%
Czech Republic	34	42,41%
Denmark	68	68%
Estonia	12	86,06%
Finland	15	79,22%
France	257	36,34%
Germany	223	55,30%
Greece	28	43,89%
Hungary	42	41,31%
Ireland	28	42,55%
Italy	195	37,50%
Latvia	32	33,27%
Lithuania	16	53,75%
Malta	11	66,21%
Nethrland	60	52,15%
Poland	73	23,30%
Portugal	41	48,87%
Romania	24	58,51%
Slovakia	24	43,49%
Slovenia	29	45,79%
Spain	101	56,77%
Sweden	30	79,49%
United Kingdom	203	36,78%

Source: BankScope.

Note: This table lists the EU countries included in the sample. Only Luxembourg has been excluded, since some of the relevant observations are lacking. Further, it reports the number of commercial banks and share of the two largest commercial banks in total assets (CR_2 %) for each of the 26 EU countries for year 2011.

4 Empirical Results

The reduced-form revenue function (equation 4) stated in previous section is linear in its unknown parameters. This way, in order to exploit both the cross-sectional and the time-series dimensions of the panel dataset, we have employed the ordinary least squares (OLS) method.

Table II displays OLS regression results. The estimate of the elasticity of interest income with respect to each of the considered three inputs proves to be positive. Given the fact that funding is the main factor in the production function of banks, it is hardly surprising that its elasticity is the largest one, followed by the coefficient of labour. From Graph I, it is also observable that over the period comprised between 2004 and 2011 funding and labour coefficient appear to be the main contributors to H-statistic. Indeed, this result is common in the PR literature and implies that excess physical capital (probably including branches) does not generate abnormal revenue. Moreover, the unit costs of the all banks' inputs are statically significant at conventional confidence levels.

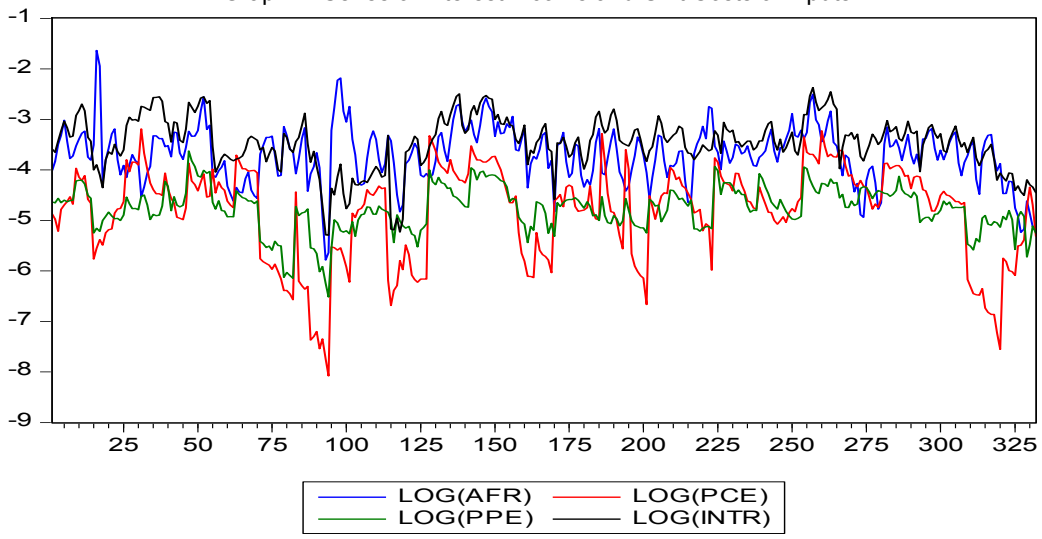
Estimation results also reveal that H differs significantly from both 0 and 1, providing evidence that a certain degree of monopolistic competition in the EU banking market is present. A priori, this conclusion is most plausible for characterizing the interaction between banks, as it recognizes the existence of product differentiation, on the one hand, and is consistent with the observation that core banking business is fairly homogeneous, for other.

Table 2: Determinants of Interest Revenue Ratio, 2004-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.365865	(0.251569)	1.454333	**0.1468**
LOG(AFR)	0.383959	(0.036114)	10.63197	**0.0000**
LOG(PCE)	0.147121	(0.034301)	4.289162	**0.0000**
LOG(PPE)	0.356232	(0.073685)	4.834491	**0.0000**
R-squared	0.535537			
F-statistic	126.4485			
Prob(F-statistic)	0.000000			

Note: The table reports the results arising from the estimation of the regression model: $\log \mathrm{IR} = \alpha_0 + \alpha_1 \log \mathrm{AFR} + \alpha_2 \log \mathrm{PCE} + \alpha_3 \log \mathrm{PPE} + \varepsilon$, where ε is the disturbance term and log is the natural logarithm. The dependent variable is the logarithm of interest revenue scaled by total assets. Variables AFR, PCE and PPE are the unit prices of three inputs: (AFR) the ratio of interest expenses to total deposits; (PCE) the ratio of depreciation and other capital expenses to fixed assets and (PPE) the ratio of personnel expenses to total assets. The H-statistic is equal to the sum of the elasticities of interest revenue with respect to three input prices: $\mathrm{H} = \alpha_1 + \alpha_2 + \alpha_3$. The model is estimated by running least square regression on a pooled sample of the 26 EU countries over the period beninging in 2004 and ending in 2011. P-values are presented in bold and standard errors in parenthesis.

Graph 1: Series of Interest Income and Unit Costs of Inputs



Note: Graph is showing the logarithmic series of banking revenues and inputs prices, such that IR: Ratio of Total Interest Revenue to the Total Balance Sheet; AFR: Average Funding Rate; PCE: Price of Capital Expenditure; PPE: Price of Personnel Expenses.

To test whether banks-specific factors are unduly omitted, the table III presents OLS regression results employing five additional explanatory variables. These control variables, which are intended to catch differences in risk, business mix and size, include: L (Loans to Total Assets), NPL (Non-performing Loans to Total Assets), DB (Deposits from Banks to Deposits and Short-term Funding), DDC (Demand Deposits from Customers to Deposits and Short-term Funding) and OI (Other Income to Total Assets). In general, they do not heavily affect the base-components of H-statistic. First, all costs remain statistically significant at conventional levels. Second, funding and labour coefficients appear to be the main contributors to H-statistic, as in the previous equation. Further, EU banks seem to have operated under monopolistic competition. Generally speaking, our findings are in keeping with comparable studies in the literature, which also point to monopolistic competition in EU countries. Particularly, Bikker and Haaf (2002a) provide strong evidence that the banking markets in 23 industrialized countries inside and outside Europe are characterized by monopolistically competitive practices over the period beginning in 1988 and ending in 1998.

From a theoretical perspective, however, there are still conflicting views on the optimal level of competitiveness. Increased competition in the banking markets will benefit investments and economic performance, while too much competition may also lead to moral hazard activities and increased risk exposure. Remarkably, this trade-off context enhances the role played by regulators as well as supervisors, inasmuch as certain prudential tools may turn out to provide a necessary buffer against adverse developments.

Regarding the coefficients of the remaining explanatory variables, the ratio of loans to total assets (L), reflecting risk, has a positive coefficient. The reported coefficient for this variable seems plausible because more loans reflect more potential interest income. As expected, the coefficient on the variable which controls for the ratio of other revenue to total assets yields a negative sign. Finally, the share of customer loans that have defaulted during each year does not have shown to be significant.

Table 3: Determinants of Interest Revenue Ratio, 2004-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.067602	(0.180621)	0.374275	**0.7084**
LOG(AFR)	0.383959	(0.036114)	10.63197	**0.0000**
LOG(PCE)	0.074160	(0.022889)	3.239998	**0.0013**
LOG(PPE)	0.294904	(0.049093)	6.006997	**0.0000**
LOG(L)	0.012819	(0.017049)	0.751885	**0.4527**
LOG(NPL)	-0.005302	(0.025604)	-0.207066	**0.8361**
LOG(DB)	0.779839	(0.044188)	17.64801	**0.0000**
LOG(DDC)	0.015598	(0.012877)	1.211321	**0.2267**
LOG(OI)	-0.030796	(0.004611)	-6.678873	**0.0000**
R-squared	0.818766			
F-statistic	181.8381			
Prob(F-statistic)	0.000000			

Note: The table reports the results arising from the estimation of the regression model: $\log \mathrm{IR} = \alpha_0 + \alpha_1 \log \mathrm{AFR} + \alpha_2 \log \mathrm{PCE} + \alpha_3 \log \mathrm{PPE} + \sum \beta_j \log \mathrm{BSF}_j + \varepsilon$, where ε is the disturbance term and log is the natural logarithm. The dependent variable is the logarithm of interest revenue scaled by total assets. Variables AFR, PCE and PPE are the unit prices of three inputs: (AFR) the ratio of interest expenses to total deposits; (PCE) the ratio of depreciation and other capital expenses to fixed assets and (PPE) the ratio of personnel expenses to total assets. Bank-specific factors included in the model are the ratio of loans to total assets (L); the ratio of non-performing loans to total assets (NPL); the ratio of deposits from banks to deposits and short-term funding (DB); the ratio of demand deposits from customers to deposit and short-term funding (DDC) and the ratio of other income to total assets. The H-statistic is equal to the sum of the elasticities of interest revenue with respect to three input prices: $H = \alpha_1 + \alpha_2 + \alpha_3$. The model is estimated by running least square regression on a pooled sample of the 26 EU countries over the period beginning in 2004 and ending in 2011. P-values are presented in bold and standard errors in parenthesis.

Before completing the analysis of the banking competition, one issue remains to be investigated. As elaborated in the literature, a critical feature of the H-statistic is that the test must be undertaken on observations that are in a long-run equilibrium. Using return on equity, we find that the hypothesis of equilibrium (H=0) cannot be rejected because the different inputs are few significant at conventional significance level, as indicated in TABLE IV. This justifies the applied methodology.

Table 4: Determinants of Return on Equity, 2004-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.433443	(0.268438)	-1.614687	**0.1074**
LOG(AFR)	-0.045011	(0.038314)	-1.174791	**0.2409**
LOG(PCE)	0.087738	(0.034067)	2.575409	**0.0105**
LOG(PPE)	0.272149	(0.073123)	3.721789	**0.0002**
LOG(L)	0.026200	(0.025540)	1.025845	**0.3057**
LOG(NPL)	0.064596	(0.038777)	1.665844	**0.0967**
LOG(DB)	0.491241	(0.065703)	7.476736	**0.0000**
LOG(DDC)	0.046515	(0.019200)	2.422631	**0.0160**
LOG(OI)	-0.032229	(0.006855)	-4.701261	**0.0000**
R-squared	0.515781			
F-statistic	42.74035			
Prob(F-statistic)	0.000000			

Note: The table reports the results arising from the estimation of the regression model: $\log \mathrm{RE} = \alpha_0 + \alpha_1 \log \mathrm{AFR} + \alpha_2 \log \mathrm{PCE} + \alpha_3 \log \mathrm{PPE} + \sum \beta_j \log \mathrm{BSF}_j + \varepsilon$, where ε is the disturbance term and log is the natural logarithm. The dependent variable is the logarithm of equity scaled by total assets. Variables AFR, PCE and PPE are the unit prices of three inputs: (AFR) the ratio of interest expenses to total deposits; (PCE) the ratio of depreciation and other capital expenses to fixed assets and (PPE) the ratio of personnel expenses to total assets. Bank-specific factors included in the model are the ratio of loans to total assets (L); the ratio of non-performing loans to total assets (NPL); the ratio of deposits from banks to deposits and short-term funding (DB); the ratio of demand deposits from customers to deposit and short-term funding (DDC) and the ratio of other income to total assets. The H-statistic is equal to the sum of the elasticities of interest revenue with respect to three input prices: $H = \alpha_1 + \alpha_2 + \alpha_3$. The model is estimated by running least square regression on a pooled sample of the 26 EU countries over the period beginning in 2004 and ending in 2011. P-values are presented in bold and standard errors in parenthesis.

According to the SCP paradigm (Bain, 1951), an increase in concentration should be linked to a decrease in competition. However, this result contradicts our empirical evidence regarding the behavior of the EU banking sector during the period under scrutiny. Indeed, our estimation outcome leads to conclude that there is apparent positive connection between competition and concentration. This result is grounded on EH due to Demestz (1973) and Peltzman (1977). According to this approach, if a bank achieves more efficiency than other banks in the market (i.e. its cost structure is comparatively more effective), its profit maximizing behavior will allow it to gain market share by reducing prices.

5 Conclusions

This article sought to assess competitive conditions in the new enlarged EU commercial banking environment during the period ranging from 2004 to 2011, using the widespread non-structural test developed by Panzar and Rosse (1987).

Firstly, our estimation outcomes lead to conclude that, during the period under scrutiny, EU banking sector seem to have earned their interest income under conditions of monopolistic competition.

From a theoretical perspective, this conclusion is most plausible for characterizing the interaction between banks, as it recognizes the existence of product differentiation and is consistent with the observation that core banking business is fairly homogeneous. Further, monopolistic competition is the prevailing outcome in the studies applying the PR method to EU countries.

According social welfare, however, there are still conflicting views on the desirable degree of competition. Increased competition in the banking markets will benefit investments and economic performance, while too much competition may also lead to lower market power and profitability of banks, weakening their ability to withstand adverse developments.

In this context, forthcoming research efforts ought to direct attention towards the common fundamentals underlying competition and market structure in banking industries. Particularly, building strong institutions and effective governance are elements for avoiding financial distress that may be caused by increased competition pressures.

Remarkably, trade off between the costs and benefits of competition enhances the role played by banking regulators and supervisors to support financial stability objectives. Thereby, issues such as banking supervision, corporate governance, accounting standards and auditing procedures need to be brought in line with best practice. This is particularly true to financial structure of European economies since are characterized more by bank financing than by direct financing in the market.

Last, but not least, our empirical study reports an apparent positive relation between competition and concentration. This result contradicts conventional view which holds that increasing concentration may lead to undesirable exercise of market power. Nevertheless, nowadays this empirical result is a plausible feature for EU banking system where waves of mergers and acquisitions have translated into containment of average production costs. Indeed, there has been a tremendous emphasis on the importance of improved efficiency in the banking sector, and thereby an increased competitive pressure.

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7 Appendix

Table 5: Correlation Matrix

	LOG(IR)	LOG(AFR)	LOG(PCE)	LOG(PPE)	LOG(L)	LOG(NPL)	LOG(DB)	LOG(DDC)	LOG(OI)
LOG(IR)	1								
LOG(AFR)	0,52	1							
LOG(PCE)	0,55	0,15	1						
LOG(PPE)	0,6	0,23	0,79	1					
LOG(L)	0,75	0,29	0,3	0,27	1				
LOG(NPL)	0,12	-0,08	0,33	0,31	0	1			
LOG(DB)	-0,23	0,04	-0,47	-0,44	-0,14	0,04	1		
LOG(DDC)	0,04	-0,28	0,19	0,24	-0,24	0,07	-0,29	1	
LOG(OI)	-0,47	-0,03	-0,22	-0,26	-0,39	-0,02	0,15	-0,13	1

Note: IR: Ratio of Total Interest Revenue to Total Assets; AFR: Average Funding Rate; PCE: Price of Capital Expenditure; PPE: Price of Personnel Expenses; L: Loans to Total Assets; NPL: Non-performing Loans to Total Assets; DB: Deposits from Banks to Deposits and Short-term Funding; DDC: Demand Deposits from Customers to Deposits and Short-term Funding; OI: Other Income to Total