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On the Relationship Between Competition and Efficiency in the EU Banking Sectors

By Laurent Weill, Strasbourg

I. Introduction

During the last decade, many efforts have been made to favor the implementation of a Single Banking Market in the European Union. The most notable measure was the Second Banking Directive, aiming to make the cross-border expansion of banks easier. These efforts were motivated by the will of increasing banking competition in the EU. Indeed, a higher degree of competition in banking markets is expected to provide welfare gains through the reduction of prices, as for every market of goods and services, but also through the impact of the reduction of loan rates favoring investment and therefore growth. These latter gains should in fact come from two channels of transmission. On the one hand, a higher degree of banking competition should result in a lower monopoly power for banks, and therefore a decrease of banking prices. On the other hand, a heightened competition should encourage banks to reduce their costs so that their cost efficiency, meaning their ability to produce with the minimal costs, would improve. This latter channel is particularly promising in terms of welfare gains, as the order of magnitude of cost inefficiencies in the EU banking sectors has been shown to average around 20 and 30 % (e. g. Allen and Rai (1996), Dietsch and Weill (2000), Altunbas et al. (2001)).

However, a striking feature of the empirical literature in banking is the lack of evidence with respect to the relationship between competition and efficiency. Apart from the commonly accepted view in favor of a positive relationship, theoretical literature provides some arguments on a negative link between competition and efficiency. The "efficient-structure" hypothesis, proposed by Demsetz (1973), suggests a negative relationship, as the most efficient banks benefit from lower costs and therefore higher market shares. Furthermore, the rare empirical studies on this issue in European banking find mixed results (Fecher and

Pestieau (1993), Lang (1996), Goldberg and Rai (1996), Punt and Van Rooij (2003)).

Our aim is to shed some light on the relationship between competition and efficiency in banking, by testing this link on the EU countries during the period 1994–1999. This issue is of utmost interest for banking integration in the EU, as this process has been motivated by the opinion that its benefits through the reduction of monopoly rents and the increase of cost efficiency would exceed its potential losses. Indeed, an increase in banking competition may weaken financial stability, as there is a financial interdependence between banks due notably to interbank deposits and loans. Furthermore, a heightened competition may incite banks to take excessive risks when granting loans, resulting in a higher probability of bankruptcy (e.g. Besanko and Thakor (1993)). It is therefore important to provide evidence regarding the efficiency gains expected from the increasing competition to check if benefits of banking competition really exceed costs.[1]

To do so, we assess competition and efficiency on a large sample of EU banks during the period 1994–1999. Banking efficiency is estimated with stochastic frontier approach, which is commonly applied to estimate a cost efficiency frontier (e.g. Allen and Rai (1996), Altunbas et al. (2001)). To measure competition, we use the non-structural test proposed by Rosse and Panzar (1977) and Panzar and Rosse (1987), which is commonly used to measure banking competition (De Bandt and Davis (2000), Bikker and Haaf (2002)). We consider this non-structural measure of competition as more relevant for our analysis than structural indicators such as concentration ratios, because it does take contestability into account.

The structure of the paper is as follows. Section II. provides a brief survey on former literature on the relationship between competition and efficiency. Section III. presents the methodologies developed for the tests of competition and the cost efficiency measures. Data and variables are described in section IV. Section V. outlines the empirical results. Finally, we provide some concluding remarks in section VI.

[1] See *Cetorelli* (2001) for a comprehensive survey of positive and negative effects of banking competition.

II. Background

This section presents the theoretical and empirical background of the relationship between competition and efficiency in banking. Relatively little theoretical literature has been done on the link between competition and efficiency. As observed by Caves (1980, p. 88), economists have "a vague suspicion that competition is the enemy of sloth".[2] This suspicion is nonetheless supported by a couple of arguments in the literature. First, Hicks (1935) considers that monopoly power allows to relax efforts. This "quiet life" assumption resorts to the idea that monopoly power allows managers to grab a share of the monopoly rents through discretionary expenses or a reduction of their effort. However, the existence of a monopoly rent does not explain its appropriation by managers. Indeed, there is no obvious reason why owners of monopolistic firms would exert a weaker control of managerial effort than those of competitive firms. Therefore, complementary theories have been suggested by Leibenstein (1966) and Demsetz (1973).

Leibenstein (1966) explains why inefficiencies inside firms (the "X-inefficiencies") exist, and why they are reduced by the degree of competition in product markets. X-inefficiencies would result from the existence of imperfections in the internal organization of firms: those imperfections have an impact on the level of information asymmetries between owners and managers. Indeed, the incompleteness of labor contracts makes the effort of managers at least partially discretionary. The discretionary share of the effort would not be the source of any problem if the owners would have means to control firm performance. But the production function is not wholly known. Therefore, owners can not check the level of effort exerted by managers. Leibenstein then considers that the main determinant of the reduction of inefficiencies is the increase of competitive pressures for two reasons.

First, competition provides incentives to managers to exert a higher effort. As they are aware of the increase of competition, managers have to improve their performance unless their firm leaves the market. Thus, managers are motivated by their will to avoid the personal costs of bankruptcy. Second, a higher number of firms on the market improves the possibilities for owners to assess firm performance, relative to other firms. They acquire in this way a better knowledge about the production

[2] For instance, *Adam Smith* (1776) vaguely argued that "monopoly ... is a great enemy to management."

function of the firm. Owners are then able to make a better assessment of managerial performance and consequently to proceed to changes in management if necessary. Being informed about the comparative possibilities of competition, managers are inclined to exert a higher effort. Following Leibenstein's works, a few studies have proposed a formalization of his ideas (Hart (1983), Selten (1986), Scharfstein (1988)). The X-efficiency theory from Leibenstein lies in fact within the scope of the "Structure – Conduct – Performance" paradigm proposed by Bain (1951). According to this paradigm, the market structure would influence firm behavior in terms of prices and quantities, and therefore firm profits.

An alternative assumption has however been proposed by Demsetz (1973), which predicts a reverse causality between competition and cost efficiency: the efficient-structure hypothesis. He considers that the best-managed firms have the lowest costs and consequently the largest market shares, which leads to a higher level of concentration. Thus, the causality of the relationship between competition and efficiency is reversed in comparison to the "Structure – Conduct – Performance" paradigm: efficiency determines competition. As concentration can be considered as an inverse measure of the competition, there should then exist a negative link between competition and efficiency. The efficient-structure hypothesis received some theoretical support with the influence of scale economies on efficiency of firms (Martin (1992), Bertoletti et Poletti (1996)). Indeed, the existence of scale economies on a market means that an increase of the number of competitors results in higher average costs for each incumbent firm. Consequently, competition would decrease cost efficiency.

This survey has until now only presented some theoretical references about the link between competition and efficiency, which are not specific to the banking industry. This generality matters, as banking markets have some specific characteristics in comparison to other markets. First of all, banking markets have a structure of imperfect competition, as observed in most studies on banking competition (e.g. Hannan (1991), Molyneux, Lloyd-Williams and Thornton (1994), De Bandt and Davis (2000), Bikker and Haaf (2002)). In fact, theoretical literature in banking suggests that imperfect competition may result from the information asymmetries between the lender and the borrower in the credit activity. As a consequence, banks have to implement some mechanisms to solve the resulting problems such as adverse selection and moral hazard.[3] One is the implementation by the bank of a customer relationship, meaning a

long-term repeated relationship, to gain some information on the borrower. Banks can then reduce the problems related to information asymmetries. In summary, banks are inclined to implement customer relationships, which are repeated and based on the proximity to have more information. This element leads to some characteristics of the banking markets, such as their local nature as banks need an information based on the proximity with customers. Furthermore, banking activities require sunk costs, as banking markets have high barriers to exit. These barriers come from the need to implement a customer relationship through a network of branches, but also from the fact that a loan portfolio is a rather illiquid asset as the potential buyers are not able to know its real value. Sunk costs have been observed to lead to excess capacities on EU banking markets (Davis and Salo (1998)). Therefore, these overcapacities of banking markets are endogenous barriers to the entry of new competitors.

These specific characteristics of the banking industry may consequently modify the relationship between competition and efficiency in banking. Diamond (1984) has shown that banks have a comparative advantage in the ex post monitoring of borrowers, in comparison to investors, because of the existence of scale economies resulting from their role of delegated monitor. These scale economies mean then that an increase in competition may decrease cost efficiency. Furthermore, an increase in banking competition may reduce the length of customer relationship. But this relationship allows to reduce monitoring costs resulting from information asymmetries in the loan activity. As a consequence, competition may increase monitoring costs because of the existence of scale economies, and of the reduction of the length of the customer relationship. In other words, the specificities of the banking industry provide some additional arguments in favor of a negative relationship between competition and cost efficiency.

We now turn to the empirical studies on the relationship between competition and efficiency in banking. Only a few works have been performed on this issue, most of them regressing cost efficiency on a set of variables for market structure: Berger (1995) and Berger and Hannan (1997) on US banks, Lang (1996) on German banks, Goldberg and Rai (1996) and Punt and Van Rooij (2003) on European banks. In these works, cost efficiency is generally measured with stochastic frontier ap-

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[3] See *Freixas* and *Rochet* (1997) for further details on the role of information asymmetries on banking activities.

proach, while market structure is taken through market share or concentration indices into account. These papers tend to support a positive relationship between cost efficiency and concentration/market share. Therefore, they are rather in favor of the "efficient-structure" hypothesis. However, Fecher and Pestieau (1993) analyze the correlation between technical efficiency and concentration in the financial sector in 11 OECD countries, and conclude in favor of a negative correlation.

In summary, theoretical literature provides conflicting arguments with respect to the relationship between competition and efficiency, while empirical literature is scarce on this issue in the EU banking sectors. It seems therefore relevant to provide new empirical evidence with respect to the relationship between competition and efficiency in EU banking sectors. Furthermore, no study on this relationship has to our knowledge used the Rosse-Panzar model to measure competition, while it is commonly applied in works assessing banking competition. We then bring new empirical elements where competition and efficiency are measured using some of the most commonly accepted tools in banking literature.

III. Methodology

Before investigating the relationship between competition and efficiency in banking, one must be able to measure these characteristics. In this section, we therefore explain how we estimate competition and efficiency. We finally present our regression model to provide evidence on the link between competition and efficiency.

1. Measurement of Competition

We aim to measure banking competition by computing the so-called Rosse-Panzar model (Rosse and Panzar (1977), Panzar and Rosse (1987)). This model has been widely applied in banking (e. g. Molyneux, Lloyd-Williams and Thornton (1994), De Bandt and Davis (2000), Bikker and Groeneveld (2000), Bikker and Haaf (2002), for applications on European countries). It is a non-structural test, as it assesses the competitive behavior of banks without using information on the structure of the banking market. Furthermore, it does not request information on output prices, which partly explains its numerous applications in banking, as output prices are hard to collect in this industry.

The major advantage of such a test in comparison to structural measures of competition such as the concentration ratio C5 or the Herfindahl

index is that it takes into account the actual behavior of the bank by including contestability. Indeed, as observed by Claessens and Laeven (2003), the actual behavior of a bank is not only related to market structure but also to the barriers to entry influencing the likelihood of the entry of new competitors and therefore the behavior of incumbents forecasting such an entry.

This non-structural test is based upon the estimation of the H-statistic, which aggregates the elasticities of total revenues to the input prices. The H-statistic determines the nature of market structure: it is equal to 0 in monopoly, between 0 and 1 in monopolistic competition, and 1 in perfect competition. Former studies using this test of competition generally conclude to monopolistic competition in EU banking markets. Molyneux, Lloyd-Williams and Thornton (1994) conclude in this sense during the period 1986–1989 with the exception of Italy where monopoly is observed. Analyzing the period 1992–1996, De Bandt and Davis (2000) find monopolistic competition for Italian banks, but also for large French and German banks, whereas their conclusion is in favor of monopoly for small French and German banks. Bikker and Groeneveld (2000), and Bikker and Haaf (2002) observe monopolistic competition in all EU countries during the period 1988–1998.

Our aim is to have a measure of banking competition for each year and each country so that we can have enough couples of observations (country, year) to test the relationship between competition and efficiency. Therefore, we need to separately run the Rosse-Panzar model for each country and each year to obtain estimates of input prices which are specific to each country and each year.

The problem of this approach is that some national samples are very small, meaning that the estimations of the Rosse-Panzar model are very poor on a statistical basis. Therefore, we need to perform this test on our whole sample for each year. However, we need to have country-specific estimates of the coefficients of input prices to analyze banking competition for each country and not for the EU as a whole, In this aim, we include interactive terms for each input price, jointing the variable with a dummy variable for each country. Consequently, we estimate the following equation for the measurement of Rosse-Panzar statistic:

$$\begin{aligned} \ln REV = {} & \alpha_0 + \alpha_1 \ln ASSETS + \alpha_2 \ln EQASS \\ & + \sum_{k=1}^{z} (\beta_k * (\ln w_1) * COUNTRY_k + \gamma_k * (\ln w_2) * COUNTRY_k \\ & + \delta_k * (\ln w_3) * COUNTRY_k) \end{aligned} \tag{1}$$

where *REV* total revenues, w_1, w_2 and w_3 prices of labor, financial capital and physical capital respectively, *ASSETS* total assets, *EQASS* the ratio of equity to total assets, k country, $COUNTRY_k$ dummy variable for the country k ($COUNTRY_1 = 1$ if country is Austria, 0 else; $COUNTRY_2 = 1$ if country is Belgium, 0 else, ...). The variables *ASSETS* and *EQASS* take differences in size and risk into account respectively, as in Molyneux, Lloyd-Williams and Thornton (1994), Bikker and Haaf (2002). Indices for each bank have been dropped in the presentation for simplicity.

The estimation results of the Rosse-Panzar model for each year are reported in tables A.1 and A.2 in the Appendix.

2. *Measurement of Efficiency*

Cost efficiency is estimated with stochastic frontier approach, following the numerous applications of this technique in the literature (e.g. Allen and Rai, 1996, Dietsch and Weill, 2000, Altunbas et al., 2001). It measures how close a bank's cost is to what a best-practice bank's cost would be for producing the same bundle of outputs. It then provides information on wastes in the production process and on the optimality of the chosen mix of inputs.

The basic model assumes that total cost deviates from the optimal cost by a random disturbance, v, and an inefficiency term, u. Thus the cost function is $TC = f(Y, P) + \varepsilon$ where TC represents total cost, Y is the vector of outputs, P the vector of input prices and ε the error term which is the sum of u and v. u is a one-sided component representing cost inefficiencies, meaning the degree of weakness of managerial performance. v is a two-sided component representing random disturbances, reflecting luck or measurement errors. u and v are independently distributed. v is assumed to have a normal distribution. We assume a gamma distribution following Greene (1990). Following Jondrow et al. (1982), bank-specific estimates of inefficiency terms can be calculated by using the distribution of the inefficiency term conditional to the estimate of the composite error term. Greene (1990) has then provided the estimate of the cost inefficiency term with a gamma distribution.

We estimate a system of equations composed of a Fourier-flexible cost function and its associated input cost share equations, derived using Shepard's lemma. We choose the Fourier-flexible form, as it has been proved that it dominates the translog form. We adopt here the specifica-

tion with only Fourier terms for the output quantities. Estimation of this system adds degrees of freedom and results in more efficient estimates than just the single-equation cost function. Since the share equations sum to unity, we solve the problem of singularity of the disturbance covariance matrix of the share equations by omitting one input cost share equation from the estimated system of equations. Standard symmetry constraints are imposed. Homogeneity conditions are imposed by normalizing total costs, price of labor, and price of physical capital, by the price of borrowed funds. Thus, the complete model is the following:

$$
\begin{aligned}
(2)\qquad \ln\left(\frac{TC}{w_3}\right) &= \beta_0 + \sum_m \alpha_m \ln y_m + \sum_n \beta_n \ln\left(\frac{w_n}{w_3}\right) + \frac{1}{2}\sum_m \sum_j \alpha_{mj} \ln y_m \ln y_j \\
&+ \frac{1}{2}\sum_n \sum_k \beta_{nk} \ln\left(\frac{w_n}{w_3}\right) \ln\left(\frac{w_k}{w_3}\right) + \sum_n \sum_m \gamma_{nm} \ln\left(\frac{w_n}{w_3}\right) \ln y_m \\
&+ \sum_k \left[\delta_k \cos Z_k + \theta_k \sin Z_k\right] + \sum_k \sum_{l=k} \left[\delta_{kl} \cos(Z_k + Z_l) + \theta_{kl} \sin(Z_k + Z_l)\right] \\
&+ \sum_k \sum_{l=k} \sum_{m=l} \left[\delta_{klm} \cos(Z_k + Z_l + Z_m) + \theta_{klm} \sin(Z_k + Z_l + Z_m)\right] + \varepsilon
\end{aligned}
$$

$$
(3)\qquad S_n = \partial \ln\left(\frac{TC}{w_3}\right) \Big/ \partial \ln w_n = \beta_n + \sum_k \beta_{nk} \ln\left(\frac{w_k}{w_3}\right) + \sum_m \gamma_{nm} \ln y_m + \eta_n
$$

$$
(4)\qquad \text{with } Z = 0.2\pi + (1.6\pi) * \frac{\ln Y_i - \ln Y_{i.\min}}{\ln Y_{i.\max} - \ln Y_{i.\min}}
$$

where TC total costs, $y_m\, m^{th}$ bank output $(m = 1{,}2)$, $w_n\, n^{th}$ input price $(n = 1{,}2), w_3$ price of borrowed funds, S_n input cost share[4] $(n = 1{,}2), \eta_n$ error term (η_n independent from ε). Indices for each bank have been dropped in the presentation for simplicity. The system of equations is estimated using Iterative Seemingly Unrelated Regression (ITSUR) estimation technique.

3. *The Regression Model*

We now turn to the model adopted to analyze the link between competition and efficiency in banking. We perform a regression of the mean of cost efficiency on a set of variables including the measure of competition. Our sample of observations includes 12 countries and 6 years, meaning 72 country-year observations. We incorporate fixed effects for

[4] S_n is equal to the expenses for the input n divided by total costs.

countries in the regression to disentangle the country effects. The dependent variable is the mean of cost efficiency scores. The main explaining variable is competition, measured by the H-statistic.

Several recent studies aiming to explain banking competition have recently used the H-statistic as a measure of competition in regressions. While Bikker and Groeneveld (2000), Bikker and Haaf (2002) and Jansen and de Haan (2003) analyze the impact of banking concentration on competition in developed countries, Claessens and Laeven (2003) test the influence of numerous variables taking banking structure and legal and economic development into account on banking competition.

As the dependent variable is bounded by construction between 0 and 1, an OLS regression model would provide biased results. We therefore resort to a Tobit procedure for the regression.

We also include some control variables as a natural robustness check of the relationship between competition and efficiency. However, due to the limited size of our sample, we consider only three control variables, relating to banking structure and economic development: per capita income, the density of demand, the intermediation ratio. The choice of these three variables is notably based on their proven influence on banking efficiency (Dietsch and Lozano-Vivas (2000), Cavallo and Rossi (2002)).

Per capita income is obtained by dividing GDP by the number of inhabitants. It is expected to have a positive influence on banking efficiency, as countries with higher per capita income may have clients consuming more banking products. The density of demand is measured by the ratio of total deposits per square kilometer. This variable is expected to have a positive influence on bank efficiency, as banks operating on markets with a lower density of demand would likely incur higher expenses. The intermediation ratio is the ratio of total loans to total deposits. This ratio is assumed to have a positive influence on efficiency, because the higher the ratio, the lower the quantity of deposits needed to produce loans will be, and so will be the cost of the production of loans. The regression model is then as follows:

$$(5) \qquad Efficiency_{it} = f\left(Competition_{it},\, GDP_{it},\, Demand_{it},\, Interm_{it},\, \sum_{j=1}^{11} Country_j\right)$$

for $i = 1, \ldots, I$ where I is the number of countries and $t = 1, \ldots, N$ where N is the number of years observed. Subscripts i and t refer to country i

for year t. $Efficiency_{it}$ is the mean efficiency score of banks. And $Competition_{it}$, GDP_{it}, $Demand_{it}$, $Interm_{it}$ the H-statistic, per capita income, the density of demand and the intermediation ratio for the country i and year t respectively. Finally, the variables $Country_j$ are dummy variables for each country, being equal to one if the bank comes from the country and else zero. One dummy variable is dropped. These variables are included to take country effects into account. We proceed to two Tobit regressions. While both include fixed effects for countries, they differ on the introduction of the three control variables to analyze their influence on the results.

IV. Data and Variables

Data for banks were gathered from the "Bankscope" database of BVD-IBCA. We use unconsolidated accounting data for 1746 banks from 12 EU member countries (156 from Austria, 62 from Belgium, 92 from Denmark, 279 from France, 347 from Germany, 20 from Greece, 453 from Italy, 110 from Luxembourg, 17 from the Netherlands, 25 from Portugal, 152 from Spain, 33 from the United Kingdom). We do not include in our study all the fifteen member countries of the EU, given the lack of sufficient data in our database for the three missing countries (Finland, Ireland, Sweden).

We use an unbalanced panel during the period 1994–1999.[5] It includes commercial, cooperative and savings banks. We adopt the Tukey boxplot, based on the use of interquartile range to clean data: banks with observations out of the range defined by the first and third quartiles that are greater or less than one and half the interquartile range were dropped for each mean input price over the period.

Two approaches are proposed in the banking literature for the definition of inputs and outputs. The intermediation approach assumes that the bank collects deposits to transform them, using labor and capital, into loans as opposed to the production approach, which views the bank as using labor and capital to produce deposits and loans. Two studies have shown that the choice of the treatment of deposits has an impact on the levels of efficiency scores but does not imply strong modifications in

[5] We choose an unbalanced panel rather than a balanced panel, to take banks gone into bankrupt or those being absorbed into account. Indeed the use of a balanced panel may overestimate cost efficiency as it ignores these banks, which may be less efficient on average.

their rankings (Wheelock and Wilson (1995), Berger, Leusner and Mingo (1997)). Furthermore, the intermediation approach is generally chosen in the banking studies applying the Rosse-Panzar model in the banking industry (Molyneux, Lloyd-Williams and Thornton (1994), De Bandt and Davis (2000), Bikker and Haaf (2002)). We therefore adopt the intermediation approach.

Two outputs are adopted in the cost efficiency frontier: loans, and investment assets. The inputs, whose prices are used to estimate the cost efficiency frontier and the Rosse-Panzar statistic, include labor, physical capital and borrowed funds. As data on the number of employees are not available, the price of labor is measured by the ratio of personnel expenses to total assets, following Altunbas, Evans and Molyneux (2001) and Bikker and Haaf (2002). The price of physical capital is defined as the ratio of other non-interest expenses to fixed assets. The price of borrowed funds is measured by the ratio of paid interests to all funding. Total costs requested in the cost frontier are the sum of personnel expenses, other non-interest expenses and paid interest. Summary statistics by country are reported in table A.3 in the Appendix. Finally, data for control variables come from OECD (2001).

V. Results

We will now present the results on the relationship between competition and efficiency in banking. We will first display the estimations by country and year for the competition and efficiency measures. Even if the analysis of the evolution of competition and efficiency in EU banking is not the core of this paper, it may provide a first glance on the relationship between competition and efficiency in banking. The results of the Rosse-Panzar tests and the estimation of efficiency scores for each country and each year are respectively shown in tables 1 and 2.

The analysis of the competition measures provides several interesting observations. First, the values of the H-statistic are included between 0 and 1 for all countries and all years, meaning a monopolistic competition structure in the EU banking markets. As mentioned above, this result is therefore in concordance with former studies on this issue. Second, the H-statistic decreased in all countries between 1994 and 1999. In other words, there was no improvement of competition during this period, but rather an increase of distance between the market structure of banking markets and perfect competition.

Table 1

H-statistic by Country and Year

Country	1994	1995	1996	1997	1998	1999	Mean
AT	0.6332	0.6196	0.6417	0.6353	0.6087	0.5520	0.5572
BE	0.6588	0.6452	0.6848	0.6196	0.5755	0.4830	0.5629
DK	0.6444	0.5461	0.5946	0.5287	0.5102	0.4825	0.4389
FR	0.6529	0.6389	0.6480	0.6107	0.6157	0.5054	0.5775
GE	0.6740	0.6244	0.6327	0.6240	0.5885	0.5373	0.5814
GR	0.6451	0.4433	0.5588	0.5241	0.5595	0.2921	0.5410
IT	0.6717	0.5807	0.6153	0.6310	0.6200	0.5725	0.6175
LU	0.7190	0.7044	0.7028	0.6594	0.6052	0.5298	0.5529
NL	0.7324	0.7132	0.7354	0.7054	0.6763	0.5669	0.5935
PT	0.7312	0.6322	0.6697	0.6238	0.5616	0.6329	0.7338
SP	0.6543	0.5969	0.6274	0.5741	0.5654	0.5164	0.5314
UK	0.7257	0.6508	0.7238	0.6858	0.5694	0.4438	0.5698

AT: Austria, BE: Belgium, DK: Denmark, FR: France, GE: Germany, GR Greece, IT: Italy, LU: Luxembourg, NL: Netherlands, SP: Spain, UK: United Kingdom

Table 2

Mean Efficiency Scores by Country and Year

Country	1994	1995	1996	1997	1998	1999	Mean
AT	67.51	68.98	73.89	66.21	73.58	77.19	75.27
BE	72.51	73.89	79.03	73.66	83.15	83.52	83.64
DK	65.27	67.09	72.60	68.89	76.00	79.66	77.23
FR	73.93	75.06	78.72	73.60	81.02	84.06	82.67
GE	70.42	71.45	74.70	68.73	75.84	78.43	75.86
GR	50.98	57.11	63.26	58.52	66.83	73.75	67.95
IT	66.12	66.13	71.19	67.00	77.46	82.85	80.52
LU	69.88	69.69	77.74	71.09	76.89	81.97	80.21
NL	76.90	74.84	76.37	74.07	77.49	82.21	84.41
PT	54.61	60.00	65.97	59.73	69.42	75.23	73.06
SP	59.26	59.26	62.82	59.46	71.46	77.48	76.27
UK	74.33	75.00	79.75	73.25	80.09	85.66	85.57

AT: Austria, BE: Belgium, DK: Denmark, FR: France, GE: Germany, GR Greece, IT: Italy, LU: Luxembourg, NL: Netherlands, SP: Spain, UK: United Kingdom

All scores in percentage

Turning now to the study of the efficiency measures, we can observe some discrepancies across countries, which is in accordance with former studies. The most striking result is however the improvement in banking efficiency for all countries between 1994 and 1999: indeed the increase in efficiency ranges from 5.31 points for the Netherlands to 22.77 points for Greece.

In summary, the main conclusion from the comparison of the evolution of competition and efficiency in the EU banking sectors during the period 1994–1999 is their opposite trends: while there was an improvement in bank efficiency, we observe a reduction in banking competition. Consequently, these facts are rather in favor of a negative relationship between competition and efficiency in banking. Nonetheless, further investigation will be needed to analyze this link.

We therefore analyze the relationship between competition and efficiency in a Tobit model. As mentioned above, we tested two equations, depending on the inclusion of the control variables. The results are displayed in table 3. The log-likelihood ratio indicates that the regressions are significant, in particular the equation with the control variables. The main conclusion is the fact that the coefficient of *Competition* is significantly negative at the 1 percent level in both regressions. Thus, we tend to support a negative relationship between competition and efficiency in banking.

Regarding the other explaining variables, the significance of the coefficients of the country dummy variables varies according to the country and of the regression. These differences come from the fact that these variables measure the existence of an advantage or a weakness in efficiency for each country in comparison to Portugal, as the dummy variable for Portugal was dropped. As a result, the significance is linked to the existence of such a significant difference in efficiency. Furthermore, a dummy variable for a country may be significant in the first regression while non significant in the second regression, because the inclusion of the control variables may explain the cross-country differences in banking efficiency. Therefore, including a variable such as *GDP* may reduce the gap in efficiency between two countries where discrepancies in *GDP* explain different efficiency levels. Regarding the three control variables, we observe as expected a positive and significant coefficient for *GDP* and *Interm,* but the coefficient is not significant for *Demand.*

However this test does not include dynamic aspects, as we consider country-year observations.[6] Therefore, it appears relevant to estimate

Table 3

Regression Results with Country-year Observations

	Without control variables	With control variables
Intercept	0.985*** (19.89)	0.560*** (4.97)
Competition	–0.535*** (–7.32)	–0.354*** (–4.04)
GDP		0.113E-5** (2.13)
Demand		–0.689E-10 (–1.11)
Interm		0.207*** (3.64)
AT	0.056** (2.47)	–0.121*** (–2.85)
BE	0.118*** (5.18)	0.038 (0.82)
DK	0.026 (1.09)	–0.072 (–1.58)
FR	0.120*** (5.24)	–0.060 (–1.45)
GE	0.076*** (3.32)	–0.059 (–1.49)
GR	–0.098*** (–3.94)	0.005 (0.15)
IT	0.062*** (2.72)	–0.106*** (–2.75)
LU	0.110*** (4.84)	0.380 (1.00)
NL	0.153*** (6.66)	0.028 (0.45)
SP	–0.020 (–0.88)	–0.049** (–2.37)
UK	0.134*** (5.89)	0.039 (1.30)
Sigma	0.039	0.034
Log-likelihood	130.742	142.131

*, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Competition: H-statistic, GDP: per capita income, Demand: density of demand, Interm: intermediation ratio. AT, BE, DK, FR, GE, GR, IT, LU, NL, SP, UK respectively dummy variables for the countries Austria, Belgium, Denmark, France, Germany, Greece, Italy, Luxembourg, Netherlands, Spain, United Kingdom.

also the relationship between the variation in competition and the variation in efficiency for each country between 1994 and 1999. As we only have one observation for each country, we do not need here to include fixed effects for countries. Therefore, we estimate the same regression than above, but by replacing the static values by variations for each variable. The regression model is then as follows:

$$(6) \qquad \Delta Efficiency_i = f(\Delta Competition_i, \Delta GDP_i, \Delta Demand_i, \Delta Interm_i)$$

[6] We thank an anonymous referee for the suggestion to analyze also the relationship between competition and efficiency over time.

Table 4

Regression Results with Variations

	Coefficients
Intercept	0.106*** (3.88)
Δ Competition	–0.276* (–2.23)
Δ GDP	–0.454E-6 (–0.95)
Δ Demand	–0.158E-9** (–3.24)
Δ Interm	0.155** (–3.24)
Adjusted R^2	0.6483

*, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Competition: H-statistic, GDP: per capita income, Demand: density of demand, Interm: intermediation ratio. Δ: the variation between 1994 and 1999.

with i for country, and Δ represents the variation between 1994 and 1999. We now proceed to a standard regression, as the explained variable is not bounded between 0 and 1. The results are displayed in table 4.

We observe some differences with the former regressions, as the variation in per capita income is not significant to explain the variation in efficiency, while per capita income was significant to explain efficiency. In a similar way, the variation in density of demand has a negative and significant influence on the variation in efficiency, while density of demand was not a significant variable to explain efficiency. Therefore, these different results underline the importance to add this regression in our analysis to include a dynamic analysis of the determinants of banking efficiency.

Nevertheless, the main conclusion of this regression is that the variation in competition is negative and significant at the 10% level. Therefore, we observe the same relationship between the variations in competition and efficiency on a dynamic perspective, than the one we observed between the efficiency and competition levels on a static perspective

This link is less significant when analyzing in terms of variations. But we have to keep in mind that the regression on variations was performed on a far smaller number of observations than the regression on static values. Consequently, the regression with variations strengthens the result of a negative link between competition and efficiency in banking.

How to interpret this result? It may seem surprising at first glance, as a positive link may seem more intuitive. However several explanations may justify such a result. First, the "efficient-structure" hypothesis can explain this result. Namely, the most efficient banks may have increased their market share, following the acquisition or the bankruptcy of the least efficient banks. It can notably be argued that the wave of domestic mergers in EU countries during the nineties led to an improvement in cost efficiency as some evidence suggests that the acquirers were more efficient than the acquired banks (Huizinga, Nelissen and Vander Vennet (2001)).

Second, the specificities of banking competition may also explain this result. Namely, a decrease in competition may have favored cost efficiency for banks, as they can benefit more from scale economies in monitoring and also from a higher length in the customer relationship, providing best information on the borrowers.

Third, we can also consider that some elements may have influenced both competition and efficiency. Indeed the perspective of the single banking market with the implementation of the single currency and more particularly the expected cross-border mergers may have incited banks to improve efficiency through two channels. On the one hand, banks have realized gains in cost efficiency so as they have more chances to survive on the new market structure. On the other hand, banks were inclined to increase their market share so that they create some barriers to entry of new competitors. Yafeh and Yosha (2001) and Weill (2002) have thus shown that banks can implement barriers to entry by increasing their customership, so that the switching costs for the customers prevent the potential competitors to come on the market.

Thus, we do not reject the positive influence of competition on efficiency, but we show that other factors play a prominent role on the relationship between competition and efficiency in banking. These latter factors are strong enough to counterbalance this positive influence for the EU banking sectors during the recent years.

VI. Concluding Remarks

This research has provided new evidence with respect to the relationship between competition and efficiency in banking. We measure these variables with tools commonly used in empirical banking literature.

Competition is measured by the Rosse-Panzar H-statistic, while efficiency is estimated with stochastic frontier approach.

We provide evidence in favor of a negative link between competition and efficiency in banking. This result may appear counterintuitive. Nevertheless the "efficient-structure" hypothesis provides some theoretical support for such a result. Furthermore, the specificities of the banking industry, where a fall in competition results in lower monitoring costs, may also explain this result. Finally, it may also be explained by the efforts of banks to be prepared to the forthcoming single banking market with the implementation of the single currency and the expected cross-border mergers. As a result, banks may have been inclined to improve their cost efficiency, but also to increase their market share so that they create some barriers to entry.

In normative terms, we do not provide support to the efforts from the European authorities to promote banking competition. However, even if these efforts were not successful in improving banking efficiency, they may have allowed a reduction of monopoly rents and therefore may have led to welfare gains. The observed reduction in banking competition is not however in favor of this assumption, even if further research is needed to assess the evolution of monopoly rents in the EU banking sectors.

In summary, the aim of this paper was to analyze the relevance of one of the expected benefits of a heightened competition in banking, the increase in cost efficiency, keeping in mind that the existence of potential losses from higher banking competition makes necessary such benefits to justify the policies promoting banking competition. We provide empirical elements qualifying this expected benefit. Our results should, however, be considered with care as this issue needs further analysis to assess the relevance of the different explanations proposed to explain them.

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Appendix

Table A.1: **Estimation of the Rosse-Panzar Model for the Years 1994, 1995, 1996**

		1994	1995	1996
	Intercept	–0.11 (–1.50)	–0.20*** (–3.45)	–0.09 (–1.53)
Austria	Price of labor	0.34*** (13.02)	0.27*** (12.13)	0.21*** (9.77)
	Price of physical capital	0.03 (1.43)	0.02 (1.22)	–0.01 (–0.25)
	Price of financial capital	0.27*** (6.65)	0.33*** (9.53)	0.44*** (13.18)
Belgium	Price of labor	0.17*** (8.80)	0.17*** (9.34)	0.18*** (10.41)
	Price of physical capital	–0.02 (–0.65)	0.02 (0.96)	0.05* (1.95)
	Price of financial capital	0.51*** (14.35)	0.45*** (13.43)	0.45*** (14.80)
Denmark	Price of labor	0.33*** (11.46)	0.30*** (13.34)	0.35*** (14.49)
	Price of physical capital	0.03 (1.05)	0.03 (1.17)	0.05* (1.87)
	Price of financial capital	0.28*** (7.80)	0.22*** (7.34)	0.20*** (6.75)
France	Price of labor	0.21*** (21.98)	0.19*** (22.85)	0.19*** (22.62)
	Price of physical capital	0.02* (1.70)	0.05*** (4.30)	0.04*** (3.38)
	Price of financial capital	0.42*** (21.33)	0.40*** (25.38)	0.41*** (25.50)
Germany	Price of labor	0.20*** (16.32)	0.19*** (18.26)	0.21*** (18.07)
	Price of physical capital	0.02** (2.05)	0.02** (2.15)	0.02* (1.90)
	Price of financial capital	0.46*** (20.51)	0.41*** (22.73	0.40*** (21.49)
Greece	Price of labor	0.03 (0.31)	0.21* (1.88)	0.14* (1.78)
	Price of physical capital	–0.05 (–0.54)	–0.07 (–0.97)	–0.02 (–0.47)
	Price of financial capital	0.66*** (3.66)	0.31* (1.67)	0.44*** (3.45)
Italy	Price of labor	0.19*** (9.51)	0.20*** (12.16)	0.20*** (12.85)
	Price of physical capital	0.05*** (2.88)	0.02** (1.99)	0.03** (2.48)
	Price of financial capital	0.43*** (13.60)	0.36*** (13.96)	0.38*** (14.69)
Luxembourg	Price of labor	0.10*** (8.95)	0.06*** (5.57)	0.09*** (8.22)
	Price of physical capital	0.01 (0.84)	0.0021 (0.15)	0.02 (1.60)
	Price of financial capital	0.60*** (24.26)	0.64*** (27.69)	0.59*** (27.36)
Netherlands	Price of labor	0.09** (2.56)	0.11*** (4.35)	0.06** (2.16)
	Price of physical capital	–0.02 (–0.54)	0.04 (1.26)	0.90E-3 (0.02)
	Price of financial capital	0.67*** (11.00)	0.56*** (11.75)	0.67*** (12.73)
Portugal	Price of labor	0.14 (1.59)	0.12*** (2.85)	0.11** (2.22)
	Price of physical capital	0.09 (1.56)	0.01 (0.24)	0.02 (0.54)
	Price of financial capital	0.50*** (2.93)	0.50*** (6.99)	0.54*** (6.45)
Spain	Price of labor	0.18*** (9.04)	0.17*** (9.91)	0.15*** (8.69)
	Price of physical capital	0.04 (1.60)	0.0251 (1.44)	0.03 (1.48)
	Price of financial capital	0.44*** (13.22)	0.40*** (13.68)	0.45*** (15.29)
UK	Price of labor	0.22*** (8.37)	0.21*** (11.15)	0.24*** (10.40)
	Price of physical capital	0.07*** (2.42)	0.06*** (2.62)	0.11*** (4.10)
	Price of financial capital	0.43*** (10.05)	0.38*** (11.44)	0.38*** (10.01)
	Assets	0.96*** (115.29)	0.96*** (135.10)	0.94*** (127.56)
	Eqass	0.03*** (3.17)	0.02*** (2.91)	0.05*** (5.82)
Adjusted R^2		0.9952	0.9962	0.9957

(i) The dependent variable is total revenues.
(ii) *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.
(iii) t-value is in brackets.

Table A.2: **Estimation of the Rosse-Panzar Model for the Years 1997, 1998, 1999**

		1997	1998	1999
	Intercept	–0.23*** (–3.31)	–0.38*** (–5.42)	–0.75*** (–10.56)
Austria	Price of labor	0.27*** (11.43)	0.32*** (15.35)	0.31*** (14.15)
	Price of physical capital	0.02 (1.24)	0.07*** (3.57)	0.05** (2.45)
	Price of financial capital	0.34*** (10.28)	0.22*** (7.49)	0.20*** (6.97
Belgium	Price of labor	0.23*** (9.99)	0.32*** (15.39)	0.35*** (15.39
	Price of physical capital	0.02 (0.92)	0.08** (2.45)	0.05 (1.53)
	Price of financial capital	0.37*** (9.75)	0.17*** (5.40)	0.09*** (2.60)
Denmark	Price of labor	0.39*** (12.74)	0.37*** (12.18)	0.42*** (14.04
	Price of physical capital	–0.02 (–0.62)	0.01 (0.05)	0.02 (0.56)
	Price of financial capital	0.16*** (4.56)	0.13*** (3.63)	0.05 (1.34)
France	Price of labor	0.22*** (9.89)	0.20*** (18.45)	0.25*** (21.24)
	Price of physical capital	0.03* (1.63)	0.06*** (3.99)	0.02 (1.04)
	Price of financial capital	0.37*** (19.27)	0.36*** (18.69	0.24*** (14.13)
Germany	Price of labor	0.23*** (17.68)	0.23*** (16.55)	0.27*** (19.22)
	Price of physical capital	0.03** (2.52)	0.04*** (3.43)	0.05*** (3.81)
	Price of financial capital	0.37*** (18.28)	0.32*** (4.56)	0.22*** (10.51)
Greece	Price of labor	0.15* (1.62)	0.09* (1.94)	0.20*** (4.17)
	Price of physical capital	–0.04 (–0.48)	0.01 (0.09)	–0.13* (–1.75)
	Price of financial capital	0.42*** (2.93)	0.46*** (5.47)	0.22*** (2.73)
Italy	Price of labor	0.19*** (9.93)	0.24*** (14.63)	0.29*** (18.67)
	Price of physical capital	0.03** (2.12)	0.07** (4.92)	0.07*** (5.60)
	Price of financial capital	0.41*** (15.17)	0.31*** (13.99)	0.21*** (12.43)
Luxembourg	Price of labor	0.10*** (7.59)	0.12*** (7.98)	0.15*** (11.07)
	Price of physical capital	0.01 (0.37)	0.02 (1.06)	0.01 (0.37)
	Price of financial capital	0.55*** (19.84)	0.46*** (15.55)	0.37*** (14.58)
Netherlands	Price of labor	0.08** (2.06)	0.07 (1.42)	0.05 (0.89)
	Price of physical capital	–0.10E-2 (–0.02)	0.01 (0.15)	–0.04 (–0.73)
	Price of financial capital	0.62*** (8.89)	0.60*** (6.83)	0.56*** (5.68)
Portugal	Price of labor	0.21*** (4.43)	0.17*** (4.48)	0.20*** (5.82)
	Price of physical capital	0.04 (0.95)	–0.03 (–0.74)	0.13*** (3.27)
	Price of financial capital	0.37*** (4.93)	0.41*** (7.10)	0.31*** (6.41)
Spain	Price of labor	0.25*** (13.52)	0.23*** (14.43)	0.30*** (16.26)
	Price of physical capital	0.29^{E}-2 (0.13)	0.03 (1.24)	0.03 (1.28)
	Price of financial capital	0.33*** (11.75)	0.30*** (12.54)	0.19*** (8.47)
UK	Price of labor	0.25*** (11.04)	0.26*** (10.18)	0.29** (12.81)
	Price of physical capital	0.13*** (3.64)	0.07** (2.04)	0.01 (0.32)
	Price of financial capital	0.32*** (8.20)	0.24*** (5.42)	0.15*** (4.28)
	Assets	0.95*** (115.41)	0.91*** (111.60)	0.94*** (113.64)
	Eqass	0.0401 (4.39)	0.0913*** (10.17)	0.06** (6.34)
Adjusted R^2		0.9941	0.9946	0.9951

(i) The dependent variable is total revenues.
(ii) *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level.
(iii) t-value is in brackets.

Table A.3

Mean Values of Variables by Country

Country	loans	inv. assets	pl	pk	pf	Revenue	Assets
Austria	1,620,531.5	1,563,791.2	1.40	74.25	4.04	194,871.7	3,337,302.0
Belgium	4,381,458.6	6,888,099.7	0.99	148.39	4.95	717,225.2	1,1807,060.3
Denmark	1,023,445.4	1,119,250.3	2.13	77.68	3.22	150,375.4	2,336,481.7
France	3,010,028.7	3,922,615.5	1.59	150.26	4.39	494,800.0	7,606,241.4
Germany	2,531,939.6	2,852,938.4	1.37	103.93	4.14	328,222.3	5,635,532.5
Greece	2,131,428.1	3,737,378.2	1.88	87.67	8.88	738,397.2	6,290,092.3
Italy	1,980,795.2	1,724,303.4	1.97	93.41	5.39	322,590.4	4,081,932.9
Lux.	1,093,757.7	3,757,216.6	0.54	147.74	5.24	317,066.1	5,011,209.7
Netherl.	427,312.5	638,316.0	0.60	196.09	5.52	68,528.9	1,097,429.1
Portugal	3,099,966.3	4,566,583.7	1.11	72.87	5.84	650,119.3	8,509,059.6
Spain	2,995,052.7	2,906,426.8	1.57	54.08	4.52	476,584.9	6,397,016.8
UK	985,472.1	1,038,294.1	1.20	252.09	4.78	160,839.1	2,193,893.7

All values are in thousands of dollars, except input prices.
inv. assets: investment assets, pl: price of labor, pk price of physical capital, pf price of financial capital.

Summary

On the Relationship Between Competition and Efficiency in the EU Banking Sectors

Evidence is scarce regarding the impact of competition on efficiency in banking, even if it represents a very relevant issue to assess the benefits of a heightened banking competition. This work investigates the relationship between competition and efficiency in banking on a sample of 12 EU countries during the period 1994–1999. Competition is measured by the Rosse-Panzar H-Statistic, while efficiency is estimated with stochastic frontier approach. We provide support to a negative relationship between competition and efficiency in banking, which does not then corroborate the intuitive positive influence of competition on efficiency. (JEL G21, L12)

Zusammenfassung

Zu den Beziehungen zwischen Wettbewerb und Effizienz in den Bankensektoren der EU

Es gibt nur wenige Beweise dafür, dass sich Wettbewerb auf die Effizienz im Bankwesen auswirkt, obwohl sie für die Bewertung des Nutzens eines verstärkten Wettbewerbs im Bankensektor von außerordentlicher Relevanz sind. In dieser Arbeit werden auf der Grundlage einer in 12 EU-Ländern durchgeführten Stichprobe die Wechselwirkungen zwischen Wettbewerb und Effizienz im Bankensektor im Zeitraum 1994–1999 untersucht. Die Wettbewerbsmessungen erfolgen mithilfe der H-Statistik nach Ross-Panzar, während bei den Effizienzschätzungen stochastisch vorgegangen wird. Wir schließen uns der Ansicht an, dass es im Bankensektor zwischen Wettbewerb und Effizienz keine Wechselwirkungen gibt, sodass der intuitiv unterstellte positive Einfluss von Wettbewerb auf die Effizienz nicht erhärtet wird.

Résumé

Relation entre la concurrence et l'efficience dans les secteurs bancaires de l'UE

Il existe peu d'études empiriques concernant l'impact de la concurrence sur l'efficience dans le secteur bancaire, en dépit du fait que cela constitue une question très importante pour évaluer les bénéfices d'une concurrence bancaire accrue. Cet article analyse la relation entre concurrence et efficience dans le secteur bancaire sur un échantillon de 12 pays de l'UE pour la période allant de 1994 à 1999. La concurrence est mesurée par la Statistique H de Rosse-Panzar, pendant que l'efficience est estimée par l'approche de frontière stochastique. Notre conclusion est en faveur d'une relation négative entre la concurrence et l'efficience dans le secteur bancaire, ce qui ne corrobore pas l'influence positive intuitive de la concurrence sur l'efficience.