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Laurent Weill

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Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex
http://ifs.unistra.fr/large

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Laurent Weill*
University of Strasbourg and EM Strasbourg Business School

Abstract:

Economic integration on the EU banking markets is expected to favor competition, which should provide economic gains. However, even if there is a commonly accepted view in favor of enhanced bank competition during the last decade, no study has been performed in the 2000s showing this trend. In this paper, we aim to fill this gap by measuring the evolution of bank competition in all EU countries during the 2000s. We estimate the Lerner index and the H-statistic for a sample of banks from all EU countries. We provide evidence of a general improvement in bank competition in the EU, even if cross-country differences are observed in the pattern of the evolution of bank competition. We check whether convergence in bank competition has taken place on the EU banking markets, by applying β and σ convergence tests for panel data. We show convergence in bank competition. These findings are also observed with standard competition measures (Herfindahl index, profitability indicators). We thus support the view that bank integration has taken place in the European Union.

Keywords: banking, competition, European integration.
JEL Classification: G21, F36, L16

* Institut d'Etudes Politiques, Université de Strasbourg, 47 avenue de la Forêt Noire, 67000 Strasbourg. Phone : (33)3-68-85-81-38. E-mail : laurent.weill@unistra.fr

1. Introduction

Economic integration in the European Union has aimed to favor competition in all industries. Increased competition was expected to provide gains for consumers through price reductions. In the banking industry, the awaited benefits are of particular interest for mainly two reasons. First, the expected gains are larger as in any other industry, as reductions in financial services prices mean notably lower loan rates which can lead to greater investment and thus favor growth. Second, banking literature has shown that these industries are characterized by the existence of switching costs and sunk costs (e.g. Yafeh and Yosha, 2002). These costs make harder the entry of new competitors on a banking market. Empirical banking literature thus mostly concludes to imperfect competition in studies done on developed and developing countries (e.g. De Bandt and Davis, 2000, for EU countries; Fungacova, Solanko and Weill, 2011, for Russia). Thus, benefits expected from increased competition are greater but harder to reach in the banking industry.

In EU banking industries, the process of integration has notably taken place through the deregulation of capital flows, the Second Banking Directive creating the single banking license, the removal of legal barriers to entry, and the creation of the single currency in 1999 dropping the exchange risk for banks, all these steps favoring the cross-border acquisitions and in the supply of cross-border services.

However we can wonder if these efforts have contributed to increase bank competition in the EU. It is striking that there is a commonly accepted view that competition has increased in the EU banking industry in the last decade. For instance, Goddard et al. (2011, p.2) pointed out that “there is a general view that competition in EU banking has increased over the last decade.” Nonetheless, this view is not empirically supported.

A few studies have analyzed bank competition in the EU in the 1990s and the very beginning of the 2000s. They find evidence of a reduction in bank competition (Fernandez de Guevara, Maudos and Perez, 2005; Weill, 2004), which is at odds with the commonly accepted view. However, this conclusion is likely not to stand in the recent years. Indeed, while in the 1990s most mergers and acquisitions taking place in the EU banking industry were domestic and thus rather anticompetitive, this situation has changed in the 2000s with many major cross-border mergers and acquisitions which should enhance the degree of competition. The implementation of the Euro at the beginning of the 2000s is also expected

to have an impact on bank competition in the EU through more supply of cross-border services and greater expectations of forthcoming entry of new competitors.

Our purpose in this paper is to fill the gap in the banking literature by providing evidence on the evolution of bank competition in the 2000s. Even if some barriers to entry remain and prevent perfect competition, we wonder if the recent changes have favored bank competition in the EU banking industries. To investigate this issue, we measure bank competition in the EU during the 2000s. In line with recent studies on bank competition (e.g. Claessens and Laeven, 2004; Berger, Klapper and Turk-Ariss, 2009; Turk-Ariss, 2010), we estimate non-structural measures: the Lerner index, and the H-Statistic provided by the Rosse-Panzar model. These indicators have the major advantage to measure bank behavior directly rather than inferring the degree of competition from indirect proxies like market shares.

We also contribute to the banking literature by providing the first application to our knowledge of tests of convergence specified for panel data on non-structural measures of bank competition. We make use of two major concepts of convergence, β-convergence and σ-convergence. β-convergence implies that countries with a lower level of bank competition have faster growth rates than countries with a higher level of bank competition. σ-convergence is observed if each country's level of bank competition is converging to the average level of the group of countries. As competition in banking might be hampered by specific obstacles, one can wonder if we have observed convergence in bank competition across EU countries. Namely, even if there is no general trend of enhanced competition in all EU countries, banking integration can take place through convergence towards the same level of bank competition. Indeed, integration should lead to the law of one price. But the persistence of obstacles to greater bank competition can prevent the application of this law in banking. Nonetheless EU banking industries can have converged towards the same level of imperfect competition.

The structure of the paper is as follows. Section 2 describes the methods used for the measures of competition and the convergence tests. Section 3 develops the empirical results. We provide some concluding remarks in section 4.

2. Methodology

Empirical research on the measurement of bank competition provides several tools. These can be divided into the traditional Industrial Organization (IO) and newer empirical IO approaches. The traditional IO approach proposes tests of market structure to assess bank competition based on the Structure Conduct Performance (SCP) model. The SCP hypothesis argues that greater concentration causes less competitive bank conduct and leads to greater profitability of the bank. In this model, competition is measured by concentration indices such as the market share of the largest banks or the Herfindahl index. These tools were widely applied until the 1990s.

The new empirical IO approach provides non-structural tests to circumvent the problems with competition measures in the traditional IO approach. Traditional competition measures suffer from the fact that they infer the degree of competition from indirect proxies such as market structure or market shares. In contrast, non-structural measures do not infer the competitive conduct of banks through the analysis of market structure, but rather measure bank conduct directly. The measures from the new empirical IO include the Lerner index, an individual measure of market power, and the Rosse-Panzar model, which provide an aggregate measure of competition. We use both these measures for our analysis.

Data are drawn from the Bankscope database. We use unconsolidated accounting data for a sample of banks from all 27 EU countries. Our sample comprises commercial, cooperative, and savings banks. The period of observation stretches from 2002 to 2008. The sample consists of 20,657 observations. Table 1 displays summary statistics for the bank-level variables adopted in the estimations.

2.1 The Lerner index

We compute the Lerner index for each bank and for each year of our sample to have a non-structural measure of competition. The Lerner index has been computed in several recent studies on bank competition. It has notably been used to measure the degree of bank competition (e.g. Fernandez de Guevara, Maudos and Perez, 2005). However, as it provides a bank-level measure of competition, unlike the Herfindahl index or the H-Statistic, it has

also been adopted in works on the determinants of bank competition (e.g. Maudos and Fernandez de Guevara, 2007, on Spanish banks) or the consequences of bank competition.[1]

The Lerner index is defined as the difference between price and marginal cost, divided by price. Following Fernandez de Guevara, Maudos and Perez (2005) and Carbo et al. (2009) among others, price is the average price of bank production (proxied by total assets) as the ratio of total revenues to total assets. We thus consider an average price across the bank activities. Marginal cost is estimated on the basis of a translog cost function with one output (total assets) and three input prices (price of labor, price of physical capital, and price of borrowed funds). One cost function is estimated for each year to allow technology to change over time. We consider one common cost function to all EU countries, as we do not have enough observations in many EU countries to estimate a specific cost function. Nevertheless we control for country effects by including dummy variables for all EU countries in the cost function.

We impose the restriction of linear homogeneity in input prices by normalizing total costs and input prices by one input price. The cost function is specified as follows:

$$\begin{aligned}\ln\left(\frac{TC}{w_3}\right) &= \alpha_0 + \alpha_1 \ln y + \frac{1}{2}\alpha_2 (\ln y)^2 + \alpha_3 \ln\left(\frac{w_1}{w_3}\right) + \alpha_4 \ln\left(\frac{w_2}{w_3}\right) \\ &+ \alpha_5 \ln\left(\frac{w_1}{w_3}\right)\ln\left(\frac{w_2}{w_3}\right) + \frac{1}{2}\alpha_6\left(\ln\left(\frac{w_1}{w_3}\right)\right)^2 + \frac{1}{2}\alpha_7\left(\ln\left(\frac{w_2}{w_3}\right)\right)^2 \\ &+ \alpha_8 \ln y \ln\left(\frac{w_1}{w_3}\right) + \alpha_9 \ln y \ln\left(\frac{w_2}{w_3}\right) + \sum_{i=1}^{26} Country_i\end{aligned} \qquad (1)$$

where *TC* denotes total costs, *y* total assets, w_1 the price of labor (the ratio of personnel expenses to total assets)[2], w_2 the price of physical capital (the ratio of other non-interest expenses to fixed assets), w_3 the price of borrowed funds (the ratio of paid interests to all funding), $Country_i$ dummy variable for the country i ($Country_1$=1 if country is Austria, 0 else; $Country_2$=1 if country is Belgium, 0 else,…). Total costs are the sum of personnel expenses, other non-interest expenses and paid interests. The indices for each bank have been

[1] For instance Berger, Klapper and Turk-Ariss (2009) explore the impact of bank competition on risk-taking for a large sample of countries, while Fungacova and Weill (2011) investigate the role of bank competition on failures in Russia.

[2] As the Bankscope database does not provide information on the number of employees, we use this proxy variable for the price of labor following Fernandez de Guevara, Maudos and Perez (2005) and Weill (2009) among others.

dropped from the presentation for the sake of simplicity. The estimated coefficients of the cost function are then used to compute the marginal cost.

2.2 The Rosse-Panzar model

To further address the validity of the results, we use an alternative measure for bank competition in our estimations. We estimate the Rosse-Panzar model (Rosse and Panzar, 1977; Panzar and Rosse, 1987), which has been widely applied in banking (e.g. De Bandt and Davis, 2000, for EU countries; Claessens and Laeven, 2004, for 50 countries). This is a non-structural test, meaning that it takes into account the actual behavior of banks without using information on the structure of the banking market. The H-statistic aggregates the elasticities of total revenues to the input prices. It 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.

Our aim is to have a measure of competition for each bank type and each year. We run the Rosse-Panzar model for year to obtain estimates of input prices specific to each year. As we need estimates of the coefficients of input prices specific to each country, we include interactive terms for each input price, joining the variable with a dummy variable for each country. For each year, we estimate the following equation:

$$\ln Revenues = \alpha_0 + \sum_{k=1}^{27} [\, \alpha_1 (\ln w_1) + \alpha_2 (\ln w_2) + \alpha_3 (\ln w_3)] \, Country_i \qquad (2)$$
$$+ \beta_1 \ln Assets + \beta_2 \ln Equity\ to\ Assets$$

where *Revenues* are total revenues, w_1, w_2 and w_3 prices of labor, physical capital, and borrowed funds, respectively, *Assets* total assets, *Equity to Assets* the ratio of equity to total assets, k country, $Country_i$ dummy variable for the country i ($Country_1$=1 if country is Austria, 0 else; $Country_2$=1 if country is Belgium, 0 else,…). The variables *Assets* and *Equity to Assets* take into account differences in size and risk respectively, akin to Bikker and Haaf (2002). Indices for each bank have been dropped in the presentation for simplicity. Thus, the H-statistic is equal to $\beta_i + \gamma_i + \delta_i$ for the country i.

2.3 Tests of convergence

We now present the tests of convergence performed to investigate convergence in bank competition. The issue of convergence has been widely studied in the growth literature during the last decade. Barro and Sala-i-Martin (1991) propose two concepts of convergence, β-(beta) and σ-(sigma) convergence which are developed in a cross-section context.

The β-convergence test aims to regress the growth rate on the initial level for any variable. There is then convergence of the β-type whether the growth rate is negatively correlated with the initial level. That is, β-convergence implies that countries with low initial level have faster growth rates than countries with high initial level. Some limits of this test have been underlined by Quah (1996). First, the interpretation of the result in terms of convergence is not straightforward. That is to say, if countries with low initial level grow faster than those with high initial level, this can lead to a situation where the first ones overpass the latter ones, meaning the absence of convergence. Second, the β-convergence test provides no information on the evolution of the dispersion of the cross-section.

The σ-convergence test does not suffer from these limits. It aims to investigate the evolution of the dispersion of a cross-section. There is then convergence if the dispersion diminishes over time. Thus, σ-convergence captures how quickly each country's level is converging to the average level of the group of countries. These two measures of convergence are complementary, but not excludable: β-convergence is a necessary but not a sufficient condition for σ-convergence to take place.

Both these tests are the most generally applied tests of convergence. We apply them to investigate the convergence in bank competition for the whole sample of countries between 2002 and 2008. To take account of both the intertemporal pattern of convergence and the cross-sectional variety of the EU countries, we use the specifications of convergence tests for panel data. This is the first application to our knowledge of these convergence tests for competition measures in the banking industry. In a related area, Weill (2009) has applied these tests to investigate convergence in bank efficiency for EU countries.

The β-convergence test is performed through the estimation of the following equation, following the specification for panel data from Canova and Marcet (1995):

$$ln\ Competition_{i,t} - ln\ Competition_{i,t-1} = \alpha + \beta\ ln\ Competition_{i,t-1} + \sum_{i=1}^{26} Country_i + \varepsilon_{i,t} \quad (3)$$

Where $Competition_{i,t}$ the measure of bank competition of country i in year t, $Competition_{i,t-1}$ the measure of bank competition of country i in year t-1, $Country_i$ country

dummies, ε_i the error term, and α and β the parameters to be estimated. Country dummies incorporate fixed effects for countries in the equation to disentangle the country effects. There is then β-convergence if the coefficient β of the initial level is negative. The values diverge from each other as quick as from their initial level (meaning that the gap between $Competition_{i,t}$ and $Competition_{i,t-1}$ is as larger) and consequently countries converge all the quicker as β is high.

σ-convergence is investigated through the estimation of the following equation, following the specification for panel data used notably by Parikh and Shibata (2004):

$$\Delta W_{i,t} = \alpha + \beta W_{i,t-1} + \sum_{i=1}^{26} Country_i + \varepsilon_{i,t} \quad (4)$$

Where $ln\ Competition_{i,t}$ the logarithm of the mean competition measure of banks of country i in year t, $MCompetition_t$ the mean of $ln\ Competition_{i,t}$ for each period, $W_{i,t} = ln\ Competition_{i,t} - MCompetition_t$, $\Delta W_{i,t} = W_{i,t} - W_{i,t-1}$, $Country_i$ country dummies, ε_i the error term, and α and β the parameters to be estimated. Country dummies incorporate fixed effects for countries in the equation to disentangle the country effects. There is then σ-convergence if the coefficient β of the initial level is negative.

3. Results

This section is devoted to the presentation of our results. We display the findings obtained with each measure of competition.

3.1 The Lerner Index

We analyze the evolution of bank competition measured with the Lerner index for EU banks between 2002 and 2008. The mean Lerner indices for each country and each year are displayed in Table 2. Several conclusions come to the front.

First, the average Lerner index for all EU 27 countries ranges from 12.20 to 20.34% over the period. As the Lerner index is the ratio of the difference between price and marginal cost to price, this figure means that on average price exceeds marginal cost between 12.20 and 20.34% relative to price. These figures are clearly comparable to what is observed in other studies. For instance, Carbo et al. (2009) find mean Lerner indices ranging from 11% to 22% for EU countries with a EU mean of 16% over the period 1994-2001. Fernandez de

Guevara and Maudos (2007) observe yearly Lerner indices between 16.9% and 24% for Spanish banks over the period 1986-2002. In the context of a transition country, Fungacova, Solanko and Weill (2011) point out a mean Lerner index of 21.4% for the Russian banking industry in the 2000s. This observation of Lerner indices in transition countries greater than in Western countries is in accordance with our findings. Indeed a comparison of old and new EU member countries shows greater competition in old EU countries: the average Lerner index over the period is 16.09% to be compared with 18.68% in new EU countries.

Second, the evolution of the Lerner index shows a decrease in 20 of the 27 EU countries between 2002 and 2007. This leads to a general reduction at the aggregate level of 1.66 points, which means a trend in favor of enhanced competition. However a striking finding is the fact that 6 of the 7 countries with an increase of the Lerner index are new EU member countries during the decade (Bulgaria, Cyprus, Czech Republic, Hungary, Malta, Slovakia), the only exception being the Netherlands. This observation suggests that new EU member countries might have known a different evolution in bank competition than "old" EU member countries. However this remark should be qualified by the fact that 6 new EU member countries have a lower Lerner index in 2008 than in 2002. Nevertheless, it results in the fact that even if the average evolution for the 27 EU countries is a reduction of 1.66 points, the conclusion differs according to the type of countries considered: a reduction of the Lerner index for 5.26 points for old EU countries vs. an increase of the Lerner index for 2.86 points for new EU countries. Thus, the conclusion of greater bank competition in the EU should be qualified by these different trends.

This latter remark should be relied to the fact that the initial levels of the Lerner index were slightly lower for old EU countries (13.51%) than for new EU countries (14.30%). Thus, linking both these comments leads to the fact that the gap in bank competition has increased between old and new EU countries over the period.

This conclusion rather pleads against convergence among countries. However an investigation is needed to analyze the convergence of bank competition between EU countries.

We consequently test β and σ convergence in bank competition. Specifications of convergence tests for panel data are then adopted, which were presented in the methodology. Both tests are performed for the full sample of countries between 2002 and 2008. The results of the β-tests and the σ-tests are displayed in table 3. We provide evidence about β-convergence and σ-convergence in bank competition between European countries. Indeed

the coefficient β, which is respectively the coefficient of $ln\ Competition_{i,t}$ and $W_{i,t-1}$ for β-tests and σ-tests, is negative and significant at the 1% level in all tests.

We thus provide support for convergence in bank competition across EU countries. We support β-convergence, i.e. the most competitive banking sectors in 2002 have known a lower improvement of competition than the least competitive banking sectors in 2002, but also σ-convergence, meaning that the dispersion of the mean competition measures between EU countries was reduced during the period of study.

Thus, we have two main findings. First, bank competition has globally increased in the EU during the 2000s. This conclusion is observed in most countries and notably in the major EU countries (France, Germany, Italy, UK). This is a finding of major interest as it is at odds with the evolution observed in the 1990s. Second, convergence in bank competition has taken place among EU countries. Both findings then provide evidence that banking integration has taken place in the 2000s.

3.2 The Rosse-Panzar model

We now turn to the results obtained with the Rosse-Panzar model, which are displayed in Table 4. We observe values between 0.0925 and 1.0129 for all countries and all years, which suggests a monopolistic competition structure in most cases. This finding accords with the vast majority of studies which estimate the Rosse-Panzar model on banks. Among others, Bikker and Haaf (2002) found an average H-statistic of 0.72 for EU countries and of 0.55 for the US for the period 1988-1998. Schaeck, Cihak and Wolfe (2009) show country measures of the H-statistic which range from -0.08 to 0.79 for a sample of 45 developed and developing countries for the period 1998-2005.

In dynamic terms, we point out the increase of the H-statistic in 25 countries, the only exceptions being Ireland and Slovenia. The mean H-statistic rose from 0.4545 in 2002 to 0.6981 in 2008, i.e. an improvement of 0.2773.

We again find that the evolution in bank competition differs on average between old and new EU member countries. The H-statistic has increased from 0.4671 to 0.7128 in old EU countries to be compared with an increase from 0.4410 to 0.6805. In other words, we observe again that the initial levels of competition were slightly greater for old EU countries than for new EU countries but the rise in competition was stronger for old EU countries. This means that the gap in bank competition increased between both groups of countries over the

period. Broadly speaking, we thus observe similar findings than with the Lerner index, with greater competition in most EU countries.

When we analyze convergence in bank competition, the tests of convergence presented in Table 5 again show β-convergence and σ-convergence in bank competition between European countries.

In a nutshell, the Rosse-Panzar model provides the same conclusions than the Lerner index on the evolution and convergence of bank competition in the EU countries. Bank competition has enhanced during the 2000s and convergence in bank competition has happened among EU countries.

3.3 Some additional measures of competition

Our estimations have clearly shown a general trend of improvement and a movement of convergence in bank competition for EU countries. These findings were obtained with non-structural measures of competition which present major advantages described above and are widely used in the academic literature on bank competition. Nonetheless, one can wonder if the conclusions would be the same when we use structural measures of competition like the Herfindahl index or more intuitive measures like profitability indicators. Conflicting results obtained with these measures would put a veil on our findings, even if the non-structural measures provide a better diagnosis on competition in our view.

Carbo et al. (2009) have used five different indicators of bank competition for 14 EU countries over the period 1994-2001 to check if they lead to similar findings. These five indicators were the Lerner index, the H-statistic, the Herfindahl index but also two accounting ratios commonly used to measure profitability: ROA, and net interest margin. They find limited evidence of consistency between these five competition measures. Indeed, even if the correlation coefficients are positive between all measures, the measures are weakly related to one another. It is thus of interest to investigate if our main findings survive to the use of other competition measures. In line with the study from Carbo et al. (2009), we check the evolution of three alternative measures of bank competition: the Herfindahl index, the ROA, and the net interest margin.

We first use the Herfindahl index. As mentioned above, this measure is flawed by the fact that it infers information on competition from indirect proxies like market shares. This notably suffers from the fact that concentration is assumed to be an inverse measure of competition, and that it neglects the procompetitive effects of the potential threat of entrants

and the possible existence of substitutes. Nonetheless, this indicator is commonly used by practitioners and public authorities. Among others, we can observe that the regular reports from the European Central Bank on the evolution of banking structures in the EU give two structural measures of competition: the Herfindahl index, and the market share of the five largest banks (e.g. ECB, 2010).

To analyze the evolution of the Herfindahl index, we do not compute this indicator from our dataset but rely to the measures given by the European Central Bank. This choice is motivated by the fact that even if our database includes most banks from EU countries and is thus representative of EU banking industries which explains its common use in works on EU banking industries (e.g. ECB reports), it is not exhaustive. This is not a major problem for the indicators obtained for bank-level measures like the Lerner index, but it might strongly affect the computation of the Herfindahl index which requires exhaustive data to provide relevant indicators. Information on Herfindahl indices is thus extracted from ECB reports (ECB 2006, 2008, 2010).

Second, we adopt two accounting ratios which reflect profitability: the ROA, and the net interest margin. ROA is the ratio of net income to total assets. It is a measure of profitability which considers all sources of income. Net Interest Margin is defined as the ratio of net interest margin to total assets. As observed by Carbo et al. (2009), this indicator measures the loan-deposit interest spread. It is linked to competition as greater competition is expected to reduce loan rates and increase deposit rates. However it takes imperfectly into account the role of costs in the decision-making process of rates. Furthermore it neglects a significant share of bank revenues, fees, but cross-subsidized pricing policy can favor the reduction of the net interest margin to increase fees.

Table 6 presents the figures for these three additional measures of competition. For space reasons, we only provide values for the first and the last year of the period, and also the evolution over the period. Interestingly, we observe a slight decrease for all three measures at the European level between 2002 and 2008. In other words, all measures yield the same finding of greater bank competition than the Lerner index and the H-statistic at the global level. Nonetheless the situation is contrasted across countries and measures. Only 12 countries have a reduction of the Herfindahl index over the period. The conclusion of a fall in the measure is more common across European countries for ROA (15 countries) and the net interest margin (17 countries).

We then proceed to the tests of β-convergence and σ-convergence. The results are displayed in Table 7. We find again evidence of β-convergence and σ-convergence in bank competition between European countries for all three measures. Interestingly, convergence is thus observed for all tested measures of competition.

Thus, our main findings have survived to the application of other competition measures. As we mentioned it above, such conclusion could not have been taken for granted, as the consistency among competition measures was shown to be weak for European banking industries (Carbo et al., 2009). It strengthens the relevance of our results.

4. Conclusion

Enhanced bank competition is one expected benefit of economic integration in the European Union. It has major economic implications as greater bank competition could contribute to reduce prices of financial services and thus favor access to credit and investment in the European Union. However, the studies done on the 90s and the very beginning of the 2000s did not conclude in favor of increased competition. With the major changes taking place during the 2000s, with notably the expansion of cross-border mergers and acquisitions and the implementation of the single currency, we can wonder if bank competition has increased.

This research has thus analyzed the evolution and convergence in bank competition in the EU during the 2000s to shed light on the recent changes in the behavior of European banks. To do so, we have used the Lerner index and the Rosse-Panzar model to estimate bank competition measures for all EU countries. We have applied the β-convergence and σ-convergence tests specified for panel data on bank competition measures.

We have two main findings. First, bank competition has increased during the 2000s. We observe a general trend of enhanced bank competition over the period, even if the situation might be different in some countries. Second, we clearly support the view of a convergence in bank competition across European countries. These findings are observed for both measures of competition and both concepts of convergence. Consequently, we provide evidence in favor of the process of banking integration in the European Union.

Thus, we bring some support in favor of the common view regarding the recent evolution in bank competition. These findings are grounds for optimism, as they show that

measures implemented at the EU level have exerted an impact on the behavior of banks and as greater bank competition should contribute to economic benefits notably through lower loan rates.

An extension of this work would be the analysis of the consequences of bank competition on financial stability in the EU. Namely, banking literature suggests that bank competition might hamper financial stability through greater non-performing loans and failures of financial institutions. We can thus wonder how increased bank competition has influenced financial stability in the recent years. The investigation of potential negative effects of bank competition would be of interest to identify the optimal level of bank competition in the EU.

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Table 1
Descriptive statistics

The table displays the country averages for the period 2002-2008 for the variables used for the estimation of competition measures. Total assets, total costs, and total revenues are in million euros. Input prices are in percentage.

	Number of banks	*Number of observations*	*Total assets*	*Total Costs*	*Total Revenues*	*Price of labor*	*Price of borrowed funds*	*Price of physical capital*
Austria	222	1,402	1,470.32	57.25	63.26	1.38	2.74	173.29
Belgium	50	307	21,286.79	754.73	775.96	1.22	3.23	380.10
Bulgaria	19	103	819.86	40.96	59.80	1.35	4.35	119.31
Cyprus	11	68	2,243.93	119.92	141.77	1.24	8.01	183.42
Czech Rep.	19	113	4,553.16	181.06	255.55	0.94	3.87	309.53
Denmark	89	595	5,380.41	195.63	233.58	2.00	2.99	381.29
Estonia	6	38	1,002.66	41.52	61.61	1.45	2.59	175.26
Finland	8	32	28,616.82	854.98	1,102.28	0.95	4.87	1,018.89
France	215	1,432	18,114.45	807.81	871.27	1.45	3.98	462.35
Germany	1,646	10,819	3,084.56	121.57	127.63	1.54	2.89	138.58
Greece	14	72	12,713.78	553.19	661.23	1.23	3.12	114.71
Hungary	15	98	2,259.84	175.73	228.15	2.13	5.70	706.94
Ireland	12	71	7,458.13	256.77	292.69	0.53	6.99	922.48
Italy	608	2,628	3,359.44	143.26	172.01	1.43	3.65	233.30
Latvia	21	139	837.07	38.38	50.61	1.54	2.14	174.59
Lithunia	10	65	1,275.95	53.01	69.60	1.39	2.43	139.88
Lux.	77	519	6,694.28	368.64	409.60	0.79	4.43	621.90
Malta	9	52	1,807.09	68.90	94.79	0.61	3.76	515.41
Netherlands	11	66	7,773.96	303.77	330.20	1.69	7.37	973.13
Poland	28	149	3,451.61	200.34	258.34	1.57	4.41	536.57
Portugal	17	94	11,915.08	617.42	684.99	1.00	4.85	292.25
Romania	18	130	1,348.82	103.13	126.33	2.65	4.97	178.97
Slovakia	11	57	1,353.14	67.05	79.09	0.99	3.59	283.83
Slovenia	15	70	2,016.91	97.70	119.40	1.09	3.41	108.28
Spain	162	611	13,493.34	496.27	615.51	1.06	2.53	167.99
Sweden	89	581	4,400.37	157.12	195.19	1.48	1.97	338.51
UK	56	346	7,333.41	149.11	188.14	1.78	4.01	729.25
Average	3,458	20,657	4,984.12	203.12	225.45	1.48	3.19	230.25

Table 2
Lerner indices of banks

This table displays the means of Lerner indices for each year and each country. All indices are in percentage. Evolution is the difference between the average Lerner index in 2008 and the average Lerner index in 2002.

	2002	2003	2004	2005	2006	2007	2008	Evolution
Austria	0.1066	0.1460	0.1371	0.1693	0.1322	0.1096	0.0462	-0.0605
Belgium	0.1091	0.1366	0.1410	0.1870	0.1952	0.1524	0.0890	-0.0201
Bulgaria	0.1347	0.1931	0.1962	0.2360	0.2463	0.2958	0.2185	0.0839
Cyprus	0.0045	0.0655	0.0880	0.0819	0.1111	0.1524	0.1509	0.146
Czech Rep.	0.1541	0.1201	0.1763	0.2020	0.2079	0.2217	0.2418	0.0878
Denmark	0.1962	0.2848	0.2877	0.3341	0.3266	0.2199	0.0113	-0.184
Estonia	0.2088	0.2592	0.2254	0.3329	0.3078	0.3126	0.2082	-0.0007
Finland	0.1871	0.3113	0.2701	0.1572	0.1791	0.1651	0.0444	-0.1427
France	0.1382	0.1566	0.1892	0.1862	0.1889	0.1650	0.1337	-0.0045
Germany	0.0627	0.0911	0.0913	0.1080	0.0941	0.0764	0.0528	-0.0099
Greece	0.1725	0.2904	0.1709	0.1807	0.2012	0.1464	0.0803	-0.0922
Hungary	0.1405	0.1326	0.1581	0.1826	0.1498	0.1898	0.1429	0.0024
Ireland	0.0888	0.1861	0.1752	0.1750	0.1327	0.0246	0.0515	-0.0373
Italy	0.1427	0.1179	0.1843	0.1780	0.2125	0.1961	0.1378	-0.0049
Latvia	0.2020	0.2340	0.2765	0.3060	0.2762	0.2431	0.1670	-0.0350
Lithuania	0.1486	0.1427	0.1612	0.1716	0.2061	0.2109	0.1020	-0.0467
Luxembourg	0.1148	0.1365	0.1743	0.1823	0.1844	0.1546	0.1110	-0.0038
Malta	0.1714	0.2663	0.3154	0.3804	0.2705	0.2178	0.2741	0.1027
Netherlands	0.0652	0.0894	0.1097	0.1601	0.1313	0.1152	0.0780	0.0128
Poland	0.1594	0.1325	0.2372	0.1895	0.2270	0.2160	0.1514	-0.0080
Portugal	0.2003	0.2207	0.2107	0.1300	0.1664	0.1346	0.0777	-0.1225
Romania	0.1464	0.1530	0.1638	0.1310	0.1283	0.1102	0.1333	-0.0132
Slovakia	0.0620	0.1533	0.0799	0.1230	0.1555	0.1793	0.1730	0.1110
Slovenia	0.1835	0.2029	0.2471	0.2224	0.1638	0.1741	0.0956	-0.0880
Spain	0.1305	0.2253	0.2136	0.2178	0.2257	0.1773	0.1285	-0.0020
Sweden	0.1744	0.2025	0.2646	0.4020	0.3244	0.2532	0.0799	-0.0945
UK	0.1369	0.2080	0.1796	0.1636	0.1740	0.1369	0.1141	-0.0228
EU15	0.1351	0.1869	0.1866	0.1954	0.1912	0.1485	0.0824	0.0526
New 12	0.1430	0.1713	0.1938	0.2133	0.2042	0.2103	0.1716	0.0286
EU27	0.1386	0.1799	0.1898	0.2034	0.1970	0.1760	0.1220	-0.0166

Table 3
Tests of convergence of Lerner indices

The table displays the results of the tests of β convergence and σ convergence performed at the country level. In the test of β convergence, the explained variable is $ln\ Lerner\ index_{i,t} - ln\ Lerner\ index_{i,t-1}$, with $Lerner\ index_{i,t}$ and $Lerner\ index_{i,t-1}$ the mean Lerner indices of country i respectively in year t and year t-1. In the test of σ convergence, the explained variable is $\Delta\ W_{i,t}$, in which $\Delta\ W_{i,t} = W_{i,t} - W_{i,t-1}$, $W_{i,t} = ln\ Lerner\ index_{i,t} - MLernerindex_t$, $ln\ Lerner\ index_{i,t}$ the logarithm of the Lerner index of country i in year t, and $MEFF_t$ the mean of $ln\ EFF_{i,t}$ for each period. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Country dummy variables are not reported.

	Coefficient	t-value
β convergence		
Intercept	-1.675***	5.72
ln ($Lerner\ index_{i,\ t-1}$)	-0.671***	6.87
Adjusted R^2	0.2271	
N	162	
σ convergence		
Intercept	-0.426***	2.79
$W_{i,t-1}$	-0.645***	6.98
Adjusted R^2	0.2734	
N	162	

Table 4
H-statistic for European banking industries of banks

This table displays the H-Statistic provided by the Rosse-Panzar model for each year and each country. Evolution is the difference between the H-Statistic in 2008 and the H-Statistic in 2002.

	2002	2003	2004	2005	2006	2007	2008	Evolution
Austria	0.4963	0.5924	0.7674	0.7075	0.7172	0.7622	0.8230	0.3267
Belgium	0.3982	0.5340	0.7273	0.6565	0.6385	0.7334	0.7536	0.3555
Bulgaria	0.2999	0.2800	0.3016	0.5261	0.4793	0.4924	0.4213	0.1214
Cyprus	0.7491	0.8450	0.7522	0.7516	0.7765	0.7444	0.7878	0.0386
Czech Rep.	0.4263	0.5044	0.6394	0.4929	0.4945	0.5430	0.5215	0.0952
Denmark	0.4306	0.5076	0.6669	0.5640	0.5702	0.6759	0.7525	0.3218
Estonia	0.6980	0.8026	0.8129	0.6225	0.5402	0.5285	1.0129	0.3149
Finland	-	-	0.7701	0.7470	0.6094	0.6732	0.7095	0.7095
France	0.4724	0.4997	0.7105	0.6429	0.6613	0.7214	0.7469	0.2746
Germany	0.4560	0.5179	0.7172	0.6401	0.6563	0.7369	0.7653	0.3093
Greece	-	0.9861	0.6154	0.6472	0.5500	0.6681	0.7248	0.7248
Hungary	0.3626	0.3558	0.5639	0.5567	0.5382	0.6345	0.6479	0.2853
Ireland	0.6691	0.1651	0.3414	0.2330	0.1530	0.0985	0.3442	-0.3249
Italy	0.4553	0.5634	0.6727	0.6665	0.6586	0.6944	0.7441	0.2888
Latvia	0.2667	0.4261	0.5863	0.4833	0.4574	0.5496	0.6527	0.3860
Lithuania	0.3928	0.4302	0.5884	0.4617	0.6695	0.7553	0.7221	0.3293
Luxembourg	0.4474	0.4764	0.6344	0.5652	0.5971	0.7076	0.7531	0.3056
Malta	0.1154	0.6802	0.7113	0.4592	0.6288	0.6387	0.8398	0.7244
Netherlands	0.4934	0.4565	0.7362	0.6059	0.5412	0.6609	0.8324	0.3389
Poland	0.4415	0.6835	0.6453	0.6460	0.6292	0.6476	0.6072	0.1657
Portugal	0.5166	0.5289	0.7164	0.6613	0.5982	0.6990	0.6934	0.1768
Romania	0.1850	0.4226	0.6145	0.5912	0.6344	0.7059	0.6571	0.4722
Slovakia	0.3445	0.3899	0.5215	0.4499	0.4817	0.5515	0.5189	0.1743
Slovenia	1.0097	0.5533	0.6608	0.6342	0.5769	0.7012	0.7764	-0.2332
Spain	0.4116	0.6113	0.6397	0.6664	0.7020	0.7544	0.7669	0.3552
Sweden	0.4183	0.4764	0.6992	0.5438	0.5887	0.6395	0.5672	0.1490
UK	0.4069	0.5062	0.7201	0.6397	0.6388	0.6521	0.7073	0.3005
EU15	0.4671	0.5301	0.6757	0.6125	0.5920	0.6585	0.7128	0.3047
New 12	0.4410	0.5311	0.6165	0.5563	0.5758	0.6244	0.6805	0.2395
EU27	0.4545	0.5306	0.6494	0.5875	0.5847	0.6433	0.6981	0.2773

Table 5
Tests of convergence of H-statistics

The table displays the results of the tests of β convergence and σ convergence performed at the country level. In the test of β convergence, the explained variable is $ln\ H\text{-}statistic_{i,t} - ln\ H\text{-}statistic_{i,t-1}$, with $H\text{-}statistic_{i,t}$ and $H\text{-}statistic_{i,t-1}$ the H-statistic of country i respectively in year t and year t-1. In the test of σ convergence, the explained variable is $\Delta W_{i,t}$, in which $\Delta W_{i,t} = W_{i,t} - W_{i,t-1}$, $W_{i,t} = ln\ H\text{-}statistic_{i,t} - MH\text{-}statistic_t$, $ln\ H\text{-}statistic_{i,t}$ the logarithm of the H-statistic of country i in year t, and $MH\text{-}statistic_t$ the mean of $ln\ H\text{-}statistic_{i,t}$ for each period. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Country dummy variables are not reported.

	Coefficient	t-value
β convergence		
Intercept	-0.346***	4.44
ln ($H\text{-}statistic_{i,\,t-1}$)	-0.880***	16.00
Adjusted R^2	0.6232	
N	158	
σ convergence		
Intercept	0.117**	1.98
$W_{i,t-1}$	-1.007***	19.48
Adjusted R^2	0.7165	
N	158	

Table 6
Additional Measures of Competition for European banking industries of banks

This table displays the Herfindahl index, the mean ROA, and the mean net interest margin for each year and each country. Values for the Herfindahl index come from ECB (2006, 2008, 2010). Evolution is the difference between the value in 2008 and the value in 2002 (in 2003 for Romania, in 2004 for Bulgaria).

	Herfindahl Index			ROA			Net Interest Margin		
	2002	2008	Evolution	2002	2008	Evolution	2002	2008	Evolution
Austria	0.0618	0.0454	-0.0164	0.3955	0.2749	-0.1206	2.7098	2.3601	-0.3497
Belgium	0.1905	0.1881	-0.0024	0.0692	0.1648	0.0956	1.9749	1.5533	-0.4216
Bulgaria	0.0721	0.0834	0.0834	0.9950	1.8068	0.8118	4.0250	5.0037	0.9787
Cyprus	0.0938	0.1019	0.0081	-0.0533	1.1389	1.1922	4.4250	2.9100	-1.5150
Czech Rep.	0.1199	0.1114	-0.0085	0.6467	1.0025	0.3558	2.2033	2.8781	0.6748
Denmark	0.1145	0.1229	0.0084	0.8426	-0.6023	-1.4448	4.5851	3.3944	-1.190
Estonia	0.4028	0.3120	-0.0908	1.6680	0.6360	-1.0320	3.4400	3.3900	-0.0500
Finland	0.2050	0.3160	0.1110	0.5000	0.2000	-0.3000	1.2200	1.4025	0.1825
France	0.0551	0.0681	0.0130	0.5134	0.6767	0.1633	2.5228	2.1896	-0.3332
Germany	0.0163	0.0191	0.0028	0.2227	0.2366	0.0139	2.8044	2.3784	-0.4260
Greece	0.1164	0.1172	0.0008	0.7550	-0.1747	-0.9297	3.3700	2.5467	-0.8233
Hungary	0.0856	0.0819	-0.0037	0.7246	0.3507	-0.3739	6.8554	5.2814	-1.5740
Ireland	0.0553	0.0794	0.0241	0.3533	0.6410	0.2877	1.1078	1.0820	-0.0258
Italy	0.0270	0.0344	0.0074	-0.1516	0.6314	0.7830	3.0589	3.3610	0.3022
Latvia	0.1144	0.1205	0.0061	1.1950	-0.0745	-1.2695	3.1856	3.7335	0.5479
Lithuania	0.2240	0.1714	-0.0526	0.3500	0.5389	0.1889	3.5456	2.5400	-1.0056
Lux.	0.0296	0.0278	-0.0018	0.6521	0.3965	-0.2556	0.9831	1.0897	0.1066
Malta	0.1806	0.1236	-0.0570	1.2560	-0.5629	-1.8189	0.7200	2.3371	1.6171
Netherl.	0.1788	0.2168	0.0380	0.1180	0.6313	0.5133	1.8590	1.5338	-0.3253
Poland	0.0792	0.0562	-0.0230	1.1943	-0.2766	-1.4708	6.5693	3.8881	-2.6812
Portugal	0.0963	0.1114	0.0151	1.2510	-0.4135	-1.6645	2.6930	2.9565	0.2635
Romania	0.1251	0.0922	0.0922	0.5467	-1.7650	-2.3117	9.0862	5.2469	-3.8393
Slovakia	0.1252	0.1197	-0.0055	0.6443	0.3220	-0.3223	3.5514	3.2010	-0.3504
Slovenia	0.1602	0.1268	-0.0334	1.4400	0.5873	-0.8527	4.7640	2.3200	-2.4440
Spain	0.0513	0.0497	-0.0016	-3.0390	0.5871	3.6262	2.1062	2.5040	0.3978
Sweden	0.0800	0.0953	0.0153	0.8522	-0.0247	-0.8770	3.9944	3.2704	-0.7240
UK	0.0307	0.0412	0.0105	0.3197	0.6549	0.3352	2.0124	3.1973	1.1849
EU15	0.0872	0.1022	0.0149	0.2436	0.2587	0.0151	2.4668	2.3213	-0.1455
New 12	0.1486	0.1251	-0.0235	0.8839	0.3087	-0.5753	4.3642	3.5608	-0.8034
EU27	0.1158	0.1124	-0.0052	0.5282	0.2809	-0.2473	3.3101	2.8722	-0.4379

Table 7
Tests of convergence of the additional competition measures

The table displays the results of the tests of β convergence and σ convergence performed for the country-level competition measures. We use alternatively the Herfindahl index, the ROA, and the Net Interest Margin for the competition measure. In the test of β convergence, the explained variable is $ln\ Competition_{i,t} - ln\ Competition_{i,t-1}$, with $Competition_{i,t}$ and $Competition_{i,t-1}$ the competition measure of country i respectively in year t and year t-1. In the test of σ convergence, the explained variable is $\Delta\ W_{i,t}$, in which $\Delta\ W_{i,t} = W_{i,t} - W_{i,t-1}$, $W_{i,t} = ln\ Competition_{i,t} - MCompetition_t$, $ln\ Competition_{i,t}$ the logarithm of the competition measure of country i in year t, and $MCompetition_t$ the mean of $ln\ Competition_{i,t}$ for each period. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Country dummy variables are not reported.

	Herfindahl index		ROA		Net Interest Margin	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
β convergence						
Intercept	-1.544***	5.14	-1.141***	6.08	0.791	7.52
ln ($Competition_{i,\ t-1}$)	-0.388***	5.26	-1.130***	13.03	-0.818***	11.18
Adjusted R^2	0.2265		0.5286		0.4224	
N			139		160	
σ convergence						
Intercept	-0.587***	4.81	-1.114***	5.19	0.004***	0.06
$W_{i,t-1}$	-0.374***	5.15	-1.105***	12.29	-0.842***	11.37
Adjusted R^2	0.2296		0.5073		0.4327	
N			139		160	

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