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European Bank Performance Beyond Country Borders: What Really Matters? *

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Abstract. The paper analyzes bank performance in the context of the integrated European Union market and its member countries. First, the paper investigates the technical efficiency of banks in each country sample using a Data Envelopment Analysis (DEA) model incorporating only banking variables. Then, a second DEA model is defined incorporating environmental factors together with banking variables in order to standardize the country-specific environmental conditions. Based on these models, the paper systematically analyzes the efficiency position for each of the European banking industry if average banks decide to operate in any other country. The results indicate that adverse (advantageous) environmental conditions are a positive (negative) factor for the home banking industry and being technically efficient appears to be a significant deterrence to foreign competition.

1. Introduction

In recent years, banking sectors in most European countries have been subjected to deregulatory initiatives and policy changes under the auspices of the European Union (EU). With banking integration as a goal, the European Commission implemented two banking directives, which aim to liberalize the capital movements among member countries. It is widely agreed that such initiatives will significantly affect the degree of actual and potential cross-border competition in the integrated

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banking sector.[1] Expecting a new cross border integrated environment, banking authorities at the national level initiated different liberalization processes – a gradual lifting of interest rate restrictions, credit controls and (in some cases) entry of new banks – aiming to improve bank performance, and thus better prepare for new customers and competitive markets.[2]

Following the Second Directive of the Union, the efficient banks in member countries are hopeful to use their competitive advantage in the new setting of free mobility – subject to the regulation of home country – without much difficulty. By granting a single passport for financial services, such directives provide an incentive for harmonization in the integrated market. Despite the enormous potential, the immediate effect of the Directives have been limited to increase consolidation of banks and banking markets at the local level and a modest evidence of cross-country banking mostly in retail banking.[3] This observed lack of integration of national markets could be explained by the lack of ample information available to banks to better understand their ability to transform their domestic comparative advantage or niche in foreign countries.

Given that the key objective of the EU Banking Directives has been to foster competition, the current differences in performance and productive efficiency among the banking sectors of member countries will largely determine or influence the future of the banking structure and competitive viability in the different countries. Therefore it is important to know the true differences or similarities of bank performance and efficiency among countries in order to better predict and/or prepare effectively for the cross-border market and competition.[4] Such understanding would allow individual banks to bench mark their performance and operating strategy in a foreign country.

Most international comparative analyses on bank efficiency to date have focused primarily on determining the relative differences in performances across banking industries. These papers estimate differences in efficiency across countries building a common frontier by pooling all the cross-country banks and assuming that banking efficiency disparity between countries are only due to some country-specific aspects of the banking technology.[5] In other words, the existing studies of bank

[1] See De Bandt and Davis (2000), and Molyneux, Lloyd-Williams, and Thornton (1994).

[2] The adoption of EU banking directives with their provision for mutual recognition, home country supervision and the elimination of capital requirements for branches within EU countries has also impacted the domestic competitive conditions.

[3] See Berger et al. (2000) for details on intra-EU acquisitions and domestic consolidations. Gual (1999) provides that banking competition in Europe focused mostly on variable costs would expect a process of national concentration without generating in the medium term a significant increase of EU wide concentration.

[4] Altunbas and Chakravarty (1998) stressed the importance of understanding the underlying differences in the banking structure across Europe.

[5] Berg, Førsund, Hjalmarson and Suominen (1993); Fecher and Pestieau (1993); Berg, Bukh, and Førsund (1995); Bergendahl (1995); Allen and Rai (1996); Pastor, Pérez and Quesada (1997), Bikker (1999), and Dietsch and Weill (2000).

productivity and efficiency in a cross-national scenario use a standard approach that assumes a common efficient frontier for all firms, regardless of their home country.

Some recent studies attempted to control for local differences (Pastor, Lozano-Vivas and Pastor, 1997; Dietsch and Lozano-Vivas, 2000) by introducing frontier estimates which incorporate country-specific environmental conditions that account for cross-country distinctions in demographics, regulations and economic conditions. These authors show that if such country-specific environmental conditions are not accounted for, the relative efficiency of firms is usually misstated. Recognizing the importance of such adjustments for diverse environments, this paper analyzes bank performance in the context of the integrated EU market and its member countries. Using Data Envelopment Analysis (DEA) models, this paper expands and improves on existing methodologies used in studying inter-country banking efficiency behavior by defining an approach that can successfully predict what the efficiency of institutions in one country would be if they were operating in another country. This is the first such systematic multi-country analysis of average bank efficiency which analyzes the potential cross-country performance by countries of the integrated European Union.

Overall, results show that an adverse environmental condition is the fundamental deterrent to cross-country banking activities. Moreover, evidence confirms the expectation that being technically efficient is an effective strategy to deter foreign competition. Banks in some of the sample countries – Spain, Denmark, and Portugal – are found to be more suitable to perform well if they decide to move to other European countries. However, it would be harder for banks from other countries to achieve similar prosperity operating in Spain, Portugal or Denmark due to the adverse local environmental conditions.

The paper is structured as follows: Section 2 describes the literature on efficiency of foreign banks and cross-country comparisons. Section 3 presents the methodology that predicts the mean cross-border efficiency behavior of European banks. The description of the data and the specification of variables are reported in Section 4. Section 5 presents the empirical results followed by the conclusions in section 6.

2. Relevant Literature

The X-efficiency literature on cross-country comparisons of banking institutions has two perspectives. One deals with comparison of foreign-owned banks with domestic-owned banks in the context of a single country. The other concentrates on cross-country comparisons among banking institutions. In the first category, the local business environmental factors are ignored as banks compete in the same market within the country. Most of the studies in the literature under this category are based on the U.S. market, and compare domestic-owned and foreign-owned banks (Hasan and Hunter, 1996; Mahajan, Rangan and Zardkoohi, 1996; DeYoung and Nolle, 1996; Chang, Hasan and Hunter, 1998; Peek, Rosengren, and Kasirye, 1999).

Overall evidence portrays foreign-owned banks as relatively less efficient compared to their domestic counterparts. These papers concluded that in general the foreign banks' capacity to transfer their unique ability and management skills in a different country is outperformed by the advantages associated with performing business in the home country. However, these findings are not uniform for similar comparisons in non-U.S. settings. Comparing acquiring institutions in Europe, Vander Vennet (1996) did not find significant differences in cost efficiency between foreign-owned and domestic-owned institutions involved in such transactions. The author further reported that over the period, foreign-owned banks tend to grow as more efficient institutions. Once adjusted for production technology differences (Mester, 1993), by estimating separate frontiers for foreign-owned and domestic-owned banking institutions in Spain, Hasan and Lozano-Vivas (1998) found no significant differences between the two groups.

Berger et al. (2000) extended this literature by comparing foreign-owned and domestic-owned banks in several countries. Their paper stresses the importance of disaggregated and separate frontier estimations based on the nations of origin. Evidence indicates no clear-cut dominance – "home field advantage" – for local banks relative to the foreign banks' ability – "global advantage" – to transfer their unique management efficiency abroad. An in-depth analysis of banks by foreign nation of origin portrays mixed results where foreign-owned and domestic-owned banks both outperform each other under some categories or groupings.

In the second category of this literature, most papers focus on the efficiency of banks in multi-country comparisons. These papers trace variability in bank performance across nations by setting a common frontier for all institutions. This assumes that any differences in efficiency between countries can be explained by country-specific banking technology (Fecher and Pestieau, 1993; Berg, Førsung, Hjalmarsson and Suominen, 1993; Berg, Bukh and Førsund, 1995; Allen and Rai, 1996; Ruthenberg and Elias, 1996; Pastor, Perez and Quesada, 1997; Bikker, 1999; Sheldon, 2001). Most of these studies are based on European institutions. However, the results did not produce any definite evidence or trends of bank efficiency of European nations. As mentioned earlier, these initiatives also did not adjust for country specific local environmental conditions or norms.

Recently, Dietsch and Lozano-Vivas (2000) analyzed banking sectors in France and Spain and defined a common frontier that incorporates the country-specific environmental conditions. The authors pointed out that the standard approach could misstate the relative efficiency of firms from different countries, because it does not account for cross-country differences in demographic, regulation and economic conditions that are beyond the control of firm managers. They also show how efficiency scores obtained from the standard approach are artificially low (high) for firms that operate under bad (good) home country conditions. Following a similar approach, this paper extends and improves on existing methodologies used in inter-country banking efficiency studies by defining an approach that can successfully predict the efficiency behavior (scores) of the average bank from one country 'i' when it is assumed to be operating in another country 'j'.

3. Methodological Issue

To predict the cross-country efficiency behavior (scores) of banks,[6] first we attempt to define the efficiency of each country's banking industry in a cross-national scenario.

At first, we evaluate the technical efficiency of the banking industry of different countries by means of a DEA model. Initially, we consider 'n' basic banking inputs and 'm' basic banking outputs for each bank and apply the Banker, Charnes, and Cooper (1984) input-oriented model, BCC. The mathematical formulation of this model is

$$\begin{array}{ll} \underset{\theta,\,\tau}{\text{Min}}\ \theta \text{ subject to} & Y\tau \geq Y_0 \\ & X\tau \leq \theta\, X_0 \\ & e\tau = 1 \\ & \tau \geq 0_n, \end{array}$$

where Y is the matrix of output-vector; X is the matrix of input-vector; (X_0, Y_0) is the unit being rated; e denotes a row-vector of 1's; θ is the vector of intensity variables; and θ is the so called efficiency score, a quantity between 0 and 1. θ lower than 1 implies that a proportional reduction of all inputs is needed in order to reach the efficient frontier. This reduction is exactly given by $(1-\theta)X_0$, which means that the projected unit given by $(\theta X_0, Y_0)$ is efficient in the sense of Debreu-Farrell or DEA weakly efficient. No further radial reduction of all inputs is possible given the present amount of outputs. It is possible that, in order to be Koopmans – or DEA – efficient, further individual reduction in some inputs and/or augmentation in some outputs is needed. To evaluate these mix-inefficiencies we need to resort to a more complex BCC model, where a non-Archimedean element in the objective function is multiplied by the sum of the slack variables. However, if the slack variables are not important, we do not need to further pursue this model.[7] This first defined model is called the "basic DEA" model.

The model so far incorporates only banking variables; thus the efficiency measure which we call "basic efficiency" reflects a bias with regards to the technical efficiency of banks. This means that in cross-country comparison, the efficiency measure continues to be influenced by the environmental conditions of a bank's respective country. Let us denote by 'i' and 'j' the sub-indexes associated with two

[6] Cross-country banking activity means average bank from one country to be operating in another country. Actually, we calculate the average of the efficiency scores of the banks of each country, which we call the efficiency behavior (score) of the average bank.

[7] This is exactly what happens with the data in this paper – the amount of any slack value is always less than 5% of the corresponding variable value.

specific countries, and let θ_{ib} denotes the basic efficiency score associated with country 'i'. As said before, the score θ_{ib} is the average of the scores associated with the banks of country 'i'.

In a second stage, a model called "complete DEA" model is developed in order to disentangle the pure technical efficiency component from the effect of the environmental factors in the respective countries. Following Dietsch and Lozano-Vivas (2000), we define a common frontier that accounts for differences in cross-country banking technology as well as for differences in country-specific environmental conditions. Since the regulatory and economic environmental conditions banks face are very different in each country, the proper comparison of banking efficiency across countries requires the definition of a common frontier incorporating environmental conditions. Therefore, banks in each country would be compared against the same standard. This complete model considers both the basic banking variables and the environmental factors as inputs and outputs.[8]

There are several ways to evaluate the influence of environmental variables in a DEA framework (see Rouse, 1996). Here, we propose the simplest method of considering environmental factors in DEA. That is, we incorporate environmental variables directly into the "basic DEA" model. It is known that adding variables to the DEA model raises the efficiency scores; our method of adding each environmental factor guarantees that only the efficiency scores of banks from countries with bad environmental conditions can change. This approach has a pre-requisite: we have to know in advance the type of influence of each environmental variable on the efficiency scores. In other words, each uncontrolled factor has a known orientated influence.

To consider the environmental variables as inputs or outputs of our model we just reverse their conditions: for example, if a given environmental variable is an input type variable ("less means better") we consider it as an output in our model (see Cooper and Pastor, 1996). Moreover, all environmental variables are treated as non-discretionary variables (Banker and Morey, 1986). The mathematical formulation of this model is

$$\begin{array}{ll} \underset{\theta,\,\tau}{\text{Min }\theta} \text{ subject to} & Y\tau \geq Y_0 \\ & Z\tau \geq Z_0 \\ & X\tau \leq \theta\, X_0 \\ & e\tau = 1 \\ & \tau \geq 0_n, \end{array}$$

where Z denotes the matrix of selected environmental variables, and Z_0 is the corresponding vector of the unit being rated. Note that we consider all the environmental variables on the output side. This is because any non-discretionary input

[8] In the DEA literature although non-discretionary variables are either inputs or outputs of the DEA model, they are never considered as inputs or outputs of the production process. The role of the non-discretionary variables is only to constrain the comparison set. Moreover, any variable which is not an input or an output of the production process must be considered as a non-discretionary variable.

can be transformed into a non-discretionary output just by reversing its sign and translating it (see Pastor, 1996). The results obtained from this model give us the "pure technical efficiency" of each country 'i', θ_{ic}. Again, θ_{ic} is the average of the efficiency scores of the banks of country i.

Based on these two models, we propose the following methodology to undertake a systematic analysis of the efficiency position for each European Banking industry if average banks decide to operate in any other foreign country. Since the basic and the complete models constitute two nested DEA models, it is well known that $\theta_{ib} \leq \theta_{ic}$. In fact we can write $\theta_{ib} = \lambda_i(\theta_{ic})$, with λ_i being a positive number less or equal than 1 which accounts for the "negative" influence exerted by the environmental conditions of country 'i' on the pure technical efficiency score. If all countries would have the same environmental conditions, then their underlying banking systems could be compared on an equal footing, that is, by means of θ_{ib}. Since this is obviously not the case, we have to resort to the pure technical efficiency score of any average bank, and modify it according to the environmental conditions of any other country. Therefore, we are able to predict the efficiency behavior of the average bank from country 'i' if it would operate in country 'j'. In fact, the average basic efficiency score, which would correspond to the average bank from country 'i' if it would operate in country 'j', is given by the product $\lambda_j(\theta_{ic})$.

The main methodology used in this paper is DEA. Being a deterministic non-parametric approach, using DEA does have some drawbacks however it also has major advantages. DEA is unable to measure any error term but on the other hand it does not need to specify any functional form for the frontier. The alternative approach to DEA is to resort to a parametric frontier approach. Here the specification of a functional form for the frontier is required, as well as certain distributional assumptions on the error term and on the inefficiency residual component. Hence, the parametric stochastic frontier approach is able to measure separately the noisy term and the technical inefficiency, but at the expense of fixing a functional form beforehand. Since neither approach strictly dominates the other, we have also considered the stochastic frontier approach in order to check the consistency of the efficiency results obtained in main primal analysis.[9]

[9] We have developed two alternative parametric models. The first one adjusts a cost frontier considering only the basic banking variables, i.e., the inputs and outputs of our basic DEA model. The second model considers the basic variables together with the environmental variables, i.e., the inputs and outputs of the complete DEA model. Comparing the parametric results with the DEA results it is worth noting several features. First, the corresponding efficiency scores of both pair of models are highly correlated, over 0.71 in any case. Second, if we rank the countries in terms of the improvement in the efficiency scores, the obtained correlation between DEA and SFA is 0.95.

4. Data and Variables

Data. In our empirical study we use 1993 data of 10 European banking industries for the definition and selection of the banking outputs and inputs. The data were obtained from the BankScope International Bank Database. The lack of a consistent and accurate data on labor across countries imposes certain restrictions on the ability to obtain a homogenous sample of domestic and international banks in terms of specialization. In our comparison we consider a sample of commercial banks in each country.

We analyze the banking industries of Belgium, Denmark, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Spain and the United Kingdom (UK). Our study is limited to these countries due to the scarcity of accurate data for a number of countries and for certain samples of banks.[10] As a result, after carefully checking the data for consistency, we have usable data for 612 commercial banks belonging to 10 European countries: 24 Belgian, 29 Danish, 150 French, 203 German, 26 Italian, 68 Luxemburgian, 22 Dutch, 17 Portuguese, 28 Spanish and 45 British institutions.

The data for the definition of the environmental variables were gathered from *Bank Profitability and Main Economic Indicators* (OECD), *Eurostat* (Money and Finance), *Anuario Estadístico del Instituto Nacional de Estadística* (INE) and *Boletín del Banco de España.* All variables presented in value terms of local currencies were converted into a common currency (U.S. dollar) using the purchasing power parity hypothesis.

Input and output variables. There has been considerable disagreement regarding the definition of outputs in the banking literature. Here, we follow the value-added approach (Berger and Humphrey, 1992) to identify bank outputs. In the value-added approach, deposits as well as assets are considered to have some output characteristics. That is, deposit provides transaction and safekeeping output services and also adds to input costs. In a value-added context, deposits typically account for over half of all capital and labor expenses at banks and so, in this sense, output services are clearly being produced. The application of the value added approach uses operating cost data to identify the major categories of asset and liabilities that are output. We have applied this approach to our data sample and the results obtained show that deposits and loans produced account for 79.74% while other assets account for 17.04% of value added in our banking sample. Accordingly, we specify three outputs: y_1 = loans, y_2 = deposits,[11] and y_3 =other earning assets.[12] We further consider labor and physical capital as inputs. Due to

[10] The selected sample can be considered as representative, given that it includes almost all the banks classified as commercial banks in IBCA Ltd. database.

[11] Deposits were defined as produced deposits (the sum of demand, savings, time, and other deposits).

[12] Earning assets were defined as the sum of all existing deposits with banks as well as short-term and other investments.

lack of direct measures, these input variables are represented by appropriated proxy variables: x_1 = personnel expenses composed of all costs associated with employee wages and related expenses, and x_2 = non-interest expenses excluding personnel expenses. So, we represent a structural model for multiproduct banking firms using labor and physical capital as inputs needed to produce asset categories and deposits as outputs.

Table I reports the average bank input and output values of sample countries standardized in a common currency, $US, in 1993. We observe differences in the average values of portfolio loans and deposits across countries. However, values are higher for deposits than for portfolio loans. A comparison of the differences between the maximum and minimum average value of deposits with the differences between the maximum and minimum average value of loan portfolios shows that the former is almost 40% higher than the latter.

Environmental variables. The environmental variables used in this paper are macroeconomic variables explaining the nationwide features of the banking industry of each country. These features include economic conditions, accessibility to banking services and regulatory conditions.[13] Hence, the environmental variables are measured at the country level, so that they reflect the specific country conditions of the environment where the banks of each country are operating in.

The first environmental variable, income per capita, or IC, of a country, is defined as the ratio between Gross National Product (in 1993 US$) over the number of inhabitants. IC affects numerous factors related to the demand and supply of banking services (mainly deposits and loans). Countries with higher IC are assumed to have a banking system operating in a mature environment and resulting in more competitive interest rates and profit margins. At the same time, these mature banking systems are likely to exert more activity. The second environmental factor, SC, or salary per capita (expressed in 1993 US$), is an indicator of each country's economic performance. It is reasonable to hypothesize that higher level of labor expense in one country indicates a less riskier environment. By riskier environment we mean that the economy as a whole may have a non-regular behavior. In this context it is reasonable to expect that higher salary per capita imply higher savings and so more opportunity for banking business which should improve bank efficiency.

The third factor, population density, or PD, is measured by the ratio of inhabitants per square kilometer. This variable measures the characteristics of the demand for banking products. For example, population density determines the strategies banks choose concerning the location of branches and it affects the bank costs through the supply of banking services. Banking industries in a country with a lower density of population are likely to incur higher operating costs, which implies

[13] It is necessary to point out that our primary goal here is not to focus on a micro level performance perspective but to determine the national average efficiency levels. This explains the nature of the considered environmental variables.

Table I. Summary statistic for banking outputs and inputs (1993)

	Belgium	Denmark	France	Germany	Italy	Luxembourg	Netherlands	Portugal	Spain	U.K.
Outputs										
y_1 = Loans	4588392.3	1964163.5	5256541.3	2860965.8	16967317.9	750671.1	5096565.8	2265049.4	6401894.6	1859216.7
y_2 = Deposits	11747008.6	3320735.6	9082831.4	3539048.8	25327940.3	2907620.6	6846185.1	4919924.3	13208616.7	3115273.9
y_3 = Other earning assets	7800801.6	1757720.8	5274525.1	2048662.5	12810940.3	2419358.9	2741402.5	2480336.5	7531540.3	1594990.9
Inputs										
x_1 = Personnel expenses	84994.4	39376.7	100692.7	40386.7	344562.3	10121.3	93797.1	86072.1	165255.2	55453.6
x_2 = Non-interest expenses	141244.3	58311.6	131495.7	64924.3	491656.1	10769.5	100096.4	89420.4	245397.2	58934.9

higher expenses for bank intermediation. The fourth factor, density of demand, or DD, is measured by the ratio of deposits (measured in 1993 US$) per square kilometer, is assumed to be a relevant feature in determining bank efficiency. Banks, which operate in markets with a lower density of demand, incur higher expenses and may cause to deter the potential of attainable efficiency level by banks and its branches.

The above four environmental variables reflect the main economic conditions in which banks exert their activities. Additionally, we define a set of environmental variables that refer to the accessibility of banking services for customers. Income per branch, IB, and deposit per branch, DB, both expressed in 1993 US$, are considered usual measures of the relative efficiency of banking industries. Countries with a higher national income per branch are assumed to have a banking system with higher chance to exert more activity. We assume that the higher the bank's IB or DB, the higher the banking efficiency levels will be. Branches per capita, BC, are an indicator of banking services. High levels of BC imply high costs of providing banking services.[14] Additionally, the variable called branch density, BD, is defined as the number of branches per square kilometer, and is an indicator of the space dimension for each national market.[15] High levels of BD indicate over dimension of the banking network and high operating banking costs, which should reduce banking efficiency.

Finally, we use the average capital and profitability ratios as indicators of regulatory and competitive conditions, respectively, of a country's banking industry. The average capital ratio is used as a proxy for regulatory conditions and is measured by equity over total assets (both in 1993 US$), EOTA. Usually, a lower EOTA leads to lower efficiency levels, because less equity implies higher risk taken and greater leverage. It is assumed that well-capitalized banks will be more efficient.[16] Finally, the profitability ratio is defined as average return over equity, ROE, and is used as an indicator of the competitiveness in each banking industry. The predicted relationship between ROE and efficiency is positive in a competitive scenario, i.e. the larger the profits, the higher the efficiency.

The use of environmental factors within DEA models requires knowledge of the influence of the environmental variables on the efficiency scores. If we presume that the higher (lower) the value of an environmental variable, the higher (lower) the efficiency scores from the complete model, then we can say that the environmental variable is an output type variable. On the other hand, if the opposite relationship holds, we say that the environmental variable is an input type

[14] The variable BC has been defined as branch per 10,000 inhabitants.

[15] See Fuentelsaz and Salas (1992).

[16] Even though the banks can control equity capital ratio, a high part of this ratio is controlled exogeneously since it has to be accommodated to the regulatory restrictions at the national and European level. Capital requirements have been the primary tools that the European regulatory authorities sought to control risk, using it as prudential regulation. Moreover, in order to maintain solvency of the banking sector while preventing moral hazard, regulators have resorted to increase capital requirements.

variable.[17] According to the above revision of the environmental factors, IC, SC, PD, DD, IB, DB, EOTA, and ROE are classified as output type variables, while BC and BD are considered as input type variables. We have been able to confirm our classification of the environmental factors by means of our complete parametric model. The parametric results show that the influence of these variables is in line with our previous reasoning. Following Cooper and Pastor (1996), the first 8 environmental factors must be introduced as non-discretionary inputs and the last 2 factors as non-discretionary outputs in a DEA model.

In order to define the complete model, first, we consider the whole set of 10 environmental variables. We implement a forward procedure (Pastor et al., 2001) in order to incorporate only the influential environmental variables into our basic model. This procedure concludes that DD, EOTA, IB, and SC, are the pertinent influential environmental variables in the complete model. Consequently, in total, the complete model contains 9 variables that include 2 basic inputs, 3 basic outputs and 4 more non-discretionary inputs corresponding to the above environmental variables DD, EOTA, IB and SC.[18] Interestingly, in the estimation of the common cost frontier the only environmental variables with statistically significant coefficients are the four variables judged as influential by the DEA analysis.

Table II contains the average value of the influential environmental variables. Overall, the values of these variables suggest large differences among countries in terms of the particular economic, banking accessibility, and regulatory conditions. Particularly, Luxembourg has high levels of salary per capita and density of demand. However, Portugal and Spain have the lowest level of these main economic conditions. Thus, it may be harder to perform banking activities in Portugal or Spain than in Luxembourg. In terms of the variables which refer to the accessibility of banking services for customers, Belgium and Spain appear to have conditions requiring high levels of bank operating costs given the level of accessibility of banking services for customers. Finally, the mean value of the capital ratio shows that there are important differences among countries in terms of particular solvency constrains imposed by the banking authorities of each country.

5. Empirical Results

We start our empirical exercise by defining a common frontier based on the standard approach, i.e., building a common frontier by pooling the data set of the banks of all countries and considering a DEA model with 2 banking inputs and 3 banking outputs. This approach does not incorporate the country-specific environmental conditions of the respective countries. Table III reports the bank efficiency scores

[17] We use the environmental variables as categorical variables in our DEA model. Therefore, those variables are organized as follows: a categorical input of the model corresponds to an output-factor. For the analysis of categorical variables in DEA see Banker and Morey (1986).

[18] The results of implementing this procedure are contained in Pastor, Lozano-Vivas, and Pastor (1997).

Table II. Summary statistic for the selected environmental variables by country, 1993

Country	SC	DD	IB	EOTA
Belgium	30759	5.1403	0.0088	0.0398
Denmark	20617	1.3945	0.0320	0.0593
France	26964	0.9689	0.0328	0.0427
Germany	24197	3.2902	0.0256	0.0430
Italy	27038	1.5369	0.0317	0.0944
Luxembourg	28925	55.149	0.0324	0.0326
Netherlands	27588	5.6392	0.0296	0.0428
Portugal	13425	0.5611	0.0329	0.1437
Spain	23022	0.6538	0.0120	0.0962
U.K.	23107	1.9059	0.0689	0.0395

for each of the sample countries by using the basic model. The results show that Luxembourg gets the highest average basic efficiency scores (around 49.5%) and Portugal and Spain post the lowest scores, 15.19% and 18.9%, respectively. Banks from Portugal and Spain are, in accordance with conventional wisdom, the least frontier efficient countries according to the basic model. The cross-country banking comparison literature however provides evidence that strong economic environment, severe local regulation, and so on, may deeply affect such performance indicators by countries. This suggests that a proper comparison of banking efficiency across countries requires the use of a common frontier that incorporate environmental conditions so that sample banks from different countries can be compared against the same standard.

To properly define a common frontier, potential differences explained by the environmental factors should be accounted for. As pointed out before, we implemented a forward procedure in order to incorporate only the influential environmental variables into our basic DEA model. In the first step, the most influential environmental variable, if any, is incorporated into the basic model. To perform this task we have to compare the efficiency scores of the basic model with the efficiency scores of each of the 10 new models obtained by incorporating to the basic model one of the 10 considered environmental variables. In this way we get the first "extended" model. In the second step, the most influential of the 9 remaining environmental variables, if any, is again incorporated to the last extended model. The procedure stops in the step where, for the first time, none of the outer environmental variables are influential. Only DD, EOTA, IB and SC were selected, in this order, as pertinent influential environmental variables (for further details, see Pastor et al. (1997)). Consequently, in total, the complete DEA model contains 9 variables, namely 2 basic inputs, 3 basic outputs and 4 more non-discretionary

Table III. Basic efficiency scores

Country	Average θ_{ib}	Std.
Belgium	42.20	28.47
Denmark	19.91	13.86
France	24.23	24.26
Germany	26.67	18.49
Italy	25.43	19.98
Luxembourg	49.49	25.67
Netherlands	37.38	25.32
Portugal	15.99	15.63
Spain	18.91	15.06
U.K.	22.08	20.85

inputs corresponding to the above environmental variables. We present the results of our complete DEA model in Table IV where the average pure technical efficiency score for each country as well as its standard deviation is reported.[19] When we introduce these variables into the model, the average efficiency scores improve markedly in almost all the countries with respect to the average efficiency scores of the basic model (Table III). Moreover, comparison of the new results with the average basic efficiency scores of Table III shows that the worse the country-specific conditions the more improvement in the average efficiency scores. The same holds when the stochastic frontier approach is used. For example, by observing the average rank position of the countries in terms of the environmental conditions (Table II) Luxembourg, the Netherlands, Italy and Belgium take the first, second, third and fourth places, respectively. The average improvement in their efficiency scores is around 12%. However, Denmark and Spain, ranked at the bottom, obtain an improvement of around 60% in their average efficiency scores.[20] On average, these results point out that unlike basic efficiency, the pure technical efficiency allows to conduct an appropriate comparison of performances across countries on an equal footing.

By obtaining the coefficient of variation in the efficiency scores of the banks in our sample, we observe that the dispersion of efficiency across banks is 0.824 (0.498) when the common frontier excludes (includes) environmental conditions.

[19] These results are consistent with the efficiency levels obtained using the common cost frontier with and without environmental variables. The efficiency levels using the stochastic frontier approach and the DEA approach are strongly correlated, as said before.

[20] Ranking the countries in terms of the improvement in efficiency from the common frontier with environmental variables versus without environmental variables we obtained that the correlation between ranks using the DEA vs. SFA is 0.95, as said before.

Table IV. Pure technical efficiency scores

Country	Average θ_{ic}	Std.
Belgium	79.32	25.50
Denmark	75.45	15.79
France	40.98	27.85
Germany	57.87	24.11
Italy	33.10	22.20
Luxembourg	62.30	23.58
Netherlands	51.75	27.35
Portugal	79.87	21.99
Spain	82.14	14.93
U.K.	58.65	30.15

Combining this finding with previous results, two important features are notable when environmental conditions are accounted for: (i) measured efficiency rises, and (ii) environmental variables decrease the efficiency differential across banks. This further confirms that environmental factors are decisive in explaining efficiency differences across national banking sectors. It is worth highlighting that although environmental factor-adjusted common frontier facilitates similar standards across countries however it cannot standardize management indulgence for inefficiency within and across banking sectors. So, it is quite possible to obtain a more homogenous group of banks across countries than within countries. Indeed, that is likely to depend on the degree of integration of the national banking markets in Europe. Our evidence in the complete model portrays, on average, that banking markets that are more integrated[21] tend to be more frontier efficient. This finding is consistent with Sheldon (2001) and supports the notion that increased integration and hence competition increases efficiency.

After obtaining the average basic and pure technical efficiency scores for each country, we focused on determining the cross-country bank efficiency, i.e., efficiency when the average countries' bank decides to operate in other territory. Following the methodology described in section 3, we obtain the efficiency scores of the average banks of a particular country in any other foreign country. Table V presents the results of the basic efficiency of the average bank of each country in any of the sample countries.

[21] National banking markets should be more highly integrated whether the efficiency dispersion (coefficient of variation) across banks within a country is below the efficiency dispersion across banks between countries banks, Sheldon, 2001.

Table V. Efficiency of the average banks in any of the sample countries

Movement of the banks to country j	Belgium $\lambda_j = 1/1.88$	Denmark $\lambda_j = 1/3.79$	France $\lambda_j = 1/1.69$	Germany $\lambda_j = 1/2.17$	Italy $\lambda_j = 1/1.30$	Luxembourg $\lambda_j = 1/1.26$	Netherlands $\lambda_j = 1/1.38$	Portugal $\lambda_j = 1/4.99$	Spain $\lambda_j = 1/4.34$	U.K. $\lambda_j = 1/2.66$
Belgium	**42.20**	20.93	46.90	36.56	60.94	63.01	57.29	15.88	18.26	29.86
Denmark	40.14	**19.91**	44.61	34.77	57.97	59.94	54.50	15.11	17.37	28.40
France	21.80	10.81	**24.23**	18.89	31.48	32.55	29.60	8.20	9.43	15.43
Germany	30.79	15.27	34.22	**26.67**	44.46	45.97	41.80	11.59	13.32	21.79
Italy	17.61	8.73	19.57	15.25	**25.43**	26.29	23.91	6.63	7.62	12.46
Luxembourg	33.14	16.44	36.84	28.71	47.86	**49.49**	45.00	12.47	14.34	23.45
Netherlands	27.53	13.66	30.60	23.85	39.76	41.11	**37.38**	10.36	11.91	19.48
Portugal	42.49	21.08	47.22	36.81	61.36	63.45	57.69	**15.99**	18.39	30.07
Spain	43.70	21.68	48.57	37.86	63.11	65.25	59.33	16.44	**18.91**	30.92
U.K.	31.20	15.48	34.68	27.03	45.06	46.59	42.36	11.74	13.50	**22.08**

The diagonal of Table V represents the average efficiency scores for each country's banking industry operating in its own market, given their particular environmental conditions, i.e., the average basic efficiency scores. The column estimates show the potential efficiency of other average countries' banks operating in the column country. For example, the second column of the table depicts the basic efficiency score of the Belgian average bank in Belgium and the efficiency scores that average banks from any other country would get if they decided to focus their banking activity in Belgium.

From Table V, columns 3, 9 and 10 show the lowest efficiency score levels. Since such columns contain information about the average efficiency score levels that any European country will reach if it operates banks in Denmark, Portugal or Spain, respectively, these results suggest that to establish banking activity in Denmark, Portugal or Spain, may apparently be difficult for any European country. This difficulty is due to the adverse environmental conditions that are prevalent in these countries. Additionally, it seems that on average the Belgian, Danish, Portuguese and Spanish banks have the highest average efficiency scores across countries, while Italy and France have the lowest scores across the board.[22] It is worth noting here that once the different banking systems are compared on an equal footing, i.e., it accounts for cross-country differences in regulation, economic and demographic conditions, there is a change in the average country's efficiency scores, where the intensity of the change depends on the average country-specific conditions. In this sense, since the worst country-specific conditions were found in Portugal and Spain, the banks in these countries are likely to become the highest efficiency score improvement.

Overall, we are able to distinguish three different results portrayed by combining the information from Tables IV and V. (i) Countries with adverse environmental conditions for banking business (given the low value that λ_j takes) whose banks reach high levels of average pure technical efficiency. Such is the case of Portugal, Spain, and Denmark. (ii) Countries with advantageous environmental conditions (high value of λ_j) but with a banking sector performing not efficiently on the home front, e.g., Italy and France. (iii) Finally, countries with good environmental conditions whose banking industries also operate with high pure technical efficiency levels, e.g., Luxembourg, Belgium, Germany, and the Netherlands.[23]

The first case reveals that if an average bank from any of the European countries decide to perform banking activities in Portugal, Spain or Denmark, it will operate with lower average basic efficiency level relative to its own basic efficiency level in

[22] It is important to note that the efficiency scores obtained are based on estimates where loans, deposits and other earning assets are considered as banking outputs. Given the availability of data, this is a detailed and appropriate measure of banking outputs.

[23] It is worth noting here that, in our analysis, technical efficiency and country-specific environmental conditions are considered to be the deciding factors for bank movements from one country to the other. However, there could be alternative factors, not discussed here because they are out of the goal of the present paper, such as entry into new product lines, regulatory arbitrage, etc, that could very well motivate banks to move to other countries.

the domestic market. This result suggests that an adverse environmental condition could be acting as a barrier against the cross-border of foreign countries.

In the second case, we observe that in terms of basic efficiency scores, Italian and French average banks are dominated in their own domestic markets by other European banks. This suggests that advantageous environmental conditions are helpful for superior banking activity but does not guarantee a better performance of domestic banks. In this case more competition can be expected in the future.

Finally, the third case suggests that advantageous environmental conditions in countries like Luxembourg, the Netherlands, Belgium or Germany provide opportunities for foreign banks to perform efficiently on their own turf. However, the efficiency level of home banking industries dominates the banking industries involved in cross-border activities only in the cases where the home banking industry account with higher pure technical efficiency than the foreign banking industries. Given our evidence shows that banking markets that are more frontier efficient are also more integrated, it is apparent that being technically efficient and building increased national market integration is an effective strategy to deter foreign competition.

Additionally, we re-calculated basic and pure efficiency scores including risk in our analysis as recent evidence in the literature rightly indicates that the failure to incorporate risk results in bias estimates of the efficiency scores of banks. Consistent with Sheldon (2001), once accounted for risk, both the basic and pure efficiency models posted higher scores. However, the relative efficiency ranking among sample countries as well as the differences between basic and pure efficiency scores between countries (measured by λ_i) in our sample remained almost unchanged. This suggests that the differences in pure efficiency with respect to basic efficiency between countries in our sample are more influenced by the country-specific environmental conditions rather than the risk preference choice of banks.

As we analyzed the cross-country average bank efficiency scores among European banks when they decide to operate in each other's territory, we also recognize the importance of understanding and investigating the individual influence of the factors associated with environmental conditions. In other words, understanding the marginal influence of environmental variables allow us to obtain pure technical efficiency levels across borders.

The procedure used for selecting the environmental variables permits us to determine the influence exerted by each of the variables in the banking performance. Table VI contains such information, where the value of λ_j by column gives information about the accumulate influence of environmental variables in each particular country. We observe that each environmental variable seems to play a particular role in the improvement of the average efficiency score of each country. For example the environmental variable DD is the one which exercises a more negative influence in the environment of Luxembourg and the Netherlands. However, for Belgium, France, Italy, Portugal, Spain and U.K. this role is played by variable IB.

On the other hand, EOTA only influences strongly the UK, while the last introduced variable SC is a major factor for Denmark and Germany.

Under these scenarios, we investigate how each of these variables affects the performance of average banks in foreign countries. Tables VII, VIII and IX contain such information. A pure technical efficiency score, resulting from the introduction of environmental variables in stages, is reported at the bottom of each table. Each column corresponds to a particular country and the efficiency scores in the column represent the potential efficiency changes of countries (in the row) operating in the column country while each environmental variable is taking into account. For instance, column 2 corresponds to Belgium in these tables. We notice that given a favorable local environmental condition and high pure technical efficiency of average Belgian banks, the efficiency level of Belgium banking industry is dominated only by the foreign banking industries that account with higher pure technical efficiency. The same is true for Luxembourg and the Netherlands. However, if we observe the columns corresponding to France and Italy (Tables VII, VIII and IX), we find that the average banks in these two nations are dominated by other European banking industries in terms of basic efficiency scores in their own domestic markets. This is true even after accounting for the significant environmental conditions, IB, which plays the most important role in determining the performance of these two banking industries. This means that the French and Italian banking industries are not performing efficiently in their own home front. Finally, the column corresponding to Spain and Portugal in Table VII shows that the average Spanish and Portuguese banks are dominated by any other European banking industry in the sample. However once the most influential environmental variables are taking into account, Tables VIII and IX, the opposite results are obtained.

Interestingly, the environmental variables which seem to play the most important role in explaining the cross country efficiency behavior are related to the main economic conditions and the accessibility of banking services of each country. This suggests that for cross-border competition in Europe, banks would need important adjustments in their behavior to compete with local banking institutions.

6. Conclusion

The increased intra-national and cross-border consolidations of financial intermediaries around the world have attracted the attention of policy makers, researchers, and managers regarding the competitive status, strategy and performance among institutions in the new environment. Such an issue is more pertinent in the European context given all the recent initiatives undertaken for an integrated and harmonized Union. Most cross-country comparisons of bank performance to date have ignored the existence of unique economic, regulatory, supervisory, and demographic, (i.e., environmental) conditions in each country in evaluating relative bank performance.

This paper takes a systematic and detailed empirical initiative to quantify bank efficiency conditions for each European banking industry if it begins to operate in

Table VI. Influence exerted by each environmental conditions of country "i" (λ_j) in pure efficiency

	Belgium	Denmark	France	Germany	Italy	Luxembourg	Netherlands	Portugal	Spain	UK
DD	1/1.14	1/1.66	1/1.28	1/1.46	1/1.03	1/1.19	1/1.23	1/1.31	1/1.33	1/1.27
DD + IB	1/1.88	1/1.86	1/1.62	1/1.69	1/1.30	1/1.19	1/1.38	1/4.97	1/4.21	1/1.57
DD + IB + EOTA	1/1.88	1/1.87	1/1.69	1/1.70	1/1.30	1/1.26	1/1.38	1/4.97	1/4.32	1/2.66
DD + IB + EOTA + SC	1/1.88	1/3.79	1/1.69	1/2.17	1/1.30	1/1.26	1/1.38	1/4.99	1/4.34	1/2.66

Table VII. Efficiency of the banks in foreign countries under the influence of DD environment

Movement of the banks to country j	Belgium $\lambda_j = 1/1.14$	Denmark $\lambda_j = 1/1.66$	France $\lambda_j = 1/1.28$	Germany $\lambda_j = 1/1.46$	Italy $\lambda_j = 1/1.03$	Luxembourg $\lambda_j = 1/1.19$	Netherlands $\lambda_j = 1/1.23$	Portugal $\lambda_j = 1/1.31$	Spain $\lambda_j = 1/1.33$	U.K. $\lambda_j = 1/1.27$
Belgium	42.20	29.03	37.65	33.01	46.79	40.50	39.18	36.79	36.23	37.95
Denmark	28.95	19.91	25.78	22.60	32.04	27.73	26.83	25.15	24.81	25.98
France	27.13	18.63	24.23	21.18	30.03	25.99	25.14	23.61	23.26	24.35
Germany	34.11	23.43	30.38	26.67	37.76	32.68	31.62	29.69	29.24	30.62
Italy	23.09	15.86	20.56	18.03	25.43	22.12	21.40	20.09	19.79	20.72
Luxembourg	51.46	35.34	45.84	40.18	56.96	49.49	47.70	44.79	44.11	46.20
Netherlands	40.33	27.70	36.92	31.49	44.64	38.64	37.38	35.10	34.57	36.21
Portugal	18.32	12.58	16.32	14.31	20.28	17.55	16.98	15.99	15.71	16.45
Spain	22.03	15.13	19.62	17.20	24.39	21.11	20.42	19.17	18.91	19.78
U.K.	24.51	16.83	21.83	19.14	27.12	23.48	22.71	21.33	21.01	22.08
Pure Efficiency Scores	*48.19*	*33.00*	*30.93*	*38.98*	*26.32*	*58.67*	*45.98*	*20.89*	*25.12*	*27.94*

Table VIII. Efficiency of the banks in foreign countries under the influence of DD and IB environment

Movement of the banks to country j	Belgium $\lambda_j = 1/1.88$	Denmark $\lambda_j = 1/1.86$	France $\lambda_j = 1/1.62$	Germany $\lambda_j = 1/1.69$	Italy $\lambda_j = 1/1.30$	Luxembourg $\lambda_j = 1/1.19$	Netherlands $\lambda_j = 1/1.38$	Portugal $\lambda_j = 1/4.97$	Spain $\lambda_j = 1/4.21$	U.K. $\lambda_j = 1/1.57$
Belgium	42.20	42.65	48.96	46.93	61.02	66.66	57.48	15.96	18.85	50.52
Denmark	19.77	19.91	22.94	21.99	28.59	31.23	26.93	7.47	8.83	23.67
France	20.82	20.04	24.23	23.16	30.11	32.89	28.36	7.88	9.30	24.93
Germany	23.94	24.19	27.78	26.67	34.62	37.82	32.61	9.05	10.69	28.66
Italy	17.56	17.74	20.37	19.53	25.43	27.73	23.91	6.64	7.84	21.02
Luxembourg	31.43	31.76	36.47	34.96	45.53	49.49	42.81	11.89	14.04	37.63
Netherlands	27.50	27.79	31.91	30.59	39.76	43.44	37.38	10.40	12.28	32.92
Portugal	42.28	42.72	49.05	47.02	61.13	66.78	57.59	15.99	18.88	50.62
Spain	42.34	42.79	49.13	47.10	61.22	66.88	57.68	16.01	18.91	50.70
U.K.	18.50	18.69	21.46	20.57	26.75	29.22	25.20	7.00	8.26	22.08
Pure Efficiency Scores	*79.32*	*37.16*	*39.14*	*45.00*	*33.00*	*61.64*	*51.69*	*79.47*	*79.59*	*51.82*

Table IX. Efficiency of the banks in foreign countries under the influence of DD, IB and EOTA environment

Movement of the banks to country j	Belgium $\lambda_j = 1/1.88$	Denmark $\lambda_j = 1/1.87$	France $\lambda_j = 1/1.69$	Germany $\lambda_j = 1/1.70$	Italy $\lambda_j = 1/1.30$	Luxembourg $\lambda_j = 1/1.26$	Netherlands $\lambda_j = 1/1.38$	Portugal $\lambda_j = 1/4.97$	Spain $\lambda_j = 1/4.32$	U.K. $\lambda_j = 1/2.66$
Belgium	42.20	42.42	46.93	46.66	61.02	62.95	57.48	15.96	18.36	29.82
Denmark	19.85	19.91	22.08	21.95	28.70	29.61	27.04	7.51	8.64	14.03
France	21.80	21.91	24.23	24.11	31.52	32.52	29.70	8.25	9.49	15.41
Germany	24.06	24.19	26.77	26.67	34.80	35.90	32.78	9.10	10.47	17.01
Italy	17.60	17.69	19.58	19.46	25.43	26.26	23.98	6.66	7.66	12.44
Luxembourg	33.14	33.32	36.86	36.65	47.92	49.49	45.14	12.54	14.42	23.42
Netherlands	27.52	27.66	30.60	30.42	39.79	41.05	37.38	10.41	11.97	19.44
Portugal	42.28	42.50	46.02	46.75	61.13	63.07	57.59	15.99	18.40	29.88
Spain	43.45	43.67	48.33	48.04	62.82	64.82	59.18	16.43	18.91	30.70
U.K.	31.20	31.36	34.70	34.50	45.12	46.55	42.50	11.80	13.58	22.08
Pure Efficiency Scores	*79.32*	*37.31*	*40.98*	*45.24*	*33.09*	*62.30*	*51.72*	*79.47*	*81.67*	*58.65*

any other foreign country. First, the paper attempts to evaluate the efficiency scores of banking industries operating in their own respective countries. Later, improving on traditional models, the paper uses a common frontier to control for the environmental conditions of each country. Such incorporation of local conditions provides a fair comparison of different banking systems by reporting efficiency scores for the average bank of each country operating in other countries.

Overall, the results based on cross-country efficiency scores suggest that the banks from Spain, Denmark, and Portugal are relatively the most technically efficient and successful in maintaining high levels of scores if they decide to move to any other sample European country. This also means that it would be harder for banks from other countries to establish profitable networks in Spain, Portugal or Denmark due to adverse environmental conditions. Incidentally, the banks from France and Italy are found to be the less efficient institutions across the board.

From a competitive point of view the results suggest that an adverse (advantageous) environmental condition could be a good (bad) competitive factor for the home banking industry. That is, an adverse environmental condition seems to be a fundamental deterrent for the cross-country banking activities. Moreover, consistent with the expectation, being technically efficient and having increased national market integration seem to be an effective strategy to deter foreign competition.

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