

Is There a Lasting Gap in Bank Efficiency between Eastern and Western European Countries ?

April 2003

Laurent Weill¹

*LARGE, Université Robert Schuman, Institut d'Etudes Politiques,
47 avenue de la Forêt-Noire, 67082 Strasbourg Cedex, France.*

Abstract:

This paper aims to compare the efficiency of banks from Western European countries and Eastern European countries to assess the performance gap between both categories of banks. We measure cost efficiency on a sample of 640 banks from 11 Western European and 6 Eastern European countries with the stochastic frontier approach. We also test the possible influence of environmental variables and risk preferences on the efficiency gap.

We conclude the following: (a) there is a gap in bank efficiency between Eastern and Western European countries, (b) this gap is hardly explained by differences in environment or risk preferences, suggesting that the main source of differences is managerial performance, and (c) the efficiency gap was reduced between 1996 and 2000 for 4 among the 6 Eastern European countries.

Keywords: banking, efficiency, stochastic frontier approach, transition.

JEL Classification: G21, P34

1. Introduction

Banking sectors in the transition economies of Eastern Europe have undergone major transformations during the 1990s. At the beginning of the transition, several key reforms were implemented to restructure the banking sectors in these countries. A two-tier banking system was implemented, separating the functions of central bank and commercial banks, while privately-owned banks were allowed. In spite of these initial reforms, major troubles occurred in the 90s for the banking systems of these countries, in particular the recurrent problem of bad loans. These troubles were resolved in many transition countries with the recapitalization and the privatization of banks. Furthermore, the privatization has allowed the massive entry of foreign banks

¹ Tel : 33-3-88-41-77-21 ; fax : 33-3-88-41-77-78 ; e-mail : laurent.weill@urs.u-strasbg.fr

in these countries. This process of privatization associated with the foreign involvement is generally considered as having a positive influence on governance and performance of banks (Weill, 2003). Nevertheless, the commonly accepted view is that the current situation of banking sectors in transition countries of Eastern Europe reveals a backwardness in comparison to the banking sectors of developed countries of Western Europe (Scholtens, 2000; Riess et al., 2002). Indeed, in spite of the changes, it might be difficult to modify the habits and behaviors inherited from the old regime within such a short period.

The reduction of bank underperformance is however particularly important for transition countries, for two reasons. First, bank credit is by far the largest source of external finance for companies in these countries (Caviglia et al., 2002). Indeed, the financial markets are underdeveloped in transition countries (Scholtens, 2000). Consequently, investment is particularly sensitive to the changes in banking performance in these countries. Indeed, an improvement of banking performance means a reduction of loan rates, but also a better allocation of financial resources, and therefore an increase in investment that favors growth.²

Second, the upcoming EU membership of several transition countries renders the question of companies' microeconomic performances more pertinent, and therefore also the performance convergence of banks. Indeed, the major point is to know if these countries may have the normal functioning of a market economy in the next years.

It is therefore of utmost interest to assess the performance of banks of transition countries of Eastern Europe in comparison to the banks of developed countries of Western Europe.³ As mentioned above, several studies have analyzed the performance of Eastern banks in comparison to Western banks. However, in spite of the extensive application of efficiency frontiers in the banking empirical literature (e.g. Kraft and Tirtiroglu, 1998, or Weill, 2001, in transition countries), no work to our knowledge has yet estimated an efficiency frontier on a set of banks from Western and Eastern European countries to allow a comparison of cost efficiency among countries.

² Koivu (2002) provides evidence on the negative link between the interest rate margin and economic growth in transition countries.

³ To simplify notation in the paper, the banks of transition countries of Eastern Europe and the banks of developed countries of Western Europe are respectively called "Eastern banks" and "Western banks". Similarly, Eastern and Western European countries are respectively called "Eastern countries" and "Western countries".

This paper aims to fill the gap in the literature about the comparative performance of Eastern and Western banks by estimating cost efficiency on a large sample of banks. We provide new elements on the gap in cost efficiency between both categories of banks to assess the differences in managerial performance. To do so, we measure cost efficiency on a sample of 640 banks in 17 European countries (11 EU countries, 6 EU accession countries) by using the stochastic frontier approach.

This work raises four fundamental questions. *Q1: Do Eastern banks have lower efficiency levels than Western banks in Europe?* Evidence is needed to assess the level of backwardness in performance of Eastern banks: does it exist? And if the answer is affirmative, how far are Eastern banks from Western banks? To provide answers, we first measure cost performance with standard accounting ratios, before comparing cost efficiency scores. It then allows us to provide concrete elements on the relative cost performance of Eastern and Western banks. Our conclusion is then that Eastern banks have a significantly lower efficiency than Western banks.

Q2: Is the efficiency gap between both categories of banks the result of economic environment? Indeed, even if there exists a weaker bank efficiency in transition countries, this gap may not be the result of a lower managerial performance, but may rather come from a less favorable economic environment for Eastern banks. For instance, Eastern countries have lower levels of per capita income and intermediation ratio⁴ than Western countries, that make more difficult the work of banks. Furthermore, Dietsch and Lozano-Vivas (2000) have among others shown that the environment may explain the differences in bank efficiency between countries. It is therefore of utmost interest to assess the role of environment in the efficiency gap. We proceed to this analysis by estimating a cost frontier that includes environmental variables.

Q3: Does the efficiency gap between both categories result of differences in risk aversion ? The efficiency gap might also come from differences in risk preferences (Hugues and Mester, 1993; Mester, 1996). The degree of risk aversion has an impact on cost efficiency: a risk-averse bank may fund its loans with a higher ratio of equity to deposits than a risk-neutral bank. Thus, by not choosing the cost-minimizing level of equity, the risk-averse bank may appear less efficient than the risk neutral one. This

⁴ Caviglia et al. (2002) observe that the ratios of domestic credit to GDP and of deposits to GDP in transition countries, that will accede to EU in 2004, represent only one-third of the EU countries' levels.

issue is particularly relevant here, as there might exist a higher degree of risk aversion in Eastern countries, because of the recent history with high volumes of bad loans, but also of the lack of expertise in risk assessment (Riess et al., 2002 ; Caviglia et al., 2002). Indeed, if Eastern banks' managers are more risk-averse than Western banks' managers, their performance would be underestimated if equity is not controlled in the cost efficiency model. To take this aspect into account, we include the level of equity in the estimation of the cost function model to control for risk preferences, following Mester (1996).

Q4: How does cost efficiency of Eastern banks evolve in the late 90s ? Even if there exists an efficiency gap, it is important to know if the performance of Eastern banks is getting closer to the Western banks' level. Indeed, a positive trend on this issue is particularly relevant to evaluate the microeconomic implications of EU membership for transition countries. We answer this question by measuring cost efficiency of banks for 1996 and 2000.

Consequently, we provide a complete analysis of the comparison in efficiency between Eastern and Western banks. In addition to the simple comparison of cost efficiency with a common frontier, we provide elements on the influence of environment and risk preferences on this gap. This combination provides information on the sources of this gap: economic environment, risk preferences, and managerial performance. These factors help assess the evolution of this gap. Indeed, if it is mostly the consequence of the differences in economic environment, it would be reduced with the economic convergence between transition countries and EU countries. But if the backwardness in bank efficiency results from managerial performance, we might expect it will take more time to close the gap. We furthermore assess the recent evolution of efficiency to test the existence of a convergence in bank efficiency for transition countries.

The structure of the paper is as follows. Section 2 provides a first glance on the comparative performance of Eastern and Western banks with standard cost ratios. Section 3 outlines the methodology used for the cost efficiency measures. Section 4 describes the data and variables. Section 5 develops the empirical results, answering each question in the order they have been presented. Finally, we provide some concluding remarks in section 6.

2. A first glance on the relative performance of banks in transition countries

This section presents data on the average costs of Western and Eastern banks. Our aim is to test the commonly accepted view according to which Eastern banks have a lower cost performance than Western banks. To do so, we measure the average cost ratio, defined as total cost⁵ divided by total assets. The sample is composed of 640 banks, and is described in the section 4. We provide the cost ratios for 1996 and 2000 to analyze the recent evolution of cost performance. Tables 1a and 1b report information on average cost ratios for each country and for each geographic zone (East or West) for 1996 and 2000.

Our results clearly support the outperformance of Western banks compared to Eastern banks: in 2000, the median of average cost ratios for Western banks is 5.78%, while it is 8.73% for Eastern banks. When investigating the dispersion of efficiency scores inside each zone, we observe that the standard deviation is more than twice as high for Eastern banks than for Western banks (4.00% vs. 1.93% in 2000). This latter result tends to suggest a more heterogeneous banking sector in Eastern countries than in Western countries in our sample. This is confirmed by the analysis by country of the medians of the cost ratios: Western countries have medians ranging from 4.89% to 7.24%, while the range of medians for Eastern countries extends from 5.77% to 11.96%. We observe in particular that the Czech Republic and Latvia have similar values than the Western countries, while the gap is considerable between these latter countries and Poland.

The analysis of the evolution of the cost ratios shows an improvement of cost performance in both zones between 1996 and 2000, with a higher reduction of the cost ratios in East (-1.10) than in West (-0.97). This tends to suggest a slight convergence between both categories of banks in the second half of the 90s. The cross-country analysis shows that all Eastern countries except Slovakia (+0.46) had a reduction of their cost ratios, with particularly significant reductions in Latvia (-3.54) and the Czech Republic (-2.45).

⁵ Total cost is the sum of operating and financial expenses.

Table 1a
Average cost ratios by zone for 1996 and 2000

Zone	1996		2000		Evolution
	Median	Standard deviation	Median	Standard deviation	
East	9.83	4.44	8.73	4.00	-1.10
West	6.75	2.18	5.78	1.93	-0.97

All figures are in percentage

Table 1b
Average cost ratios by country for 1996 and 2000

Country	1996		2000		Evolution
	Median	Standard deviation	Median	Standard deviation	
Czech Rep.	8.22	6.39	5.77	4.15	-2.45
Hungary	10.47	3.47	9.01	3.63	-1.46
Latvia	9.75	4.16	6.21	3.13	-3.54
Poland	12.56	3.87	11.96	2.69	-0.60
Slovenia	8.04	2.21	7.95	1.44	-0.09
Slovakia	8.54	1.85	9.00	4.83	+0.46
Austria	5.85	1.48	5.34	2.39	-0.51
Belgium	5.94	1.31	6.47	1.67	+0.53
Denmark	6.31	0.92	6.50	0.94	+0.19
France	7.00	1.93	6.18	2.02	-0.82
Germany	5.85	1.84	5.71	2.02	-0.14
Greece	11.55	2.89	7.24	1.69	-4.31
Italy	9.03	0.96	5.52	1.01	-3.51
Netherlands	5.16	3.48	6.59	3.89	+1.43
Portugal	7.50	1.84	5.35	0.96	-2.15
Spain	8.18	1.25	4.89	1.89	-3.29
UK	6.04	1.66	6.78	1.71	+0.74

All figures are in percentage

In summary, the analysis of the cost ratios provides several interesting results. First, there exists a gap in cost performance between Western and Eastern banks. Second, some Eastern countries (the Czech Republic, Latvia) have, however, “Western levels” of bank cost performance. There are, in fact, some substantial differences in cost performance between Eastern countries. Third, the gap in performance between both zones was slightly reduced between 1996 and 2000.

In comparison to cost ratios, the cost efficiency measures derived from the application of efficiency frontiers offers more sophisticated information on bank performance. They provide measures allowing the aggregation of different outputs.

They are directly relative measures, meaning that the scale effects are taken into consideration, unlike in the application of cost ratios. In other words, a bank is compared to a virtual bank that supports the same costs on the efficiency frontier, to observe the difference in outputs between both banks. This allows to disentangle the scale effect, that might come from (dis)economies of scale, whereas cost ratios compare each bank with all other banks whatever their size.

In considering the evolution of cost performance measures, the influence of exogenous variables on the whole set of banks has some impact on the cost ratios, but does not affect the cost efficiency measures. For instance, a reduction of interest rates that allows the decrease of the financial costs, results in the reduction of the average cost ratios, but does not lead to the improvement of the cost efficiency scores, as these latter measures are relative and consequently do not change when all banks evolve in the same direction.

Finally, the impact of variables that are exogenous to the managerial performance can be extracted from the efficiency scores. This is a issue of utmost interest for our investigation, as the differences between both zones, but also inside the West zone, may be the result of differences in environment.

As a result, while the analysis of cost ratios has provided a first glance on the dominance of Western banks relative to Eastern banks, the application of efficiency frontiers gives a more relevant view on this issue.

3. Methodology

Several techniques have been proposed in the literature to measure efficiency with frontier approaches. They mainly differ in the distributional assumptions used to disentangle inefficiency differences from random errors. We choose here the stochastic frontier approach, which disentangles inefficiency from random error by assuming a normal distribution for the random error and an one-sided distribution for the inefficiency term. Other approaches include distribution-free approach, thick frontier approach, DEA (Data Envelopment Analysis). Distribution-free approach does not allow the assessment of evolution of efficiency, as it assumes that bank efficiency is stable over time. Thick frontier approach only provides average

efficiency scores for the whole tested sample, whereas we aim here to compare the efficiency of Eastern and Western banks. Finally, DEA implies a more difficult treatment of control variables in the estimation of a cost frontier, relative to the stochastic frontier approach. As we test the presence of environmental variables and risk in the cost frontier, we then prefer to use the stochastic frontier approach than DEA, taking into consideration that literature considers both techniques as equally satisfactory.

Thus, we use here the Stochastic Frontier Approach to estimate cost efficiency scores (Aigner et al., 1977), following the applications from Mester (1996), Allen and Rai (1996), Altunbas et al. (2000). Cost efficiency measures how close a bank's cost is to what a best-practice bank's cost would be for producing the same bundle of outputs. It then provides information on wastes in the production process and on the optimality of the chosen mix of inputs.⁶

The basic model assumes that total cost deviates from the optimal cost by a random disturbance, v , and an inefficiency term, u . Thus the cost function is $TC = f(Y, P) + \varepsilon$ where TC represents total cost, Y is the vector of outputs, P the vector of input prices and ε the error term which is the sum of u and v . u is a one-sided component representing cost inefficiencies, meaning the degree of weakness of managerial performance. v is a two-sided component representing random disturbances, reflecting bad (good) luck or measurement errors. u and v are independently distributed. v is assumed to have a normal distribution. We assume a gamma distribution following Greene (1990). Following Jondrow et al. (1982), bank-specific estimates of inefficiency terms can be calculated by using the distribution of the inefficiency term conditional to the estimate of the composite error term. Greene (1990) has then provided the estimate of the cost inefficiency term with a gamma distribution.⁷

We estimate a system of equations composed of a Fourier-flexible cost function and its associated input cost share equations, derived using Shepard's lemma. We choose the Fourier-flexible form, as it has been proved that it dominates the translog form (McAllister and McManus, 1993). We adopt here the specification with only

⁶ We do not estimate profit efficiency, as profit in transition countries is affected by differences in provisioning rules and behaviors, making uneasy a cross-country comparison. Moreover, as profit efficiency is influenced by market power, this concept provides a worse information on managerial performance than cost efficiency.

⁷ See Kumbhakar and Lovell (2000) for further details on Stochastic Frontier Analysis.

Fourier terms for the output quantities following Berger, Leusner and Mingo (1997) and Altunbas, Evans and Molyneux (2001).

Estimation of this system adds degrees of freedom and results in more efficient estimates than just the single-equation cost function. Since the share equations sum to unity, we solve the problem of singularity of the disturbance covariance matrix of the share equations by omitting one input cost share equation from the estimated system of equations. Standard symmetry constraints are imposed. Homogeneity conditions are imposed by normalizing total costs, price of labor, and price of physical capital, by the price of borrowed funds. The system of equations is estimated using Iterative Seemingly Unrelated Regression (ITSUR) estimation technique.⁸

4. Data

Data were gathered from the "Bankscope" database of BVD-IBCA. We use unconsolidated accounting data for 640 banks in 2000. There are 535 banks from 11 Western countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, the United Kingdom), and 105 banks from 6 Eastern countries (the Czech Republic, Hungary, Latvia, Poland, Slovenia, Slovakia). The sample is slightly different in 1996 with 639 banks from Western countries and 100 banks from Eastern countries.

As one key issue is the convergence of bank efficiency of accession countries towards EU countries' levels, Western countries have been selected among EU member countries. We only keep 11 countries among 15 EU countries, because of lack of data for the last 4 countries. This sample of EU countries seems however satisfactory to provide a benchmark for the Eastern countries, as it includes major EU countries such as France and Germany, and catching-up countries such as Greece or Portugal at the same time. We can then compare the bank performance of Eastern countries with various categories of EU countries. Eastern countries have been selected mainly among the EU accession countries. The selection is based on the availability of data, but it includes the largest EU accession countries of the next membership wave in 2004.

⁸ Kmenta and Gilbert (1968) proved that this procedure generates maximum likelihood estimates.

We consider only commercial banks for Western countries. The reason is twofold. First, almost all banks selected for Eastern countries are commercial banks. It is consequently more relevant for our comparison to consider only the same category of banks in Western countries. Second, to keep all cooperative and savings banks in Western countries would have result in a sample largely dominated by German banks, as Germany has a very developed network of cooperative and savings banks. Therefore, we have considered that a frontier including all these banks would have been a less representative European efficiency frontier than the one estimated here with only commercial banks for Germany.

We measure efficiency for two years: 1996, and 2000. The choice of these years is linked with the availability of data: 1996 was the oldest year with enough data for Eastern banks to estimate a relevant efficiency frontier. When comparing the evolution of bank efficiency between both years, we use an unbalanced sample of banks.

We proceed to a different treatment of outliers on Western and Eastern banks, because of the different size of the samples. We adopt the Tukey box-plot, based on the use of interquartile range to clean the data for Western countries: banks with observations out of the range defined by the first and third quartiles greater or less than one and half the interquartile range were excluded for each mean input price over the period. As the set of banks from Eastern countries is clearly lower, we do not adopt the Tukey box-plot for Eastern countries, but only eliminate outliers.

For the definition of inputs and outputs, we adopt the intermediation approach proposed by Sealey and Lindley (1977). It assumes that the bank collects deposits to transform them, using labor and capital, into loans as opposed to the production approach, which views the bank as using labor and capital to produce deposits and loans⁹. Two outputs are included: loans, and investment assets¹⁰. The inputs, whose prices are used to estimate the cost frontier, include labor, physical capital and borrowed funds.

As data on the number of employees are not available, the price of labor is measured by the ratio of personnel expenses to total assets, following Dietsch and

⁹ Two studies analyzed the influence of the choice of the treatment of deposits on efficiency results (Wheelock and Wilson, 1995; Berger, Leusner and Mingo, 1997). Both concluded that the chosen approach has an impact on the levels of efficiency scores but does not imply strong modifications in their rankings.

Weill (2000) and Altunbas, Evans and Molyneux (2001). The price of physical capital is defined as the ratio of other non-interest expenses to fixed assets. The price of borrowed funds is measured by the ratio of paid interests to all funding. Total costs are the sum of personnel expenses, other non-interest expenses and paid interest. Table 2 reports summary statistics for outputs, inputs, input prices, total cost, and total assets by geographic zone. Summary statistics by country are reported in tables A.1 and A.2 in Annex. We observe large differences between banks of both zones. In terms of size, the mean Western bank is larger than the mean Eastern bank: Western banks are approximately six times bigger on average. The mean price of borrowed funds is somewhat higher for Eastern banks. However, the mean price of physical capital is largely higher for Western banks.

Table 2
Descriptive Statistics

	East		West	
	Mean	Std Dev.	Mean	Std Dev.
<i>Outputs</i>				
Loans	663,038.02	1,206,983.4	3,848,452.11	13,984,360.0
Investment assets	682,807.99	1,382,437.8	3,598,711.42	3,598,711.4
<i>Inputs</i>				
Personnel expenses	23,410.30	52,153.4	81,934.27	297,369.3
Other non interest expenses	28,717.38	57,077.3	64,598.77	214,132.0
Interest paid	99,140.15	214,955.4	322,136.25	1,524,427.2
<i>Input prices</i>				
Price of labor	0.0152	0.0090	0.0156	0.0090
Price of physical capital	1.4371	1.4839	2.0727	1.9569
Price of borrowed funds	0.0689	0.0413	0.0404	0.0173
<i>Other characteristics</i>				
Total assets	1,483,900.66	2,828,195.9	8,381,665.91	35,802,928.9
Total costs	151,267.84	321,553.9	468,669.29	1,993,749.1

All values are in thousands of dollars, except input prices.

5. Results

Four questions on the comparative efficiency of Eastern and Western banks were presented in the introduction. This section is organized so as to answer each

¹⁰ This item includes the « other earning assets » in IBCA terminology, which are all the earning assets other than loans.

question in turn. Namely, the first subsection describes cost efficiency scores obtained with a common cost frontier on the whole set of banks for 2000 to assess the gap in bank efficiency between both zones. The second and third subsections display the results obtained with cost frontiers including environmental variables and risk, in order to test their possible influences on the efficiency gap. Finally, the fourth subsection analyzes the evolution of bank efficiency in both zones between 1996 and 2000 to evaluate the convergence of Eastern banks towards Western banks.

5.1 Comparison of efficiency levels

We compare here the efficiency of Eastern and Western banks by estimating a cost frontier on the whole set of banks for 2000. Main descriptive statistics for the cost efficiency scores are presented in tables 3a and 3b. We observe that Western banks are more cost-efficient than Eastern banks: the median cost efficiency score is 68.97% for Western banks, while it is 54.45% for Eastern banks. A test of significance on the means shows that the mean of Western banks is significantly different at the 1% level than the mean of Eastern banks.

The cross-country analysis shows in fact that Western countries have efficiency scores medians ranging from 61.48% for Portugal to 75.63% for the United Kingdom, while the medians for Eastern countries range from 45.09% for Slovakia to 73.24% for the Czech Republic.

In both zones, we then observe large differences in bank efficiency. But the range of efficiency medians is clearly higher for Eastern countries than for Western countries. Among Western countries, Greece and Portugal have the least efficient banking sectors. It is noticeable that these countries are also the EU catching-up economies with the lowest per capita income among EU countries. Among Eastern countries, it appears that Czech banks are as cost efficient as the most efficient EU banks, while Hungarian banks outperform the banks of the least efficient EU banks, namely Greek and Portuguese banks. Otherwise, the banks originating from the four other Eastern countries clearly underperform the banks of EU countries.

It must be stressed that the hierarchy of Eastern banks in terms of efficiency is different than in terms of cost ratios. For instance, Latvian banks have lower average cost ratios but also lower cost efficiency scores than Hungarian banks.

Table 3a
Efficiency scores by zone for 2000

Zone	N	Median	Standard deviation
East	105	54.45	13.32
West	535	68.97	10.25

All figures are in percentage

Table 3b
Efficiency scores by country for 2000

Country	N	Median	Standard deviation
Czech Rep.	15	73.24	11.61
Hungary	11	63.68	10.80
Latvia	18	57.14	9.09
Poland	32	51.55	13.05
Slovenia	13	57.11	11.81
Slovakia	16	45.09	14.00
Austria	30	65.74	10.27
Belgium	20	68.27	6.78
Denmark	42	63.74	5.74
France	115	71.39	13.22
Germany	142	72.16	9.72
Greece	10	62.09	10.56
Italy	75	68.70	6.57
Netherlands	10	72.27	17.35
Portugal	13	61.48	13.05
Spain	56	65.95	8.46
UK	22	75.63	7.73

All figures are in percentage

Our results then support the existence of an efficiency gap between Eastern banks and Western banks. We consequently provide a negative answer to question Q1. Therefore, we have now to investigate the reasons of this gap. A first answer would be to accuse the managers of Eastern banks: the lower efficiency may result from their weaker performance. Furthermore, the commonly accepted view is that Eastern banks suffer from weak managerial expertise, due notably to a short experience of banking in a market economy.

Nevertheless, some alternative explanations can be advanced. First, the environments in which banks operate are undoubtedly different in both zones. The macroeconomic environments are not comparable, as Eastern countries suffer from a

backwardness in economic development. Furthermore, the features of banking structure are very different, notably because of the weaker maturity of banking markets in Eastern countries. Consequently, the differences in environment might explain the efficiency gap: Eastern banks may be less efficient only because of more difficult environmental conditions.

Second, risk preferences may be dissimilar between managers of Eastern and Western banks. Indeed, Eastern banks have faced large amounts of bad loans during the 90s. Eastern banks' managers may then be more risk adverse than Western banks' managers.

Therefore, before accusing weak managerial performance, a satisfactory conclusion on the sources of the weaker efficiency for Eastern banks needs an analysis of the impact of environment and risk preferences on efficiency scores. Both following subsections provide these elements.

5.2 The role of environment

We now test the role of environment on the efficiency gap between Eastern and Western banks. Indeed it might happen that the differences in efficiency between both categories may result only from dissimilar environments. Dietsch and Lozano-Vivas (2000) have notably demonstrated that the efficiency gap between French and Spanish banks was reduced when environmental variables taking macroeconomic and banking structure variables into account were introduced in the cost efficiency frontier.

Environments are particularly different between both parts of Europe for obvious reasons. The transition started just a decade ago, making the macroeconomic environment still underperforming in Eastern countries, as emphasized by the comparison of per capita income or rate of inflation, even if there are substantial differences among these countries. Furthermore, the banking structure is very different, in particular because of the difference of maturity of the banking markets, as Eastern countries were still endowed with planned banking industries one decade ago.

The study of Grigorian and Manole (2002) provides some support on the potential influence of macroeconomic environment on bank efficiency in transition countries. They adopt a two-step procedure to analyze the determinants of commercial bank efficiency in transition countries. In the first step, they estimate technical efficiency with data envelopment analysis in 16 transition countries. In the second

step, they regress the efficiency scores on a set of variables including firm-specific variables, but also country-specific variables such as per capita income, rate of inflation, and the ratio of broad money to GDP. Their conclusion from these macroeconomic variables is that only per capita income has a significant influence on bank efficiency: per income capita is positively linked with bank efficiency.

We estimate a cost frontier that includes environmental variables. We test 7 environmental variables, categorized into two groups. The first group is called “Macroeconomic conditions”, including per capita income, rate of inflation, and population density. Income per capita is obtained by dividing GDP by the number of inhabitants. This factor is expected to affect the demand and supply of deposits and loans in numerous ways. In particular, the countries with higher per capita income may have clients consuming more banking products.

Inflation might increase inefficiency, as excessive branch networks are often associated with high inflationary environments, as suggested by Grigorian and Manole (2002). The density of population is measured by the ratio of inhabitants per square kilometer. We assume that banks in low density countries will face higher costs than banks in high density countries, consequently the density of population is supposed to have a positive influence on efficiency.

The second group is called "Banking conditions", including the density of demand, the accessibility of banking services, the intermediation ratio, and banking competition. Those variables give information on the features of the structure of the European banking markets. The density of demand is measured by the ratio of total deposits per square kilometer. This variable is expected to have a positive influence on bank efficiency, as banks which operate in markets with a lower density of demand would likely incur higher expenses. The accessibility of banking services is obtained by dividing the number of branches by the number of square kilometers. A higher banking density may favor bank efficiency by making the access to banking products easier for customers. The intermediation ratio is obtained by dividing the total of loans by the total of deposits. This ratio is assumed to have a positive influence on efficiency, because the higher the ratio, the lower the quantity of deposits needed to produce loans will be, and consequently the cost of the production of loans. Banking competition is measured here by the number of banks divided by the number of inhabitants. A positive influence on bank efficiency is expected, as banking competition might be associated with customers demanding more banking products.

The environmental variables used in this paper describe country-specific conditions in terms of wealth, structure of the banking market, regulation. Data come from the European Banks Federation and OECD are displayed by zone in table 4.

We observe large differences in environmental variables between both zones that can explain the efficiency gap. All variables are significantly higher on average in West than in East, except the rate of inflation that is higher in East. Thus, the Western levels of environmental variables can clearly favor bank efficiency, as they are associated with higher bank efficiency. It is therefore relevant to test their influence on the efficiency gap between Eastern and Western banks.

Table 4
Mean values of environmental variables for Western and Eastern banks

	East	West
Macroeconomic conditions		
Per capita income (GDP / nb of inhabitants)	10,436.59	21,461.78
Rate of inflation	6.553	1.637
Population density (nb of inhabitants / km ²)	0.101	0.181
Banking conditions		
Density of demand (deposits / nb of inhabitants)	2,777.24	23,795.08
Accessibility of banking services (branches / km ²)	0.016	0.181
Intermediation ratio (loans / deposits)	0.704	1.065
Banking competition (banks / nb of inhabitants)	0.006	0.014

Source: European Federation of Banks; Main Economic Indicators, OECD.

Table 5 displays the results for the OLS estimation of the cost function estimated with the 7 environmental variables. We only report the coefficients of these latter variables to assess their influence on the cost efficiency measures. We observe that only two variables are significant: per capita income, and intermediation ratio, with expected negative signs. The results of the estimation of the cost frontier with environmental variables are reported in tables 6a and 6b. We observe that the efficiency gap is hardly reduced: the medians of cost efficiency scores are 54.65% for Eastern banks and 69.24% for Western banks.

Why does the inclusion of environmental variables result in such a small reduction in the efficiency gap between Eastern and Western banks? Our explanation

is based on the fact that even if there are differences between both categories of banks, the least efficient banks among Eastern countries are not in the least favorable environments, the only exceptions being per income capita and intermediation ratio. For instance, Slovenia and Slovakia have the highest accessibility of banking services, even if their banks do not rank on the top of the hierarchy of Eastern countries.

Table 5
OLS estimation of cost function system

Parameter	Coefficient	t-value
GDP per capita	-6.86E-6**	-2.15
Rate of inflation	0.0025	0.44
Density of demand	0.3190	1.18
Accessibility of banking services	-0.0068	-0.02
Demand density	-2.07E-9	-1.32
Intermediation ratio	-0.1336***	-3.13
Competition	0.5233	0.55
Adjusted R ² on OLS equation	0.9879	

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

The cross-country analysis provides interesting remarks. The efficiency of Western banks is slightly affected by the inclusion of environmental variables: only two among the eleven Western countries have a variation in efficiency higher than 1 point (Netherlands with +1.99, and the UK with +1.04). In the meantime, the efficiency of Eastern banks is clearly influenced by environmental variables, as four of the six Eastern countries have a variation in efficiency above 1 point. Nevertheless, these four countries do not have similar variations: Hungarian (+2.04) and Slovak (+2.70) banks improve their efficiency, but Czech (-1.26) and Latvian (-2.78) banks are then less efficient. Thus, these opposite modifications of efficiency for Eastern banks lead to the conclusion that the inclusion of environmental variables does not reduce the efficiency gap between both zones. It can however be argued that this inclusion reduces the substantial differences in efficiency between Eastern countries. Indeed, as the efficiency of the most efficient banking sector (in the Czech Republic) was reduced, while the efficiency of the least efficient banking sector (in Slovakia) was increased, the range of cost efficiency medians among Eastern countries is smaller when environmental variables are taken into account.

Nevertheless, the differences in macroeconomic and banking environments do not provide a satisfactory explanation to the efficiency gap between Western and Eastern banks. Thus, the answer to the question Q2 is rather negative.

Table 6a
Efficiency scores by zone for 2000
With environmental variables

Zone	N	Median	Standard deviation
East	105	54.65	13.14
West	535	69.24	10.24

All figures are in percentage

Table 6b
Efficiency scores by country for 2000
With environmental variables

Country	N	Median	Standard deviation
Czech Rep.	15	71.98	12.22
Hungary	11	65.72	10.59
Latvia	18	54.36	9.68
Poland	32	51.93	13.08
Slovenia	13	57.26	11.81
Slovakia	16	47.79	13.81
Austria	30	65.64	10.36
Belgium	20	68.10	6.81
Denmark	42	63.89	5.77
France	115	72.06	13.06
Germany	142	71.45	10.11
Greece	10	61.22	10.68
Italy	75	69.19	6.52
Netherlands	10	74.26	16.38
Portugal	13	62.31	6.99
Spain	56	66.77	8.29
UK	22	77.03	7.15

All figures are in percentage

5.3 The influence of risk preferences

Mester (1996) has suggested that the differences in cost efficiency may result from differences in managers' risk preferences. Indeed, if managers from a bank are more risk-averse than the managers from the others, they can hold a higher level of

equity than the cost-minimizing level. Consequently, by omitting the level of equity in the cost frontier, we may consider a bank as inefficient while it behaves optimally given the risk preferences of its managers.

This issue is particularly relevant in Eastern countries, where banks have had huge volumes of bad loans during the 90s and might still suffer from a lack of expertise in risk analysis. Riess et al. (2002) has argued that Eastern banks do not take enough risks, resulting in a suboptimal loan portfolio, in comparison to the available funds. Caviglia et al. (2002) also support this assumption. Furthermore, when testing empirically the reverse on a sample of banks from 16 transition countries, Fries et al. (2002) find no evidence on the existence of an excessive risk-taking of banks. Therefore, the potential influence of risk preferences on the efficiency gap between Eastern and Western banks has to be tested.

Following Mester (1996) and Altunbas et al. (2000), we estimate a cost frontier on the whole sample of banks, where the level of equity is included to take the risk preferences into account. As some banks have a negative level of equity, we proceed to a transformation of the equity variable to get a positive value of the logarithmic expression of equity in the model. We add the absolute value of the minimum of the equity variable computed in the sample and the unity to each value of equity.

The medians of the cost efficiency scores for this new estimation are reported in tables 7a and 7b. We find no clear reduction of the efficiency gap between Western and Eastern banks: the median efficiency scores are 54.48% for Eastern banks, and 68.93% for Western banks (they are 54.45% and 68.97% respectively, in the initial common frontier without environmental variables).

Table 7a
Efficiency scores by zone for 2000
With equity in the cost frontier

Zone	N	Median	Standard deviation
East	535	54.48	13.32
West	105	68.93	10.25

All figures are in percentage

Table 7b
Efficiency scores by country for 2000
With equity in the cost frontier

Country	N	Median	Standard deviation
Czech Rep.	15	73.28	11.60
Hungary	11	63.65	10.80
Latvia	18	57.13	9.08
Poland	32	51.52	13.08
Slovenia	13	57.08	11.81
Slovakia	16	45.98	13.99
Austria	30	65.74	10.28
Belgium	20	68.30	6.76
Denmark	42	63.68	5.75
France	115	71.41	13.23
Germany	142	72.12	9.71
Greece	10	62.02	10.56
Italy	75	68.65	6.57
Netherlands	10	72.26	17.36
Portugal	13	61.50	7.11
Spain	56	65.97	8.47
UK	22	75.57	7.74

All figures are in percentage

The cross-country analysis shows that cost efficiency medians are scarcely modified when risk preferences are taken in the cost frontier into account. If we except Slovakia with a positive variation of 0.89 point, all countries have variations in bank efficiency lower than 0.10 point. Thus, there seems no substantial differences in risk preferences between Eastern and Western countries. Our results are not in accordance with the comments of Riess et al. (2002) and Caviglia et al. (2002), suggesting a higher risk aversion for Eastern banks than for Western banks. However, further research is needed on the assessment of the risk aversion of both categories banks to provide more conclusive remarks on this issue.

Therefore, the differences in risk preferences can not be considered as a major explanation to the efficiency gap between Western and Eastern banks. Accordingly, the answer to the question Q3 is without doubt negative.

5.4 The evolution of efficiency

We now focus on the dynamic analysis of the efficiency gap between Western and Eastern banks. Until now, our work has provided evidence on the existence of

such a gap. It is therefore of utmost interest to analyze whether this gap was reduced during the recent years. This will provide information on the convergence in microeconomic performances between EU and EU accession countries.

We have shown above that the differences in environment and risk preferences were not the main reasons for the efficiency gap between Western and Eastern banks. Therefore, in our analysis of the evolution, we will not consider these factors as potential determinants of the evolution of bank efficiency between both zones.

Consequently, the investigation of the evolution of the efficiency gap is performed by estimating a cost frontier for the whole sample of banks for 1996, without including environmental variables and risk preferences, and by comparing the obtained scores with those for 2000 presented in the first subsection of this section.

Table 8a
Efficiency scores by country for 1996 and 2000

Zone	1996			2000			Evolution
	N	Median	Std Dev.	N	Median	Std Dev.	
East	100	49.39	14.19	105	54.45	13.32	+5.06
West	639	65.21	10.79	535	68.97	10.25	+3.76

All figures are in percentage

Table 8b
Efficiency scores by zone for 1996 and 2000

Country	1996			2000			Evolution
	N	Median	Std Dev.	N	Median	Std Dev.	
Czech Rep.	18	54.12	16.52	15	73.24	11.61	+19.12
Hungary	10	53.20	9.42	11	63.68	10.80	+10.48
Latvia	17	47.52	12.59	18	57.14	9.09	+9.62
Poland	32	48.59	13.73	32	51.55	13.05	+2.96
Slovenia	11	53.97	12.58	13	57.11	11.81	+3.14
Slovakia	12	40.61	14.49	16	45.09	14.00	+4.48
Austria	35	64.45	8.74	30	65.74	10.27	+1.29
Belgium	32	67.48	7.38	20	68.27	6.78	+0.79
Denmark	47	59.40	5.12	42	63.74	5.74	+4.34
France	156	68.45	10.04	115	71.39	13.22	+2.93
Germany	167	71.06	9.30	142	72.16	9.72	+1.10
Greece	18	54.65	10.31	10	62.09	10.56	+7.44
Italy	69	59.67	6.80	75	68.70	6.57	+9.03
Netherlands	13	70.98	8.52	10	72.27	17.35	+1.29
Portugal	18	54.96	9.91	13	61.48	7.12	+6.52
Spain	57	54.24	9.60	56	65.95	8.46	+11.71
UK	27	70.58	13.93	22	75.63	7.73	+5.05

All figures are in percentage

The results of this cost frontier are presented in tables 8a and 8b with a reminder of the results for 2000 presented above. Several conclusions emerge. First, cost efficiency of banks improved in all countries of our sample. Second, the improvement of efficiency was higher for Eastern banks (+5.06%) than for Western banks (+3.76%), suggesting the existence of a phenomenon of convergence in bank efficiency between both categories of zones.

Third, the differences in the evolution of bank efficiency are very contrasted between Eastern countries. The increase was particularly high in the Czech Republic (+19.12%). This can be explained by the improvement of the governance of Czech banks during this period with the privatization of most banks and their acquisition by foreign investors. Indeed, at the beginning of the period, only one bank was foreign-owned (Zivnostenska Banka), while at the end of the period, there was only one major bank still domestic-owned (Komerčni Banka). Hungarian and Latvian banks have also known a strong improvement in their bank efficiency (with respectively +10.48% and +9.62%). The increase was clearly lower for Polish, Slovak and Slovenian banks with improvements ranging between 3 and 4%.

Consequently, the gap increased between the least and most efficient banks among Eastern countries. In fact, the most efficient banks (the Czech and Hungarian banks) increased their advantage, but the least efficient banks had a lower improvement than the Western banks on average, meaning that the efficiency gap increased during this period for them.

Therefore, the answer to the question Q4 is ambiguous. On the one hand, the efficiency of Eastern banks improved between 1996 to 2000, and approached the level of efficiency of Western banks on average. On the other hand, the cross-country analysis shows a divide between the banking sectors reaching or maintaining Western levels (the Czech, Hungarian, Latvian, and to a lesser degree Slovakian sectors), and the banking sectors widening their gap (the Polish and Slovenian sectors).

However, this conclusion is rather positive in the perspective of EU membership for the converging Eastern countries. As it has been stressed that the efficiency gap between Eastern and Western banks was not significantly influenced by environmental variables, the observation of the reduction of this gap tends to suggest that the managerial performance of banks in Eastern countries is improving. This is grounds for optimism, as it means that the habits and mentalities inherited from the old regime might be changing. Nevertheless, the pessimistic point of our conclusion is that this convergence is not observed for all Eastern countries. A reason for this difference among Eastern countries might come from the foreign involvement in bank ownership. As this element is expected to influence bank performance, the differences among countries on this foreign involvement might explain the different evolutions of bank performance. This assumption is partly supported by the fact that Slovenia is the Eastern country of our sample with the least foreign ownership in banking. However, other elements may play a role on this convergence in bank efficiency. The only conclusion we can suggest is, following our former results, that the differences in environmental variables may not explain the different evolutions of bank efficiency.

6. CONCLUSION

This work aimed to analyze the existence of a efficiency gap between Eastern banks and Western banks in Europe. We have investigated this question by answering

four questions about this possible efficiency gap. (1) *An efficiency gap exists between banks in Eastern countries and those in Western countries.* Some Eastern countries, e.g. the Czech Republic, have higher efficiency levels than some Western countries, e.g. Greece, but it is the exception rather than the rule. Hungarian banks have levels of efficiency similar to Portuguese or Greek banks, which are the least efficient EU banks in our study. Otherwise, banks from the four other Eastern countries are clearly dominated by Western banks in efficiency. (2) *The efficiency gap is neither explained by differences in environmental variables,* (3) *nor by differences in risk preferences.* Indeed, the estimation of the cost frontier for the whole set of banks with the inclusion of environmental variables or risk does not significantly reduce the differences between the efficiency means of banks of both groups of countries. Therefore, we tend to support the hypothesis of a lower managerial performance in Eastern countries than in Western countries. (4) *The efficiency of banks in Eastern countries increased between 1996 and 2000.* In fact, the efficiency improved in all countries of our sample for this period, but the increase in efficiency was higher in Eastern countries than in Western countries. This tends to support the hypothesis of a convergence in efficiency for Eastern banks towards Western banks levels. However, this convergence was not observed for each country, as the efficiency gap increased for Polish and Slovenian banks.

In summary, our work has provided evidence on the existence of an efficiency gap between Western and Eastern banks, mainly caused by differences in managerial performance. Nevertheless, this gap is more or less lasting, depending on the Eastern country as we observe a convergence in bank efficiency for four among the six countries. This convergence may be the result of the increasing foreign involvement in bank ownership in transition countries. Foreign involvement might explain the lack of convergence for Slovenia, as this is the country in our sample with the least foreign ownership in banking. However, as observed by Riess et al. (2002), the effects of the changes in governance provided by the foreign ownership might take some time, which can explain why we observe this slight convergence in the recent years.

Our results should, however, be considered with care. Indeed, further research is needed on the comparison of Western and Eastern banks in terms of efficiency, but also on the evolution of efficiency and its explanations. This work should be considered as an exploratory approach on these issues.

REFERENCES

- Aigner, D., Lovell, C.A.K., and Schmidt, P., "Formulation and Estimation of Stochastic Frontier Production Function Models." *Journal of Econometrics* **6**, 21-37, 1977
- Allen, L., and Rai, A., "Operational Efficiency in Banking, An International Comparison." *Journal of Banking and Finance* **20**, 655-672, 1996.
- Altunbas, Y., Liu, M.H., Molyneux, P., and Seth, R., "Efficiency and Risk in Japanese Banking." *Journal of Banking and Finance* **24**, 1605-1628, 2000
- Altunbas, Y., Evans, L., and Molyneux, P., "Bank Ownership and Efficiency." *Journal of Money, Credit and Banking*, **33**, 4, 926-954, 2001.
- Berger, A., Leusner, J. and Mingo, J., "The Efficiency of Bank Branches." *Journal of Monetary Economics* **40**, 1, 141-162, 1997.
- Caviglia, G., Krause, G. and Thimann, C., "Key Features of the Financial Sectors in EU Accession Countries." In C. Thimann, Ed., *Financial Sectors in Transition Countries*, European Central Bank, Francfort, 2002.
- Dietsch, M. and Lozano-Vivas, A., "How the Environment Determines the Efficiency of Banks, A Comparison between French and Spanish Banking Industry." *Journal of Banking and Finance* **24**, 6, 985-1004, 2000.
- Fries, S., Neven, D., and Seabright, P., "Bank Performance in Transition Economies", EBRD Working Paper n°76, November 2002.
- Greene, W.H., "A Gamma-Distributed Stochastic Frontier Model." *Journal of Econometrics* **46**, 141-163, 1990.
- Grigorian, D. A., and Manole, V., "Determinants of Commercial Bank Performance in Transition, An Application of Data Envelopment Analysis." *IMF Working Papers*, WP n°02/146, 2002.
- Hugues, J.P., and Mester, L., "A Quality and Risk-Adjusted Cost Function for Banks." *Journal of Productivity Analysis* **4**, 293-315, 1993.
- Jondrow, J., Lovell, C.A.K., Materov, I., and Schmidt, P., "On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model." *Journal of Econometrics* **19**, 233-238, 1982.
- Kmenta, J. and Gilbert, R.F., "Small Sample Properties of Alternative Estimators of Seemingly Unrelated Regressions." *Journal of the American Statistical Association* **63**, 1180-1200, 1968.
- Koivu, T., "Do Efficient Banking Sectors Accelerate Economic Growth in Transition Countries ?" *BOFIT Discussion Papers* 14/2002, Bank of Finland, 2002.
- Kraft, E. and Tirtiroglu, D., "Bank Efficiency in Croatia, A Stochastic-Frontier Analysis." *Journal of Comparative Economics* **26**, 2, 282-300, 1998.
- Kumbhakar, S., and Lovell, C.A.K., *Stochastic Frontier Analysis*, Cambridge University Press, 2000.
- McAllister, P., and McManus, D., "Resolving the Scale Efficiency Puzzle in Banking." *Journal of Banking and Finance* **17**, 389-406, 1993.
- Mester, L., "A Study of Bank Efficiency Taking into Account Risk-Preferences." *Journal of Banking and Finance* **20**, 1025-1045, 1996.
- Riess, A., Wagenvoort, R. and Zajc, P., "Practice Makes Perfect, A Review of Banking in Central and Eastern Europe." EIB Papers, European Investment Bank, **7**, 1, 31-54, 2002.
- Scholtens, B., "Financial Regulation and Financial System Architecture in Central Europe." *Journal of Banking and Finance* **24**, 525-553, 2000.
- Sealey, C.W., and Lindley, J.T., "Inputs, Outputs, and Theory of Production Cost at Depository Financial Institutions." *Journal of Finance* **32**, 1251-1266, 1977.
- Weill, L., "Does Restructuring Improve Banking Efficiency in a Transition Economy ?" *Applied Economics Letters* **9**, 5, 279-281, 2001.
- Weill, L., "Banking Efficiency in Transition Economies, The Role of Foreign Ownership." *Economics of Transition* (forthcoming), 2003.
- Wheelock, D., and Wilson, P., "Evaluating the Efficiency of Commercial Banks, Does Our View of What Banks Do Matter ?", *Review of Federal Reserve Bank of Saint-Louis* **77**, 4, 39-52, 1995.

APPENDIX

Table A.1
Mean values of variables by country (1/2)

	Loans	Investment assets	Personnel expenses	Other non interest expenses	Interest paid
Austria	1,049,592.43	535,707.93	16,443.07	10,452.83	53,667.97
Belgium	4,606,494.75	5,107,222.40	71,553.80	75,619.05	391,573.35
Czech Rep.	521,931.07	829,206.93	13,797.60	23,843.33	56,553.47
Denmark	1,116,166.21	1,030,886.83	29,526.86	24,266.17	81,352.45
France	4,598,870.37	6,442,259.79	110,379.24	77,345.72	630,595.66
Germany	2,519,389.37	2,030,327.87	43,011.56	46,255.55	152,325.82
Greece	4,672,285.40	5,875,735.20	162,595.60	94,687.20	643,480.00
Hungary	658,710.91	619,518.27	16,268.73	29,187.09	73,158.73
Italy	7,434,851.52	4,753,491.01	162,168.25	120,735.67	402,207.04
Latvia	86,123.44	110,368.94	4,200.78	6,045.44	5,558.56
Netherlands	738,529.30	541,356.20	6,625.20	6,076.10	84,740.60
Poland	1,282,875.88	1,226,906.31	52,003.09	55,080.94	226,885.16
Portugal	5,689,189.62	3,781,126.15	90,895.54	93,494.00	430,600.15
Slovakia	403,623.75	426,303.25	9,835.13	18,233.31	57,539.88
Slovenia	421,844.31	336,426.08	13,468.23	13,344.31	36,588.54
Spain	4,658,614.91	3,868,262.96	98,717.88	63,643.98	312,345.79
UK	2,510,815.36	2,189,597.05	59,291.45	64,084.50	218,132.64

All values are in thousands of dollars.

Table A.2
Mean values of variables by country (2/2)

	Price of labor	Price of physical capital	Price of borrowed funds	Total assets	Total cost
Austria	0.0153	1.6984	0.0367	1,642,581.80	80,563.87
Belgium	0.0163	1.5644	0.0388	10,508,080.30	538,746.20
Czech Rep.	0.0071	2.1923	0.0565	1,460,957.67	94,194.40
Denmark	0.0217	0.9136	0.0319	2,338,477.07	135,145.48
France	0.0164	2.4846	0.0438	13,289,028.54	818,320.63
Germany	0.0151	2.8861	0.0395	4,790,947.20	241,592.92
Greece	0.0160	0.8859	0.0598	11,276,395.40	900,762.80
Hungary	0.0146	2.9269	0.0761	1,363,897.00	118,614.55
Italy	0.0164	1.2412	0.0362	13,444,817.23	685,110.96
Latvia	0.0188	1.0511	0.0295	225,179.56	15,804.78
Netherlands	0.0055	1.8021	0.0767	1,345,988.20	97,441.90
Poland	0.0195	1.2797	0.0997	2,797,944.66	333,969.19
Portugal	0.0097	0.7564	0.0490	10,600,394.92	614,989.69
Slovakia	0.0094	0.8510	0.0746	917,162.25	85,608.31
Slovenia	0.0171	0.9480	0.0485	817,713.85	63,401.08
Spain	0.0125	1.2835	0.0334	9,491,061.20	474,707.64
UK	0.0148	4.1390	0.0536	5,186,076.91	341,508.59

All values are in thousands of dollars, except input prices.