EXPLAINING BANK COST EFFICIENCY IN EUROPE: ENVIRONMENTAL AND PRODUCTIVITY INFLUENCES.

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Explaining Bank Cost Efficiency in Europe: Environmental and Productivity Influences.

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1. Introduction.

As Europe adopts policies that move it toward a single market, cross-country differences in banking efficiency can affect the future competitive position of a country's financial market as well as the development of European money centers. Using recent data covering a set of large banks in ten countries in Europe over 1996-2002, we seek to determine the relative importance that business environmental influences and internal productivity measures may have in explaining cross-country differences in bank efficiency. While both will affect costs, business environmental influences are largely exogenous and not easily altered while internal productivity indicators are mostly endogenous and more amenable to change. Putting the issue differently, is the business environment in some countries markedly more favorable for bank cost efficiency compared to others? If so, then efforts to build up so-called "national champions" in various countries prior to cross-border entry is unlikely to offset this natural advantage. Alternatively, if a large subset of banks are cost efficient even though they operate in different business environments in different countries, then the coming cross-border competition among banks--national champions or otherwise--will be determined more by differences in basic costs and productivity which can be partially altered by internal management decisions.

In Section 2, we outline some important differences in business environment across Spain, Germany, Italy, the U.K., and France that can affect cross-country bank efficiency levels. Important differences in common measures of banking productivity are also compared, both at a national and individual bank level. This information, augmented with additional standard cost function variables, is used in Section 3 to model bank cost efficiency for 153 large banks across ten European countries. A Distribution Free Approach (DFA) is used to determine the cost frontier in Section 4. The efficiency values obtained are averages and reflect the general level of cost efficiency over 1996-2002. We find that estimated cross-country cost efficiency levels are markedly less than levels obtained applying the same model to individual countries separately.

Importantly, average levels of cost efficiency across countries are very similar suggesting that differences in business environment--while important--are not so strong as to confer a marked advantage to a subset of countries. Indeed, when the top one-third of the most efficient banks are contrasted with those in the lowest one-third, differences in business environment are typically quite small indicating that sets of efficient banks can be found in almost each country regardless of environmental differences. Applying the DFA model to individual countries, or to particular types of banks, yields high efficiency as bank productivity measures augment the standard cost function approach normally used in the efficiency literature. These and other results are summarized in Section 5 which concludes the paper.

2. Differences in Business Environment and Bank Productivity Across Countries.

Based on the limited data available, Table 1 illustrates some of the differences in business environment and bank productivity that exist in five (of the 10) European countries that comprise our data set.[1] Total banking costs are comprised of interest and operating cost. Operating cost, composed of labor, physical capital, and materials expenses and affected by technical change over time, is where the focus should be when trying to estimate and explain bank cost efficiency either within or across countries. This is because bank interest expenses are almost solely determined by market interest rates so there is little interest cost inefficiency to worry about (c.f., Carbó-Valverde, Humphrey, and López del Paso, 2004). Consequently, in what follows, we focus on determining and comparing bank operating cost efficiency rather than total cost efficiency.

An approximate measure of average operating cost for the individual banks in our cross-country data set is shown in the first row of Table 1 (the number of large banks covered is shown

[1] Due to data availability, our sample of large banks for the other five countries (Belgium, Ireland, Netherlands, Portugal, and Sweden) is small and so these countries are not shown in Table 1.

in the last row). On average over 1996-2002, the ratio of operating cost to the value of bank assets is lowest in Germany (at .019) and from 37% to 84% higher, respectively, in Spain and Italy. Both the U.K. and France have average operating costs about 50% higher than Germany. As seen in row 2 of the table, scale economies could seemingly account for some of this difference in costs since the sampled banks in Germany are larger than those in Spain and especially Italy. However, the largest banks by far are in the U.K. and France but their average operating costs are higher, not lower, than those for Germany.

Looking at the national business environment, a less densely populated country (lower population per sq. km) may be expected to need more branches and ATMs per unit of population to deliver convenient services to depositors. In this regard Spain is the least densely populated (row 3) and has the most ATMs and branches per unit of population (rows 8 and 9). There is one ATM or Branch per 1,000 persons in Spain while in the U.K., which has a high population density, each ATM is spread over 2,100 persons and branch offices are even less numerous as they are spread over 5,200 persons. Another business environment influence on banking costs is related to the average size of a deposit account. Deposit account size data are not publicly available but it is known that higher income depositors tend to hold higher average balances. This typically lowers the cost of servicing an account per euro of deposits held. Using GDP per person as a cross-country indicator of relative income levels (row 4), one may expect that the cost of servicing deposits, relative to the deposits raised, would be higher in Spain and Italy (which likely have a lower average balance per account due to the lower income level) than in the other three countries.

Table 1: Cross-Country Differences in Business Environment and Bank Productivity

Averages (1996-2002)	Spain	Germany	Italy	U.K.	France
1. Unit operating cost (OC/TA)	.026	.019	.035	.029	.028
2. Total assets per bank (bil)	23	29	10	125	88
Business Environment:					
3. Population density	79	230	191	245	111
4. GDP per person (ths)	14	24	19	22	23
5. Cash (ATM value/deposits)	.25	.52	.23	.20	.19
6. Share electronic payments	.89	.96	.75	.71	.59
7. 4-Firm concentration ratio (CR4)	.56	.28	.40	.41	.39
8. Population per ATM	1,000	1,800	1,900	2,100	1,900
9. Population per branch	1,000	2,000	2,100	5,200	2,300
10. Price of labor (ths)	52	60	57	120	87
Internal Productivity:					
11. ATM/Branch ratio	1.1	1.2	1.1	2.6	1.2
12. Deposits per worker (mil)	3.3	8.4	2.1	7.9	4.5
13. Workers per branch	6	43	12	45	13
14. Deposits per branch (mil)	21	138	27	172	41
15. Number of large banks	42	34	33	10	16

* Entries have been rounded and simplified to make the contrasts easier to see. Values are in euros and amounts can be in thousands (ths), millions (mil), or billions (bil).

The level and composition of payment transactions processed by banks also affects bank costs. Banks in countries that rely relatively heavily on cash for point of sale and bill payments will tend to have more ATMs and branches to meet this demand. And, among the countries that rely less on cash, those that make a larger share of their non-cash payments using lower cost electronic methods should experience lower back office operating costs. Data on cash use is quite limited and is approximated here by the ratio of the value of ATM cash withdrawals to the value of transferable deposits in each country (row 5).[2] By this measure, Germany relies most heavily on cash use but at the same time -largely due to their electronic processing of paper checks- also have a large share of their non-cash transactions in lower cost electronic form (row 6). Thus Germany should experience greater costs in delivering cash to depositors but lower costs in processing payments since almost all of its non-cash transactions are electronic. The other four countries have a lower but similar intensity of cash use with France apparently experiencing the lowest level of electronic payments. The level of banking market concentration, indicated by the 4-firm total asset concentration ratio (CR4 in row 7), could also affect cost efficiency as incentives to lower cost are likely weaker when markets are more concentrated. Spain has the highest concentration while Germany has the lowest (with Italy, the U.K., and France having equal concentration in the middle).

A final business environment influence shown in Table 1 concerns the average national price of labor paid by businesses in each country (row 10). This is influenced by labor market conditions in each country and banks likely have only partial control over its level. Spain, Germany, and Italy pay a roughly similar national wage per year but unit labor costs are half again higher in France relative to Spain and more than double in the U.K. While this may seem to be an overwhelming disadvantage for France and the U.K. compared to Spain, it is also the case that the value of deposits raised per worker in France and the U.K. (row 12) are, respectively, 36% and 140% higher compared to Spain. Thus “deposit productivity” per worker at individual banks can serve as a partial offset to a country business environment which generates high unit labor costs.

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[2] Information on cash withdrawals at branch offices or received via Acash back≅ opportunities at the point of sale are not available.

Similarly, the cost impact for Spain of providing the largest number of ATMs and branches relative to its population (rows 8 and 9), is counterbalanced by the fact that each office is relatively small. Indeed, office size differs considerably across countries. The ratio of employees to branches in Spain averages only 6 per branch (row 13) with twice as many employees per branch in Italy and France and 43 and 45 per branch in Germany and the U.K. Differences in office size are largely the reason why the value of deposits per office is so different across countries (row 14). An additional cost consideration is the ratio of ATMs to branch offices since ATMs are much cheaper to establish and maintain than a stand-alone office. In this regard, the U.K. provides twice as many ATMs per office as does any of the other four countries (row 11). This, along with the fact that relatively few branches are provided to serve the population in the U.K. to begin with (row 9), is one way to compensate for the very high average price of labor being paid (row 10).

Our purpose in discussing in some detail how a country's business environment and internal productivity may affect bank operating cost is to illustrate actual differences in business environment among European countries as well as noting how these differences may be reinforced or offset by differences in bank measures of labor and capital productivity. Clearly, cross-country comparisons of cost efficiency must take both into account and not rely -as some studies have- on simple comparisons using only a cost function. Although we are not the first to make cross-country comparisons using measures of a country's business environment (e.g., Dietsch and Lozano-Vivas, 2000; Lozano-Vivas, Pastor, and Pastor, 2002), we have added direct measures of individual bank productivity in a fuller model that contains standard cost function influences. While we report the levels of cross-country cost efficiency we find, our main interest is in trying to sort out the relative importance of a country's business environment versus a bank's internal productivity in determining cost efficiency across countries.

3. Determining Cross-Country Differences in Bank Operating Cost Efficiency.

3.1. Parametric Approach to Measuring Cost Efficiency. The most common approach to cost efficiency measurement has been to relate total banking costs to the value of various balance sheet components along with funding and labor and capital input prices within a parametric cost function. While the specific form used imposes some structure on the technical relationship between banking inputs and outputs, a more important component is how efficiency is measured. The composed error Stochastic Frontier Approach (SFA) typically assumes a half-normal distribution for inefficiencies and uses this assumption to separate inefficiencies from normally distributed error in a panel regression.[3] The Distribution Free Approach (DFA)--the model used here--assumes that averaging each bank's residuals across separate yearly cross-section regressions reduces normally distributed error to minimal levels leaving only average inefficiency (Berger, 1993). Although both models involve strong assumptions, they generate similar levels and rankings of banking inefficiency (Bauer, Berger, Ferrier, and Humphrey, 1998).

A second approach to measuring inefficiency utilizes linear programming, assumes that random error equals zero, and--unlike the cost function parametric approach--places no structure on the specification of the piecewise linear best-practice frontier that results. Of two linear programming models, Data Envelopment Analysis (DEA) is by far the most used.[4] While the parametric models rely on some strong assumptions regarding the form of the distribution of

[3] The assumption that most banks are close to the efficient frontier so that inefficient firms are skewed away from the frontier (as in a half-normal distribution of inefficiency) does not appear to be the case in practice (Bauer and Hancock, 1993; Berger, 1993). The distribution of inefficiencies is more like a symmetric normal distribution which would make it difficult to locally identify separately from normally distributed error.

[4] The other approach is the Free Disposal Hull and will be either congruent with or interior to the DEA frontier. When it is interior, lower estimates of average inefficiency will result (Tulkens, 1993).

inefficiency or the ability to average random errors to levels close to zero for individual banks over time, the drawback with the DEA model is that the more influences specified as potentially having an effect on explaining efficiency, the higher will be the measured efficiency. Importantly, this occurs whether or not the specified variables really are related to efficiency or not. Each additional influence (constraint) in the DEA approach reduces the set of banks being compared with the result that average efficiency necessarily rises. With the DFA parametric approach, if a specified influence is truly unimportant, measured efficiency is unchanged. Since we wish to specify a relatively large number of possible influences on cross-country cost efficiency, our choice is to apply the parametric Distribution Free Approach.

Studies trying to explain differences in inefficiency among banks have not had much success. Indeed, the resulting explanatory power of these ancillary regressions is often quite low (e.g., with R^2s < .10). Even so, a few studies have gone beyond the usual set of variables drawn from a bank's balance sheet and have been more informative. Berger and Mester (1997), for example, have expanded on the usual set of bank size and liability/asset composition variables to include organizational form, governance, market competition, geographical location, and regulatory structure. As well, Dietsch and Lozano-Vivas (2000) have looked deeper still and included variables that reflect how a bank's economic environment--regional per capita income and population, deposit, and branch density--can help explain efficiency differences between two countries. Finally, using a survey-based data set similar to a time-and-motion analysis of numerous specific retail bank deposit and loan activities, Frei, Harker, and Hunter (2000) developed efficiency measures for 135 U.S. banks (comprising about 75% of banking assets in the early 1990s). It was suggested that these specific and diverse efficiency indicators are, when viewed in their entirety, what makes a bank efficient. If so, these micro productivity measures for individual banks should be correlated with and help "explain" efficiencies measured using DFA frontier analyses. Similarly, publicly available indicators of bank productivity commonly used within the industry for inter-bank and peer group comparisons should also be able to "explain" these efficiencies.

3.2. Distribution Free Approach (DFA) to Efficiency Measurement. The DFA model of cost frontier measurement uses panel data but does not estimate a panel regression. Instead, for each year of the panel a separate cost function is estimated using cross-section data. The unexplained residuals to each of these cross-section regressions is assumed to contain random measurement error, temporary variations in costs, and persistent but unknown cost differences.

The DFA parametric model of operating cost we specify is a function of business environment, technical (or cost function), and internal bank productivity influences:

(1) $\ln OC = a_0 + \text{Environmental} + \text{Technical} + \text{Productivity} + \ln u + \ln v$.

The efficiency measure is derived from the average value of the unexplained composite residual ($\ln u + \ln v$) in (1). The cost efficiency measure (EFF) derived from seven separate cross-section estimations is obtained under the assumption that the random error term $\ln v$ averages out to a value close to zero while the mean value of the inefficiency term $\ln u$ (represented as $\ln u^*$) will reflect the average bank-specific level of cost inefficiency over the period (Berger, 1993).[5] The bank with the lowest average inefficiency term ($\ln u^*_{\min}$) is deemed to be the most cost efficient and the efficiency of all the other i banks is determined relative to this standard:

(2) $\text{EFF}_i = \exp(\ln u^*_{\min} - \ln u_i^*) = u^*_{\min} / u_i^*$

As u_i is multiplicative to OC_i in the un-logged version of the operating cost function in (1), $OC_i = C(Q,P)_i\ u_i\ v_i$, and the ratio $u^*_{\min} / u_i^*$ is an estimate of the ratio of operating cost of the most efficient bank--for a given scale of operation, input prices, and other influences--to the operating

[5] Using U.S. banking data, DeYoung (1997) devised a test to determine how many years of separate cross-section regressions may be needed to have the random error likely average out close to zero and achieve a stable measure of efficiency. Six years was the result. We have 7 years of data and, instead of positing that measured efficiency should be stable, we interpret our results as an average indicator of efficiency over our period.

cost of bank *i* using the same output levels, input prices, and other influences.[6] If the EFF ratio u^*_{min}/u_i^* = .80, resources used at the most efficient bank represent only 80% of the level of resources used at the i^{th} bank. This suggests that the i^{th} bank is inefficiently using around (1.00 - .80)/.80 = .20/.80 = 25% of its own resources compared to the most cost efficient bank.[7]

Bank operating cost (*OC*) includes labor, physical capital, and materials expenses. Our illustrative specification in (1) augments these standard cost function influences with business environment and internal bank productivity measures which, as outlined above using Table 1, can also impact bank operating cost. Environmental influences specified concern the average wage in a country (*WAGE*) which can affect the average wage a bank pays, population density (*DENSITY*) which may help determine the number of ATM and/or branch offices supplied, and the level of GDP per person (*INCOME*) which can affect the types of banking services demanded as well as average account size. Also included are an indicator of the level of cash use (*CASHUSE*), the number of paper-based (*PAPER*) and electronic (*ELE*) payment transactions, and the share of electronic payments in total non-cash transactions (*ELESHARE*). These payment-related influences, as noted above, can also affect banking service delivery and payment processing costs. Finally, we include the asset size of the banks being compared in a country (*TA*) along with each country's four-firm concentration ratio (*CR4*). These two variables define the competitive structure of a country's banking system that -except for widespread mergers- is not easily changed. Other influences that could be useful to specify but are not available would be differences in property prices, restrictions on hiring/firing workers, and a

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[6] The ratio $u^*_{min}/u_i^* = (OC_{min} / C(Q,P)_{min})/(OC_i / C(Q,P)_i)$ and when evaluated at the same output level, input prices, and other influences, the predicted values of operating cost $C(Q,P)_{min}$ and $C(Q,P)_i$ are equal as both are at the same point on the estimated operating cost curve, leaving the ratio OC_{min} / OC_i . The value of EFF can vary from zero (where bank *i* uses multiple times the resources of the most efficient bank) to one (where bank *i* is just as efficient as the most efficient bank).

[7] The level of inefficiency (INEFF) at the i^{th} bank is INEFF = (1 - EFF)/EFF = (1/EFF) - 1.

cross-country comparison of banking regulations that may restrict the services banks may offer. Thus the business environment influences on operating cost efficiency in (1) are:

$$\text{(3) Environmental} = e_1 \ln WAGE + e_2 \ln DENSITY + e_3 \ln INCOME + e_4 \ln CASHUSE + e_5 \ln PAPER + e_6 \ln ELE + e_7 \ln ELESHARE + e_8 \ln TA + e_{88}\ .5\ (\ln TA)^2 + e_9 \ln CR4.$$

All of these variables except asset value (*TA*) are national and vary by country but in each year are constant for the banks within each country. As our Distribution Free Approach (DFA) requires separate estimation for each year, matrix singularity is a problem if squared and cross products among these influences are specified (hence the linear expression in the equation).

Technical or cost function influences on bank operating cost follows a translog specification. The level of detail regarding the main services banks provide differs across countries and we specify two main services: loans (*LOAN*) and deposits (*DEP*). Two Input prices are used: a bank's average cost of labor (*PL*) and an approximation to the cost of physical capital (*PK*)--the ratio of depreciation to the value of physical capital. Adding two additional variables--the value of loss reserves which can indicate loan risk (*RISK*) and a dummy variable identifying the type of bank (*BKTYPE*)[8]--this specification is:[9]

$$\begin{aligned}\text{(4) Technical} = {} & a_1 \ln LOAN + a_2 \ln DEP + a_3 \ln RISK + a_4 \ln BKTYPE \\ & + a_{11}\ .5\ (\ln LOAN)^2 + a_{22}\ .5\ (\ln DEP)^2 + a_{33}\ .5\ (\ln RISK)^2 \\ & + a_{12} (\ln LOAN)(\ln DEP) + a_{13} (\ln LOAN)(\ln RISK) + a_{23} (\ln DEP)(\ln RISK) \\ & + b_1 \ln PL + (1 - b_1) \ln PK + b_{11}\ .5\ (\ln PL)^2 + b_{11}\ .5\ (\ln PK)^2 \\ & + b_{12} (\ln PL)(\ln PK) + d_{11} (\ln LOAN)(\ln PL) + (-d_{11}) (\ln LOAN)(\ln PK) \\ & + d_{21} (\ln DEP)(\ln PL) + (-d_{21}) (\ln DEP)(\ln PK).\end{aligned}$$

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[8] There are five possible types: commercial, savings, cooperative, real estate/mortgage, and medium/long-term credit banks.

[9] Note that the necessary cost function restrictions of symmetry and linear homogenity in input prices are directly imposed in (4).

Three measures of internal bank productivity are available. For each bank these are the value of deposits "produced" by each employee or the deposit/labor ratio (*DEPL*), the number of workers per branch office (*LABORBR*), and the deposit/branch ratio (*DEPBR*). Data on ATMs provided or owned by each bank are not available (except for Spain) and, while this information exists on a national basis, matrix singularity occurs when it is specified (due to the large number of national level variables already specified to describe the business environment).[10] The specification of productivity influences on operating costs is:

(5) Productivity = i_1 *DEPL* + i_2 *LABORBR* + i_3 *DEPBR*.

4. Cross-Country Bank Cost Efficiency.

Our cross-country cost efficiency model (1) combines the separate influences from a country=s business environment (3), technical or cost function relationships (4), along with indicators of individual banks' productivity (5). Before our cost efficiency results for 10 European countries are presented, it is instructive to see how well this same model performs in determining efficiency in an individual country.[11]

4.1. Cost Efficiency at the Country Level. The samples of individual large banks in Spain, Germany, and Italy are large enough to separately estimate our DFA model. However, as the cross-country business environment influences are constant for each country, these -with the exception of total asset value- have to be excluded for estimation to occur. Thus all data for each of three countries in (6) is at the individual bank level:

$$(6)\ \ln OC = a_0 + e_8 \ln TA + e_{88}\ .5\ (\ln TA)^2$$
$$+ a_1 \ln LOAN + a_2 \ln DEP + a_3 \ln RISK + a_4 \ln BKTYPE$$

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[10] Recall that although we have panel data, the Distribution Free Approach to determining cost efficiency requires separate yearly regressions so the number of national variables in each year will have to be less than the number of countries.

[11] The country model is (1) and uses (4) and (5) but excludes all but *TA* influences from (3).

$$+ a_{11}\,.5\,(\ln LOAN)^2 + a_{22}\,.5\,(\ln DEP)^2 + a_{33}\,.5\,(\ln RISK)^2$$

$$+ a_{12}\,(\ln LOAN)(\ln DEP) + a_{13}\,(\ln LOAN)(\ln RISK) + a_{23}\,(\ln \text{DEP})(\ln \text{RISK})$$

$$+ b_1 \ln PL + (1 - b_1) \ln PK + b_{11}\,.5\,(\ln PL)^2 + b_{11}\,.5\,(\ln PK)^2$$

$$+ b_{12}\,(\ln PL)(\ln PK) + d_{11}\,(\ln LOAN)(\ln PL) + (- d_{11})\,(\ln LOAN)(\ln PK)$$

$$+ d_{21}\,(\ln DEP)(\ln PL) + (- d_{21})\,(\ln DEP)(\ln PK)$$

$$+ i_1\,DEPL + i_2\,LABORBR + i_3\,DEPBR + \ln u + \ln v.$$

Considering only technical (or cost function) influences, the resulting level of bank cost efficiency is .76 for Spain, .57 for Germany, and .80 for Italy. However, adding the three internal measures of banking productivity raises this to .93 for Spain, .73 for Germany, and .93 for Italy. If we truncate the top 5% of the EFF values, setting them all equal to 1.00, the efficiency values for Spain and Italy rise by only one percentage point while the EFF value for Germany rises from .73 to .85. We conclude that our DFA model, especially when augmented with measures of internal bank productivity, does a good job -except perhaps for Germany- in explaining the variation in operating cost efficiency.

In earlier work with a richer data set, but covering almost all banks for Spain rather than concentrating on only large banks here, we estimated cost efficiency levels of .94 to .96 without any truncation. These estimates included both bank productivity variables as well as certain within-country influences on banking costs such as the average regional wage, regional GDP to account for business cycle effects, and other likely determinants of bank costs within a country (Carbó-Valverde, Humphrey, and López del Paso, 2004). These results demonstrate that with the proper identification of influences on banking costs it is possible to determine almost all of the sources of cost efficiency across banks. Rather than differences in governance, management charisma, and other unspecified possible sources of banking efficiency, it seems more useful to focus on existing measures of banking productivity to explain why previously unexplained cost efficiency differences were being measured across banks.

4.2. Cross-Country Cost Efficiency. Our cross-country DFA model is (6) plus adding in all of the business environment variables specified in (3). It is applied to 153 large banks across 10 European countries -the five shown in Table 1 (Spain, Germany, Italy, U.K., and France) plus limited observations on individual large banks in Belgium, Ireland, the Netherlands, Portugal, and Sweden (the banks are listed in the Appendix along with the parameter estimates). With no truncation of extreme values, the average DFA cost efficiency value is only .48. This rises to .73, and later .81, when truncation is applied to the top 5%, and later 10%, of efficiency values. The logic behind truncation has been the possibility that some banks may have achieved the highest level of efficiency through errors in the data or luck. We prefer to view the truncation exercise, which is common with the Distribution Free Approach, as a way to illustrate how dense or sparse the sample of banks with very high efficiency values may be.

The fact that the overall average cost efficiency for the 10 countries jumps from .48 to .73 with a 5% truncation indicates that there are important outliers such that re-setting the cost efficiency values of the top eight banks (5% of 153) all equal to 1.00 raises the average measured cost efficiency for the entire sample by 52%. The difference in the distribution of cost efficiency (EFF) values with and without a 5% truncation is seen in Figure 1. The distribution before truncation (the one on the left) is very skewed as there is only one observation that has an EFF value above .76. This observation (for which EFF = 1.00) defines the cost frontier from which the other 152 banks are compared. Redefining the frontier such that the eighth most efficient bank defines the cost frontier gives the distribution with 5% truncation.[12] In either case, the distribution of cost efficiency appears to resemble a roughly normal distribution with few banks with either very low or very high measured efficiency. Of course, had our business environment and other cost influences been able to explain almost all of the variation in

[12] The estimated density (which smooths the data) only appears to go beyond the maximum value of 1.00 in Figure 1. Had these figures been shown using a bar chart, this would not have occurred.

operating cost in (1), the efficiency distribution would have shifted even more closely to 1.00 and been more peaked. Even so, the adjusted R^2s we obtained averaged .97 so most of the variation in operating cost is already accounted for. This makes the job of finding additional business environment or other cost influences difficult given the paucity of publicly available cross-country data.

Some earlier cross-country bank efficiency studies have assumed that a common cost frontier exists without specifying possible cross-country differences in business environment (e.g., Berg, Forsund, Hjalmarsson, and Suominen, 1993; Fecher and Pestieau, 1993; Bukh, Berg, and Forsund, 1995; Pastor, Pérez, and Quesada, 1997). If this assumption is not correct, and if no effort is made to introduce information that can adjust for having to operate in different banking environments, then conclusions regarding apparent differences in cost efficiency across countries may not be accurate. For example, a common impression is that Spain has an inefficient banking system compared to the rest of Europe. The large number of small branches in Spain, relative to other countries, is the indicator most point to as prima facie evidence of over-branching and apparent low efficiency. In this regard, one study found that Spanish commercial banks in 1992 had the second highest efficiency after France, exceeding that of Germany, the U.S., and the U.K., when efficiency was measured relative to each country=s own cost frontier (Pastor, Pérez and Quesada, 1997). However, when Spanish commercial banks were compared using a common frontier across subsets of European countries, banking productivity in Spain--an indicator of efficiency--was found to be low (along with France, the U.S., and the U.K.). Thus Spanish banks are seemingly efficient when compared against their own productivity standard (their own cost frontier) but have a low productivity when compared against standards existing in other countries.

Our cross-country cost efficiency results, which include cost influences specific to each country's business environment specified in (1), are shown in Table 2. We have not succeeded in identifying all cross-country sources of cost efficiency since, unlike the EFF results found for individual countries reported above, the EFF values are not close to .95 or 1.00. However, with the business environment and other influences specified the cross-country efficiency levels found are basically all the same (regardless of the level of truncation). This suggests that there probably is not much difference in the cost efficiency levels banks have achieved after they adapt to differences that exist in their specific business environment. Thus it would seem that efforts by certain countries to build up "national banking champions" prior to moving across borders may not confer any real advantage. That is, banks that are efficient in one country do not seem to enjoy any real country-specific cost advantage compared to banks in other countries.

Table 2: Cross-Country Cost Efficiency for Large Banks Across 10 Countries

Country Averages (1996-2002)	**EFF**	**EFF (5%)[1]**	**EFF (10%)[1]**	**Number of Banks**
Spain	.48	.73	.81	42
Germany	.49	.72	.81	34
Italy	.48	.73	.82	33
U.K.	.50	.75	.83	11
Belgium	.48	.73	.79	4
Ireland	.48	.74	.83	1
Netherlands	.49	.74	.81	4
Portugal	.48	.73	.81	7
Sweden	.48	.73	.82	1
France	.47	.72	.81	16
Cross-Country Average:	.48	.73	.81	153

Business Environment only	.14	.35	.59	153
Technical (Cost Function) only	.26	.60	.61	153
Productivity only	.07	.30	.44	153
Sum of 3 Influences Above:	.47	1.25	1.64	

[1] Efficiency values with 5% or 10% truncation. All entries have been rounded.

4.3. Sources of Efficiency and Efficiency by Type of Bank. The last four rows in Table 2 illustrate the separate effects on efficiency from business environment, technical (cost function), and productivity influences. Technical or cost function influences generate efficiency values twice as large as do either environmental or productivity influences. This holds until truncation rises to 10% at which point environmental and technical influences have an equal effect. Summing the separate influences gives the last row in the table. The difference between this value and the value reported as the "Cross Country Average" indicates the extent to which the three separate influences contain the same information, statistically speaking. For example, with 5% truncation the sum of the separate influences is 1.25 while the same influences pooled and estimated together give an efficiency value of .73. If the information in each of the three separate sets of influences was orthogonal to each other, the difference would be small (as it is when no truncation occurs and the two values are .47 and .48, showing how outliers can affect data collinearity).

So far, five different types of banks in 10 countries have been pooled together for Table 2 with a dummy variable (BKTYPE) used to identify their potential differences.[13] If the 76 commercial banks which are in 8 of these countries are modeled separately, the average efficiency values are larger at .72 (no truncation), .77 (5% truncation), and .80 (10% truncation).[14] Focusing on only the 42 savings banks raised efficiency further still: .87 (no truncation), .92 (5% truncation), and .94 (10% truncation). While savings banks existed in 6 of the 10 countries, over

[13] The five types of banks are commercial, savings, cooperative, real estate, and long-term credit.

[14] As fewer countries are covered, singularity of national level data meant that we only added four of the eight business environment variables specified in (3) to the model in (6). These were the national wage rate (WAGE), GDP per person (INCOME), an indicator of cash use (CASHUSE), and the share of electronic payments (ELESHARE). Since there is only one type of bank in this sub-sample, the dummy variable (BKTYPE) in (6) was deleted--it would be perfectly collinear with the intercept otherwise.

60% of these institutions were in one country (Spain).[15] The adjusted R^2s here averaged .98 and .99, respectively, for commercial and savings banks over the seven separate annual estimation periods. While the model does a good job in explaining the observed variation in operating cost at large banks across countries it will likely be difficult to find additional publicly available information capable of explaining the remaining 1 or 2 percentage points.

5. Comparing High and Low Cost Efficient Banks.

5.1. Differences in Variables Between High and Low Efficient Banks. While more work is needed to do as complete a job in identifying the sources of cross-country cost efficiency as was done for banks in individual countries, the results obtained so far can be used to illustrate the most important cost differences across our 10 countries. This is seen in Table 3 where the average top and bottom one-third cost efficiency values and the values of their associated explanatory variables are compared.[16] It is not surprising to see that efficiency values at banks in the highest group exceed those in the lowest group by some 40%. Indeed, this difference is mirrored by the 33% lower ratio of operating cost to total assets between these two groups.[17] What is surprising is to see the small differences between these two groups for most of the cost influences specified to derive the EFF values in the first place. While Table 1 illustrated that many of the business environment and other variables differed substantially among countries, it

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[15] Samples of the other three types of banks (cooperative, real estate, and long-term credit) were not large enough to run the model.

[16] Deleting the middle one-third makes these differences clearer than if the sample were merely split in half. This simple approach is taken since we wish to draw some general conclusions regarding influential variables in the efficiency calculation. It would be improper to regress the top and bottom one-third efficiency values (EFF) on the corresponding values of the variables used to derive EFF to begin with.

[17] The R^2 between cost efficiency (EFF) and the common indicator of average operating cost (the ratio of operating cost to total assets or OC/TA) is only .23. This low correlation is to be expected since EFF is a dispersion measure indicating the percent of operating cost differences among banks explained by our regressions while OC/TA reflects the variation in the level of operating cost before any differences are explained. Thus banks with a low average operating cost are not necessarily the same banks with high average cost efficiency. To take an extreme case, if all differences in operating cost among banks

turns of that the set of countries and their frequency are almost equally represented in the high and low efficiency groups. Consequently, averages of the country-specific data used in the analysis will be very similar between groups.

Table 3: Cross-Country Differences in Business Environment and Bank Productivity

Averages (1996-2002)	**Bottom 1/3rd**	**Top 1/3rd**	**Percent Difference**
EFF, no truncation	.40	.58	43
EFF, 5% truncation	.62	.86	40
EFF, 10% truncation	.70	.95	36
Unit operating cost (OC/TA)	.031	.021	-33
Total assets per bank (bil)	34	37	8
Business Environment:			
Population density	175	178	1.8
GDP per person (ths)	19	20	2
Cash (ATM value/deposits)	.35	.32	-8
Share electronic payments	.81	.82	1
4-Firm concentration ratio (CR4)	.46	.46	0
Population per ATM	1,660	1,680	1
Population per branch	2,200	2,200	.4
Price of labor (ths)	71	58	-18
Internal Productivity:			
ATM/Branch ratio	1.32	1.29	-2
Deposits per worker (mil)	5.6	5.3	-5
Workers per branch	23	25	12
Deposits per branch (mil)	166	135	-19
Number of large banks	51	51	

Entries have been rounded and values are in euros. Entries in the bottom 1/3rd are always the base for the percent changes in the last column. Entries have been rounded.

were explained then all EFF values would equal 1.0 and the R^2 between EFF and OC/TA would be zero.

Looking at the last column in Table 3, and focusing only on percent differences of 5% or more, banks in the top one-third of cost efficiency are on average only 8% larger, are in countries with 8% less cash use and have an 18% lower average cost of labor. These potential cost benefits from scale, lower payment processing costs, and -very importantly- a large advantage in labor costs, are probably offset to some degree by also having 5% fewer deposits associated with each worker (related to having 12% more workers per branch) and 19% fewer deposits per branch office. Average differences between high and low cost efficient banks in their population density, GDP per person, average share of electronic payments, 4-firm concentration ratio, population per ATM or branch office, or even the ATM/branch ratio, are all less than 5%.[18]

These results suggest that although internal bank productivity differences can help explain an important component of cost efficiency on an individual country basis above and elsewhere, the dominant explanation still appears to be associated with technical or cost function influences rather than national differences in business environment. Put differently, adding bank productivity to cost function influences succeeds in explaining close to all cost efficiency differences among banks within a single country so productivity differences are clearly important but at both the cross-country and individual country level cost function influences dominate. This is important since technical or cost function influences, as well as productivity differences, are subject to managerial intervention and alteration while national business environment differences are not.

5.2. Convergence in Variables Important for Cost Efficiency Differences. Variables that differed by more than 5% between high and low cost efficient banks were shown in Table 3, along with other variables where differences were relatively small. Banks in the top one-third of

[18] After rounding, the average 4-firm concentration ratios show no difference between the top and bottom one-third cost efficient banks. This is because there are very similar numbers of banks from each country in both efficiency categories, resulting in the same average CR4. Correspondingly, the maximum CR4 (.91) and minimum CR4 (.28) values are the same for both groups.

cross-country cost efficiency were on average 8% larger, had customers that used 8% less cash, employed workers that had an 18% lower average wage, had employees that "produced" 5% fewer deposits per worker, had 12% more employees per branch, and had branches that "produced" 19% fewer deposits. The last three influences are likely the result of having a lower price of labor which permitted the set of high cost efficient banks to substitute labor for capital resulting in fewer deposits per worker, more workers per branch, and fewer deposits per branch.

Table 4: Convergence in Business Environment and Bank Productivity differences

Convergence Indicators (*CI*)

$$CI = \left(\frac{V_{\text{high } 1/3 rd}}{V_{low\, 1/3 rd}}\right)_{2002} - \left(\frac{V_{\text{high } 1/3 rd}}{V_{low\, 1/3 rd}}\right)_{1996}$$

	$\left(\frac{V_{\text{high } 1/3 rd}}{V_{low\, 1/3 rd}}\right)_{1996}$	$\left(\frac{V_{\text{high } 1/3 rd}}{V_{low\, 1/3 rd}}\right)_{2002}$	***CI* Percent Change**
where ***V*** is:			
*Unit operating cost (OC/TA)	.70	.67	-5
*Total assets per bank	1.07	1.12	-5
Business Environment:			
Population density	1.02	1.02	0
GDP per person	1.01	1.02	-1
*Cash (ATM value/deposits)	.95	.91	-5
Share electronic payments	.99	.99	0
4-Firm concentration ratio (CR4)	1.00	.98	-2
Population per ATM	1.01	1.01	0
Population per branch	.99	1.00	-1
*Price of labor	.80	.83	4
Internal Productivity:			
ATM/Branch ratio	.97	.98	1
*Deposits per worker	.83	.90	8
*Workers per branch	1.07	1.09	-3
*Deposits per branch	.69	.89	28

CI > 0 denotes variable convergence between the top and bottom 1/3rd banks between 1996 and 2002.
CI < 0 denotes variable divergence between the top and bottom 1/3rd banks between 1996 and 2002.
*Denotes variables that in table 3 show more than a 5% difference between the highest and lowest 1/3rd

cost efficient banks. Data have been rounded.

The differences observed in these variables between high and low efficient banks may be getting smaller (converging) or larger (diverging). If they are converging then banks in the lowest cost efficiency group would face cost influences more similar to those faced in the highest group so that the efficiency differences we measure may be reduced over time. The extent of apparent convergence or divergence is shown Table 4. For each variable shown in Table 3, Column 1 of Table 4 shows the ratio of the average value of that variable for the highest one-third efficient banks in 1996 to the average value of the lowest one-third cost efficient banks in the same year. Looking at total assets per bank, in 1996 the top banks held 7% more assets. Column 2 indicates that in 2002 the top banks held 12% more assets. Thus bank size is seen to be diverging by 5% during 1996-2002 (Column 3) rather than getting closer together. If bank size is an important determinant of cost efficiency, as suggested in Table 3 and from our regression results, then differences between the highest and lowest cost efficiency banks may not be reduced but instead be increased. The six variables shown to have important differences between high and low efficient banks in Table 3 are starred (*) in Table 4. As noted, the difference in total assets is diverging (at -5%). Divergence is also seen for cash use (-5%) and workers per branch (-3%). However, convergence is evident for the price of labor (4%), deposits per worker (8%), and deposits per branch (28%).[19] As some variables are converging while others are diverging, it is not possible to conclude that the cross-country efficiency differences between sets of high and low cost efficient banks will become smaller in the near future.

[19] Convergence or divergence for the other variables shown in Table 4 is less important since differences in these variables between high and low efficient banks was found to be relatively small in Table 3.

6. Conclusions and Areas for Further Research.

In a single banking market, current cross-country differences in banking efficiency can affect the future competitive position banks and financial markets. We have used recent data on 153 large banks in ten countries in Europe over 1996-2002 to determine the relative importance of a country's business environment, technical influences from a cost function, and internal bank productivity may have in explaining cross-country differences in cost efficiency. While all three will affect costs, business environment influences are largely exogenous are not easily altered while internal productivity indicators and some cost function influences are mostly endogenous and often more amenable to change. Current efforts by certain European countries to promote "national banking champions" are premised on the likelihood that this may lead to cross-border champions as well, especially if the business environment in some countries is markedly more favorable than in others. However, if a large subset of banks in most or all countries are found to be equally cost efficient when compared to one another, even though they operate in different business environments, then future cross-border competition among banks will be determined more by differences in basic cost function and productivity influences which can be partially altered by internal management decisions.

We specify an expanded cross-country Distribution Free Approach (DFA) to cost efficiency measurement. When the model only includes standard cost function influences and is applied to each of three countries separately, cost efficiency values are .76, .57, and .80, respectively, for Spain, Germany, and Italy. Adding in internal bank productivity indicators raises efficiency to .93, .73, and .93 for the same three countries. The conclusion is that instead of trying to account for unexplained differences in cost efficiency by looking at balance sheet, corporate governance, or other possible sources, it is more productive to focus on measures of internal banking productivity. In principle, with a rich enough data set, it should be possible to explain almost all differences in cost efficiency that are now left unexplained in published studies.

After augmenting our model with a set of cost influences associated with different business environments in 10 countries, cost efficiency estimates were obtained from a pooled data set covering 153 large banks representing those institutions most likely to compete on a cross-border basis. The estimated cross-country efficiency levels are markedly less than those obtained on an individual country basis: they averaged only .48 but rose to .73 and .81, respectively, with 5% and 10% truncation. Even so, the R^2s in the underlying regressions averaged .97 suggesting that it may be difficult to do a much better job (with the DFA model at least) given the data currently available.

The main result of the cross-country analysis was that the large banks in each of the 10 countries had almost identical average efficiency values. This suggests that differences in business environment--while important--are not so strong as to confer a marked advantage to a subset of countries. When the top one-third of the most efficient banks are compared with those in the lowest one-third, differences in business environment are often quite small indicating that sets of efficient banks can be found in almost every country regardless of environmental differences. Cost efficiency at the top one-third of banks was 40% higher and, correspondingly, average operating cost was 33% lower. Banks that were most efficient were on average only somewhat larger in size (scale effect), in countries that tended to use less cash, but experienced an 18% advantage in unit labor cost. While these most efficient banks also held fewer deposits per employee and had 19% fewer deposits per branch office, all of the other environmental differences were less than 5%.

Overall, it is clear that all three specified determinants of cost efficiency differences among countries -business environment, cost function influences, and internal bank productivity-help explain the observed differences in unit operating cost. However, since the resulting cost efficiency measures are almost equal across our 10 countries for the large banks in our sample, it is also clear that once banks accommodate to their different national environments they seem to be about equally efficient. While a policy of cultivating “national champions” can confer the advantage of scale (one important difference between low and high efficiency banks) it is unlikely to have much affect on differences in unit labor costs (the other important difference identified). And although adding bank productivity measures to cost function influences succeeds in explaining close to all cost efficiency differences among banks within a country, at both the cross-country and individual country level cost function influences seem to dominate.

In terms of further research, since it now seems possible to explain almost all the difference in cost efficiency among banks in a single country, comparisons of residual inefficiency (which will be very small) will not be very informative. Instead, having driven residual inefficiency to a low level, it will be more productive to focus on determining the relative importance of the various determinants of efficiency. As it becomes clear how much of the cost difference among banks is the result of influences beyond the effective control of management, it will be possible to identify better those managerial-affected cost influences that contribute to or reduce profits. Only the latter truly reflect inefficiency.

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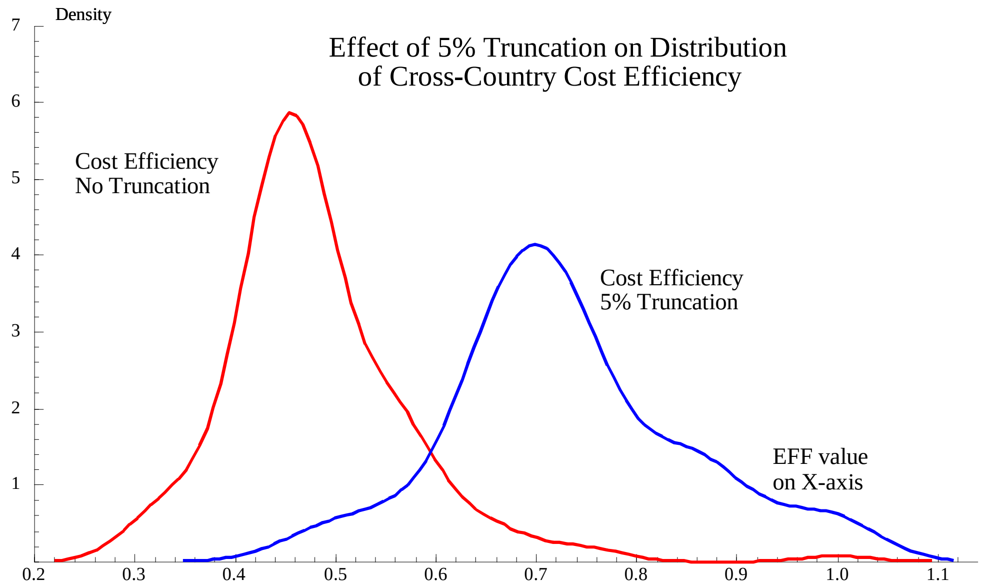

Density
Effect of 5% Truncation on Distribution
of Cross-Country Cost Efficiency
Cost Efficiency
No Truncation
Cost Efficiency
5% Truncation
EFF value
on X-axis
7
6
5
4
3
2
1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1

Figure 1

Appendix

A. Data Used in the Analysis.

Our sample covers a set of 153 large banks in ten European countries over 1996-2002 from Bureau Van Dijk´s Bankscope database plus individual bank annual reports. Only banks with assets greater than 1 billion euros were selected. A balanced panel is needed to estimate our Distribution Free Approach (DFA) cost frontier so institutions with missing data for any year over our 7-year period could not be included. Although many banks had complete data on Bankscope, only 153 also had data on the number of branch offices and employment by bank in annual reports available on the Internet. ATM data by bank was available only for one country so national data had to be used instead.

Our panel includes commercial banks, savings banks, cooperative banks, mortgage banks, and medium and long term credit banks. Depending on the country, these banks accounted for 60% to 80% of the total banking assets in Spain, Italy, Germany, the U.K., and France in 2002. For the other four countries (Belgium, Ireland, Portugal, and Sweden), the asset share represented is smaller although some of the largest banks in these countries are included in our sample. Finally, data corresponding to the national level cross-country business environment variables are taken from OECD data sources (GDP, market interest rate, national wage, population density, etc.) and the Blue Book published by the European Central Bank (for national information on a country's payment system).

The names of the 153 banks used in the study and their country of origin are listed below. The cross-country efficiency rank of each bank is shown in brackets and indicates if the bank belongs to the top [t], medium [m] or bottom [b] one-third cost efficiency category (discussed in Table 3).

Spain: Banca March [b], Banco Atlántico [b], Banco Bilbao Vizcaya Argentaria (BBVA) [m],Banco de Andalucía [b], Banco de Castilla [m], Banco de Galicia [t], Banco de Sabadell [b], Banco Español de Crédito (Banesto) [m], Banco Guipuzcoano [m], Banco Pastor [b], Banco Popular Español [m], Banco Simeón [t], Bankinter [t], Barclays Bank, BBK [m], Caja de Ahorros de Cataluña [m], Caja de Ahorros de Castilla - La Mancha [m], Caixa Galicia [t], Caja de Ahorros de la Inmaculada de Aragón [t], Caja Murcia [t], Caixa Sabadell [b], Bancaja [m], Caja Vital [t], Caja de Ahorros del Circulo Católico [m], Caja de Ahorros del Mediterráneo [m], Caixa de Girona [t], Caixanova [m], Caja Sur [m], Kutxa [t], Caja de Ahorros y Monte de Piedad de las Baleares [m], Caja Navarra [t], Ibercaja [b], La Caixa [m], Caja de Badajoz [b], Caja de Burgos [t], Caja de Extremadura [m], Caja Canarias [b], Caja Granada [m], Caja Insular de Ahorros de Canarias [b], Caja Madrid [m], BSCH [m], Unicaja [b].

Germany: Baden-Wuerttembergische Bank AG [t], Bankhaus Reuschel [t], Berenberg Bank - Joh. Berenberg [m], Berliner Volksbank eG [b], Berlin-Hannoverschen Hypothekenbank AG [b], BHW-Bank AG [t], Deutsche Apotheker- und Arztebank eG [m], Deutsche Bausparkasse BADENIA AG [b], Deutsche Hypothekenbank (Actien-Gesellschaft) [t], Deutsche Schiffsbank AG [t], Die Sparkasse Bremen [b], Dresdner Bank AG [m], DVB Bank AG [t], Eurohypo AG [m], Hypothekenbank in Essen [b], Kasseler Sparkasse [m], KD-Bank eG - die Bank fuer Kirche und Diakonie [t], Kreissparkasse Bautzen [b], LIGA Bank eG [t], M.M. Warburg & CO Kommanditgesellschaft auf Aktien [m], Merck Finck & Co Privatbankiers [b], Münchener Hypothekenbank eG [t], Norddeutsche Landesbank Girozentrale NORD/LB [b], Norisbank AG [b], Oldenburgische Landesbank – OLB [b], Sal oppenheim jr. & Cie kgaa, SEB AG [m], Südwestbank AG [t], Vereins-und Westbank AG [b], Volksbank Pforzheim eG [b], Westdeutsche Immobilienbank [t], Westfälische Hypothekenbank AG [t] - Die WestHyp, Wiesbadener Volksbank eG [m].

Italy:Banca Antonveneta-Banca Antoniana Popolare Veneta SpA [b], Banca Carige SpA [m], Banca delle Marche SpA [m], Banca di Credito Cooperativo di Roma [b], Banca Fideuram SpA [b], Banca Monte Parma SpA [t], Banca Nazionale del Lavoro SpA – BNL[m], Banca per il Leasing– Italease [t], Banca Popolare dell'Adriatico S.p.A. [m], Banca popolare dell'Etruria e del Lazio Spa [b], Banca Popolare di Ancona SpA [b], Banca Popolare di Bari Scarl [t], Banca Popolare di Intra [m], Banca Popolare di Puglia e Basilicata [m], Banca Popolare di Sondrio SCarl [t], Banca Popolare FriulAdria SpA [t], Banca Toscana SpA [m], Banco Desio - Banco di Desio e della Brianza SpA [m], Banco di Sardegna SpA [t], Bank Fuer Trient und Bozen-Banca di Trento e Bolzano SpA [t], Capitalia SpA [t], Cassa di risparmio di Alessandria SpA [m], Cassa di Risparmio di Prato SpA (Cariprato) [b], Cassa di risparmio di Rimini SpA (Carim) [m], Cassa di risparmio di San Miniato SpA [b], Cassa di Risparmio di Savona SpA [m], Cassa di risparmio in Bologna SpA (Carisbo) [m], Credito Artigiano [t], Credito Bergamasco [t], Credit Valtellinese SCarl [b], Interbanca SpA [t], Suedtiroler Volksbank-Banca Popolare dell'Alto Adile [b], Veneto Banca Scparl [b].

UK: Abbey National Plc [t], Bank of Scotland [t],Barclays Bank Plc [t], British Arab Commercial Bank Limited [t], Co-operative Bank Plc [b],Daiwa Securities Trust and Banking [b], HSBC Bank plc [b], Merrill Lynch International Bank Limited [b], Royal Bank of Scotland plc [t], Singer & Friedlander Ltd

[b], Standard Chartered Plc [t].

Belgium: Bank J. Van Breda en Co NV [m], Banque Degroof NV-Banqu Degroof SA [b], CBC Banque S.A. [t], ING-ING Belgium SA/NV [t]. **Ireland**: ACCBank Plc [m]. **Holland**: ABN Amro Holding NV [m], Fortis Bank Nederland (Holding) N.V. [b], Friesland Bank [t], Rabobank Group-Rabobank Nederland [m]. **Portugal**: Banco Espirito Santo [b], Banco Internacional de Crédito [t], Banco Totta & Açores [b], Banco Internacional do Funchal (Banif) [t],Caixa Economica Montepio Peral [m], Caixa Geral de Depositos [b], Credito Predial Portugues [b]. **Sweden**: Foereningssparbanken (Swedbank) [m].

France: Crédit Industriel et Commercial (CIC) [t], Crédit Industriel de Normandie-Banque (CIN) [t], Crédit Industriel de l'Ouest-Banque (CIO) [b], Banque Hervet S.A. [m],Crédit Agricole Indosuez [t], Fortis Banque France SA [b], Banque Scalbert Dupont (BSD) [m], CCF [m], Crédit Lyonnais [m], Société Générale [b], Crédit Agricole CA [b], Banque Populaire de la Côte d'Azur [m], Caisse Centrale de Crédit Coopératif [t], BRED Banque Populaire [m], Crédit Coopératif [t], Banque Populaire Provençale et Corse [m].

B. Parameters for the Seven Separate Cross-Section Translog Cost Function Estimates.

Number of observations = 153 for each year. Standard Errors are computed from a heteroscedastic-consistent matrix (Robust-White). This estimation is from combining equations (3), (4), and (5) into (1) with an intercept term added. When equation (6) was estimated (not shown here), certain variables that are constant within a country were necessarily deleted.

Parameter estimate	1996	1997	1998	1999	2000	2001	2002
a_0	-4.81546 [.265]	-2.03029 [.644]	1.76685 [.774]	-3.22271 [.431]	-2.83140 [.459]	-7.60385* [.062]	-7.18658** [.013]
Ln WAGE	2.42668*** [.001]	1.22552* [.086]	1.66484** [.034]	.434016 [.370]	1.12349* [.076]	.792422 [.203]	1.02793** [.041]
Ln DENSITY	.519229** [.024]	.408066 [.122]	.415978 [.198]	.532966** [.027]	.285533 [.204]	.641238*** [.002]	.596657*** [.000]
Ln INCOME	.323261** [.023]	.292659* [.052]	.169207 [.444]	.387809*** [.008]	.209618* [.081]	.455387*** [.000]	.469349*** [.000]
Ln CASHUSE	-.282239 [.468]	-.150668 [.613]	-.158593 [.678]	-.335514 [.267]	.069677 [.786]	-.248193 [.314]	-.432453* [.072]
Ln PAPER	-.163004 [.255]	-.297735*** [.009]	-.198170 [.270]	-.218720** [.017]	-.278367*** [.007]	-.214519** [.020]	-.301270*** [.002]
Ln ELE	.245382 [.369]	-.0189956 [.913]	.496883E-02 [.975]	.096542 [.265]	.014851 [.864]	.022840 [.758]	-.453596E-02 [.911]
Ln ELESHARE	-.376628 [.129]	-.190804 [.198]	-.057515 [.683]	-.252262*** [.002]	-.124380 [.185]	-.191973*** [.008]	-.246805*** [.000]
Ln TA	.431763 [.772]	-.601916 [.523]	-.738566 [.307]	-.185932 [.750]	-.457406 [.396]	-.838313 [.123]	-1.43939** [.014]
Ln CR4	-.508054*	-.806671**	-.212370	-.677232**	-.220352	-.634843*	-.596802

	[.073]	[.046]	[.755]	[.025]	[.520]	[.062]	[.179]
Ln LOAN	-1.61428*** [.001]	-.425552 [.533]	-1.70152** [.027]	-.901231* [.064]	-.918411 [.177]	-.224538 [.566]	-.245377 [.612]
Ln DEP	-1.03664** [.023]	-.791643 [.134]	-1.34010 [.157]	-.030408 [.950]	.256174 [.743]	-.069559 [.887]	-.222969 [.601]
Ln RISK	1.05265*** [.000]	.732261*** [.000]	1.81902*** [.005]	.984217*** [.000]	.687381*** [.007]	.628842*** [.000]	.522495*** [.009]
Ln BANK TYPE	-.040218 [.157]	-.055530** [.024]	-.096732*** [.006]	-.060683*** [.010]	-.053317** [.016]	-.052262** [.022]	-.058960** [.019]
Ln LOAN^2	.247474** [.010]	.028669 [.847]	.269915* [.059]	.138500 [.118]	.053520 [.692]	.010286 [.919]	.348691E-02 [.983]
Ln DEP^2	.260986*** [.006]	.169745 [.256]	.214018 [.177]	.066660 [.492]	-.087043 [.488]	.017463 [.835]	-.033904 [.778]
Ln RISK^2	.140543*** [.000]	.029180 [.151]	.181751*** [.003]	.062545*** [.010]	.125374*** [.001]	.105612*** [.000]	.082365*** [.000]
Ln LOAN Ln DEP	-.931149E-02 [.886]	.036444 [.740]	.038399 [.704]	.029816 [.636]	.113842 [.104]	.062241 [.319]	.104356 [.318]
Ln LOAN Ln RISK	-.158743*** [.001]	-.024229 [.622]	-.209419*** [.009]	-.133050*** [.008]	-.141290* [.066]	-.086545* [.095]	-.117497*** [.007]
Ln DEP Ln RISK	.358818E-02 [.940]	-.050957 [.329]	-.034890 [.682]	.936475E-02 [.861]	.033340 [.624]	-.374029E-02 [.938]	.043111 [.363]
Ln LOAN Ln PL	-.205532*** [.000]	-.057564 [.493]	.022488 [.746]	-.057542 [.373]	-.289556E-02 [.971]	.029697 [.678]	.106388 [.155]
Ln DEP Ln PL	.223627*** [.000]	.097975* [.212]	-.997582E-02 [.875]	.092645 [.132]	.066168 [.429]	.024505 [.755]	-.064423 [.418]
Ln PL	.341123* [.069]	.339844 [.108]	.647760** [.036]	.361037* [.055]	.116105 [.603]	.199475 [.270]	.152129 [.259]
Ln PK	.053673 [.156]	.121192*** [.004]	.126585*** [.004]	.112367*** [.008]	.119298*** [.003]	.124009*** [.000]	.079771*** [.000]
Ln PL Ln PK	.131349*** [.001]	.042779 [.424]	.077980 [.186]	.045711 [.395]	.035272 [.519]	.039167 [.413]	.078095*** [.002]
Adjusted R-squared	.968520	.976353	.953157	.979893	.973211	.973323	.971651
LM het. test	2.22643	1.39318	1.83546	4.76587	1.16959	1.94643	5.60929
Durbin-Watson	2.32482	2.16490	2.11296	1.99167	1.88442	1.93734	2.01792

Notes: ***/**/* denotes significance at 1, 5 and 10 % levels. p-value in brackets

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