

**OWNERSHIP AND PERFORMANCE IN EUROPEAN AND US  
BANKING – A COMPARISON OF COMMERCIAL, CO-OPERATIVE  
& SAVINGS BANKS**

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# **Ownership and Performance in European and US Banking - A comparison of Commercial, Co-operative & Savings Banks**

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## **Abstract**

This paper contributes to the governance/agency issues literature by investigating ownership and efficiency issues in European and US banking. In particular, we examine the efficiency features for a large sample of private commercial banks and mutual savings and co-operative banks in order to investigate whether systematic differences in efficiency occur between the different bank organisational forms. Overall we find that commercial banks tend to be less cost efficient but more profit efficient than their mutual sector competitors. The higher costs incurred by the commercial bank sector appear to be reflected in higher revenues. Large banks also appear to be more profit efficient than smaller banks from the same ownership category.

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*Keywords:* Banking; Efficiency; Ownership, Frontiers

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## **ABSTRACT**

This paper contributes to the governance/agency issues literature by investigating ownership and efficiency issues in European and US banking. In particular, we examine the efficiency features for a large sample of private commercial banks and mutual savings and co-operative banks in order to investigate whether systematic differences in efficiency occur between the different bank organisational forms. Overall we find that commercial banks tend to be less cost efficient but more profit efficient than their mutual sector competitors. The higher costs incurred by the commercial bank sector appear to be reflected in higher revenues. Large banks also appear to be more profit efficient than smaller banks from the same ownership category.

## **1. Introduction**

The relationship between ownership type and firm efficiency remains a central feature in the corporate governance debate. Seminal work by Jensen and Meckling (1976), Fama (1980) and Fama and Jensen (1983) have drawn attention to the separation of ownership and control of quoted and other types of corporate form that has spawned an extensive literature. The principal agent framework and public choice theory highlight the importance of management being constrained by capital markets discipline. The main argument is that a lack of capital market discipline for firms weakens owners' control over management making management freer to pursue its own agenda, and thus providing it with fewer incentives to be efficient. Traditionally, the bulk of the literature has focused on the private versus public ownership

debate with most studies concluding that the former are likely to be more efficient.<sup>1</sup> As noted in earlier studies, however, less attention has been paid to examining the performance features of other ownership forms - particularly differences between private, public and mutual firms.<sup>2</sup> This is mainly because there are few industries where firms of these different ownership types compete against one another.

One industry where private and mutual firms operate together in a competitive market is in banking, particularly in Europe.<sup>3</sup> Nevertheless, there is little empirical guidance to suggest whether there are systematic differences in the performance features of these different types of banking firms<sup>4</sup>. The US literature focuses on comparisons between private and mutual banks and appears inconclusive as to which ownership form is the most efficient. For instance O'Hara (1981) and Nicols (1967) indicate that mutual firms are likely to be more efficient than their private sector counterparts. Mester (1989, 1993) finds that mutual firms are more efficient while Cebenoyan et al. (1993) suggests there is no difference between the efficiency of mutual and joint stock Savings and Loans (S&L) banks.<sup>5</sup> As for Europe, Altunbas et al's (2001) study on German banking finds little evidence that private commercial banks are more cost or profit efficient than their mutual or public sector counterparts<sup>6</sup>.

In order to extend the aforementioned literature this paper derives cost and alternative profit efficiency measures for a large sample of commercial, savings and co-operative banks operating in Europe and the US during the 1990s in order to see if substantial efficiency differences arise across bank types. As noted by Berger and Humphrey (1997) there is a paucity of cross-country studies in the bank efficiency area and as far as we are aware there have not been any previous studies that investigate ownership and efficiency issues across different banking systems.

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<sup>1</sup> See Berle and Means (1932), Grossman and Hart (1980) and Frech (1980) for seminal articles on the public versus private ownership debate.

<sup>2</sup> See, for example, Altunbas, Evans and Molyneux (2001)

<sup>3</sup> See Goddard, Molyneux and Wilson (2001) chapter 2 for a detailed exposition of the structure and ownership features of European banking markets.

<sup>4</sup> Most of the extant literature on bank efficiency focuses on commercial banks operating in single banking systems (see Berger and Humphrey 1997 for an extensive review). Various other studies focus on the same type of mutual banks within countries (such as Drake and Weyman-Jones (1996) on UK building societies) and across countries (including Carbo et al (2002) for European savings banks).

<sup>5</sup> These inconclusive findings could be because, as noted by Miles (1994), that pressures on managers of mutual firms to perform may be greater than for quoted banks, as the threat of members (depositors) withdrawing funds may be a greater sanction on their behaviour than shareholders selling stock.

<sup>6</sup> In Germany the savings banks can be regarded as public banks that have the same objectives as mutual institutions. See the Section 3 in this paper for a discussion of the legal features of the savings bank sector across countries.

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The structure of the paper is as follows. Section 2 outlines the main methodological issues. Section 3 discusses data and results and section 4 is the conclusions.

## 2. Methodology

As suggested by Mester (1989, 1993) and Berger and Mester (1997) this paper first estimates cost and profit efficiency for individual ownership types - savings banks, commercial banks and co-operative banks. Mester argues that one should compare banks that have the same ownership features as differences in inefficiency are less likely to be attributed to differences in production features. Alternatively, Altunbas, Evans and Molyneux (2001) have argued that it makes more sense to compare the efficiency of banks across ownership types. This, they argue, is more relevant for public policy making as regulators are likely to be more interested in the efficiency features of different ownership types, as opposed to efficiency differences within individual bank categories. To put this another way, it is more interesting to see whether savings banks are more or less efficient than commercial banks, rather than investigating which commercial banks or savings banks are the most efficient within their individual sectors. To address these issues we pool our total sample of banks and derive efficiency estimates for the three different bank types from the full sample. We then estimate cost and alternative profit efficiencies for the different ownership groups: savings banks, commercial banks and co-operative banks separately. These results are then compared.

We use a similar modelling approach to Altunbas, Evans and Molyneux (2001) and Altunbas, Gardener, Moore and Molyneux (2001) to estimate cost and alternative profit efficiencies for the three bank ownership categories. For our definition of inputs and outputs we choose the intermediation approach as suggested by Sealey and Lindley (1977), where the inputs, labour, physical capital and deposits are used to produce earning assets. We include two outputs: loans and securities<sup>7</sup>.

Inefficiency measures are estimated using the stochastic frontier and distribution-free approaches<sup>8</sup>. The stochastic frontier approach labels a bank as inefficient if its costs are

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<sup>7</sup> Various studies use different output specifications and more recently the literature tends to include a measure of off-balance sheet output. However, due to data limitations we use the simplest output definition in order to help maximise sample size.

<sup>8</sup> We also re-estimated the model using different distributional assumptions, half-normal and truncated normal, but the results remained similar and so are not reported.

higher, or profits lower, than those predicted for an efficient bank producing the same input/output combination and the difference cannot be explained by statistical noise. The cost or alternative profit frontier is obtained by estimating a cost or alternative profit function with a composite error term, the sum of a two-sided error representing random fluctuations in cost or profit and a one-sided positive error term representing inefficiency using the stochastic frontier methodology. Following Berger and Mester (1997) distribution-free inefficiencies from the cost and alternative profit function are estimated for each period of the panel data set. The random error is assumed to average out over time so the average of a bank's residuals from all of the regressions will be an estimate of the inefficiency term.

The next step, given the choice of inefficiency measures, relates to choosing the underlying cost and profit function specification. To estimate cost and profit inefficiencies we use the standard cost function and alternative profit function approaches as detailed in Berger and Mester (1997). Inefficiencies are derived from a cost or profit function in which total costs or total profits depend on the prices of variable inputs, outputs and a time trend.

In this paper we use the Translog form to examine the specification which best fits the underlying cost and profit structure of our European and US banks. The choice of the Translog was motivated by the recently identified problems associated with using the Fourier functional form (see Altunbas and Chakravarty, 2001) especially when dealing with heterogeneous data sets<sup>9</sup>.

The translog function estimated is as follows:

$$\begin{aligned} \ln \text{TC} = & \alpha_0 + \sum_{i=1}^2 \alpha_i \ln Q_i + \sum_{i=1}^3 \beta_i \ln P_i + t_1 T + \\ & \frac{1}{2} \left[ \sum_{i=1}^2 \sum_{j=1}^2 \delta_{ij} \ln Q_i \ln Q_j + \sum_{i=1}^3 \sum_{j=1}^3 \gamma_{ij} \ln P_i \ln P_j + t_{11} T^2 \right] + \\ & \sum_{i=1}^3 \sum_{j=1}^2 \rho_{ij} \ln P_i \ln Q_j + \sum_{i=1}^2 \psi_{it} \ln Q_i T + \sum_{i=1}^3 \theta_{it} \ln P_j T + \varepsilon \end{aligned}$$

where

$\ln TC$  = the natural logarithm of total costs (Operating and Financial cost);

$\ln Q_i$  = the natural logarithm of bank outputs (with one added to avoid problems with taking the log of zero);

$\ln P_i$  = the natural logarithm of  $i$ th input prices (*i.e.* wage rate, interest rate and physical capital price);

$T$  = time trend;

$\alpha, \beta, \delta, \gamma, \theta, \Psi, \rho$ , and  $t$  are coefficients to be estimated.

The alternative profit function has the same specification as the above, the only difference being that the dependent variable is replaced with profits. The usual input price homogeneity and symmetry restrictions are imposed on the cost and alternative profit function estimates. We use the random effects estimation procedure following Lang and Welzel (1996).

### 3. Data and Results

This study uses banks' balance sheet and income statement data for a sample of European and US banks between 1990 and 2000, obtained from the London-based International Bank Credit Analysis Ltd's 'Bankscope' database. The sample comprises 10,274 private commercial bank observations, 8,042 savings bank observations and 7,425 co-operative bank observations across 15 European countries and the US between 1990 and 2000<sup>10</sup>. An important point to note is that commercial banks are either listed or privately owned and co-operative banks are all mutual institutions. However, savings banks have different legal forms across countries. German savings banks are government-owned institutions while the Spanish savings banks have strong links to local government but mainly retain the mutual legal features of the traditional savings banks sector. Italian, Austrian and French savings banks have undergone various forms of legal conversion in recent years making them quasi private institutions while in the UK the remaining building societies sector also maintain their mutual legal status. There have also been many mutual-to-stock conversions in the US savings & loan industry over the last decade.<sup>11</sup> While the legal form of savings banks clearly differs substantially across countries these institutions generally follow similar strategic objectives and therefore

<sup>9</sup> See Carbo et.al (2002) for details on the use of the Flexible Fourier functional form for cost efficiency estimates for the European savings banks sector.

<sup>10</sup> Caution needs to be made about interpretation of the year 2000 data as all banks that were included in 1999 had not been included in the database for 2000 at the time of study

<sup>11</sup> See Gardener *et.al.* , 1999, and Peristiani and Wizman, 1997 for an extensive review of the institutional features of European and US savings institutions.



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for ease of exposition we analyse these as a single bank type.<sup>12</sup>

The sample is shown in Table 1.

**Table 1 Data Sample – European and US Commercial, Co-operative and Savings Banks 1990-2000**

Our sample from Bankscope is rather unbalanced. One can see from Table 1 that German savings and co-operative banks tend to be over-represented. This, of course, merely reflects the nature of the German banking sector where savings and co-op banks (of which there are over 3,500 in number) have over 55% of the retail market<sup>13</sup>. Table 1 clearly suggests that co-operative banks are a less evident sector in many European banking markets - co-op banks with mutual status no longer exist in the UK and US. The closest type of organisational form to the co-operative banks are credit unions, however, we do not have data on these types of financial firms.<sup>14</sup> The size distribution of banks in the sample is shown in Table 2.

**Table 2 Asset Size Distribution of European and US Commercial, Co-operative and Savings Banks 1990-2000**

Table 2 shows that for the sample overall the commercial banks are evenly represented across the different size classes. Co-operative banks have greater representation in the smaller size group, especially under Euro 500 million in assets size. Most of the savings banks are in the Euro 500 – Euro 2500 million asset size group.

Table 3 is divided into two sections. Part 3a) reports cost inefficiencies derived from the pooled and individual ownership type estimates for each country. Part 3b) reports both the pooled and individual cost inefficiencies across ownership types according to bank asset size. (Parameter estimates for the pooled and individual ownership type estimates are reported in the Appendix)

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<sup>12</sup> The main aims of the savings bank sector are: to foster savings among the general population; to develop the economy of the locality or area; to carry out social works in that locality; and to operate in the best interest of their members.

<sup>13</sup> We estimated the cost and alternative profit efficiency estimates excluding the German observations but this had no material effect on the main findings, so these are not reported.

<sup>14</sup> Another limitation of our sample is that we were unable to accurately distinguish between quoted and unquoted US savings banks (S & Ls). As such, inferences drawn about the US savings bank sector and mutual /

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**Table 3 Cost Inefficiency - Pooled and Individual Ownership Type Estimates 1990 to 2000**

The pooled (or common frontier) estimates reveal differences in cost inefficiency across bank types and countries. In all countries (apart from in Finland, Luxembourg and the Netherlands) savings banks appear more cost efficient than their private commercial bank competitors and in most cases co-op banks are also more efficient. Co-operative banks also appear to be more cost efficient than the commercial banks (apart from in Spain). In general, the results from the pooled estimates suggest that mutual sector is more cost efficient than the commercial banks. Comparing these results with those obtained from the individual ownership type estimates it is still the case, in the majority of countries, that on average the savings banks sector is more efficient than that of commercial banks. This means that there is evidence that savings banks lie closer (in the majority of countries) to their industry's best-cost practice frontier compared with commercial banks. In contrast, in most cases co-operative banks lie further away from their industry's cost frontier compared with commercial banks. While recognising that comparisons across different cost frontier estimates for commercial, savings and co-operative banks may be problematic, this information, taken together with the pooled results, does suggest that commercial banks do not have any major cost efficiency advantage over the mutual savings and co-operative bank sector.

The second part of Table 3 shows cost inefficiencies according to bank size. Here the pooled estimates reveal that, on average, larger banks, irrespective of ownership type, tend to be more inefficient than smaller banks. This finding is generally confirmed from the individual ownership type estimates<sup>15</sup>.

So far we find little evidence that private commercial banks are more cost efficient than the mutual sector banks. This, of course, could be because commercial banks are more efficient in generating revenues than in minimising cost and this is something that cost efficiency estimates do not tell us. It could be that cost efficient banks are offering lower cost but poorer quality services and this may be reflected in lower levels of profitability. So as to incorporate an earnings dimension into the analysis we estimate alternative profit efficiency for the pooled and individual bank types. Table 4 shows the pooled alternative profit efficiency results.

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private ownership need to be treated with caution. Nevertheless, as they are distinct from commercial banks the results, at least, will provide at least a benchmark for comparisons with the European savings bank sector.

<sup>15</sup> Apart for the largest category of co-operative banks.

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**Table 4 Alternative Profit Efficiency Estimates - Pooled and Individual Ownership Type Estimates 1990 to 2000**

The pooled estimates reported in section Table 4a reveal that commercial banks are more profit efficient (apart from in Finland, Netherlands and Portugal) than their mutual sector counterparts. Or to put it another way, commercial banks (on average) lie closer to the maximum profit frontier compared with mutual banks. The individual ownership estimates reveal that commercial banks, on average, lie further away from their sector's maximum profit frontier compared with the savings and co-operative banks. Taken together with the pooled estimates this simply means that commercial banks lie closer to the industry best profit frontier (compared with mutual banks) but there is greater heterogeneity in commercial bank profit efficiency compared with the savings and co-operative bank sectors. The second part of the Table 4b reveals that for the pooled estimates larger mutual banks are more profit efficient. The individual ownership type estimates also suggest that for each ownership type larger banks are more profit efficient.

Taking the results together, the pooled cost and profit efficiency measures do seem to indicate that commercial banks have a profit efficiency advantage over their mutual sector competitors across most countries. This, however, does not appear to be driven by cost efficiency advantages. The greater profit efficiency of commercial banks, therefore, must be brought about by either some kind of market power or by factors that give them stronger revenue generating ability<sup>16</sup>. This may be explained by such factors as higher quality services, better risk management procedures, greater brand and franchise values and so on that result in higher costs<sup>17</sup>.

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<sup>16</sup> Berger and Mester (2003) in their study of US bank efficiency between 1991 and 1997 find that cost efficiency declined whereas profits performance increased and this they ascribe to the fact the banks increased their service quality over the period. That is, higher costs led to better service resulting in greater revenues and therefore profits. Also see Berger (2003) for a review of the recent literature on US bank productivity and a summary of these findings.

<sup>17</sup> The presence of a higher degree of market power for commercial banks cannot be ruled out. Their relative cost inefficiency raises the question as to whether these higher costs were passed on to depositors and borrowers (which may give rise to a higher level of profit efficiency) or if they were absorbed by the commercial banks (which would result in lower profit efficiency). The former appears to be the case from our empirical evidence. An alternative hypothesis is suggested by Berger, Humphrey and Pulley (1996): lower cost inefficiencies and higher profit inefficiencies may imply that banks have market power in the pricing of their outputs and that consumers value the joint consumption of banking outputs, consumers appear to be willing to pay for "one-stop banking" (see Berger, Humphrey and Pulley, 1996).

#### **4. Conclusion**

This paper extends the literature on bank ownership and efficiency by estimating cost and alternative profit efficiency estimates for a large sample of savings, commercial and co-operative banks operating in Europe and the US. The main finding is that, on average, commercial banks tend to be less cost efficient but more profit efficient than their mutual sector competitors. The higher costs incurred are therefore reflected in higher revenues. This may relate to the more diverse business mix of the commercial bank sector. Large banks within each ownership type appear also to be more profit efficient than smaller banks from the same ownership category.

The general view that corporate governance issues may create less incentive for mutual banks to operate as cost efficiently as their private sector competitors is not borne out by our analysis. However the finding that mutual banks tend to be less profit efficient on average, may suggest that there is some substance to this argument. Of course, it could simply be that the risk profile of mutual and private commercial banks is so different that one is bound to find that commercial banks are more profit efficient because they undertake more risky business or have higher quality services. Additionally, they may also enjoy a greater degree of market power. These issues deserve further investigation but are not within the scope of the current study.

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**Table 1 Data Sample – European and US Commercial, Co-operative and Savings Banks 1990-2000**

Country	Number of Savings Bank Observations	Number of Commercial Bank Observations	Number of Co-operative Bank Observations
Austria	255	221	79
Belgium	93	286	31
Denmark	229	361	10
Finland	7	40	-
France	326	1767	982
Germany	4073	1300	5297
Greece	-	72	-
Ireland	-	90	-
Italy	463	570	988
Luxembourg	7	735	14
Netherlands	24	286	-
Portugal	16	279	-
Spain	297	514	24
Sweden	14	49	-
UK	15	733	-
USA	2223	3071	-
<b>TOTAL</b>	<b>8042</b>	<b>10374</b>	<b>7425</b>

Source: Bankscope (2000)



**Table 2 Asset Size Distribution of European and US Commercial, Co-operative and Savings Banks 1990-2000**

<b>Assets Size (Euro million)</b>	<b>Number of Savings Banks</b>	<b>Number of Commercial banks</b>	<b>Number of Co-operative banks</b>
1-99.9	248	706	716
100-199.9	388	1019	1504
200-299.9	662	694	1593
300-499.9	1178	956	1287
500-999.9	2014	1628	912
1000-2499.9	2052	1948	738
2500-4999.9	817	1087	336
5000+	683	2336	339

**Table 3 Cost Inefficiency - Pooled and Individual Ownership Type Estimates 1990 to 2000**

<b>Table 3a</b>	<b>Pooled Estimates</b>			<b>Individual Ownership Type Estimates</b>		
<b>Country</b>	<b>Commercial Banks</b>	<b>Co-operative Banks</b>	<b>Savings Banks</b>	<b>Commercial Banks</b>	<b>Co-operative Banks</b>	<b>Savings Banks</b>
<b>Austria</b>	0.231	0.22	0.178	0.162	0.237	0.13
<b>Belgium</b>	0.31	0.281	0.279	0.255	0.295	0.297
<b>Denmark</b>	0.283	0.138	0.234	0.193	0.26	0.205
<b>Finland</b>	0.231		0.286	0.184		0.226
<b>France</b>	0.343	0.333	0.319	0.284	0.296	0.307
<b>Germany</b>	0.264	0.195	0.196	0.195	0.236	0.145
<b>Greece</b>	0.333			0.288		
<b>Ireland</b>	0.272			0.229		
<b>Italy</b>	0.293	0.229	0.271	0.245	0.247	0.229
<b>Luxembourg</b>	0.37	0.239	0.55	0.314	0.259	0.462
<b>Netherlands</b>	0.249		0.349	0.199		0.332
<b>Portugal</b>	0.323		0.306	0.273		0.273
<b>Spain</b>	0.304	0.36	0.25	0.242	0.303	0.205
<b>Sweden</b>	0.287		0.195	0.263		0.193
<b>UK</b>	0.331		0.292	0.284		0.299
<b>USA</b>	0.34		0.261	0.284		0.212

<b>Table 3b</b>	<b>Pooled Estimates</b>			<b>Individual Ownership Type Estimates</b>		
<b>Bank Size (Euro million)</b>	<b>Commercial Banks</b>	<b>Co-operative Bank</b>	<b>Savings Banks</b>	<b>Commercial Banks</b>	<b>Co-operative Bank</b>	<b>Savings Banks</b>
<b>1 - 99.9</b>	0.261	0.167	0.215	0.158	0.249	0.187
<b>100 - 199.9</b>	0.294	0.192	0.203	0.2	0.24	0.152
<b>200 - 299.9</b>	0.316	0.197	0.213	0.231	0.236	0.16
<b>300 - 499.9</b>	0.315	0.207	0.218	0.24	0.235	0.167
<b>500 - 999.9</b>	0.325	0.23	0.224	0.258	0.246	0.175
<b>1,000 - 2,499.9</b>	0.33	0.283	0.23	0.275	0.276	0.179
<b>2,500 - 4,999.9</b>	0.349	0.326	0.251	0.308	0.283	0.214
<b>5,000 +</b>	0.321	0.325	0.259	0.303	0.247	0.23

Note: All figures are mean cost inefficiencies. Other descriptive statistics are available from the authors on request.

**Table 4 Alternative Profit Efficiency Estimates - Pooled and Individual Ownership Type Estimates 1990 to 2000**

<b>Table 4a</b>	<b>Pooled Estimates</b>			<b>Individual Ownership Type Estimates</b>		
<b>Country</b>	<b>Commercial Banks</b>	<b>Co-operative Banks</b>	<b>Savings Banks</b>	<b>Commercial Banks</b>	<b>Co-operative Banks</b>	<b>Savings Banks</b>
Austria	0.299	0.331	0.356	0.318	0.238	0.294
Belgium	0.224	0.253	0.233	0.231	0.15	0.115
Denmark	0.19	0.26	0.202	0.228	0.109	0.124
Finland	0.307		0.242	0.304		0.187
France	0.196	0.217	0.27	0.208	0.169	0.179
Germany	0.291	0.34	0.324	0.307	0.234	0.256
Greece	0.171			0.178		
Ireland	0.291			0.289		
Italy	0.277	0.303	0.279	0.279	0.197	0.18
Luxembourg	0.214	0.363	0.04	0.228	0.268	0
Netherlands	0.314		0.285	0.322		0.214
Portugal	0.139		0.113	0.144		0.07
Spain	0.188	0.124	0.218	0.202	0.079	0.148
Sweden	0.245		0.354	0.229		0.25
UK	0.304		0.355	0.306		0.264
USA	0.278		0.313	0.284		0.241

<b>Table 4b</b>	<b>Pooled Estimates</b>			<b>Individual Ownership Type Estimates</b>		
<b>Bank Size (Euro million)</b>	<b>Commercial Banks</b>	<b>Co-operative Bank</b>	<b>Savings Banks</b>	<b>Commercial Banks</b>	<b>Co-operative Bank</b>	<b>Savings Banks</b>
1 - 99.9	0.262	0.347	0.275	0.298	0.219	0.215
100 - 199.9	0.252	0.338	0.314	0.284	0.225	0.249
200 - 299.9	0.244	0.335	0.322	0.271	0.228	0.255
300 - 499.9	0.253	0.332	0.32	0.276	0.231	0.249
500 - 999.9	0.247	0.316	0.312	0.265	0.222	0.238
1,000 - 2,499.9	0.247	0.265	0.311	0.258	0.187	0.235
2,500 - 4,999.9	0.244	0.239	0.297	0.245	0.195	0.216
5,000 +	0.257	0.226	0.276	0.237	0.199	0.208

Note: All figures are mean cost inefficiencies. Other descriptive statistics available from the authors on request

## Appendix

### Table A1 Translog Cost Function Estimates – Pooled Data

Variable	Parameter	Coefficient	Standard Error	T-Value	P-value
Constant	$\alpha_0$	-2.5408	0.02873	-88.45	0
$\ln Q_1$	$\alpha_1$	0.3858	0.00631	61.17	0
$\ln Q_2$	$\alpha_2$	0.5295	0.00640	82.7	0
$\ln P_1$	$\beta_1$	0.5444	0.01026	53.08	0
$\ln P_2$	$\beta_2$	0.3023	0.01160	26.05	0
$\ln Q_1 \ln Q_1 / 2$	$\delta_{11}$	0.0129	0.00011	121.96	0
$\ln Q_1 \ln Q_2$	$\delta_{12}$	-0.0116	0.00008	-140.16	0
$\ln Q_2 \ln Q_2 / 2$	$\delta_{22}$	0.0111	0.00010	110.02	0
$\ln P_1 \ln P_1 / 2$	$\gamma_{11}$	0.0061	0.00020	30.8	0
$\ln P_1 \ln P_2$	$\gamma_{12}$	-0.0053	0.00048	-11.08	0
$\ln P_2 \ln P_2 / 2$	$\gamma_{22}$	0.0336	0.00532	6.31	0
$\ln P_1 \ln Q_1$	$\rho_{11}$	-0.0051	0.00126	-4.05	0
$\ln P_1 \ln Q_2$	$\rho_{12}$	-0.0146	0.00126	-11.57	0
$\ln P_2 \ln Q_1$	$\rho_{21}$	-0.0109	0.00128	-8.48	0
$\ln P_2 \ln Q_2$	$\rho_{22}$	0.0359	0.00136	26.37	0
T	$\tau$	-0.0148	0.00300	-4.96	0
TT	$\tau_{11}$	0.0010	0.00017	6.1	0
$\ln Q_1 T$	$\psi_{1\tau}$	0.0004	0.00035	1.18	0.239
$\ln Q_2 T$	$\psi_{2\tau}$	-0.0006	0.00035	-1.7	0.09
$\ln P_1 T$	$\theta_{1\tau}$	0.0062	0.00053	11.76	0
$\ln P_2 T$	$\theta_{2\tau}$	-0.0070	0.00063	-11.02	0
Number of obs =		25841	Wald chi2(20):		692892
Number of groups =		3695	Prob > chi2:		0
R-sq:		0.985			
Variance components:					
	$\sigma_u^2 =$	0.1454	$\sigma_v^2 =$	0.1170	

**Table A2 Translog Cost Function Estimates for Individual Ownership Types – Commercial banks, Savings banks and Co-operative banks**

Variable	Commercial Banks			Savings Banks		Co-operative Banks	
	Parameter	Coefficient	T-Value	Coefficient	T-Value	Coefficient	T-Value
Constant	$\alpha_0$	-2.3263	-45.73	-2.7871	-56.72	-2.9587	-99.02
$\ln Q_1$	$\alpha_1$	0.3812	38.90	0.4787	33.89	0.4242	39.73
$\ln Q_2$	$\alpha_2$	0.5099	48.27	0.4987	43.05	0.5365	54.84
$\ln P_1$	$\beta_1$	0.5224	31.54	0.5223	29.19	0.3920	27.14
$\ln P_2$	$\beta_2$	0.3155	17.27	0.3528	15.56	0.5068	30.58
$\ln Q_1 \ln Q_1 / 2$	$\delta_{11}$	0.0121	76.17	0.0119	39.39	0.0200	68.19
$\ln Q_1 \ln Q_2$	$\delta_{12}$	-0.0109	-82.96	-0.0106	-55.85	-0.0193	-77.95
$\ln Q_2 \ln Q_2 / 2$	$\delta_{22}$	0.0105	65.19	0.0099	63.67	0.0188	69.86
$\ln P_1 \ln P_1 / 2$	$\gamma_{11}$	0.0060	18.94	0.0061	19.01	0.0016	4.94
$\ln P_1 \ln P_2$	$\gamma_{12}$	-0.0047	-6.54	0.0014	1.29	-0.0062	-7.00
$\ln P_2 \ln P_2 / 2$	$\gamma_{22}$	0.0325	4.05	-0.0491	-4.16	0.0690	6.61
$\ln P_1 \ln Q_1$	$\rho_{11}$	-0.0066	-3.46	0.0084	3.32	0.0065	2.10
$\ln P_1 \ln Q_2$	$\rho_{12}$	-0.0130	-6.52	-0.0087	-4.11	-0.0214	-7.65
$\ln P_2 \ln Q_1$	$\rho_{21}$	-0.0088	-4.51	-0.0137	-5.11	-0.0118	-3.62
$\ln P_2 \ln Q_2$	$\rho_{22}$	0.0339	15.66	0.0261	10.92	0.0275	9.08
T	$\tau$	-0.0066	-1.18	-0.0170	-4.10	-0.0139	-5.34
TT	$\tau_{11}$	0.0010	3.04	0.0013	6.32	0.0006	4.22
$\ln Q_1 T$	$\psi_{1\tau}$	0.0000	0.05	-0.0001	-0.10	0.0041	8.47
$\ln Q_2 T$	$\psi_{2\tau}$	-0.0006	-0.97	-0.0025	-4.24	-0.0030	-6.41
$\ln P_1 T$	$\theta_{1\tau}$	0.0070	8.14	-0.0020	-1.89	0.0108	15.71
$\ln P_2 T$	$\theta_{2\tau}$	-0.0083	-7.73	0.0014	1.30	-0.0117	-13.17
Number of obs:		10374		8042		7425	
Number of groups		1411				1129	
R-sq:		0.9799		0.9904		0.9967	
Variance components:							
	$\sigma_u =$	0.193157		0.088448		0.062751	
	Wald chi2(20):	205005		424426		717750	
	Prob > chi2:	0		0		0	
	$\sigma_v =$	0.16553		0.07137		0.04141	

Note: full diagnostic statistics available from the authors on request

**Table A3 Translog Alternative Profit Function Estimates – Pooled Data**

Variable	Parameter	Coefficient	Standard Error	T-Value	P-value
Constant	$\alpha_0$	-2.5688	0.0336	-76.50	0.000
$\ln Q_1$	$\alpha_1$	0.4079	0.0074	55.18	0.000
$\ln Q_2$	$\alpha_2$	0.5521	0.0075	74.02	0.000
$\ln P_1$	$\beta_1$	0.4268	0.0120	35.48	0.000
$\ln P_2$	$\beta_2$	0.3947	0.0137	28.71	0.000
$\ln Q_1 \ln Q_1 / 2$	$\delta_{11}$	0.0137	0.0001	110.76	0.000
$\ln Q_1 \ln Q_2$	$\delta_{12}$	-0.0123	0.0001	-128.16	0.000
$\ln Q_2 \ln Q_2 / 2$	$\delta_{22}$	0.0109	0.0001	92.95	0.000
$\ln P_1 \ln P_1 / 2$	$\gamma_{11}$	0.0055	0.0002	23.66	0.000
$\ln P_1 \ln P_2$	$\gamma_{12}$	-0.0025	0.0006	-4.39	0.000
$\ln P_2 \ln P_2 / 2$	$\gamma_{22}$	0.0196	0.0064	3.08	0.002
$\ln P_1 \ln Q_1$	$\rho_{11}$	0.0001	0.0015	0.06	0.952
$\ln P_1 \ln Q_2$	$\rho_{12}$	-0.0110	0.0015	-7.44	0.000
$\ln P_2 \ln Q_1$	$\rho_{21}$	-0.0216	0.0015	-14.26	0.000
$\ln P_2 \ln Q_2$	$\rho_{22}$	0.0353	0.0016	21.94	0.000
T	$\tau$	-0.0094	0.0036	-2.61	0.009
TT	$\tau_{11}$	0.0003	0.0002	1.57	0.116
$\ln Q_1 T$	$\psi_{1\tau}$	-0.0011	0.0004	-2.67	0.008
$\ln Q_2 T$	$\psi_{2\tau}$	0.0019	0.0004	4.46	0.000
$\ln P_1 T$	$\theta_{1\tau}$	0.0066	0.0006	10.32	0.000
$\ln P_2 T$	$\theta_{2\tau}$	-0.0077	0.0008	-10.10	0.000
Number of obs =		25841	Wald chi2(20):		545701.1
Number of groups =		3695	Prob > chi2:		0
R-sq:		0.982			
Variance components:					
	$\sigma_u =$	0.1577	$\sigma_v =$	0.1453	

**Table A4 Alternative Profit Function Estimates for Individual Ownership Types – Commercial banks, Savings banks and Co-operative banks**

Variable	Parameter	Commercial Banks		Savings Banks		Co-operative Banks	
		Coefficient	T-Value	Coefficient	T-Value	Coefficient	T-Value
Constant	$\alpha_0$	-2.4559	-40.6	-2.5474	-49.87	-2.9002	-59.29
$\ln Q_1$	$\alpha_1$	0.4148	35.6	0.4333	29.56	0.3467	19.94
$\ln Q_2$	$\alpha_2$	0.5308	42.5	0.5322	43.97	0.6275	39.31
$\ln P_1$	$\beta_1$	0.4136	21.0	0.3823	20.40	0.3352	13.87
$\ln P_2$	$\beta_2$	0.4341	19.8	0.3932	16.50	0.4094	14.55
$\ln Q_1 \ln Q_2 / 2$	$\delta_{11}$	0.0129	68.8	0.0125	39.72	0.0221	46.33
$\ln Q_1 \ln Q_2$	$\delta_{12}$	-0.0118	-76.1	-0.0104	-52.77	-0.0198	-48.64
$\ln Q_2 \ln Q_2 / 2$	$\delta_{22}$	0.0105	55.1	0.0096	59.21	0.0175	39.68
$\ln P_1 \ln P_1 / 2$	$\gamma_{11}$	0.0052	13.7	0.0061	18.09	0.0029	5.39
$\ln P_1 \ln P_2$	$\gamma_{12}$	-0.0022	-2.6	0.0076	6.81	-0.0078	-5.13
$\ln P_2 \ln P_2 / 2$	$\gamma_{22}$	0.0210	2.2	-0.0953	-7.65	0.1005	5.62
$\ln P_1 \ln Q_1$	$\rho_{11}$	-0.0007	-0.3	0.0107	4.05	-0.0065	-1.28
$\ln P_1 \ln Q_2$	$\rho_{12}$	-0.0125	-5.3	0.0023	1.05	-0.0044	-0.96
$\ln P_2 \ln Q_1$	$\rho_{21}$	-0.0210	-9.0	-0.0123	-4.38	-0.0061	-1.15
$\ln P_2 \ln Q_2$	$\rho_{22}$	0.0343	13.2	0.0177	7.04	0.0201	4.02
T	$\tau$	0.0047	0.7	-0.0302	-6.91	0.0016	0.35
TT	$\tau_{11}$	0.0002	0.6	0.0010	4.49	-0.0002	-0.65
$\ln Q_1 T$	$\psi_{1\tau}$	-0.0018	-2.7	0.0026	3.62	0.0033	4.05
$\ln Q_2 T$	$\psi_{2\tau}$	0.0017	2.4	-0.0044	-7.18	-0.0026	-3.23
$\ln P_1 T$	$\theta_{1\tau}$	0.0078	7.6	-0.0056	-4.99	0.0125	10.48
$\ln P_2 T$	$\theta_{2\tau}$	-0.0110	-8.4	0.0038	3.28	-0.0093	-6.07
Number of obs:		10374		8042		7425	
Number of groups:		1411		1155		1129	
R-sq:		0.975		0.990		0.992	
Variance components:							
	$\sigma_u =$	0.2181		0.0876		0.0889	
	Wald chi2(20):	154025.2		399990.6		307150.9	
	Prob > chi2:	0		0		0	
	$\sigma_v =$	0.2058		0.0768		0.0731	

Note: full diagnostic statistics available from the authors on request

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