Challenges Facing the Polish Banking Industry: A Comparative Study with UK *Banks*

Catarina Figueira
Joseph G. Nellis
David Parker

In 2004 Poland entered the EU. This paper investigates the performance of the Polish banking industry over the period 1999–2004, by looking specifically at its comparative efficiency in relation to one of the largest banking sectors in the EU namely, that of the UK. Based on a range of efficiency measures, the empirical results reveal a surprising degree of relative efficiency in the Polish banking industry, no doubt reflecting the substantial economic changes introduced in Poland since 1989. The findings suggest that the Polish banking sector should be able to withstand the new competitive pressures that it faces following entry into the banking sector of the EU.

Key Words: Poland, UK, banking, efficiency, performance
JEL *Classification:* C52, F36, G21

Introduction

Poland entered the EU as one of a number of new Member States in 2004. Entry into the EU implies increased competitive pressures for the Polish corporate sector created by the European Single Market and EU competition law. This is particularly true for Poland's financial services that until recently were state owned and protected from competition. The banking industry has been transformed in the EU during the last decade as a result of three major developments: (a) the establishment of a Single European Market in financial services, which has intensified competitive pressures and forced the pace of rationalization across the industry; (b) the impact of developments concerning information technology and the con-

Catarina Figueira is Research Fellow in Economics at the Cranfield School of Management, Cranfield University, United Kingdom.

Joseph G. Nellis is Professor of International Management Economics at the Cranfield School of Management, Cranfield University, United Kingdom.

David Parker is Professor of Privatisation and Regulation at the Cranfield School of Management, Cranfield University, United Kingdom.

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sequences for the delivery of financial products and services, as well as new product development (involving, for example, internet banking and money transmission services); and (c) extensive merger activity, bringing about closer integration and, to a large degree, the globalization of financial markets. This has created a business environment in which institutional investors are now challenging the dominant positions of commercial banks in both deposit-taking and loan-financing facilities. Also, Poland is by far the largest country amongst the new EU Member States and, therefore, can be expected to attract considerable attention from the European financial services industry, as its economy develops and gravitates towards the EU average.

The purpose of this paper is to consider the likely competitive pressures facing the Polish banking industry in the future. The contributions of the paper are in terms of identifying the relative competitiveness of Poland's banking sector and in applying a number of measures including stochastic cost frontier analysis. To make the research manageable, the efficiency of Poland's banking sector is compared with the efficiency of banking in the UK. The UK's banking sector is one of the largest in the EU[1] and is generally recognized as internationally competitive. It therefore provides a useful benchmark for comparing the efficiency of Polish banks with those of the EU in general.

The alternative, of comparing Polish banking with the average performance of banking across the EU, would arguably be less satisfactory because average EU performance masks differences within the EU. A number of performance measures are used, namely financial ratios, including profitability, and figures for operating and financing costs. Later in the paper, performance differences are also investigated using a stochastic cost frontier analysis. The paper concludes that the Polish banking sector seems already broadly comparable to the UK's banking sector in many areas of performance. It is, however, still relatively small scale, and competition is not as developed as it is in the UK when measured in terms of the number of competing banks. It also suffers from a relative weakness in terms of liquidity and poorly performing loans.

The structure of the remainder of the paper is as follows: in the second section, we describe developments in the Polish banking system since 1989, to provide an appropriate context for the statistical analysis. The third section details the various performance measures used to assess efficiency differences between the Polish and UK banking sectors, the data used and provides results using descriptive statistics and tests of signifi-

cance between means. In the fourth section, relative performance using a stochastic cost frontier analysis is reported. Finally, in the fifth section, we draw together conclusions and consider some implications for future research.

Developments in the Polish Banking System Since 1989

Prior to 1989 Poland's banks were state owned and competition was limited. In 1989 the sector was primarily composed of co-operative banks. By 1993 there were still 1653 co-operative banks out of a total of 1740 banks in the country.[2] With the collapse of communism and the introduction of Poland's economic reform program to create a market economy, the Polish banks underwent privatization, so that by 2000 most of the banks had been transferred to the private sector. By then the industry consisted of 754 banks, however around 680 were still small co-operative units. A total of 47 of the larger banks had come under foreign ownership, with banking organizations in EU Member States being the largest single set of foreign owners.

Since the end of the 1980s, the Polish banking sector has experienced three main stages of development. Firstly, from 1989 to 1992 there was a dramatic increase in competitive pressures, but still lacking was the necessary institutional underpinning to develop a sound market-based banking system. In particular, a robust legal and regulatory framework was missing. Secondly, between 1992 and 1997 a restructuring of financial institutions occurred including recapitalization of the banks, privatization,[3] and new legal reforms that led to a more orderly competitive environment.[4] Thirdly, since 1998 strategic investors have become progressively more active, taking advantage of the benefits brought about by privatization and market liberalization. In other words, during the 1990s the banking sector became more commercially orientated, involving significant restructuring in parallel with restructuring changes going on elsewhere in the Polish economy.

In recent years, the pace of competition within the banking sector in Poland has intensified, in both the corporate finance and retail sectors. This has resulted largely from an influx of foreign-controlled banks. In fact, more than 75% of the capital in the Polish banking industry is now foreign-owned – German, Austrian and Dutch investors dominate (Balcerowicz and Bratkowski 2001). The consequence has been the development of new competitive strategies, the promotion of new human resource skills[5] and the expansion of systems to identify and cap-

ture new markets (Balcerowicz and Bratkowski 2001; Figueira, Nellis, and Schoeneberg 2007).[6] In the retail sector there has been extensive development of branch networks and the use of IT in money transmission services.[7]

There has also been an improvement in the public perception of the banking industry in general, as the less popular and less efficient banks have either been closed or been merged with more efficient banks.[8] However, it appears that there are still some areas of the financial market which remain under-developed, especially the housing market. Very few Polish banks seem to specialize in providing mortgages[9] and, those which do, impose a number of conditions which restricts the number of people eligible to apply for a mortgage.[10] This compares unfavourably with the position in the EU Member States and especially the UK with its well-developed mortgage market supplied by banks and building societies.

Previous studies have compared banks operating in Poland and Western Europe according to a range of efficiency ratios and concluded that, in 1997, Polish banks were less efficient. However, given the continuing changes in the Polish banking sector it seems timely to assess this performance again, using a wider range of performance measures including econometric analysis, particularly given Poland's recent entry into the EU.

Performance Measurement, Data and Initial Findings

In recent years, several studies have focused on performance in the banking sector, however many of them have concentrated on a particular country and the analysis of scale and scope economies. For example, Berger (1993) analyzed US banks between 1980 and 1989 and concluded that management of resources is critical to achieving efficiency, while scale differences played a relatively minor role. Additional studies that have evaluated the performance of US banks include those by Peristiani (1996), Berger and Mester (1997), Mukherjee, Subhash, and Miller (2001), Barr et al. (2002) and Akhigbe and McNulty (2002). Other performance studies of banking include those by Gough (1979), Hardwick (1989; 1990), Drake (1992), Dietsch (1993) and Lang and Welzel (1996).

Altunbas et al. (2001) extended the existing literature on modelling costs in banking systems by estimating scale economies, inefficiencies and technical change. In their study a sample of EU countries was used and efficiency was measured using stochastic cost frontier (SCF) techniques (for an explanation of SCF, see below). The results revealed that

production inefficiencies were larger than scale inefficiencies, a finding consistent with the majority of US studies. The study also concluded that inefficiencies tend to vary across countries and over time. Since then, other studies have focused on cost and profit efficiency issues related to EU banking, such as Maudos et al. (2002) and Weill (2004).

However, despite the recent entry of a number of Central and Eastern European countries into the EU, there appear to have been few studies of the performance of banks in these countries. The majority of studies tend to be descriptive and a number are restricted to a comparison of accounting ratios, such as return on assets or return on equity (Weller 2000; Marek and Baun 2002; Keren and Ofer 2002). Although a few studies have applied econometric modelling including SCF analysis (Mertens and Urga 2001; Hasan and Marton 2003), the literature lacks a direct comparison between the banking systems in these countries and members of the EU pre-2004. As Berger and Humphrey (1997) conclude from a survey of studies of efficiency of financial institutions, international comparisons deserve additional attention.

In this paper the performance of Poland's banking sector is compared with performance in UK banks. Bank performance can be measured along a number of dimensions, including charges, financial ratios and costs of operation. Economists usually differentiate between allocative efficiency and productive efficiency when assessing economic performance. Allocative efficiency is concerned with price-cost margins, and productive efficiency with costs of production. A distinction is also made between static efficiency gains, which are gains at a point in time or in the short-run, and dynamic efficiency gains, which are more concerned with longer-term economic performance improvements, usually associated with innovation in products and processes.

In this study, for reasons of data availability, the concern is with performance over the period 1999–2004, and with efficiency in the provision of outputs. Data do not exist to discuss price-cost margins and therefore allocative efficiency (although the existence of competition in UK banking and the growing competition in Polish banking implies a high degree of allocative efficiency) or longer-term dynamic gains. The focus is therefore on relative static efficiency using measures of productive efficiency.[11]

The main measures used are profitability (since in a competitive marketplace profits reflect cost control as well as revenue maximisation), other financial ratios and costs of production. The data are drawn from the *Bankscope* data base which contains balance sheet and income state-

TABLE 1 Data sample – UK and Polish banks, 2004

	United Kingdom	Poland
Total assets (US$m)	10,703.266	168.099
Sample assets (US$m)	6,814.344	149.299
% assets included	64	89
% of commercial bank assets included	72	89
Total number of banks	140	23
Commercial banks	66	20
Savings banks	2	1
Co-operative banks	0	2
Real estate and mortgage banks	58	0
Investment banks and securities houses	14	0

ment data published by the London-based International Bank Credit Analysis Ltd. The sample used comprises 163 banks, 140 of which are UK banks and the remaining Polish. Prior to 1999 the data in *Bankscope* are incomplete, thus preventing analyses prior to that year.

The banks examined in the *Bankscope* data base fall into the following categories: commercial, savings, co-operative, real estate and mortgage as well as investment banks and securities houses, with the majority being commercial banks. For the UK, around 41% of the banks are real estate and mortgage banks and 10% are classified as investment banks and securities houses. In contrast, the *Bankscope* data base has no Polish banks classified as investment banks and securities houses. This means that for Poland the classification 'commercial banks' includes banks that provide services which in the UK are mainly offered by specialist real estate and mortgage banks and investment banks. This introduces a potential lack of homogeneity in the classification of banks' activities across the two countries. However, banks in the *Bankscope* data base are categorized according to their primary activity or, more precisely, the activity to which more than 50% of operations relate. This means that heterogeneity in activities is limited and should not constitute a significant problem when comparing banks in Poland and the UK.

The information in table 1 highlights other important differences in the two countries' banking systems. In particular, there are many more banks in the UK than in Poland, and each of the banks has much larger average assets – averaging over $6.814 billion in the UK as against more

than $149 billion in Poland. Performance results may therefore be affected by firm size or scale of operation, something we test for later in the paper. It is also clear from the table that the commercial banks dominate both banking systems. For this reason, in the discussion below we concentrate upon the relative performance results for the commercial banks. As can be seen from table 1, more than 60% of the total assets of the banks in both countries are included in the study and over 70% of commercial banks' assets, which suggests that the sample used is sufficiently large to offer a fairly representative picture of performance in the UK and Polish banking sectors, especially with respect to commercial banking.

Table 2 presents the results for a range of performance measures for banks in the two countries. The indicators are chosen to reflect key banking metrics, namely asset quality ratios, capital ratios, operations ratios and liquidity ratios. Standard deviations are given in parentheses and indicate that for some of the measures, such as profitability, no major differences exist in data dispersion between Polish and UK banks, permitting a focus on the mean figures. For other indicators, such as impaired loans (defined as loans with suspended interest), there is a noticeable difference in the data dispersion, which means that both the means and standard deviations should be considered together. Two-tailed *t*-tests were undertaken to determine whether the difference between means for each of the performance measures was statistically significant at the 10% level. The results are provided in the final column of the table.

Starting with the asset quality ratios, it is clear from the information presented in table 2 that in Poland the ratio of impaired loans to total loans is significantly higher than in the UK, confirming that Poland has a more serious problem with underperforming loans in its banks' balance sheets (Polish banks also record higher average loan loss reserves to gross loans, and the difference between means is statistically significant at the 10% level). This result is almost certainly a legacy of the economic restructuring of the 1990s and the greater difficulty in assessing a borrower's credit worthiness in Poland than in the UK, with a less-well developed system of credit referencing in the former. In terms of capital ratios, however, banks in Poland are not obviously under-capitalized, as suggested by the mean value shown in the table. Moreover, the difference between the banks in the two countries is only just statistically significant at the 10% level for the ratio of equity to liabilities. Looking at the standard deviations, it is clear that loan loss reserves vary more

TABLE 2 Cost and profitability ratios of banks in the UK and Poland[a] (average values 1999–2004)

Banks	United Kingdom[b]	Poland[b]	(1)
Asset quality ratios[c]			
Loan loss reserves/gross loans	2.108 (3.987)	5.984 (3.177)	Yes
Impaired loans/gross loans	4.001 (7.313)	17.198 (12.029)	Yes
Capital ratios			
Equity/total assets	10.437 (9.772)	9.840 (3.116)	No
Equity/liabilities	14.551 (22.001)	11.169 (3.989)	Yes
Operations ratios			
Net interest margin	2.602 (2.745)	4.195 (2.518)	Yes
Average profit (profit/assets)	0.014 (0.028)	0.015 (0.008)	No
Return on assets employed	1.035 (2.253)	0.840 (1.016)	No
Return on equity	9.325 (11.042)	8.022 (10.565)	No
Average costs (costs/assets)	0.065 (0.071)	0.106 (0.016)	Yes
Average operational costs	0.032 (0.074)	0.051 (0.014)	Yes
Average financial costs	0.033 (0.010)	0.055 (0.008)	Yes
Cost to income ratio	68.968 (23.251)	70.676 (17.640)	No
Liquidity ratios			
Net loans/total assets	56.786 (27.903)	47.080 (13.807)	Yes
Liquid assets/total deposits & borrowing[c]	38.541 (39.976)	16.684 (10.818)	Yes

NOTES (1) Difference statistically significant (2-tailed test; 10% level). [a] Note that the results reported in this table are based on a 'balanced' panel data set – i. e. the same sets of banks are analysed in each year. [b] Standard deviations in parentheses. [c] The ratios were constructed with data from 140 UK banks and 23 Polish banks, with the exception of the following ratios where fewer banks were considered, due to data limitations: loan loss reserves/gross loans (130 UK and 18 Polish banks), impaired loans/gross loans (40 UK and 17 Polish banks) and liquid assets/total deposits and borrowing (61 UK and 20 Polish banks).

across UK banks, although the reverse is true for impaired loans. On balance, the standard deviations do not detract from the general conclusion that Poland has a greater problem with underperforming loans. With regard to the equity financing ratios, there is a wider dispersion around the mean figure for the UK.

Turning to the operations ratios, profitability is conventionally measured as a return on assets employed and as a return on equity. The

profitability figures in table 2 suggest that for banks in Poland and the UK, profits on assets employed vary little between the two. Also, while on first inspection the descriptive statistics may suggest that returns on assets employed and return on equity are higher in the UK banks than in their Polish equivalents, the mean differences proved statistically insignificant (again at the 10% level). The conclusion is that the Polish and UK banking sectors have similar profitability.

By contrast, costs of production in relation to assets employed are lower in the UK and this result is statistically significant, while the cost to income ratio is slightly higher in Polish banks (though this difference is not statistically significant) than in the UK counterparts.[12] This leads to the conclusion that banks in Poland have higher costs in relation to asset size than in the UK. These higher costs seem to be compensated for by higher revenues in relation to assets employed (note the higher net interest margin for Poland's banks), probably reflecting the lower level of competition in Polish banking. In turn, this suggests that as competition puts downward pressure on bank charges, the Polish banks will need to reduce their asset base, probably through further consolidation, if they are to remain competitive.

In banking, costs of production can be divided between the costs of operating the bank, including branch networks, and the cost of raising loanable funds. It is therefore useful to explore performance differences separately in terms of operational costs and financial costs. Table 2 provides figures on operational and financial costs in relation to assets employed in banks in Poland and the UK. Both operational and financial costs in relation to assets employed are on average much higher in Poland – a mean figure of 0.051 and 0.055 respectively compared with 0.032 and 0.033, and these differences are statistically significant. This finding is consistent with the notion that Poland's financial market is less advanced and competitive than the UK's. This suggests that, in general, it costs Polish banks more to raise loanable funds than is the case for UK banks with an equivalent asset base. However, with Poland's membership of the EU and the creation of single money and capital markets, this differential is likely to be eroded. This may be expected to improve the competitiveness of Polish banks in terms of raising finance.

Finally, the liquidity ratio figures in table 2 suggest that Poland's banks are more exposed in terms of liquid assets with respect to total deposits and borrowing. This finding is of particular concern when set alongside the ratio for impaired loans. Together the results suggest that a number of

Poland's banks are likely to be less able to absorb the impact of a financial crisis than banks in the UK.

A Cost Frontier Analysis of Banking Performance

So far, the relative performance of Polish and UK banks has been measured using descriptive statistics. Here we assess performance using econometrics and specifically a stochastic cost frontier approach. Cost functions provide a more comprehensive analysis of performance than the simpler ratio analysis reported above. A cost function relates the costs of production observed in the data period – in this case 1999–2004 – to input and output variables, and derives directly from the theory of the firm (Varian 1992). We would have liked to have included an assessment of Polish and UK banks performance also based on a profit frontier analysis. However, like Bos (2002) and Bikker (2004), we found that while one single cost frontier exists when comparing across countries, this does not hold true for the profit frontier, probably due to different market conditions. Hence, the profit function approach does not allow for satisfactory comparisons across countries or regions.

Cost efficiency is the ratio between the minimum cost (C^{min}) necessary to achieve a desired level of output and the observed total cost (C). Total costs are therefore a function of the output (y), the price of inputs (w) and a set of other factors, which we here decompose into two parts: the level of cost inefficiency in production (u) and a random part (v). The latter accounts for measurement error and other random factors, such as the effects of strikes, etc., on the value of the output variables, together with the effects of unspecified input variables in the cost function (see Coelli, Rao, and Battese 1998). Assuming that u and v are multiplicatively separable from the other variables of the function and also that the variables are expressed in logarithms, then the cost function can be written as:

$$\ln C = f(y, w) + \ln u + \ln v. \tag{1}$$

Cost efficiency for an individual bank can then be described by the function:

$$\frac{C^{min}}{C} = \frac{\exp[f(y, w)] \cdot \exp(\ln v)}{\exp[f(y, w)] \cdot \exp(\ln v) \cdot \exp(\ln u)} = \exp(-\ln u). \tag{2}$$

The model employed in this paper is a standard translog functional

form (Casu and Girardone 2002; Figueira, Nellis, and Parker, forthcoming). Hence the cost equation to be estimated is:

$$\begin{aligned}\ln C = \alpha &+ \sum_{i=1}^{3}\beta_i \ln w_i + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3}\beta_{ij}\ln(w_i)\cdot\ln(w_j) \\ &+ \sum_{n=1}^{2}\gamma_n \ln(y_n) + \frac{1}{2}\sum_{n=1}^{2}\sum_{m=1}^{2}\gamma_{nm}\ln(y_n)\cdot\ln(y_m) \\ &+ \sum_{i=1}^{3}\sum_{n=1}^{2}\rho_{in}\ln(w_i)\cdot\ln(y_n) + \delta_E \ln(E) + \frac{1}{2}\delta_{EE}\ln(E)^2 \\ &+ \sum_{n=1}^{2}\lambda_{En}\ln(E)\cdot\ln(y_n) + \sum_{i=1}^{3}\tau_{Ei}\ln(E)\cdot\ln(w_i) + \ln v + \ln u, \qquad (3)\end{aligned}$$

where restrictions of symmetry and linear homogeneity have been imposed on input prices. The variables included in the model are total costs (C), which include financial and operating costs, input prices described as price of loanable funds or the costs of raising funds to lend out (w_1), the price of labour (w_2) and the price of physical (fixed) capital e. g. buildings (w_3), and the quantity of outputs, which are deposits, including loans (y_1) and other earning assets (y_2) and financial capital (E), which is a proxy for banks' insolvency risk.[13] The price of loanable funds is obtained by dividing financial cost by the corresponding liabilities, which include deposits, money market funding and other funding. The price of labour would ideally be the marginal cost of employing labour, but in the absence of these data an approximation was used based on the ratio between personnel expenses and total assets. The rationale for this approximation is that it crudely represents the labour cost per worker adjusted for variations in labour productivity (Altunbas et al. 2001).[14] Finally, the price of physical capital is approximated by dividing expenditures on plant and equipment (non-labour costs) by fixed assets (Bikker and Haaf 2002; Maudos et al. 2002). One possible difficulty relating to the analysis is aggregation bias because of the mixing of different sizes of banks in the two countries. We tested for this by including the logarithm of total assets. However, this proved to be insignificant in the explanation of total costs. Therefore, the mixing of different sizes of banks in UK and Poland does not seem to affect the results.

In common with some of the earlier studies of bank performance reviewed above, we estimate an *efficient frontier* for the banking industry.

A bank's performance is then assessed by measuring how efficient it is, based on its distance from the efficient frontier, a concept that dates back to Farrell (1957). Such values are sometimes referred to as measures of x-inefficiency (Berger 1993). Here the frontier is estimated by amalgamating data from the Polish and UK banking sectors and again drawing from the *Bankscope* data base. In this stage of the analysis all banks in Poland and the UK were included in the data set so as to maximise the degrees of freedom and provide a more robust estimate of the cost frontier. To model the frontier we used stochastic cost frontier analysis (SCF), as proposed by Aigner, Lovell, and Schmidt (1977), and equation 3 above.[15] SCF breaks down the error term into the two distinct parts already referred to, namely v_i or the random error, which is assumed to be independently and identically distributed following a normal distribution, and u_i. This is a non-negative inefficiency term and assumed to be independently and identically distributed and to follow a truncated normal or exponential distribution. The estimated inefficiency for any firm is taken as the conditional mean of the distribution of the inefficiency term, given the observation of the composed error term.

The model proposed by Battese and Coelli (1995) is used in this paper and is close to that proposed by Aigner, Lovell, and Schmidt (1977). It differs in imposing allocative efficiency and allows the use of panel data.[16] The estimation of the model occurs in three main steps. The first involves the estimation of the function by Ordinary Least Squares (OLS). The parameters obtained are all unbiased with the exception of β_0 (intercept) and σ_s^2 (sum of the variance of u_i and v_i). The second step is carried out with the estimation of a likelihood function based on Battese and Corra (1977),[17] which is evaluated for a series of values of γ between zero and one – where γ equal to zero means that the deviations from the frontier are due only to noise, while a value of one indicates that the deviations are due entirely to inefficiency. The estimates for σ_s^2 and β_0 are adjusted, with the remaining coefficients unchanged. The final step uses the best estimates from the second step as starting values in an iterative procedure to achieve the final Maximum Likelihood estimates.

An individual bank's cost efficiency is then predicted from the estimates of the stochastic cost frontier. Battese and Coelli (1988) point out that the best predictor of $exp(-u_i)$ is given by:

$$E[\exp(-u_i)|e_i] = \frac{1 - \Phi\frac{\sigma_A + \gamma e_i}{\sigma_A}}{1 - \Phi\frac{\gamma e_i}{\sigma_A}} \exp(\gamma e_i + \frac{\sigma_A^2}{2}), \tag{4}$$

TABLE 3 Relative cost efficiency using SCF analysis, 1999–2004[a]

Banks	United Kingdom[b]	Poland[b]
By specialization		
Commercial	0.739 (0.173)	0.672 (0.098)
Savings	0.763 (0.008)	0.626 (n. a.)
Real estate and mortgage	0.858 (0.050)	—
Investment	0.695 (0.209)	—
Co-operative	—	0.700 (0.060)
By size		
Large	0.751 (0.146)	0.641 (0.061)
Small and medium	0.827 (0.150)	0.723 (0.113)

NOTES The results are based on a 'balanced' panel data set. Results for an 'unbalanced' panel data set have also been produced and similar relative values and conclusions have been obtained. These are available from the authors on request. [a] Final maximum likelihood estimates from which the cost efficency estimates are derived and are presented in table 4. [b] Average cost efficient estimates. The corresponding standard deviation values are in parentheses. Where only one bank is included, the standard deviation is not applicable (n. a.).

where $\sigma_A = \sqrt{\gamma(1-\gamma)\sigma_s^2}$ and $e_i = \ln(y_i) - x_i\beta$. The resulting cost efficiency estimates are reported in table 3. They were calculated based on data which were pooled for 6 years (1999 to 2004 inclusive) for 163 UK and Polish banks, giving a total number of 978 observations.[18]

The results confirm the earlier findings relating to relative costs for banks in Poland and the UK based on descriptive statistics. Commercial banks in Poland are less cost efficient than equivalent UK banks using SCF analysis, and the difference is statistically significant. The results also highlight the high relative efficiency of real estate and mortgage banks within the UK banking sector.

Table 3 also presents cost efficiency results from the SCF analysis according to bank size. As we saw earlier, the average size of banks in the UK is appreciably larger than that of banks in Poland. This means that size or economies of scale may affect the relative costs of production. To test for this, efficiency in relation to bank size was assessed. In the analysis, a large bank is one with total assets of over one billion US dollars, a definition consistent with that used by *Bankscope*. The estimates reveal that there are differences in costs across small and large banks and between UK and Polish banks, as presented in table 3. Small and medium-sized banks tend to be more cost efficient than large banks.

Conclusions

The paper provides a basis for considering the prospects for Polish banking following the country's accession to the EU by comparing financial ratios and other performance measures between a range of banks in Poland and the UK, including commercial, savings, real estate and mortgage, investment and co-operative banks. The UK banking sector is used as an exemplar because it is generally recognized to be one of the most efficient and competitive in Europe.

The Polish banking sector has gone through considerable changes since 1989 and the results from this study suggest that, while Poland's banks still seem to be weaker in terms of impaired loans and liquidity, in other respects they are now well placed to compete successfully in the EU and, in particular, they appear to be competitive in terms of profitability. We did find evidence that Polish banks suffer higher costs of raising funds and this almost certainly reflects the less well developed money and capital markets in Poland than the UK. Over time, EU membership should progressively lead to more competitive financial markets and this should assist Polish banks in reducing financing costs in the future.

Our results have focused mainly on commercial banks, because there were an insufficient number of banks in our data set operating in the more specialist areas of banking, such as savings, real estate financing and investment and securities, to permit meaningful comparisons between Poland and the UK. It should be stressed that there are significant structural differences between the banking sectors of the two countries, for example, the UK banking industry has a very large number of real estate and mortgage banks, as well as investment banks and securities houses. In contrast, the activities of such banks have tended to be carried out by commercial banks in Poland.

Future research could usefully focus on the specialist banking functions to see whether our comparative results for commercial banking also apply to specialist banking services. In addition, while the use of the UK as a 'best practice' benchmark for the rest of the EU seems sound, further research might focus on comparisons between Polish banking and banking elsewhere within the EU. Moreover, our approach could be usefully extended to analyzing the performance of banks in other new EU members, such as Hungary and the Czech Republic, especially where the banking sector has less foreign ownership than is the case in Poland. A particular question which arises is concerned with the extent to which

the relative performance of Polish banks is a function of the high levels of foreign investment.

In the SCF analysis we found evidence that small and medium-sized banks did not suffer a cost disadvantage compared to larger banks, implying a low minimum efficient scale in banking in both the UK and Poland. It would be interesting to test the robustness of this result further and to know whether it applies to banks in other European countries too. Finally, future research could consider other bank performance dimensions that we were unable to assess given the available data, in particular customer service levels.

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Notes

1 The UK banks' total assets amounted to almost US $11 trillion in 2004.
2 For an overall picture of the number and type of banks operating in Poland from 1993 to 2000, see table 3 in Balcerowicz and Bratkowski (2001).
3 Privatization was one of the main objectives of the reforms that were carried out from January 1990, and the program for the privatization of state-owned banks was approved in March 1991. However, the preparation of each privatization proved time-consuming and the process did not actually start until 1993. The delay was mainly due to the enormous amount of bad debts held by state-owned banks.
4 The current supervision of banking and capital markets is based on guidance provided by the Basle Committee on Banking Supervision and the Joint Forum on Financial Stability. The Banking Act and the Act on the National Bank of Poland, which were introduced in 1997, reinforced the legal reforms. Finally, new amendments came into effect in 2000, which were aimed at addressing needs related to the improvement of supervision and the application of sanctions.
5 Opiela (2001) claims that the strategies of what he considers the most efficient banks operating in Poland are supported by fewer, but more highly paid and effective human resources.
6 Examples are the fast growth of retail banking, together with the intensification of the development of new IT, the creation of new products, such as credit cards and home banking, and the linkage between tra-

TABLE 4 Final maximum likelihood estimates, obtained by using the stochastic frontier approach

	Coefficient	*t*-ratio
α	2.390	6.429
$\ln w_1 - \ln w_3$	0.386	5.189
$\ln w_2 - \ln w_3$	−0.023	−0.445
$(\ln w_1)^2/2$	0.100	4.487
$(\ln w_2)^2/2$	−0.002	−0.421
$(\ln w_3)^2/2$	0.204	11.228
$\ln w_1 \cdot \ln w_2$	0.019	2.689
$\ln w_1 \cdot \ln w_3$	−0.153	−12.604
$\ln w_2 \cdot \ln w_3$	0.019	2.228
$\ln y_1$	0.499	7.425
$\ln y_2$	0.520	7.861
$(\ln y_1)^2/2$	0.104	19.662
$(\ln y_2)^2/2$	0.109	17.191
$\ln y_1 \cdot \ln y_2$	−0.098	−15.648
$\ln w_1 \cdot \ln y_1$	0.000	−0.020
$\ln w_1 \cdot \ln y_2$	−0.033	−2.781
$\ln w_2 \cdot \ln y_1$	0.007	1.618
$\ln w_2 \cdot \ln y_2$	0.020	3.586
$\ln w_3 \cdot \ln y_1$	0.035	5.793
$\ln w_3 \cdot \ln y_2$	0.054	5.432
$\ln E$	−0.180	−1.569
$(\ln E)^2/2$	0.013	0.598
$\ln E \cdot \ln y_1$	0.004	0.479
$\ln E \cdot \ln y_2$	−0.019	−1.667
$\ln E \cdot \ln w_1$	0.025	1.375
$\ln E \cdot \ln w_2$	−0.015	−1.661
$\ln E \cdot \ln w_3$	−0.108	−7.520
σ^2	0.153	6.523
γ	0.907	53.420
Log likelihood $f(\cdot)$	464.32	—
LR test ($\chi^2_{(1)}$)	561.89	—

NOTE The table refers to the final maximum likelihood estimates (MLE) from which the cost efficiency estimates in table 3 are derived. The equation estimated is based on equation (4) and takes into account the restrictions of symmetry and linear homogeneity, which have been imposed on input prices.

ditional banking and insurance services. Moreover, banks started to look at small and medium-sized enterprises as a new target market.

7 By 1999, more than 52% of Polish households had at least one bank card, compared with none in the mid-1990s. Moreover, from 1995 to 1999, consumer loans increased from 4% to 6% of total GDP (USAID 2000).

8 It is likely that this is being achieved at the cost of changes in the way the financial environment is controlled and the elimination of inefficient entities through mergers and acquisitions.

9 According to the classification used by the Bank Guarantee Fund and to Gołajewska and Józefowska (2001), there are currently three banks specialized in providing mortgages.

10 The Mortgage Bond and the Mortgage Banks Act restricted housing lending to individuals whose maximum loan-to-value (LTV) ratio per single loan was 80% (however, in 2002 this was increased to 100%), with an average LTV for the whole portfolio of 60% plus 10% of the total assets secured with mortgages (from 2002, increased to 60% plus 30%) (Kempny 2002). As Chiquier (1999, 15) also claims 'lenders are given strong incentives to use alternative forms of collateral, such as a general pledge over the whole patrimony of the borrower, third-party guarantees and pledged leases'.

11 Due to a lack of comparable data, the study also does not consider quality of service as perceived by consumers.

12 However, the standard deviation for the cost to income ratio is substantially higher in the UK, reflecting a greater variability in this cost ratio in UK than Polish commercial banking.

13 A bank's objective is to lend and invest profitably but not to do so recklessly so that there is high risk of insolvency. Hence, it is legitimate to include insolvency risk as a bank's output alongside loans and other earning assets.

14 This follows because $(PE/A) = (PE/L)(L/A)$, where PE is personnel expenses, A is total assets and L is labour employed.

15 An alternative approach to frontier analysis uses linear programming techniques, referred to as data envelopment analysis (DEA). DEA is a non-parametric method that has the advantage over SCF analysis in not requiring the prior specification of a functional form. It has, however, the major disadvantage of attributing all deviations from the frontier as inefficiency and is more easily biased by outliers in the data. As a cross-check on the SCF results, a DEA analysis was undertaken using the same data. The results suggested a larger gap in efficiency between Polish and UK banks, in favour of Polish banks. The DEA results can be obtained from the authors, but we consider them less ro-

bust than the SCF results because of the properties of DEA. Hence, our preference to report the SCF results.

16 See Coelli, Rao, and Battese (1998) for a more detailed explanation of the model used.

17 Battese and Corra's (1977) log-likelihood function is equal to:

$$\ln(L) = -\frac{N}{2}\ln(\frac{\pi}{2}) - \frac{N}{2}\log(\sigma_s^2) + \sum_{i=1}^{N}\ln[1-\Phi(z_i)]$$
$$-\frac{1}{2\sigma_s^2}\sum_{i=1}^{N}(\ln y_i - x_i\beta)^2$$

where $z_i = (\ln y_i - x_i\beta)/\sigma_s\sqrt{\gamma/(1-\gamma)}$ and $\Phi(\cdot)$ is the distribution function of the standard normal random variable.

18 Details of the calculations at each stage of the SCF analysis are available from the authors on request.

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