

**COST AND PROFIT EFFICIENCY IN THE SPANISH BANKING SECTOR
(1985-1996): A NON-PARAMETRIC APPROACH***
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Abstract

The aim of this study is to analyse the efficiency in costs and in profits of the Spanish banking sector (SBS) in the period 1985-96 using a non-parametric approach. The results obtained show the existence of profit efficiency levels well below those corresponding to cost efficiency, alternative profit efficiency being below standard profit efficiency. These results imply the existence of market power in the setting of prices and/or the existence of differences in the quality of bank output reflected in the differences in prices. With regard to the immediate future, of full economic and monetary integration, the reduction of profit levels associated with higher competitive pressure may be offset by the reduction of all kinds of inefficiency, which is a very important potential source of competitiveness. Indeed, the results referring to 1996 indicate that the return on assets (ROA) and on equity (ROE) of the SBS could increase by 2.4% and 24.4% respectively, eliminating the combined inefficiency in costs and revenues.

Key Words: efficiency, costs, profits, Spanish banking sector
JEL: G2, D2

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1. Introduction

Since the early 1990s the analysis of efficiency has given rise to a plentiful literature in the area of financial institutions, as demonstrated by the recent survey by Berger and Humphrey (1997) which collates the information from 130 studies that apply frontier techniques to the analysis of the efficiency of financial institutions in 21 countries¹.

As shown in the survey by Berger and Humphrey (1997), the majority of studies have centred on the analysis of cost efficiency. On the other hand, the revenue and profit side has been dealt with much less, and has only begun to be approached in the last few years. In fact, of the 130 studies referred to in this survey, only 14² undertake the study of efficiency in revenue and/or profits³.

The small amount of empirical evidence available has shown that profit inefficiency is quantitatively more important than cost inefficiency, which is indicative of significant inefficiencies on the revenue side, either due to the choice of a composition of production that is not the most suitable given the prices of outputs, or due to a bad pricing policy.

With the exception of the study by Miller and Noulas (1996), the estimated efficiency in profits is lower than that in costs, the former reaching a value of 64% for the average of studies referring to the US banking system. Nevertheless, only three studies (Berger and Mester, 1997; Rogers, 1998 and Maudos et al., 1998a) compare the results in terms of both types of inefficiency with the same sample, profit efficiency always being higher⁴.

The case of the Spanish banking sector has not been an exception to this general interest in the efficiency of financial institutions, so there is also plenty of literature centred on the study of this sector. The common aim of this literature has been to analyse the evolution of the sector in the context of the structural changes to which it has been subjected in the last years: deregulation of interest rates, liberalisation, adaptation to Community directives, abolition of legal investment coefficients, legal homogenisation of commercial banks and savings banks, abolition of geographical restrictions on the opening of branch offices, freedom of establishment, adaptation to the new telecommunications technologies, etc.

As to the technique employed, although we can find studies that analyse cost efficiency with parametric techniques and with non-parametric techniques, only one study (Färe et al, 1997b) analyses standard profit efficiency by non-parametric methods, but without comparing it with cost efficiency, and there is no study in the literature that calculates alternative profit efficiency by non-parametric methods.

Furthermore, the analysis of efficiency acquires renewed interest at the start of the third phase of the European Union. Thus, with a view to full economic and monetary integration, the higher pressure of competition – and the consequent reduction of market power – will compel the SBS to make an effort to reduce its levels of inefficiency, not only on the costs side, but also on the revenue side. The reduction of levels of profitability due to greater competition makes the

reduction of all types of inefficiency a very important potential source of gains in competitiveness.

In this context, the aim of the study is to analyse the efficiency of the SBS in a decade characterised by continual changes. In order to enrich the analysis we will compare cost efficiency and profit efficiency in both commercial banks and savings banks, using a non-parametric approach. For this purpose the study uses the innovative methodology of a non-parametric technique for estimating alternative profit efficiency. We will analyse both standard profit efficiency (which assumes that there is no market power in the setting of prices) and alternative profit efficiency (which does allow the existence of market power), and the degree of competitiveness of the SBS can be analysed by comparison of the two concepts of profit efficiency. Also, the estimation of profit functions allows correction of any possible bias that the different specialisation and/or orientation of the banking business may have on cost efficiency, and also implicitly considers the revenue side.

The paper is organised as follows. Section 2 introduces the concepts of cost efficiency and profit efficiency, distinguishing in the latter case between standard and alternative efficiency. Section 3 describes the methodology used as well as that developed for the calculation of alternative profit efficiency. Section 4 describes the sample and variables used, and in section 5 the results are presented, distinguishing between commercial banks and savings banks. Finally, section 6 presents the conclusions of the study.

2. Cost efficiency and profit efficiency

The two types of efficiency analysed – cost and profit efficiency – correspond to two important economic objectives: respectively, the minimisation of costs and the maximisation of profits, and are based on the comparison of observed values (of costs and profits) with the optima, determined by the respective frontier. Thus, cost efficiency is defined as the quotient between the minimum cost at which it is possible to obtain a given vector of output as determined by the frontier (C^*) and the cost actually incurred (C). Thus, a cost efficiency value of $CE=C^*/C$ implies that it would be possible to produce the same vector of production with a saving in costs of $(1-CE) \cdot 100$ per cent.

The costs of an organisation depend on the vector of output (y), on the vector of the prices of the inputs used (w), and on the level of inefficiency in costs (u). Thus, the cost frontier determines the minimum cost that each firm could attain, given its output vector (y) and the input price vector (w), and can be expressed as:

$$[1] \quad C = C(y, w, u)$$

Unlike cost efficiency, profit efficiency relates the profits generated with a specific production vector (P) to the maximum possible profit associated with that vector as determined by the frontier (P^*). Depending on whether or not we consider the existence of market power in the pricing of outputs, following Berger and Mester (1997) we can distinguish two profit frontiers: the *standard* profit frontier and the *alternative* profit frontier.

The standard profit frontier assumes the existence of perfect competition in the input and output markets, so that firms take prices as given. Given the vector of output prices (r) and that of input prices (w), the banking firm tries to maximise profits by adjusting the amounts of the vectors of output quantity (y) and input quantity (x). Thus, the *standard* profit frontier can be expressed as:

$$[2] \quad P = P(w, r, u)$$

As occurred with cost efficiency, standard profit efficiency is defined as the quotient between observed profit (P) and the maximum profit attainable as determined by the standard profit frontier given the prices of inputs and outputs (SP^*). Thus, a standard profit efficiency value of $SPE=P/SP^*$ implies that it would be possible to increase the profits of the firm by $(1-SPE) \cdot 100$ per cent given the input and output prices faced by the firm. The exogenous nature of the price of the output vector in the above concept of profit efficiency has the disadvantage that it implies assuming the non-existence of market power in pricing.

If instead of taking this price vector as given, we assume the possibility of imperfect competition or market power in the setting of prices, we will take as given the vector of output (y), but not that of output prices (r). In this case we will be looking at the *alternative* profit frontier:

$$[3] \quad P = P^a(y, w, u)$$

Observe that at the alternative profit frontier firms take as given the vector of outputs (y) and the vector of input prices (w) and maximise profits by adjusting the vector of output prices (r) and the amount of input (x). The measure of alternative profit efficiency is defined, as in the case of standard efficiency, as the quotient between observed profit (P) and the maximum profit as determined by the alternative profit frontier (AP^*). An alternative profit efficiency value of $APE=P/AP^*$ implies that it would be possible to increase the company's profit by $(1-APE) \cdot 100$ per cent given the input and output prices faced by the firm. As indicated by Berger and Mester (1997) and Rogers (1998), alternative efficiency is a closer representation of reality whenever the assumption of perfect competition in the setting of prices is questionable, when there are differences in output quality among individuals of the sample, or when there are problems of information for the calculations of output prices.

In sum, profit efficiency, whether in its standard or alternative versions, is a wider concept than cost efficiency since it takes into account the effects of the choice of a certain vector of production both on costs and on revenues, thus offering complementary information useful for the analysis of the efficiency of banking firms.

3. Estimation of cost and profit efficiency by non-parametric techniques.

Although a number of studies analyse cost efficiency and some compare it to profit or revenue efficiency, only Berger and Mester (1997) compare cost efficiency, standard profit efficiency and alternative profit efficiency for the same sample of United States banks, using a parametric approach. As the authors recognise, parametric frontier approaches must make distributional assumptions which in most cases are quite arbitrary⁵. Furthermore, the studies in which the true distribution of inefficiencies has been compared with imposed distributions have found that the former are much more symmetrical than those usually imposed (e.g. half-normal)⁶. Even though the availability of panel data allows the use of techniques that relax these assumptions, and enables efficiency to be estimated by means of a parametric frontier without having to assume any distributional form for inefficiency, they only enable one inefficiency per firm to be calculated, common to the whole period, which implies the assumption that firms do not vary their management during the period analysed, an assumption that becomes riskier the longer the period. In order to avoid the problem of assuming a particular distributional form, Berger and Mester (1997) use panel data and apply the so-called distribution-free approach.

Having determined the method for estimating the frontier, the next problem presented by parametric methods is the choice of a functional form. An important problem, as McAllister and McManus (1993), Mitchell and Onvural (1996) and Berger and De Young (1997) have shown, is that the results are sensitive to the functional form selected. The basis of the problems found is that simple, and therefore restrictive, forms are ill-adjusted to the data. These problems of imperfect fit with the sample occur even with flexible functional forms such as the translog, and therefore these authors propose the estimation of even more flexible functional forms such as the Fourier. However, the problem with the Fourier functional form is the large number of parameters to be estimated, which prevents its estimation in the case of a small sample. Berger and Mester (1997) use the Fourier to avoid this possible bias because they have a sample of more than 6,000 firms observed over 5 years.

In sum, Berger and Mester (1997) attempt to lessen the problems deriving from the use of a parametric approach, using a flexible functional form because their sample is a large one, and using a technique based on panel data (distribution free approach) which does not require a distribution function to be assumed for the residues in exchange for renouncing the analysis in time of the evolution of efficiency.

The use of non-parametric techniques to calculate the frontier is in many cases a preferable alternative to parametric techniques because they enable efficiency scores to be obtained without having to assume any distribution function for inefficiencies or to specify any functional form for the frontier. Also, unlike panel techniques, they do not avoid the problem of assuming a distribution function for inefficiency in exchange for doing without the time dimension of efficiency. However, these techniques do not consider the existence of an error term, so its existence may bias the results⁷.

This study uses the non-parametric DEA technique to calculate the indices of cost and profit efficiency. The frontier is obtained by means of linear combinations of efficient firms contained in the sample. Although cost efficiency obtained by means of non-parametric techniques has been a widely used procedure, the estimation of profit efficiency by non-parametric techniques has never been done. As far as we know only Färe et al. (1997a) have calculated profit efficiency by means of non-parametric techniques, though without comparing it to cost efficiency, whereas there is no study that develops a procedure for calculating alternative profit efficiency. In this section we present the three non-parametric models: the well-known and widely used model for calculating cost efficiency, the model developed by Färe et al (1997a and b) for calculating standard profit efficiency and a new model for calculating alternative profit efficiency.

3.1. Cost efficiency (CE)

To illustrate the non-parametric methodology for calculating cost efficiency, let us suppose that there exist N firms ($i=1, \dots, N$) that produce a vector of q outputs $y_i=(y_{i1}, \dots, y_{iq}) \in \mathfrak{R}^{q_{++}}$ that they sell at prices $r_i=(r_{i1}, \dots, r_{iq}) \in \mathfrak{R}^{q_{++}}$ using a vector of p inputs $x_i=(x_{i1}, \dots, x_{ip}) \in \mathfrak{R}^{p_{++}}$ for which they pay prices $w_i=(w_{i1}, \dots, w_{ip}) \in \mathfrak{R}^{p_{++}}$. The cost efficiency for the case of firm j can be calculated by solving the following problem of linear programming:

$$\begin{aligned}
 [4] \quad & \text{Min} \quad \sum_p w_{pj} x_{pj} \\
 & \text{s.t.} \quad \sum_i \lambda_i y_{iq} \geq y_{jq} \quad \forall q \\
 & \quad \quad \sum_i \lambda_i x_{ip} \leq x_{jp} \quad \forall p \\
 & \quad \quad \sum_i \lambda_i = 1; \quad \lambda_i \geq 0; \quad i = 1, \dots, N
 \end{aligned}$$

the solution to which, $x_j^*=(x_{j1}^*, \dots, x_{jp}^*)$ corresponds to the input demand vector which minimises the costs with the given prices of inputs, and is obtained from a linear combination of firms that produces at least as much of each of the outputs using the same or less amount of inputs. If this hypothetical firm had the same input price vector as firm j would have a cost $C_j^* = \sum w_{pj} x_{pj}^*$

which, by definition, will be less than or equal to that of firm j ($C_j = \sum w_{pj} \cdot x_{pj}$).

Having obtained the solution to the problem, the cost efficiency for firm j (CE_j) can be calculated as follows:

$$[5] \quad CE_j = \frac{C_j^*}{C_j} = \frac{\sum_p w_{pj} x_{pj}^*}{\sum_p w_{pj} x_{pj}}$$

where $CE_j \leq 1$ represents the ratio between the minimum costs (C_j^*) – associated with the use of the input vector (x_j^*) that minimises costs — and the observed costs (C_j) for firm j .

3.2. Standard profit efficiency (SPE)

Similarly to cost efficiency, the calculation of standard profit efficiency can be done, for the case of firm j , by solving the following problem of linear programming proposed by Färe et al. (1997a and b):

$$[6] \quad \begin{aligned} \text{Max} \quad & \sum_q r_{qj} y_{qj} - \sum_p w_{pj} x_{pj} \\ \text{s.t.} \quad & \sum_i \lambda_i y_{iq} \geq y_{jq} \quad \forall q \\ & \sum_i \lambda_i x_{ip} \leq x_{jp} \quad \forall p \\ & \sum_i \lambda_i = 1; \quad \lambda_i \geq 0; \quad i = 1, \dots, N \end{aligned}$$

the solution to which corresponds to the vector of outputs $y_j^* = (y_{j1}^*, \dots, y_{jq}^*)$ and the input demand vector $x_j^* = (x_{j1}^*, \dots, x_{jp}^*)$ which maximise the profits with the given prices of outputs (r) and of inputs (w). This solution is obtained from a linear combination of firms that produces at least as much of each of the outputs using the same or less amount of inputs. If this hypothetical firm were subject to the same input and output prices as those faced by firm j it would have a profit $P_j^* = \sum_q r_{qj} y_{qj}^* - \sum_p w_{pj} x_{pj}^*$ which, by definition, will be higher than or equal to that of firm j $P_j = \sum_q r_{qj} y_{qj} - \sum_p w_{pj} x_{pj}$

Having solved the above problem, standard profit efficiency (SPE_j) is then calculated as follows:

$$[7] \quad SPE_j = \frac{P_j}{P_j^*} = \frac{\sum_q r_{qj} y_{qj} - \sum_p w_{pj} x_{pj}}{\sum_q r_{qj} y_{qj}^* - \sum_p w_{pj} x_{pj}^*}$$

where SPE_j represents the ratio between the observed profits (P_j) and the maximum profits (P_j^*)

- associated with the production of the output vector y_j^* and with demand for inputs x_j^* which maximise profits for firm j .

3.3. Alternative profit efficiency (APE)

Finally, the calculation of alternative profit efficiency can be done by solving the following problem of linear programming for the case of the firm j .

$$\begin{aligned}
 & \text{Max} \quad R_j - \sum_p w_{pj} x_{pj} \\
 & \text{s.t.} \quad \sum_i \lambda_i R_i \geq R_j \\
 [8] \quad & \sum_i \lambda_i y_{iq} \geq y_{jq} \quad \forall q \\
 & \sum_i \lambda_i x_{ip} \leq x_{jp} \quad \forall p \\
 & \sum_i \lambda_i = 1; \quad \lambda_i \geq 0; \quad i = 1, \dots, N
 \end{aligned}$$

the solution to which corresponds to the revenue R_j^* and input demand $x_j^* = (x_{j1}^*, \dots, x_{jp}^*)$ which maximise profits given the prices of the inputs (w). This solution is obtained from a linear combination of firms that produce at least as much of each of the outputs using a smaller or equal quantity of inputs and obtains at least as much revenues as firm j .

Alternative profit efficiency is then calculated as follows:

$$[9] \quad APE_j = \frac{P_j}{AP_j^*} = \frac{R_j - \sum_p w_{pj} x_{pj}}{R_j^* - \sum_p w_{pj} x_{pj}^*}$$

where APE_j represents the ratio between the observed profits ($P_j = R_j - \sum_p w_{pj} x_{pj}$) and the maximum profits ($AP_j^* = R_j^* - \sum_p w_{pj} x_{pj}^*$) associated with the maximum revenue and the input demand x_j^* that maximise profits for firm j .

4. Variables and sample used

Table 1 shows all the variables used in the calculation of cost and profit efficiency - both standard and alternative - as well as their principal descriptive statistics for the last year analysed (1996). It must be taken into account that when selecting the variables we are limited by the public information available as well as by the methodological change that took place in 1992 in the presentation of balance sheets and profit and loss accounts of the commercial and savings

banks. This change makes it necessary first to undertake the homogenisation of the information before and after 1992. Taking into account these two questions, the following variables were selected:

- a) The outputs used are two: y_1 = profitable assets⁸, and y_2 = securities portfolio⁹.
- b) The prices of the two outputs have been approximated as follows: r_1 = financial products and others ordinary products¹⁰/ y_1 ; r_2 = return on the securities portfolio/ y_2 .
- c) The inputs used are the following: x_1 = loanable funds; x_2 = number of employees; and x_3 = physical capital.
- d) The prices of the inputs were calculated as follows: w_1 = financial costs / x_1 ¹¹; w_2 = staff costs/ x_2 ; and w_3 = amortisations and other administrative costs / x_3 .

The specification of financial assets as output and financial liabilities as input is consistent with the "intermediation approach" when modelling banking firms.

Regarding the variables to be explained, the costs include both financial and operating costs. In the case of the profit frontier, profitability is proxied using the operating profit, since it reflects the profit from the typical banking activity¹².

For the sub-sector of savings banks, the sample consists of the total of those existing in each year of the sample, the size having been reduced from 77 in 1985 to 50 in 1996 as a consequence of mergers and takeovers. In the case of the national banking system, it has been necessary to eliminate some banks from the sample due to the lack of information on some of the necessary variables. Thus, the sample finally used varied from 98 banks in 1985 to 75 in 1996.

The three problems of optimisation posed in section 3 (cost efficiency, standard profit efficiency, alternative profit efficiency) were solved for savings and commercial banks together - common reference frontier - so that the measurements of efficiency of savings banks and commercial banks are directly comparable with each other, and the average levels of efficiency of the Spanish banking sector are obtained in addition¹³.

5. Results

Table 2 presents the results of (weighted) average efficiency in costs and in profits - both standard and alternative - of savings banks and commercial banks, as well as the total for each of the years of the period analysed, 1985-1996. In the case of cost efficiency, the comparison of savings banks and commercial banks shows higher efficiency levels in the commercial banks for all the years of the sample, with a difference that fluctuates between 7 and 13 percentage points, in 1992 and 1988 respectively. For the average of the period, the cost efficiency of the commercial banks is 0.909 and that of the savings banks is 0.802, the average

efficiency of the SBS therefore being 0.871.

If we now concentrate on standard profit efficiency, the middle part of table 2 shows that the efficiency levels of the commercial banks are also higher than those corresponding to the savings banks for all the years of the period analysed, with a maximum (minimum) difference of 28 (10) percentage points in 1990 (1996). The evolution over time shows that in both categories efficiency decreased in the period analysed - more intensively in the last three years - with a much greater decrease in commercial banks than in savings banks, efficiency levels thus clearly converging to such an extent that the minimum difference occurs in the last year of the sample. The dispersion of standard profit efficiency (measured by means of the standard deviation) is much greater than that of cost efficiency, suggesting that this type of efficiency is highly dispersed with firms that earn much more or much less than the average. It can also be seen that, although the commercial banks as a whole have higher efficiency levels, they are more heterogeneous - unequal - than the savings banks. For the total of savings banks and commercial banks, average profit efficiency is 57.4%, 30 percentage points lower than that of cost efficiency.

In the case of alternative profit efficiency - lower part of table 2 - the commercial banks also enjoy higher levels in all the years of the sample, being as a whole highly volatile, with a reduction of efficiency from the late 1980s. For the average of the complete period 1985-1996, the average efficiency of the savings banks (0.347) is nearly 20 points lower than that of the commercial banks (0.529).

It is important to emphasise that the levels of standard profit efficiency are higher than those corresponding to alternative efficiency, which may explain the existence of market power in pricing or of differences in the quality of banking output. If, as pointed out by Berger and Mester (1997), banking firms make a bad choice of the quality of output compared to the firms that define the frontier, and this choice is reflected in reduced prices and revenues, alternative profit efficiency, unlike standard profit efficiency, captures this source of inefficiency. Likewise, if the market power explains part of the differences in profitability¹⁴, the dispersion in relation to the alternative profit frontier will be greater than in relation to the standard frontier, since the former does not assume that the prices of outputs are exogenous.

Figure 1 enables us to appreciate the broad features of the evolution of cost and profit efficiency in the Spanish banking sector: a) the smallest differences in efficiency between savings banks and commercial banks occur on the cost side, with a relatively stable efficiency level in the period analysed of around an average value of 87%; b) the greatest differences between savings banks and commercial banks occur in alternative profit efficiency, with maximum differences of more than 30 percentage points in the late 1980s and early 1990s. However, in the last 4 years there was a substantial convergence with a minimum difference of 10 percentage points in 1996 which is even lower than the difference in cost efficiency; c) standard profit efficiency presents greater stability than alternative efficiency, with a clear reduction both in savings banks and in commercial banks from 1994.

If we concentrate on the analysis of the three types of efficiency among savings banks or among commercial banks, figure 2 shows clearly the substantial differences in the levels of cost and profit efficiency. In the case of the commercial banks, the differences between cost and profit efficiency have increased since 1988 due to the fall in profit efficiency. It can also be observed that alternative efficiency, with the exception of 1986, is always lower than the standard type, reflecting the existence of differences in market power or quality of banking output reflected in differences in output prices. In the case of the savings banks, the differences between profit and cost efficiencies are greater than among commercial banks, with a relatively stable evolution, all types of efficiency decreasing in the last years of the period analysed. The combined behaviour of savings banks and commercial banks shows obviously the substantial differences in cost and profit efficiency, as well as the decrease of the last years.

One fact that calls the attention is that, curiously, the average levels of efficiency obtained in the Spanish banking sector are very similar to those obtained by Berger and Mester (1997) in the US banking sector in the period 1990-1995 using a sample of more than 6,000 banks. Thus, as against the average values of cost, standard profit and alternative profit efficiencies obtained here, 0.871, 0.574 and 0.425 respectively, Berger and Mester obtain levels of 0.868, 0.549 and 0.463 in their "preferred" specification: Fourier-flexible using the *distribution free approach*. The similarity of results is even more surprising if we take into account that the approach used in Berger and Mester is parametric and stochastic – as against the non-parametric and determinist approach used in this study.

Using the conditions of consistency proposed by Bauer et al. (1998), table 3 shows the rank correlation coefficients among accounting ratios of profitability and costs and indices of efficiency. Starting on the cost side, a negative correlation is obtained between average costs (costs per unit of assets) and cost efficiency in the savings banks, although the correlation is positive in the commercial banks. The "unexpected" positive sign in the commercial banks, which has also been obtained by Maudos et al (1998a) for a broad sample of banks belonging to the European Union, may be due to differences of specialisation, which are much greater among commercial banks than among savings banks¹⁵, and imply that firms with more costly specialisations may at the same time be more efficient¹⁶. In fact, in the case of the commercial banks there is a positive rank-order correlation coefficient between average costs and profitability.

In the case of the profit indicators, the expected positive sign between efficiency and profitability is always obtained - measured as return on assets (ROA) and/or on equity (ROE). Thus, the most profit-efficient banking firms are the most profitable. It is important to emphasise that the correlations are higher in the alternative efficiency indicator, so that once again market power and differences in quality - and therefore in prices - appear implicitly as elements that influence differences in profitability.

Contrary to other studies (Berger and Mester, 1997; and Maudos et al., 1998a), we always obtain positive rank correlation coefficient between cost efficiency and profit efficiency, in both

categories of bank, so that the more cost-efficient firms are also more profit-efficient.

Finally, positive - and very high - coefficients of ranking are always obtained between standard and alternative profit efficiency, this result being common to the other studies that estimate both types of profit efficiency.

The three measurements calculated are measurements of efficiency relative to the reference frontier, so that the levels calculated must be interpreted in relation to that frontier. Consequently, in order to compare cost and profit efficiency levels with each other it is first necessary to standardise them, i.e. to express them in relation to a common denominator. For this reason table 4 offers a standardised comparison in the three types of efficiency in 1996 using as reference the total assets (A) and equity (K). Thus, the meaning of the ratios is the proportion of the excess of costs and the loss of profits - standard and alternative - in relation to assets and to equity respectively.

In the case of the savings banks, cost inefficiency in relation both to assets and to equity, is lower than profit inefficiency, standard efficiency being higher than alternative efficiency. Thus, the potential saving in costs and the potential increase in profits in relation to assets is 1.72%, 2.04% and 3.49%, respectively, these percentages being 15.74%, 18.66% and 31.88% in relation to equity. In the commercial banks, cost inefficiency is higher than standard profit inefficiency, though lower than alternative profit inefficiency. For the SBS as a whole, alternative profit inefficiency (2.40% on assets and 21.41% on equity) is almost double that of costs (1.37% on assets and 13.95% on equity).

The above results show that the higher costs incurred by products of higher quality are not offset by higher revenues since profit efficiencies are lower than cost efficiencies. Furthermore, alternative profit inefficiency is higher than standard, so that market power exists in the setting of prices.

6. Conclusions

In recent years the study of the efficiency of banking firms, the analysis of accounting ratios and economies of scale has been complemented by numerous analyses of X-inefficiencies, since the abundant evidence available today shows the existence of much greater differences in average costs for firms of a given size than among firms of different sizes.

The studies made so far have mostly concentrated on the analysis of cost efficiency, paying little attention to the possible inefficiencies on the revenue side. However, the studies that have analysed joint efficiency in costs and revenues by means of the estimation of frontier profit functions show the existence of higher levels of inefficiency in profits than in costs, indicating the under-estimation involved in analysing exclusively the cost side for a proper evaluation of efficiency. This approach may offer a biased image of efficiency, as it is contaminated by the fact

that specialisation in a particular composition of banking output also has effects on the vector of prices, and therefore on revenues, which the study of costs does not consider.

In this context, the aim of this study has been to analyse the efficiency in both costs and in profits of the SBS, in both commercial banks and savings banks, in a period of structural change and increasing competition from 1985 to 1996. The main innovation of the study is that so far it is the only one to make a comparison of cost efficiency and standard and alternative profit efficiency in the SBS on the basis of a single sample. Furthermore, it is the only study that uses a non-parametric technique to calculate alternative profit efficiency.

Using a non-parametric frontier approach, the evidence obtained shows the existence of average levels of cost efficiency in savings banks and commercial banks of 80.2% and 90.9% respectively, much higher than the levels of profit efficiency. The standard profit efficiency levels of the commercial banks (66.5%) are higher than those of the savings banks (47.2%), converging in recent years to such an extent that the minimum difference occurs in the last year of the sample. In the case of alternative profit efficiency - admitting the existence of market power in setting the prices of output - the commercial banks also enjoy higher levels of efficiency (52.9% as against the savings banks' 34.7%), with a reduction in the levels from the late 1980s.

Levels of standard profit efficiency higher than alternative profit efficiency imply the existence of market power in the setting of prices and/or the existence of differences in the quality of banking output reflected in differences of price. Thus, even in the current context of increased competitive pressure, market power in the setting of prices continues to exist to a greater or lesser extent, and may, as indicated in other studies (Maudos, 1998), be associated with the size of production.

With a view to the immediate future of full economic and monetary integration, the higher pressure of competition – and the consequent reduction of market power – will compel the Spanish banking sector to make an effort to reduce its levels of inefficiency, not only on the costs side, but also on the revenues side. Also, the reduction of levels of profitability associated with higher pressure of competition could be offset if firms reduced all types of inefficiency, which would be a very important potential source of gains in competitiveness. In fact, the results obtained for 1996 indicate that the SBS's profitability – operating profit - on assets and on equity could be increased by 2.4% and 24.4% respectively, by eliminating the combined inefficiency in costs and revenues.

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Table 1: descriptive statistics (1996)

Variable	Mean	Std. Dev.
y_1 = Loans and other earning assets	623193.0	1370586.6
y_2 = Securities	195898.4	497548.0
x_1 = deposits and other funding	781880.0	1767768.4
x_2 = number of employees	1725.6	3455.3
x_3 = physical capital	23571.4	52466.9
r_1 = interest received and other operating income/ y_1	0.123	0.025
r_2 = profits from financial operations/ y_2	0.005	0.009
w_1 = interest paid/ x_1	0.061	0.014
w_2 = personnel expenses / x_2	6.848	1.671
w_3 = other expenses/ x_3	0.610	0.664
Total costs= $\sum w_p \cdot x_p$	67747.4	155423.8
Operating profits= $\sum r_q \cdot y_q - \sum w_p \cdot x_p$	8870.0	18176.1

Table 2: Efficiency (weighted mean)

Cost Efficiency (<i>CE</i>)						
	Savings banks		Banks		Total	
	Mean	Std.	Mean	Std.	Mean	Std.
1985	0.776	0.12	0.899	0.11	0.862	0.12
1986	0.776	0.12	0.901	0.13	0.858	0.13
1987	0.768	0.11	0.887	0.13	0.844	0.14
1988	0.766	0.12	0.909	0.16	0.860	0.16
1989	0.824	0.14	0.935	0.16	0.897	0.16
1990	0.824	0.12	0.921	0.13	0.887	0.14
1991	0.816	0.12	0.921	0.13	0.885	0.14
1992	0.857	0.12	0.921	0.13	0.898	0.14
1993	0.846	0.10	0.929	0.17	0.898	0.15
1994	0.817	0.12	0.897	0.20	0.867	0.17
1995	0.786	0.10	0.895	0.18	0.855	0.16
1996	0.769	0.11	0.889	0.17	0.844	0.15
Mean	0.802		0.909		0.871	

Standard profit efficiency (<i>SPE</i>)						
	Savings banks		Banks		Total	
	Mean	Std.	Mean	Std.	Mean	Std.
1985	0.423	0.21	0.647	0.35	0.546	0.29
1986	0.440	0.20	0.667	0.34	0.564	0.28
1987	0.484	0.17	0.649	0.37	0.570	0.29
1988	0.483	0.16	0.736	0.34	0.623	0.28
1989	0.512	0.20	0.773	0.39	0.660	0.32
1990	0.455	0.16	0.736	0.44	0.610	0.34
1991	0.441	0.15	0.695	0.78	0.583	0.61
1992	0.511	0.19	0.631	0.46	0.577	0.38
1993	0.522	0.19	0.666	0.71	0.589	0.57
1994	0.529	0.19	0.706	0.48	0.615	0.39
1995	0.458	0.17	0.575	2.32	0.511	1.82
1996	0.404	0.17	0.500	1.02	0.445	0.80
Mean	0.472		0.665		0.574	

Alternative profit efficiency (<i>APE</i>)						
	Savings banks		Banks		Total	
	Mean	Std.	Mean	Std.	Mean	Std.
1985	0.374	0.19	0.480	0.31	0.436	0.26
1986	0.443	0.18	0.681	0.34	0.561	0.28
1987	0.324	0.16	0.480	0.32	0.395	0.25
1988	0.391	0.14	0.637	0.35	0.498	0.28
1989	0.377	0.15	0.696	0.36	0.508	0.29
1990	0.244	0.11	0.595	0.36	0.373	0.28
1991	0.359	0.15	0.583	0.37	0.450	0.31
1992	0.292	0.14	0.422	0.40	0.344	0.33
1993	0.390	0.15	0.497	0.47	0.439	0.38
1994	0.354	0.13	0.476	0.41	0.413	0.32
1995	0.330	0.16	0.409	0.48	0.365	0.39
1996	0.284	0.13	0.386	0.40	0.325	0.32
Mean	0.347		0.529		0.425	

Table 3: Spearman correlation coefficients. 1996

Savings banks						
	<i>TC/A</i>	<i>ROA</i>	<i>ROE</i>	<i>CE</i>	<i>SPE</i>	<i>APE</i>
<i>TC/A</i>	1.000	-0.508	-0.222	-0.337	-0.730	-0.548
<i>ROA</i>		1.000	0.713	-0.064	0.677	0.655
<i>ROE</i>			1.000	-0.224	0.349	0.394
<i>CE</i>				1.000	0.598	0.552
<i>SPE</i>					1.000	0.916
<i>APE</i>						1.000

Banks						
	<i>TC/A</i>	<i>ROA</i>	<i>ROE</i>	<i>CE</i>	<i>SPE</i>	<i>APE</i>
<i>TC/A</i>	1.000	0.608	0.578	0.204	0.149	0.189
<i>ROA</i>		1.000	0.973	0.307	0.519	0.670
<i>ROE</i>			1.000	0.311	0.543	0.702
<i>CE</i>				1.000	0.642	0.600
<i>SPE</i>					1.000	0.846
<i>APE</i>						1.000

Total						
	<i>CT/A</i>	<i>ROA</i>	<i>ROE</i>	<i>CE</i>	<i>SPE</i>	<i>APE</i>
<i>TC/A</i>	1.000	0.507	0.463	0.065	-0.033	0.022
<i>ROA</i>		1.000	0.919	0.187	0.456	0.598
<i>ROE</i>			1.000	0.166	0.448	0.606
<i>CE</i>				1.000	0.611	0.546
<i>SPE</i>					1.000	0.847
<i>APE</i>						1.000

TC/A = Total costs / Assets,
ROA = Operating profit / Assets,
ROE = Operating profit / Equity
CE = Cost efficiency
SPE = Standard profit efficiency
APE = Alternative profit efficiency

**Table 4: Cost, standard and alternative profit efficiencies relative to assets and equity
Weighted mean efficiencies (1996)**

	Savings banks		Banks		Total	
	Mean	Std.	Mean	Std.	Mean	Std.
(C-C*)/A	1,72%	0,01	1,09%	0,97	1,37%	0,75
(SP*-P)/A	2,04%	0,02	0,97%	0,22	1,44%	0,18
(AP*-P)/A	3,49%	0,03	1,54%	0,51	2,40%	0,40
(C-C*)/K	15,74%	0,21	12,23%	2,78	13,95%	2,18
(SP*-P)/K	18,66%	0,36	10,84%	1,29	14,67%	1,02
(AP*-P)/K	31,88%	0,57	17,26%	1,86	24,41%	1,48

C=Observed Costs, P=Observed profits, C*= Minimum Costs, SP*=standard potencial profit, AP*= Alternative potencial profit, A=Total Assets, E=Equity.

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Notes

¹ See also Molyneux et al. (1996).

² Berger et al. (1993), De Young and Nolle (1996), Miller and Noulas (1996), Akhavein et al. (1997a and b), Berger and Mester (1997), Humphrey and Pulley (1997), Hasan and Hunter (1996), Berger et al. (1996), Grifell and Lovell (1996 and 1997), Ellinger et al. (1997), English et al. (1993), and Elyasiani and Mehdiian (1990).

³ To these must be added the studies published later by Rogers (1998) and De Young and Hasan (1998).

⁴ In Berger and Mester (1997), profit efficiency is approximately half of cost efficiency. Rogers (1998) obtains an average efficiency in profits of 69.2% as against 75.6% in costs, efficiency in revenue being lower (43.7%). In the case of the banking system of the European Union, Maudos et al (1998a) obtain an average inefficiency in profits of 84% as against 91% in costs.

⁵ Page 906, Berger and Mester (1997)

⁶ See Bauer and Hancock (1993) and Berger (1993)

⁷ Berger and Mester (1997) state that the non-parametric technique DEA also has the disadvantage that it ignores prices and serves to estimate only technical inefficiency, not cost inefficiency (Berger and Mester, 1997; p.905). This affirmation is not correct, as many studies analyse cost efficiency taking input prices into account (see for example Pastor, 1996).

⁸ Profitable assets are the items financial intermediaries, credit investments, cash and deposits in banks and fixed income.

⁹ The securities portfolio includes shares and other variable income securities and participations.

¹⁰ The absence of disaggregated information on the "other ordinary products" item of the profit and loss account obliges us to add them all to output y_r . The alternative of not including them in the price of any output has the disadvantage that profit efficiency would refer to profit without taking into account this income of growing though limited importance in the Spanish banking sector (less than 10% of total income for the average of the sector).

¹¹ The profit and loss account of commercial and savings banks do not offer disaggregated information on financial costs by type of asset after 1992. This fact, together with the need to introduce the price of financial input into the estimation, compels all liability items that carry financial costs to be put together under the generic name of *loanable funds*, their price (w) being calculated as a quotient of the financial costs and the loanable funds.

¹² Observe that the product of output prices and output (total income) minus that of input prices and input (total costs) is equal to the operating profit.

¹³ As in Pastor (1995 and 1999), Pérez et al., (1999), Maudos et al., (1998b), etc., the consideration of separate frontiers for commercial banks and for savings banks was judged inappropriate as it has been shown that the consideration of sub-samples based on institutional differences is not appropriate. Other studies (Pérez et al., 1999) have detected a homogenisation of specialisations in both groups of institutions.

¹⁴ In Maudos (1998) it is shown that although cost efficiency is the main variable explaining the profitability of banking firms in Spain, market power, reflected in the market share variable, also positively affects profitability. These results do not allow rejection of the so-called modified efficient structure hypothesis.

¹⁵ Using a cluster analysis to form groups of similar specialisation on the basis of the structure of the balance sheet, Pérez et al. (1999), Freixas (1996) and Sánchez and Sastre (1995) find that almost all the savings banks appear in the same specialisation group. On the other hand, clear differences of specialisation appear among the commercial banks, with one cluster of small regional banks, one of intermediary banks and one of foreign banks. Thus, the existence of important differences in specialisation among commercial banks may explain the positive correlation obtained between cost efficiency and average costs.

¹⁶ The specification of two outputs within the vector of production means that specialisation is taken into account to a very limited extent.