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Relative Efficiency in the branch network of a Greek bank: A quantitative analysis

By

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Abstract

Measuring and evaluating the efficient use of resources of Bank branches plays a decisive role in a Bank's strategic planning. Usually, efficiency is measured by using accounting ratios, such as labor productivity, capital productivity, return on assets etc. When these ratios are properly used, they provide significant information regarding the effective operation of the branch, and contribute in carrying out intrabank comparisons and comparisons over a period of time. However, by using such ratios, an important part of the branch operation remains uncovered: the measurement of the effective use of the resources. New mathematical programming models that are related with the degree at which each branch makes use of its resources, are applied to deal with the weaknesses of such ratios. This study discuss the limitations of using accounting ratio analysis for assessing performance and, presents and interprets the results from the application of mathematical programming models in a sample of branches of a Greek Bank.

Keywords: banking, efficiency, mathematical programming
JEL Classification: C60, G21

1. Introduction

The new reforms, which aim to harmonize the Greek banking system with that of the European Union, and mainly the pressure of competition, which will become increasingly stronger following the integration and growth of foreign banks in Greece, force the Greek banking system to make drastic changes in its organization and operation and become competitive. Among the factors that currently put pressure and will put more pressure in the future on Greek banks are the increasing number of banks, the frequent mergers, acquisitions and alliances

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or partnerships with foreign banks, the steadily growing and more rational demands of customers, the budget deficits, which already affect the banking sector (in terms of private consumption and income), the liberalization of interest rates, combined with the internationalization of the banking system and the growing competition, and the obligation to incorporate relevant community directives in the Greek banking law. Profit margins will further decrease and banks will have to achieve a "smarter" and more productive growth. In addition, rising competition makes it very difficult to increase the volume of production, therefore banks must now manage the cost of capital more effectively. At the same time, they must pay special attention to the development of information and measurement systems, as well as to production evaluation and improvement procedures. As a general rule, in this field, emphasis is laid on the management of assets and liabilities, as well as on the promotion of new banking products. However, along with the monitoring and improvement of financial figures of each Bank, considerable interest is shown in the last years in designing a method for the processing of branch operations. Undoubtedly, if such an analysis points out the reasons of reduced performance of the Bank's resources, the relevant information may be utilized to improve its results. A significant number of researchers showed interest in Bank efficiency research, in the last years, thus enriching international bibliography with important empirical analyses.

The results of these analyses are used to make comparisons over a period of time and intrabank comparisons, and they help the Bank's decision-makers to: i) identify the relatively efficient branches of the Bank (or efficient departments of branches), so that the efforts for the improvement of efficiency will concentrate on those branches (or departments of branches) they need it the most; ii) follow a "correct" pricing policy that will help "properly" allocate cost to the various banking products offered; iii) utilize their production resources in the best possible way; iv) identify those branches that are in need of a specific input (e.g. additional personnel); v) determine the existence or not of economies of scale, in respect of the branch size; vi) plan the Bank's strategic growth, etc. The above mentioned conclusions play a decisive role, in that they are key factors in the achievement of the Bank's objectives.

The scope of this study is the efficiency measurement of the branches of a Greek Bank, by using the appropriate quantitative methods. Efficiency is examined in terms of the branch's capacity to provide a maximum number of transactions-services with the minimum possible operating cost.

The remainder of this article is organized as follows. In the next section we present an overview of the literature. In section 3 the reader can find the details of the chosen mathematical modeling approach, DEA, for assessing branch efficiency. The input-output framework of the present study is described in section? . Empirical results derived from the proposed methodology are documented in Section 5. Concluding remarks follow in section 6.

2. Overview of the literature

The traditional method for estimating the effective use of a Bank branch resources is to develop accounting ratios, such as: a) the labor productivity ratio, that relates output to labor; b) the capital productivity ratio, that relates output to capital; c) the multi-factor index, that relates output to capital and labor; d) the return on capital used, expressed by the ratio: return/capital used. In addition, several special ratios are calculated, such as return on assets, loans to assets, loans per employee, profits per customer, cost to income, etc. Such ratios provide information regarding the financial operation of the Bank's branches and allow for comparisons over a period of time, as well as comparisons with other branches. However, like any simple solution, this method is subject to restrictions (Sherman and Gold, 1985; Oral and Yolalan, 1990), and it is therefore reliably applied only under the following specific conditions:

- These ratios do not take into account the activities and investment decisions of the management, which will affect the Bank's results in the future. For example, a branch that does not promote new products or make the necessary modernization investments, appears to have an efficient operation (due to the high cost of the above activities), although this may decrease its future efficiency. Namely, it is not possible to assess managerial decisions of a time-frame longer than one year, and therefore sacrifices within a one-year period, made with the expectation of a higher future income, may not be justified in the calculation of a ratio. This observation is important because if, for example, the managers of a branch decide not to invest in modern equipment and personnel training, they minimize short-term cost, however they put off the problem of efficiency, therefore the branch may have increased future needs in the aforementioned investments, thus endangering its very survival. On the contrary, if the necessary investments are made, the branch shall have lower profits, however it will secure its long-term goals and prospects.
- These ratios gather many dimensions of a branch's functionality into one. This is because they are general ratios, and as such they cannot examine the interaction existing among the various departments of a Bank branch (e.g. market research, sales promotion, etc.). Thus, a branch can be appearing as efficient even though one of its departments may not be operating satisfactorily, since the good efficiency achieved in another department compensates for the specific department's low performance.
- When the ratios are used as analysis tools, no explicit mention is made to the composition of banking operations. A branch may have high operating costs and low profits because the services provided require high expenses. For example, the operating cost per service is different depending on the service offered. A Bank must provide to its customers all services required, even if some of them are not profitable, such as services not related to fund-raising, e.g. withdrawals. So, a branch that performs many operations of this kind will appear to have low profits. A branch offering high cost services could appear less profitable than another branch which is offering low cost services

- Each ratio is limited to only two factors, one input and one output, and it is difficult to accommodate situations where multiple outputs are produced using multiple inputs to aggregate many aspects of performance; then to formulate a ratio, one has to use relative weights, which are not always available for all such units.
- A branch may occupy the first position when compared with a certain ratio, while it may occupy the last position when compared with another ratio; as a result, relative weights for each ratio are needed when large sets of ratios are calculated.
- Ordering efficiency across many branches, for a given ratio, makes it difficult to explain the behavior of individual branches. If the branch with the largest value is efficient, how far below this value (cut-off point) another unit is also efficient is not easy to detect.

As a conclusion, the "traditional" methods used to measure branch efficiency are apparently insufficient. Their insufficiency is even more pronounced when a Bank has many branches and an in-depth analysis with certain ratios is particularly difficult. In addition, these indicators may not be easily applied when many inputs are used for the production of many outputs. It is obvious that bank branches are mainly characterized by the usage of many resources (inputs) for the production of many products (outputs).

An alternative method that surpasses the simple application of financial ratios is the econometric-regression analysis, which estimates a production or cost function taking into account the interaction between inputs and outputs of Bank branches. In the single-input case, input levels can be regressed on output levels to estimate an explanatory model. If a satisfactory model is found, then, in order to estimate the "efficiency" of each branch, the ratio of its expected cost to its actual cost is taken. The larger this ratio is, the more efficient the branch is considered to be. In an analogous way regression analysis can be used to access the efficiency of branches which produce a single output. However, the problem is that an estimate of the branch cost (or production) function using this technique results in a mean relationship that does not directly locate inefficient branches. This is because regression analysis is an average method in that it estimates an average level for the dependent variable (input or output) given the levels of the explanatory variables (Thanassoulis, 1993). Econometric regression techniques, though, can be successfully used for the determination of scale economies, marginal productivity of production factors (labor, capital), the substitution relations among inputs and outputs, etc. Other econometric models, such as Stochastic Frontier Analysis as described in Aigner, Lovell and Schmidt (1977) – sometimes referred to as the econometric frontier approach- have been developed to estimate efficiency (see the review of Berger and Humphrey, 1997). These techniques do not evaluate relative efficiency based on comparisons with the mean, as the comparisons are done with the best observed performers. Recent econometric developments are summarized in Ferrier and Lovell (1990), Resti (1997), Berger and Mester (1997), and Kumbhakar and Lovel (2000) discuss applications to banking.

The limitations of ratio analysis, together with recent advances in the management science field, have led to the development of new multivariate models for assessing Bank branches´ efficiency, for example Data Envelopment Analysis-DEA- (Charnes et al., 1978). These new models are related with the degree at which each branch makes use of its resources and not only are they considered complementary to the previous models (financial ratios mainly) but they also provide useful information to those that are responsible for decision making (see section 3 for the model formulation). By taking into account many inputs and outputs simultaneously, such multivariable models have the ability to detect the branches with the same resources (inputs) and, under the same conditions, either produce higher outcome or produce the same outcome but of higher quality and using fewer resources.

DEA was originally introduced by Charnes et al. (1978) for assessing the relative efficiency of DMUs (in our study branches) that utilize multiple incommensurate inputs to produce multiple incommensurate outputs. The technique is based on an efficiency concept proposed by Farrel some years ago (1957). DEA is capable of overcoming most of the difficulties associated with ratio analysis, and it is, therefore, a useful complement of this type of analysis. With DEA, one can consider simultaneously the case of multiple inputs and outputs to gain an overall evaluation of a branch's efficiency, without the need to calculate relative weights. Using as a reference the so-called peer groups members, this technique measures existing inefficiencies and suggests the adjustments needed (input reduction and/or output augmentation) that could make an inefficient branch efficient. This is done on a quantitative basis, by reallocating available resources among the branches being evaluated in order to improve overall efficiency. The data used in a DEA approach (inputs and outputs) may be measured or estimated in their natural physical units, without the need for a unified measurements environment. In fact DEA may objectively rank the available branches by their efficiency outcomes, without introducing an (arbitrary) cut-off point that separates efficient and inefficient branches. In that respect, DEA measures efficiency by making comparisons among the whole spectrum of the available branches, thus avoiding comparisons that are based on an average relationship that simply reflects a mixture of efficient and inefficient behavior.

The flexibility and versatility of DEA has been demonstrated in numerous applications since its first appearance in 1978, particular in the areas of banking and finance. Initially, DEA was used for the analysis of non-profit organizations (hospitals, schools, public organizations etc), where typical accounting techniques could not provide solutions. However, it has gradually become more widely accepted as it is obvious that it provides useful information about the operation of profit making organizations, that are mainly characterized by the usage of many resources (inputs) for the production of many products (outputs). Over the last years, a large number of studies that examine the efficiency of banking organizations have been published, both at the aggregate level (Bank efficiency studies) and at the branch level (branch efficiency studies). The research literature concerning the efficiency of banking institutions using DEA has experienced a phenomenal growth in the nineties, which was translated into a considerable volume of theoretical and empirical research (see special issue of the Journal of Productivity Analysis (1993); Journal of Banking and Finance (1993); European Journal of Operational Research (1997); Interfaces (1999)). One of the interesting aspects of these research activities is the gradual increase in the non-US dimension of banking research devoted to efficiency. The remarkable European dimension emanates from the financial integration of EU countries followed by the deregulation and reorganization of the traditional financial services´ structure.

Some of the studies using this approach for estimating the efficiency among a Bank's branches include: Athanassopoulos, 1997 and 1998; Athanassopoulos and Giokas, 2000; Berger et al., 1997; Camanho and Dyson, 1999 and 2005; Drake and Howcroft, 1994; Donatos et.al., 2002; Golany and Storbeck, 1999; Giokas, 1991 and 2008a,b; Hartman et al., 2001; Noulas et al. 2008; Oral and Yolalan, 1990; Oral et al., 1992; Paradi and Schaffnit, 2004; Parkan, 1987; Portela and Thanassoulis, 2005; Sherman and Gold, 1985; Schaffnit et al., 1997; Soteriou and Zenios, 1999; Vassiloglou and Giokas, 1990.

3. The model

DEA is basically a mathematical programming technique suggested by Charnes et al. (1978) for assessing the relative efficiency of decision making units (DMU´s), which utilize multiple incommensurate inputs to produce multiple incommensurate outputs. The relative efficiency of a DMU (in our study branch) is defined as the ratio of the weighted sum of outputs to the weighting sum of inputs, the weights to each input and output having been determining so as to maximize the efficiency rating h_k of the k DMU been evaluated. Different mathematical forms of the DEA model have been suggested in the literature (Banker et al, 1984). The formulation that was used in this study is based on the following form (Charnes et al., 1978).

$$\max h_k = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}}$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad \forall j = 1,...,n \qquad (1)$$

$$u_r, v_i \geq \varepsilon \qquad i=1,\ldots,m, \quad r=1,\ldots,s$$

Where:

h_k is the relative efficiency of DMUk (branch k), k is the DMU being assessed, n is the number of DMUs, r is the number of outputs (r=1,..s), i is the number of inputs (i=1,..,m), y_{rj} is the observed amount of output r from DMU j, x_{ij} is the observed amount of input i to DMU j, ε is a small positive number to ensure that all inputs and outputs have at least some weighting in the efficiency measure. v_i,

u_r are virtual multipliers (the weights to be determined) for input i and output r, respectively. The above fractional programming model is converted into linear programming (LP) form (Charnes et al. 1978, Banker et al. 1984), so that the methods of LP can be applied. The equivalent DEA model, can be stated as follows:

$$Maxh_k = \sum_{r=1}^{s} u_r y_{rk}$$

$$s.t.$$

$$\sum_{i=1}^{m} v_i x_{ik} = 1 \qquad (2)$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, \; j = 1,...,n$$

$$u_r, v_i \geq \varepsilon$$

This analysis is run repetitively, with each DMU in the objective function, to derive an efficiency rating for each of the DMUs. Thus, for each DMU, the observed of the y_{rj} outputs and x_{ij} inputs are used in order to estimate the respective coefficients u_r and v_i which maximize the objective function. By applying the model to a set of branches, it is possible to compare each of them to the rest in the data set and draw the following conclusions:

1.Each branch being evaluating, has a derived efficiency rating of h_k=1, which implies relative efficiency, or h_k<1, which implies relative inefficiency.

2. For each branch (k) designated as relatively "non-efficient", DEA finds its reference set, namely the total efficient branches with which the branch (k) has been directly compared during calculation of its efficiency level and has been found relatively non-efficient.

3. Suggestions are made regarding specific targets to be set by the "non-efficient" branches in order to improve their efficiency. According to these suggestions, the branches could reduce the consumption of specific inputs, without diminishing their outputs or, respectively, increase outputs, if the same level of inputs is maintained.

In the aforementioned model, the branches are evaluated according to constant returns to scale. To evaluate the branches according to variable returns to scale, the above model is changed accordingly (known as BCC model, Banker et al, 1984). The authors extended the CCR model by relaxing the assumption of constant returns to scale. The resulting model is used to assess the efficiency of units with production process characterized by variable returns to scale. This done by introducing a new variable u_k (unconstrained in sign) in the objective function and the second constraint of model 2. The u_k is a variable which can be used to ascertain the nature of returns to scale for each unit.

The above analytical presentation establishes that the application of the method is subject to the determination of inputs and outputs, namely the resources used to produce the products and services of a production process, since there is no commonly accepted definition of banking products. Determination of inputs and outputs means their clear and definite specification, in order to enable the measurement of their consumption and production, namely the quantitative measurement in a given period of time.

4. Application of model –inputs and outputs measures

For the purpose of this research, Bank branches of a major Greek Bank were divided in two groups. In particular, DEA was applied to: 150 branches of the Bank that provide products to individuals IND (deposits, housing, consumer and personal loans) and 90 branches that provide products to enterprises and individuals (ENIND). For confidentiality reasons, the identity of the Bank is not disclosed. The efficiency of each category of branch was examined in terms of the branch's capacity to provide the maximum number of transactions-services at the minimum possible operating cost.

The quantitative analysis requires the grouping of certain variables in order to express the key productive inputs and the key outputs of the production process. Based on the available information, for which there are full details (accounting data of the year 2002), and on the foregoing, the following variables were established for the determination of inputs and outputs:

Inputs: Personnel costs (PCO), running costs (RCO), other operating expenses (OOE). Outputs: Deposit based transactions (DTR), loan based transactions (LTR) and remaining transactions (OTR). As mentioned before, the efficiency of the Bank branches was assessed in the light of contrasting the operating cost of the branches with the volume of services provided (through transactions with customers). Personnel costs include also overtime salary costs. Running costs of the building include rents for Bank branches' space, electricity, etc. For branches that are owned by the Bank an estimate of the market value for the rent of the space occupied by the branch was used. Other operating expenses reflect the consumption of a range of inputs by the Bank branch and cover all the operating expenses of the branches, such as those for telephone, insurance, advertising expenses, stationery and other supplies. Only those inputs which directly concern Bank branches were used, ignoring Bank overheads, since the objective of this analysis was to evaluate the use of inputs consumed directly by the branch. Regarding output variables, it is necessary to make clarifications concerning their composition. That is, each of the categories included as final outputs were made of a number of subcategories composing the whole range of branch-customer transactions. To accommodate the differences in degree of complexity and difficulty in handling the branch's transactions, we have used information about the time spent at each branch to process specific types of transactions. Several DEA models may be used for the evaluation of branches, by emphasizing on the reduction of inputs, the increase of outputs, under constant or variable returns to scale. The use of alternative scenarios is not the result of experimental applications; on the contrary, it allows to approach the efficiency of branches under alternative specifications and objective goals. By emphasizing on the reduction of inputs, a branch is designated as non-efficient when, under the same conditions, there are other branches or a combination of other branches which, although they produce at least the same quantity for each output, they use a smaller quantity in at least one input and not a larger quantity for each of the remaining inputs. Respectively, by emphasizing on the increase of outputs, a branch is designated as relatively non-efficient when, under the same conditions, there are other branches or a combination of other branches which, although they use the same or lower quantity for each input, they produce at least the same quantities for all outputs and a larger quantity for at least one output.

Moreover, the branches may be evaluated under the assumption of constant (model CCR) or variable returns to scale (model BCC). For the first assumption**,** the reference basis for branch evaluation is the branch, the activity volume and the effectiveness of its management. In this case, an efficient branch should remain efficient even if its inputs change at the same rate. Therefore, in constant returns to scale, if the branch's cash desks are doubled, the number of customers should also be doubled. The second assumption is used to evaluate the branches, in case the effect of the branches' size scale has been previously removed. Therefore, under variable returns to scale, branch performance is evaluated on the basis of the branch's size characteristics in the market, and by emphasizing on management figures.

In this study, the BCC model was used (input oriented), which evaluates branches under the assumption of variable returns to scale. The validity of the assumption was formally tested using two semi-parametrical tests and one additional non-parametric (Kolmogorov-Smirnov), (Banker, 1996) in order to examine the null hypothesis H_0 that the branches operate under constant returns to scale versus the alternative H_1 hypothesis that the branches operate under variable returns to scale (Table 1). According to the results, under all tests, the null hypothesis of constant returns to scale is rejected at the 5% level of significance, and the H_1 hypothesis is accepted, according to which the branches operate under variable returns to scale.

Table 1. Statistical assessment (under three different inefficiency specifications) for the production process of the branches

Group of branches	H_0 vs H_1	Exponential distribution assumption	Half-normal distribution assumption	No assumption about the inefficiency distribution	Result
		F_{value}	F_{value}	D_N	
IND CRS	CRS[(a)] vs VRS	1.44	1.90	0.28	Reject
	critical value	1.30*	1.21	0.16	

ENIND CRS	CRS[a] vs VRS	1.67	2.12	0.23	Reject
	critical value	1.41	1.28	0.20	

[a] CRS, VRS = Constant and variable returns to scale, respectively. * at the 5% level of significance

5. Empirical results
5.1 Efficiency findings

The application of DEA produced the combined results shown in Tables 2 and 3. Table 2 contains the ratios of relative efficiency according to which the branches are classified as efficient and non-efficient, and Table 3 contains the descriptive statistics of the ratio of relative efficiency for the two groups of branches**.**

Table 2. Efficiency distribution for the two groups of branches .

Efficiency range (%)	Number of branches by group ENIND	%	IND	%
30 - < 40	-	-	1	0.7
40 - 50	-	-	7	4.6
50 - 60	2	2.2	14	9.3
60 - 70	6	6.7	34	22.7
70 - 80	13	14.5	34	22.7
80 - 90	22	24.4	21	14.0
90 - 99	22	24.4	13	8.7
100	25	27.8	26	17.3
Total	90	100	150	100

Branches with efficiency ratio equal to 100 are designated as relatively efficient, while branches with efficiency ratio than 100 are designated as non-efficient. A significant number of branches, around 72% of ENIND and 83% of IND have a reduced efficiency, compared to the others, and they may therefore be designated as non-efficient. Of the 150 IND branches 26 show a maximum (100%) degree of relative efficiency, while 56 show less than 70%, 55 between 70% and 90% and 13 between 90% and 99%. It is evident that large branches (ENIND) are superior on their efficiency results as compared to the small branches (IND). Large branches have on average efficiency of 88.3%, whilst the total percentage of efficient branches is 28% (Table 3). Small branches have on average efficiency 76.4% with a lower percentage of efficient branches (17%), and a quite high dispersion in the efficiency ratios (coefficient of variation: large branches=13.5%, small branches=21.3%). In particular, there is statistical evidence of significant difference in the DEA efficiency between the two groups.

Table 3. Descriptive statistics of the ratio of relative efficiency for the two groups of branches.

	ENIND (large) (90)[(a)] (1)	IND (small) (150) (2)	Significant t test (1)-(2)
Average efficiency (%)	88.3	76.4	6.5*
St. deviation	11.9	16.3	
Median	90.7	74.3	
1st Quartile (Q_1)	81.2	64.7	
3rd Quartile (Q_3)	100.0	91.0	
Minimum value of the ratio	53.2	38.2	
Coefficient of variation	13.5	21.3	
% of efficient branches	27.8	17.3	

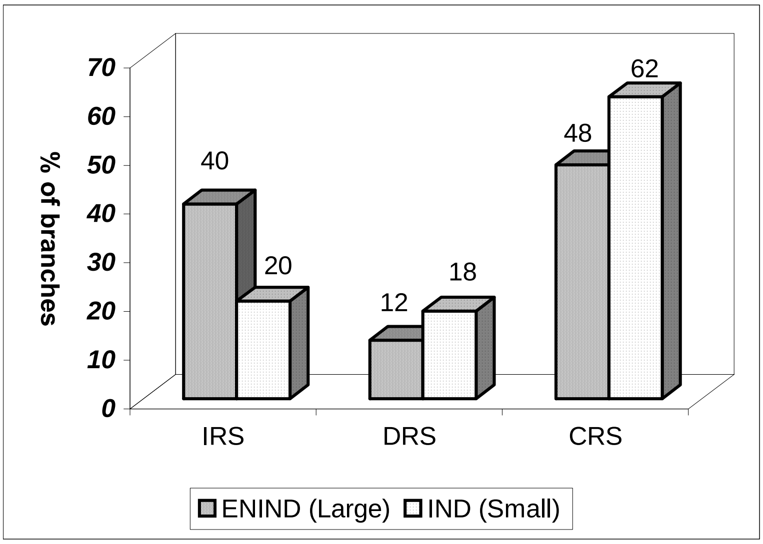
[a] indicate the number of branches per group. * means statistically significant at 5% level

With regard to efficient branches, this means that there are no other branches indicating that these efficient branches could use their resources in a more effective way. Non-efficient branches, in order to be designated as efficient, must reduce their total operating cost, in average, by 33% for IND and 24% for ENIND.

5.2 Returns to scale and efficiency

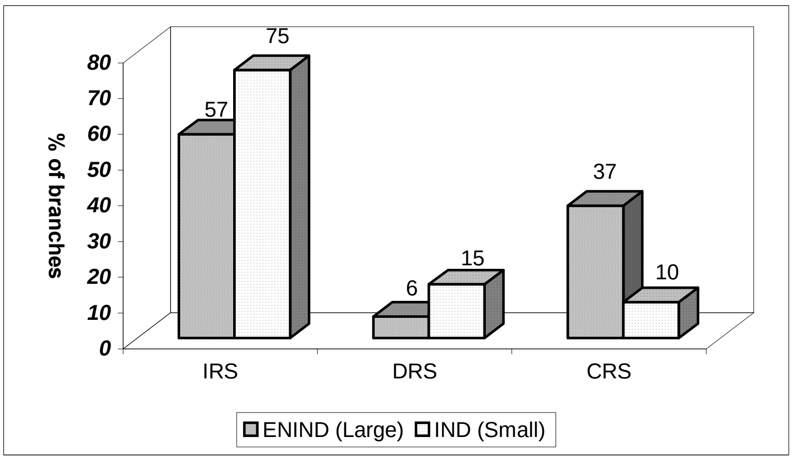
It is very important for a Bank to be aware of the change in output in case of input increase. Thus, emphasis was placed on characterizing the returns to scale exhibited by the efficiency models. The classification of the returns to scale can only be referred to branches located on the VRS frontier. For Branches not operating on the frontier, their returns to scale can only be determined after the elimination of pure technical inefficiency through the projection towards the VRS frontier (Banker et al, 2004).

Figure 1. Returns to scale characterization for the two groups of branches (efficient branches)



The analysis of the results of Figure 1 suggests that 48% of the technically efficient branches for large group (ENIND) are operating under constant returns to scale (CRS), 40% under increasing local returns to scale (IRS) and the remaining 12% under decreasing returns to scale (DRS). About 57% of the inefficient branches are operating under IRS, 37% under CRS and 6% under DRS (Figure 2). For IND branches (small) the results indicate that 62% of the technically efficient branches operate under CRS, 20% operate under local IRS and finally 18% of the efficient branches operate under local DRS. In the same way as before, the model suggests also that about 75% of the inefficient branches are operating under IRS, 10% under CRS and 15% under DRS.

Figure 2. Returns to scale characterization for the two groups of branches (non-efficient branches)



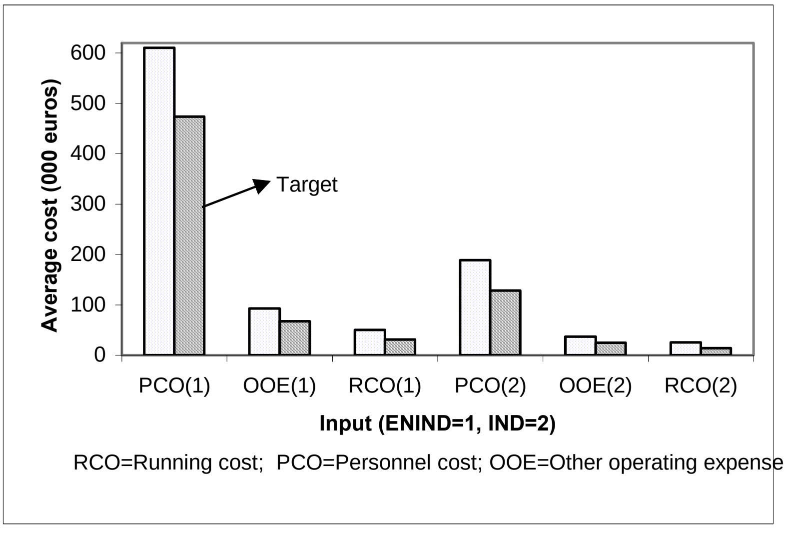
The indication that there are economies of scale in the inefficient branches means that there is room for improvement of branch efficiency, and the Bank's management should take advantage of it. More specifically, the results indicate that a possible increase in the scale size of the branches´ operations will lead to increased levels of volume of transactions-services with a rate higher than that used to increase the input level. In other words there is potential in the branch network to accommodate and manage higher levels of transactions. The latter does not mean that there is need to incalculably increase the size of the branches. In addition, attention must be paid to the sales margins of each branch, so that a possible increase in their size is accompanied by a parallel increase of their production in terms of sales and other accounts and transactions. Increasing returns to scale also suggest that the branches can achieve cost reduction by developing parallel markets, namely by selling new financial products.

5.3 Input-output targets that would render an inefficient branch efficient

The analysis of DEA results makes it possible to set input improvement targets for each branch. Targets refer to the increase in outputs or the decrease of inputs for non-efficient branches, compared to their respective benchmarks. In particular, according to the analysis, non-efficient branches could reduce the consumption of specific inputs, without diminishing their production or, respectively, increase outputs, if the same level of inputs is maintained. Based on this information, decision-makers can choose the most feasible and cost-effective method to turn a "non-efficient" branch into an "efficient" one.

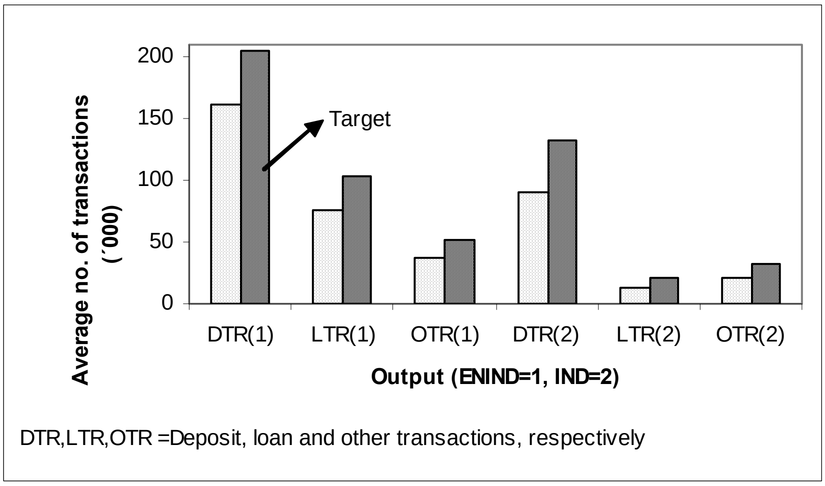
Figure 3 leads to the conclusion that, as far as operating cost is concerned, the largest part of the cost covers the Bank's staff salaries. The average staff salaries per branch, for non-efficient branches, amount to 610 thousand Euros, while the respective salaries, if all these branches were efficient, would be 474 thousand Euros (-22.3%).

Figure 3. Possible savings (average) in bank branches costs for inefficient branches



Any measure taken to reduce the high operating cost must be accompanied by a number of improvement interventions that will reduce operating cost but also increase each branch's effectiveness in the supply of services. How can this be achieved: by using technology more effectively, optimally planning customer communication processes, and gradually enhancing the role of employees. Namely, the Bank's employees should turn from mere transaction processors into active agents selling products and creating relationships with the customers. Therefore, there is the need to reduce operating cost which, of course, should be achieved not by reducing the number of personnel (in absolute numbers), but by changing roles in the branches and redesigning key procedures, which are possibly performed in a non-productive/non-effective way.

Figure 4. Average output change required for attaining full efficiency (for inefficient branches)



As far as transactions are concerned, deposit transactions generate the biggest output of the branches (Figure 4). Of course, these measurements do not take into account the special nature of various types of transactions, as well as the role of technology in "releasing" the branch from the burden of simple transactions, in order to emphasize on more composite yet more profitable transactions for the Bank.

Based on the total results, IND branches have the higher possibility for reducing costs compared to ENIND branches (Table 4). The highest possible reduction is in running costs (improvement index=0.54). When emphasizing on the increase of outputs, IND branches are also more likely to increase outputs. The highest possible increase is in lending transactions (improvement index=1.63).

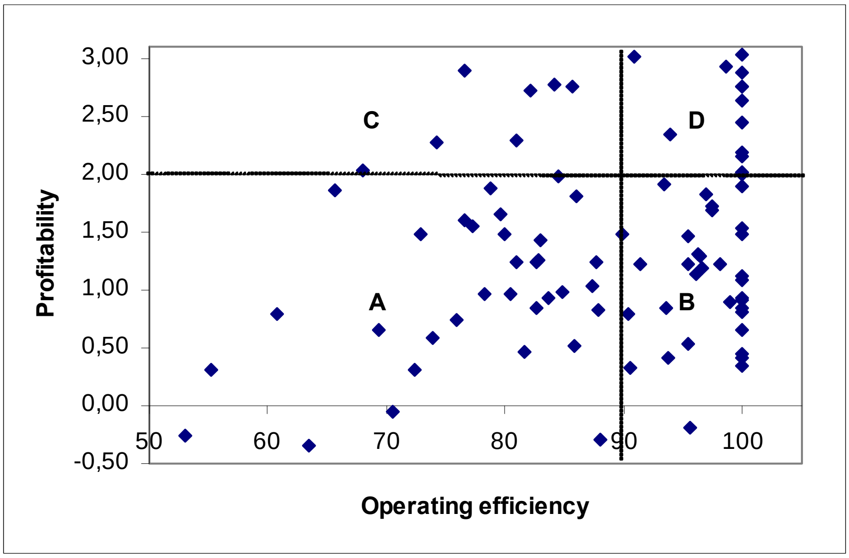
Table 4. Operating efficiency performance targets for non-efficient branches

Input /Output	ENIND	IND
PCO	0.78	0.68
OOE	0.73	0.67
RCO	0.62	0.54
DTR	1.27	1.47
LTR	1.35	1.63
OTR	1.42	1.56

5.4 Profitability and efficiency

The comparison of the branches, in terms of profitability and efficiency, established that a "profitable" branch is not necessarily efficient and vice versa (see for example Figure 5, for ENIND branches). The profit index that was used to measure profitability is obtained dividing revenue before indirect costs by total assets. The criteria used to create the Figure are: profit index <2 and efficiency ratio DEA <90%. We choose a threshold of about 90% for good production (or/and transaction or/and intermediation) efficiency and a threshold of about 2% for good profitability and consider that below these values branches have scope to improve performance. As Camanho and Dyson (1999) and Athanassopoulos and Thanassoulis (1995), point out the precise boundary positions between quadrants is clearly subjective. What is apparent, however, is that no matter where the boundaries are drawn, some branches that score well on efficiency have low profitability. This is despite the more general trend, also apparent, that higher efficiency is associated with higher profitability.

Figure 5. Operating efficiency vs profitability for large group (ENIND)



The branches were classified per profitability and efficiency ratio in four areas: low efficiency and low profitability (area A), high efficiency and low profitability (area B), low efficiency and high profitability (area C) and high efficiency and high profitability (area D). It was established that a number of branches are in areas A and C, namely these branches have the potential to increase profits by increasing efficiency. Branches in area D are practically “model” branches, with limited room for efficiency improvement, as there is no indication (although not impossible) that their production process can be improved. Branches in area B have high efficiency, yet low profitability. This may be due to “particularities” in the branch’s market, and mainly due to the nature of operations performed by the branch. Special attention must be paid to examine profitability improvement through the new product mix offered by these branches. Branches in area C are profitable, but not efficient. Their profitability may be due to their favorable operation environment rather than effective management. These branches may improve their efficiency, by further increasing their profits.

6. Concluding remarks and suggestions

We have illustrated, using actual data, the powerful use of DEA in measuring relative efficiency in bank branches. Apart from the measure of relative efficiency of each branch DEA also yields other information about bank branch performance not available from other traditional techniques. Low efficiency is observed in a good many branches, for which a lack of correspondence was found between their comparative cost and the “work” they do. Moreover, the results of the analysis examining the relation between DEA efficiency scores and category of branches show that branches which provide products to enterprises and individuals (large branches) have higher operating efficiency, while branches that provide products only to individuals (small branches) possess lower efficiency.

It has also observed that there is not a close relationship between the efficiency (as defined in our study) and profitability of a bank branch. In general, a bank branch with low profits may not necessarily performs less efficiently that the ones with high profits. More specifically, a bank branch may not be very efficient according to the number of transactions but may be quite profitable, or vice versa. It has been also observed that the DEA approach is not only complementary to the traditional use of accounting ratios to evaluate performance but also a useful management tool for improving bank branch efficiency and profitability.

The results of the analysis on examining the nature of returns to scale of the branches indicate that a possible increase in the scale size of the inefficient branches´ operations will lead to increased levels of volume of transactions-services with a rate higher than that used to increase the input level. In other words there is potential in the branch network to accommodate and manage higher levels of transactions.

The results from the evaluation of the Bank's network operational efficiency did not reveal any substantial particularity compared to other banks, for which a similar study was carried out. It is worth noting that, just as in other banks, there is a significant number of branches whose relative cost does not correspond to their output. A next step would be for the Bank's executives to interpret and utilize the findings, mainly with regard to efficient and non-efficient branches. The Bank's network efficiency may be improved in terms of better organization of operations, human resources cooperation, elimination of operations that do not provide added value, and better utilization of technology.

The network was evaluated under a number of specifications relating to the quality and completeness of information available by the Bank. The existing information must be enriched in the future, for a more effective evaluation of operating cost. In addition, the evaluation must also cover other forms of efficiency, such as product sales per branch.

The Bank's effective operation will depend in the future on efficient operation of service/product distribution channels. The service distribution channels have a broad mission including, but not limited to, sales and provision of services, consultancy and customer support, participation and guidance of promotion and advertising officers, collection of information for better planning of marketing projects. The traditional service distribution channel in the banking sector is the Bank branch. Technological developments and changes in the Bank-customer interaction have changed the role of branches in the conduct of business activities. Of course, without the distribution channels there can be no viable banking operation. The Bank should consider the dynamic support of branch strategies including the functions of Bank product sales, customer service and utilization of each branch's funds for the Bank's profitability.

A critical part of each branch's role must be the sales of new products. The increasing role of marketing in financial services is related to the objective to transform branches from cost centers into sales centers that promote Bank-customer relationships. The character of Bank branches could change through the systematic intervention of marketing techniques aiming to analyze the environment of each branch, estimate sales goals and constantly monitor the quality of services rendered by the Bank to the customers. This study could not evaluate the sales effectiveness data of the branches, as there is no information available on the environment dynamics of each branch.

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