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Disentangling Within- and Between-Country Efficiency Differences of Bank Branches

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Disentangling Within- and Between-Country Efficiency Differences of Bank Branches [1]

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Abstract: In this paper we propose a framework to assess the efficiency of bank branch networks operating in different financial environments. The framework can be used to disentangle within- from between-country performance differences. The framework is *constructive* in that it identifies operational aspects responsible for superior performance and suggests guidelines for branch improvement. We report results from three bank branch networks in the U.K., Greece and Cyprus, and demonstrate how branch networks can benefit from such international comparisons.

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Keywords : Bank Branch Efficiency, International Benchmarks, Data Envelopment Analysis.

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1. Introduction

The assessment of the performance of financial institutions is given unprecedented publicity for reasons related to stringent market conditions, competitive pressures, entrance of substitute channels of distribution, consumer demand and technological progress. Bank management is under constant pressure to improve operations competitiveness which include issues of financing, product development, innovation, marketing and human resource management. A critical aspect of their marketing endeavor emanates from the redefinition of channels of distribution and service provision which is, historically, a role played by bank branch networks. As a result, the different aspects of managing large scale networks have, over the last years, been given great attention by both practitioners and academics. The proliferation and commercialization of new technologies, however, has brought up serious questions regarding the management and more generally the role of branch networks as aids to the banks' strategies. These questions are further complicated when examining branch networks operating in different financial environments, at different levels of development. In the developed economy of the UK, for example, the impact of new technologies led to a reduction by 35 percent in the number of bank branches in the period 1981 to 1996. At the same time period the number of bank branches in Greece has risen by 48%, as a result of deregulation and the growth of financial services industry.

Bank branches, irrespective of the context of assessment, act as a front-line of the corporate bank servicing existing customers and selling new products. Therefore, one would expect some congruence between the operating features of bank branches across different markets. This similarity is related to the universal role of banking and

also the presence of foreign banks in different countries which adds to the homogeneity of their operations. The similar functions pursued by branch networks do not imply similar performance since there are many operational aspects (e.g. technology use or human resource investment) that differentiate their performance.

Despite the information asymmetries and incompatibilities across banking institutions from different countries, the development of a culture which lends itself into international performance comparisons is evident. In Europe, the reality of the single European market has changed the traditional way of thinking in terms of European banking. This is expressed by the increased international comparisons of banking institutions, see Berg et al. (1993) and Allen and Rai (1996). The scope of most these comparisons is, heretofore, exhausted at the corporate banking level seeking to measure different aspects of X-efficiency (e.g. cost minimization and economies of scale and scope). Much less attention has been reported at the micro-analytic level and the bank branches of competing banks.

In this paper we propose a research framework for assessing the efficiency of bank branch networks operating at different country settings. Our modeling effort has succeeded in disentangling within- from between-country performance differences. We were able to assess branch efficiency in the light of production operations. To preempt our findings the paper has concluded that country performance differences do exist among the UK, Greek and Cypriot bank branches that were included in our assessment, with the UK branch network exhibiting an overall dominance over the other networks. This finding may be considered trivial, since the more advanced stage of development of the UK banking and financial system vis-à-vis the Greek and Cypriot ones, is well known to the average observer. However, the framework we develop is *constructive*, and as such it indicates those aspects of the branches' operations that create superior

performance, thus providing improvement guidelines for the less efficient branches. Furthermore, in spite of the overall lower efficiency ratings, the Greek and Cypriot network contain mechanisms that can be used by the UK branches in order to improve further their efficiency. A final, surprising observation is that the Cypriot branch network does not, on average, appear less efficient than the Greek one, in spite the fact that it operates in a highly regulated environment.

The remainder of the paper is organized as follows. In section 2 we present a brief discussion on the strategic role of bank branch networks, along with a series of propositions which are addressed in this paper. Section 3 presents bank branch efficiency studies relevant to this research, and develops the framework which disentangles within- from between- country efficiencies. An application of the framework is described for three national branch networks in Section 4. Section 5 discusses the insights that were obtained from the application of the framework. Concluding remarks follow in Section 6.

2. The strategic role of bank branch networks

In the changing world of financial services many scholars have sought to examine the strategic role of branch networks. Carroll (1991), argues that bank branch management practices should resolve issues of profitability and efficiency measurement, location appropriateness, marketing conduct prior to embarking into areas of service quality and customer retention. McCormick and Rose (1994), suggest that the continuous decline of the role of branches in US banking is attributable to both the products sold, the markets targeted and the distribution network. Rose (1992), argues that demand for bank credit and liability products have a sluggish growth while on the other hand the

supply of these products will increase rapidly. Critical issue for retail intermediaries will prove to be their decision to refine their management practices in terms of cross-selling efforts, effective branch location and customer targeting.

Gibson (1994) makes an assessment about the strategic dilemmas of retail bankers in their pursuit for increased market share. That is, whether to proceed into the acquisition of expensive bank branches or to proceed more actively into the electronic banking environment. This type of questions seem to form common ground among bank management. Gibson concludes that the future of retail banking does not lie in the elimination of bank branches by means of electronic banking but, instead, into the strategic role of bank branches of the future acting mainly as sales forces and not service centers. This latter is also enforced by Arent and Lunt (1993) who argue that there exists future role for bank branches provided that issues of efficiency, location, technology mix and specialization are resolved.

There is widespread agreement among academics (Berger and Humphrey, 19 97) and practitioners (Pihl and Whitmyer, 1994) about the strategic relevance of performance measurement in bank branch networks. The universal message from both academia and practice advocates the use of non-financial measures of performance and also the need for *global* performance assessment of individual branches. The micro-analytic focus at the branch performance level exerts particular measurement problems since the demand for accurate and inspiring measures is greater. Recent research concerning branch-related performance measurement yardsticks has revealed the need for customized methods of efficiency assessment at the level of the branch. Furthermore, the strong process component in the operations of bank branches has inspired the use of benchmarking methodologies focusing on the efficiency of particular

processes (e.g. the lending process) or the overall efficiency of the branch (Frei and Harker, 1996).

The focus given so far on benchmarking branch network efficiencies has been based on internal comparisons among the branches of individual banks. Since the effectiveness of individual branch networks is recognized as a source of competitive advantage, banking institutions are reluctant to share their database information concerning the operations of their branches. On the other hand, the regulating bodies of each country do not consider the performance of branch networks as part of their *monitoring* activities. Therefore, empirical evidence regarding branch performance is solely based on individual branch networks and not cross-network comparisons. The international aspect of institutional performance is an area of recent popularity in the banking sector. The socioeconomic developments in the European dimension have accelerated the demand for this type of comparisons which in turn has brought up empirical research regarding the cross-country performance of banking institutions. Following the recent developments in Europe a number of banks, such as for example Eastern European banks, have found themselves operating in less restrictive and more competitive environments. Others, are preparing for such liberalized regimes as the European Union expansion is under way.

The focus on the performance of bank branch network yields particularly useful information concerning the need to control the operations of these branches. This type of assessment is myopic in the sense that it lacks information regarding the competitive positioning of the branch network against other networks operating on the same or different markets. Comparisons between branches competing in the same local markets are difficult to implement due to data accessibility. On the other hand, cross-national comparisons are easier to implement with additional benefits due to the encapsulation of

factors related to the different stage of development of the financial markets across different countries.

Empirical results regarding international performance comparisons are presented by Berg et al. (1993) who studied 799 banks from the Nordic countries, and Allen and Rai (1966) who examined 194 banks from 15 countries during a five year period. In both cases the assessment was based on corporate banking performance and the studies were intended to examine the presence of technical inefficiency among the banks. Despite the limitations imposed by data availability, the two empirical studies demonstrated evidence about performance differences among banks at either the national or international level. For example, Berg et al. (1993) reported the dominance of the Swedish banks compared to those of Finland and Norway insofar as their production efficiency was concerned. The more detailed study by Allen and Rai (1996) led to a number of important conclusions regarding performance differences among banks of different countries and of different sizes. Their results have shown evidence that the existence of national barriers cause non-optimal cost behavior. Global banking institutions exhibit the highest efficiency with particular strong banks emanating from Japan, Austria, Australia, Denmark, Sweden and Canada. Banks in France, Italy, UK and the US were found less efficient.

In this research we consider a number of research questions that cannot be addressed at the corporate level of a bank. The questions span a wide range of issues that are summarized in the following propositions:

PROPOSITION 1: Bank branch networks that operate into markets that exert high internal controls are also expected to exhibit a more homogenous picture of their performance profile. That is, such branch networks will exhibit low variability in their efficiency compared to branch networks that operate under less organized controls.

PROPOSITION 2: Branch networks characterized by close branch proximity are expected to exhibit low variability in their efficiency. This can be attributed to the ability of branch management to cross-validate management behavior and practices.

PROPOSITION 3: The assessment of the efficiency of bank branch from a single network can lead to "myopic" results due to the absence of more competitive comparators from branches that belong to different networks.

PROPOSITION 4: Benefits can be derived from the comparative assessment of bank branches that operate under different local market conditions. Such comparative assessment can yield information regarding performance gaps that need to be eliminated, not only for branch networks operating in less dynamic environments, but also for branch networks operating in more dynamic financial markets.

In the next section, a framework to address these issues is presented.

3. Theoretical framework development

3.1 Bank branch network efficiency

The research literature concerning the efficiency of banking institutions 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* (forthcoming, 1997) and *Interfaces* (forthcoming, 1997)). One of the interesting aspects from these research activities is the gradual increase of the non-US dimension of banking research devoted to efficiency. The notable European dimension emanates from the financial integration of EU countries followed by deregulation and reorganization of traditional financial services' structures. Three

important and interrelated sources of competition concern the intensified national competition by domestic players, the entrance of international players within national markets and the globalization of financial services due to the entrance of substitute forms of operation which include *inter alia* bankassurance, leasing, grocery chains, and automotive giants.

The growing literature of banking performance has placed particular emphasis on micro-efficiency studies focusing at the branch level (Schaffnit et al., 1997; Zenios et al. 1995; Athanassopoulos, 1997) or even at the branch-processes level (Frei and Harker, 1996). The empirical evidence of these studies, however, has been drawn from country specific studies which limits the ability of the banker to draw any firm conclusions about bank branch competitiveness in a global competitive environment. The current state of empirical evidence about the various aspects of branch efficiency indicates that there are significant cost gains that can be achieved by individual bank branches at a level that often exceeds 20% of their current costs. The relevant branch performance literature which is being reviewed by Berger and Humphrey (1997) indicates a wide spectrum of models that are used to assess the efficiency of branch operations. These models are partly driven by the different functions that coexist within each branch (for example, selling, servicing, intermediating functions) and also the differing data availability that constrain the aspirations of various research attempts.

A closer look into the review article by Berger and Humphrey (1997) reveals the existence of alternative branch-efficiency models. A summary of the main definitions that are chiefly used in the literature of branch-efficiency studies is given in Table 1.

Table 1
Branch-specific efficiency definitions.

Activity	Efficiency	Description	Objective
Transaction	Technical, Scale	Inputs: operating costs and technology Outputs: volume of transactions	Minimize operating costs
Production	Technical, Scale	Inputs: operating costs and technology Outputs: volume and/or number of accounts	Minimize operating costs
Intermediation	Technical, Scale, Allocative	Inputs: interest and non interest costs Outputs: volume and non-interest income	Minimize total costs

The information in Table 1 summarizes the three main branch activities which are analyzed in studies of branch efficiency. The assessment of technical and scale efficiency are prevalent in all three cases while in the intermediation models there are examples of input-mix efficiency (allocative). It is noteworthy that even under the previous breakdown of efficiency measures there are incompatibilities on the way particular variables are measured. For example, the transactions of individual branches can appear in the form of raw numbers or alternatively the time equivalent that corresponds to them. Furthermore, the volume of deposit accounts can either be considered as an input or as an output in the intermediation models, see Berger et al. (1994).

3.2 A modeling framework based on Data Envelopment Analysis

The assessment of bank branch efficiency can be undertaken by means of financial measures of their activities which emphasize the aspects of revenue generation from intermediating funds and assuming risks, see Holmer and Zenios (1995). Of equal importance are also the operating aspects of their performance which they focus on the cost of servicing the customers of each branch. In this paper we concentrate on the use

of data envelopment analysis as a method of assessing the operating efficiency of bank branches. The method was initially applied by Sherman and Gold (1985) for assessing the efficiency of bank branches and thereafter it proved a very promising tool for monitoring efficiency in banking (see Berger and Humphrey, 1997).

Data envelopment analysis is a linear programming based method originally suggested by Charnes, Cooper and Rhodes (1978). Given a set of decision making units (DMUs) *j*=1,2,...,n, utilizing quantities of inputs $X \in \Re_+^m$ to produce quantities of outputs $Y \in \Re_+^s$ we can denote x_{ij} the amount of the i^{th} input used by the j^{th} DMU and y_{rj} the amount of the r^{th} output produced by the j^{th} DMU. The mathematical programming model (weights model) and its dual (envelopment model) for assessing the efficiency of unit k under the assumption of constant returns to scale (CRS) is stated as follows:

Weights' model	Envelopment Model
$\underset{v_i,u_r}{Maximise} \quad \sum_{r=1}^{s} u_r y_{rk}$	$\underset{l_j,h}{\text{Minimise}}\ h_k = h - e\left(\sum_i s_i^- + \sum_r s_r^+\right)$
$\sum_{i=1}^{m} v_i x_{ij} = 1$	$\sum_{j=1}^{n} l_j x_{ij} + s_i^- = h x_{ik} \quad i = 1,\ldots,m$
$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \ \forall j$	$\sum_{j=1}^{n} l_j y_{rj} - s_r^+ = y_{rk} \quad r = 1,\ldots,s$
$v_i, u_r \ge e,$	h *free* and $l_j \ge 0, \forall j$
$0 < e \ll 1$	$s_i^-, s_r^+ \ge 0, \quad 0 < e \ll 1.$

where

v_i, u_r are weight factors for the input *i* and output *r* of each assessed branch obtained from the solution to the weight's model,

l_j is the intensity factor showing the contribution of branch j in the derivation of the efficiency of branch k in the envelopment model,

h is the radial efficiency factor showing the rate of reduction to the input levels of branch k,

s_i^-, s_r^+ are slack variables accounting for extra savings in input i and extra gains in output r,

ε is a very small positive number used as a lower bound to input/output weights; it is also used to scale the input/output slacks in the envelopment model. Commercial DEA software implements two-phase optimization routines to avoid using this small positive number.

A sequence of linear programming problems need to be solved, one for each DMU j=1,...,n to assess their relative efficiency. DMUs with solution $h_k^* = \sum_{r=1}^{s} u_r^* y_{rk} = 1$ are characterized as relatively efficient or as benchmark DMUs. In any other case, h_k^* gives the maximum proportionate reduction to the inputs of DMU k that must be achieved in order to make it efficient.

The assessment of performance is often associated with the need to contrast alternative policies that characterize various subgroups of the branches included in the assessment. In the first study of this nature, Charnes et al. (1981) describe an approach to isolate and evaluate school program efficiency. Other examples are reported in the literature by Banker and Morey (1986), Athanassopoulos and Thanassoulis (1995), Zenios et al., (1995), Brocket and Golany (1996), and Berg et al. (1993). In this study the presence of three national networks motivates an organized multi-stage comparison of performance. This includes the assessment of each branch network separately and

then the pooling of the branches into a single sample, but only after their inputs-outputs were adjusted at their within-country efficient level. This analysis will yield within- and between-country efficiency indices that will enhance our understanding about the competitiveness of national branch networks when operating in an open market European economy.

The modeling framework we propose for benchmarking branch networks operating in different countries, proceeds in three steps:

Step 1: Apply DEA to each network separately to examine efficiency differences within a country. Insights can be obtained regarding different management practices in different financial environments.

Step 2: Remove managerial inefficiencies observed within the financial environment branches operate in as identified in Step 1. This is done by projecting inefficient branches onto their efficient frontier. A set of virtual branches is constructed for each branch network.

Step 3: Apply DEA to the pooled data set consisting of all efficient and virtual branches from all branch networks under consideration. Between-country differences can now be examined. Information on how branches can benefit from management practices observed in branches operating in different financial environments can be obtained.

Following the original assessment of bank branches at both national and international levels, one can focus on some by-products of the method to gain additional insights.

- The assumption of constant returns to scale may prove restrictive and thus the branch networks were also assessed under the variable returns to scale (VRS) assumption. In operational terms this would imply the use of an extra free variable in the formulation of the weights model or the use of an extra constraint

($\sum_{j=1}^{n} l_j = 1$) in the formulation of the envelopment model. Banker and Thrall (1992) provide more details about economies of scale and their identification. The analysis will yield, therefore, efficiency indices under constant (E_k^{CRS}) and variable (E_k^{VRS}) returns to scale. A combination of the latter two can be used as the basis for estimating the *scale efficiency* ($E_k^{Scale} = E_k^{CRS} / E_k^{VRS}$) of each branch.

- A follow up of the assessment of the scale efficiency of individual branches is to investigate the extent to which this is due to increasing or decreasing returns to scale. This information is available from either the weights and/or the envelopment models provided the user will re-run the original efficiency model examining the possible effect of multiple optimal solutions that might distort the original results. We implement the method suggested by Banker and Thrall (1994) whereby we examine the sign of the variable returns to scale factor.
- In assessing the efficiency profile of the branch networks we shall also focus upon their input-output mix. In the absence of unit prices we focus on the relative importance given by each inefficient branch to its inputs and/or outputs when assessed for its efficiency. This information is obtained from the disagreggation of the composite weighted input/output factors in the solution of the weights DEA model. That is $u_r y_{rk} / \sum_{r=1}^{s} u_r y_{rk}$ and $v_i x_{ik}$ give respectively the relative importance of output *r* and input *i* when the efficiency of branch *k* is assessed. Due to the presence of multiple optimal sets of weights (v_i *and* u_r) in efficient branches this analysis is applied mainly to inefficient branches. Analyzing the distribution of weights we obtain information about the effect of pooling the national branch networks under one common frontier denominator as compared to the case of being assessed separately.

We next demonstrate the applicability of this framework using data from three bank branch networks operating in the UK, Greece and Cyprus.

4. Application to three national branch networks

4. 1 Description of the national branch networks

Each of the branch network we studied represents a distinct and different market environment which varies from the highly competitive conditions of the UK and the emerging competitive environment of Greece to the more segmented in size and scope environment of Cyprus. All three countries, however, share the similar vision of the common European market and therefore there is a common competitive threat that will affect their performance in the future.

In the UK, for example, there has been a considerable decline in the bank branch numbers over the last decade which does not seem to have reached its limitations. This branch decline resulted into 100,000 job cuts since the early nineties and industry experts predict a further reduction up to 15% to the total number of branches before the end of 1998. The signs of overbranching that are experienced in various developed economies are undoubtedly accelerated by the rapid commercialization of new technologies such as Internet, Virtual and Home Banking, and by the entrance of non-financial institutions that have capabilities to support retail financial services. Apart of the maturity of the financial services industry in the UK one can spot the pressure that is imposed by the entrance of alternative distribution channels on the branch networks. The concern of retail bankers about the efficiency of their branch networks has been intensified by the changing role of the branch networks that is being promoted by the changing market conditions within the industry.

The UK branch network examined, has regional base in Central England and corresponds to one of the largest five clearing banks in the UK. The particular bank competes in all aspects of retail and commercial banking in the UK and its branches have full scale responsibility to market and service the bank's product base.

The dismantle of the administrative controls in the Greek banking sector in 1987 was soon followed by the creation of new market segments, the appearance of new business opportunities and the entrance of new competitors into the Greek banking market. The intensified competition has not as yet affected the state controlled banks who hold over 75% of the total assets with the 50% concentrated in the big five banking institutions. The foreign representation of banks in Greece includes 21 institutions (e.g. Citibank, Barclays, Natwest, Amex) with a total network of 100 (out of a total of 2500) branches and holding 17% of loans and 6% of total deposits. The banking sector in Greece is currently undertaking large scale technology infrastructure projects varying from the development of ATM facilities to the modernization of the computer platforms of their branches. The optimistic prospects of financial services in Greece is associated with a phenomenal expansion to the numbers of bank branches. Branch management administration varies from aggressive expansion from the newer private banks to efforts for cost containment and consolidation from the large networks of traditional public sector banks.

The Greek bank branch network we examine contains a large sample of branches from also one of the largest five banks in Greece with full scale commercial operations. The bank concerned is not considered as a market leader with noticeable aspects of its profile the large asset and depository base, relative small credit and non-

banking activities and finally the lack of sufficient computerized facilities in its branch network.

Finally, the branch network considered in Cyprus forms the largest single network in the country, with approximately 45% share of local market deposits. Its total assets in 1994 during which the study took place, were CYP 2.03B (1 CYP $\approx$ 2 USD), and the before-tax earnings for the same period were CYP 20.3M. A full range of retail banking services is offered to commercial clients and individuals in more than 140 branches. These branches are scattered among the four major cities of the country and among various villages and tourist resorts. A total of 83 branches are located in urban areas, 41 are located in rural areas and 20 branches operate near tourist resorts along the coast of the island. All branches offer a full range of services: personal and savings accounts, company and credit application accounts.

The Cyprus Bank operates in an environment with tight government regulations, fixed interest rates, and highly controlled level of competition. During 1994, interest rates, for example, were kept at the same level and so did competition. This is at best an *oligopolistic* environment where two banks alone hold more than 75% of the market share, the remaining 25% of which is shared by less than ten banks. Cyprus belongs, however, in the group of potential European Union partners, with membership negotiations expected to begin within 1997. The banking environment in Cyprus is thus anticipating a major change towards a more liberalized regime, resulting in the removal of restrictions on interest rates and competition. Most banks, including the one we studied, have initiated a number of programs targeting the improvement of efficiency and performance, in order to be able to survive and successfully compete in the new environment. The management of the Bank expressed a great interest in the results of

this study, since they would provide a good indication on how their efforts have been paying off.

4.2 Research Hypotheses Formulation

The following set of hypotheses were formulated in order to shed light into the propositions described in Section 2, and to provide insights from separating the within-form the between-country efficiencies. The hypotheses, which are specific to the three bank branch networks described above, are as follows:

Hypothesis 1: When benchmarked against branches in their own networks, branches operating in more liberalized regimes will exhibit higher average efficiency ratings, than branches operating in less liberalized regimes.

Hypothesis 1a and 1b stem directly from hypothesis 1, which in turn is based on propositions 1 and 2:

Hypothesis 1a: The mean efficiency of the UK branch network, will be higher than the mean efficiency of the branch networks operating in Greece and Cyprus.

Hypothesis 1b: The mean efficiency of the Greek branch network, will be higher than the mean efficiency of the branch network operating in Cyprus.

We also expect that some of the differences observed in different financial environments can be revealed by this type of analysis. Thus, we postulate

Hypothesis 2: The relative importance placed on product mix and resource structure by branches operating in different environments such as the UK, Greece, and Cyprus will differ.

The remaining hypotheses focus on the between-country differences.

Hypothesis 3: Branches operating in environments where competition and concentration is high will exhibit higher efficiency ratings.

Hypotheses 3a and 3b follow:

Hypothesis 3a: *The UK branches operating in an environment where competition and concentration is high, will exhibit higher efficiency ratings compared to those observed in Greece and Cyprus.*

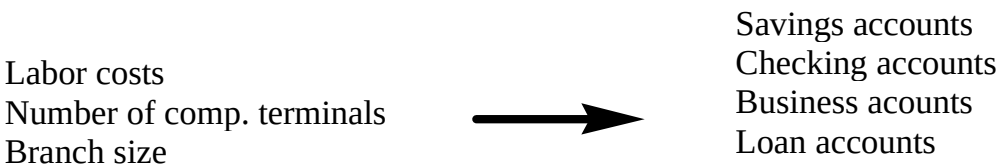
Hypothesis 3b: *The Greek branches operating in an environment where competition and concentration is higher than that of Cyprus, will exhibit higher efficiency ratings compared to those observed in Cyprus.*

Hypothesis 4: *UK branches will appear more frequently in the peer group of inefficient branches, when a common frontier for all branches is constructed.*

4.3 Specification of input and output set

We assessed the efficiency of the branch networks focusing on their production activities. The selection of inputs and outputs for these assessments was in part affected by the need for identical measurements and representation across the three branch networks. In previous cross-national studies the empirical models were substantially constrained by the lack of adequate information across all national cases, see, e.g., Berg et al. (1993).

Figure 1
Input-output sets for assessing branch operating efficiency



The input-output set that was used for assessing production efficiency is listed in Figure 1. Production efficiency is assessed in order to capture the nature of the bank branches as a service producer. Three cost related factors which represent branch

operations, where used as inputs. They include the resources available to the bank branch: space, computers and cost of personnel (see Sherman and Gold (1985) and Vassiloglou and Giokas (1990) for a more detailed discussion on the choice of inputs). On the output side we have grouped the branch products into four different types of accounts: savings, current, business and loan accounts [1]. The definition of the input-output set is compatible with previous research (Berger et al., 1994). The main objective of this assessment is to compare the cost structure of the three networks concerning the number of accounts under their management. The orientation of such an assessment is cost minimizing and the results were obtained under the assumption of constant and variable returns to scale[2].

Detailed information on the branches of the three Banks described above, was obtained for the period January-December 1994. More specifically, data on 126 branches from the Cyprus Bank, 185 from the Greek Bank, and 196 branches from the UK Bank were collected. Typical banking data sets are constructed from regulatory reports which vary among different economic and regulatory environments, and they are not designed to measure performance (Berger et al., 1994). The data sets used in this study were constructed directly from information provided to us by the Banks, and are thus likely to be more clean and accurate.

One of the problems in cross-country comparisons is that data, such as costs and other dollar-denominated variables - product volumes etc. - are not comparable. Data for example, were made available to us in Cyprus pounds, British pounds, and

[1] The number of accounts as a proxy for the non-easily obtained number of transactions has been used extensively in the literature.

[2] An alternate model which included the volume of the different accounts in the output set was also considered. Such a model focuses on the effect that small or large accounts might have on the cost efficiency of branches. Other models based on the intermediation approach, accounting for interest costs and revenue per branch can also be utilized. The focus of this paper is to demonstrate the framework to disentangle efficiency differences in operational efficiency; thus, we only report results from the production approach model.

Greek drachmas. To overcome this problem, data were first converted to a common currency (US$) and then adjusted using the "average cost of a basket of goods" described in the Prices and Earnings around the Globe, issued by the Union Bank of Switzerland for 1994[3]. This conversion of the dollar denominated variables to "number of baskets" made such variables comparable across countries. Table 2 presents means of the variables used, for the three networks.

Table 2
Mean values of the variables included in the model.

VARIABLES	UK Branches	Greek Branches	Cyprus Branches
Inputs			
Cost of Personnel (No. of baskets)	195.1	271.7	135.16
Space (m^2)	446.5	429.3	140.52
Computers	5.1	1.5	3.9
Outputs			
Current Accounts	13425	6858	352.4
Savings Accounts	1381.4	962.5	1657
Company Accounts	306.5	63.41	139.5
Credit Accounts	2168	1419.6	345.7

Interbranch transactions, i.e. transactions which branches perform to serve other branches, can influence the efficiency ratings of certain branches operating within the same network. These will be the branches performing a lot of services for other branches without receiving similar service from other branches (Berger et al., 1994, Soteriou and Zenios, 1996). Since data on interbranch transactions were not available for two out of the three Banks we studied, they were not included in the model.

[3] The basket of goods is typically used to determine living costs and contains 111 different goods and services, chosen based on the average monthly needs of a European family of three. Food products accounted for 20%, beverage products for 5%, clothing for 7%, rent for 18%, heat and electricity 5%, household appliances 7%, personal care products 7%, transport 14% and miscellaneous services 17%.

4.4 Benchmarking within-country branch efficiencies

In the following sections we present empirical results obtained from analyzing the three branch networks described above, and testing the developed hypotheses. First, each of the three networks was examined separately. The Warwick DEA (Thanassoulis, 1994) software was utilized for the analysis. Table 3 outlines some descriptive statistics on the input-minimization efficiency ratings obtained, when a separate frontier was constructed for each branch network.

Table 3
Descriptive statistics on efficiency ratings obtained
(Separate frontiers for each branch network, input minimization,)

	No. of branches	Mean	Median	StDev	Min	Max
			CRS			
Cyprus branches	126	74.45	78.73	24.04	17.45	100
Greek branches	185	68.75	67.04	20.88	22.46	100
UK branches	196	62.42	58.78	20.80	20.75	100
			VRS			
Cyprus branches	126	88.89	92.89	11.93	54.65	100
Greek branches	185	74.28	73.83	19.82	33.36	100
UK branches	196	78.77	78.57	21.03	28.58	100

Following previous empirical studies our results indicate the presence of considerable cost inefficiencies even at the level of within-country comparisons. Clearly, cost efficiency is not the sole driver in the management of branch networks. This may provide some explanation for the presence of such large inefficiencies. Our production efficiency estimates are close to previous empirical results (Berger et al., (1994) from the US; Tulkens (1993) from Belgium and Athanassopoulos (1996) from the UK) that indicate an average level of cost efficiency below 75% and 80% for the CRS and VRS case, respectively. These magnitudes of technical inefficiency are considerably lower from those reported by previous studies based on small data sets.

Since the efficiency distributions are not normal, non-pa rametric tests were used to test the hypotheses. To test Hypothesis 1 a non-parametric Kruskal-Wallis test was used to test the null hypothesis that all three networks follow the same efficiency distribution. This null was rejected ($p<0.001$) when CRS or VRS were considered. Non-parametric Mann-Whitney tests were also used to test differences between efficiency pairs. For Hypothesis 1a, the null hypothesis specifies that the mean efficiency of the UK branches will exceed that of the Greek and Cyprus branches. Both Hypotheses 1a and 1b are rejected ($p < 0.001$), strongly suggesting that the Cyprus branches find themselves, on average, closer to their efficient frontier compared to how far the Greek and the UK branches are from their own efficient frontier. This is also evident in Table 4 which demonstrates that a great proportion of Greek and U.K. branches fall in the lower category of efficiency ratings of less than .65.

Table 4
Number of branches exhibiting different efficiency levels
(Separate frontiers for each branch network, input minimization,).

Efficiency Range:	Cyprus Branches (Total 126)	Greek Branches (Total 185)	U.K. Branches (Total 196)
CRS			
98% - 100%	31	26	20
90% - 98%	17	17	8
80% - 90%	10	14	18
65% - 80%	24	43	30
less than 65%	44	85	120
VRS			
98% - 100%	49	39	79
90% - 98%	18	18	8
80% - 90%	27	20	11
65% - 80%	27	39	26
less than 65%	5	69	72

The branches from the Cyprus branch network exhibit a uniform within-country performance profile. This is attributed to the tight management controls that exist within the system and the geographical proximity of the branches. The lower efficiency

distributions of the Greek and UK branches can be attributed to fundamentally different strategic choices. In the UK, the demanding competitive environment has driven, historically, all retailing banks towards a battle for market share. Their commercial presence is sustained in some trade areas of low potential or stiff competition and thus, poor customer base and not cost management is to be blamed for low cost efficiency. The intensification of new technology use in the UK retail banking has a progressive adverse effect on the market share strategy. For the Greek branch network the variability in the assessed efficiencies can be due to the limited internal controls within the bank regarding issues of branch efficiency and more general bank performance. The very wide local proximity of the particular branch network reduces the opportunities for organizational learning via informal flows between branches. Lack of proximity and internal controls lead inevitably to great heterogeneity in the operating efficiencies of individual branches.

4.4 Benchmarking between-country branch efficiencies

The assessment of the within-country efficiency indices can lead to useful descriptive conclusions about the state of performance within each network. A more challenging question, however, is the assessment of branch performance using as a reference base the best practices across all three branch networks. Here we make an implicit assumption that the three branch networks operate within a global competitive market, after managerial inefficiencies at the country level have been removed.

We follow the three step framework presented in Section 3 to construct a common frontier for all networks and isolate efficiency differences that can be attributed to differences in the environment the branches operate in. First, the model

for each branch network is run separately and all inefficient branches are projected on their corresponding frontier. We then pool all efficient and virtual units and run the analysis again. Tables 5 and 6 present descriptive statistics on the efficiency ratings, and information on the efficiency distributions, respectively.

Table 5
Descriptive statistics on efficiency ratings obtained
(Single frontier on pooled data set, input minimization).

	No. of branches	Mean	Median	StDev	Min	Max
			CRS			
Cyprus branches	126	78.33	80.45	15.62	25.84	100
Greek branches	185	80.98	82.57	19.75	37.04	100
UK branches	196	96.31	98.21	5.09	66.68	100
			VRS			
Cyprus branches	126	91.21	94.98	10.69	43.03	100
Greek branches	185	84.16	88.16	17.55	19.44	100
UK branches	196	96.63	98.99	5.38	66.37	100

Table 6
Number of branches exhibiting different efficiency levels
(Single frontier for all countries, input minimization).

Efficiency Range:	Cyprus Branches (Total 126)	Greek Branches (Total 185)	U.K. Branches (Total 196)
CRS			
98% - 100%	13	83	104
90% - 98%	24	4	67
80% - 90%	24	11	24
65% - 80%	30	38	1
less than 65%	35	49	0
VRS			
98% - 100%	31	83	121
90% - 98%	58	7	55
80% - 90%	20	24	18
65% - 80%	13	36	2
less than 65%	4	35	0

A Kruskal-Wallis test was used again to test the null hypothesis that efficiency distributions from the three different networks are identical. This null was rejected ($p<0.001$), for both the VRS and the CRS case. Additional Mann-Whitney tests were

used to examine efficiency differences between pairs of branch networks. The null for Hypothesis 3a was that the mean efficiency of the UK branches will be higher than that of the Greek and the Cyprus networks. Indeed, this null could not be rejected ($p>0.05$), suggesting that the average efficiency of the UK branches does indeed outperform the average efficiency demonstrated by the branches of Greece and Cyprus. However, the null hypothesis that the average efficiency of Greek branches will, on average, dominate that of the Cyprus ones, was rejected ($p<0.05$). Even though a little surprising, this result suggests that the Greek branches have not, on average, demonstrated efficiency superiority over the Cyprus branches, even though they operate in the more favorable, more competitive European Union environment. This can of course be attributed to the poor management practices of the particular bank. As we can see from Table 2, the particular Bank in Greece lacks, for example, sufficient computer support. We also know that even though one of the largest in the country, it is not considered a market leader.

However, irrespective of the context of the environment, all inefficient branches can benefit by carefully examining best practices by branches in their peer groups. In Hypothesis 4, we speculate that the average efficiency dominance of the UK branches would also result in peer groups dominated by UK branches. We conducted a χ^2 test to test Hypothesis 4. More specifically, the null hypothesis was that the branch proportion from each country appearing as peers will equal to the proportion of the branches from each country in the data set. This null was not rejected ($p>0.05$). A more careful examination of the country of origin of peer groups further confirms the suggestions which can be made based on this result: In spite of the efficiency dominance of the UK branches, best practice units include branches from Cyprus and Greece which can serve as role models even for UK inefficient branches. A more detailed examination can

reveal the management practices in such yardstick branches which can provide direction for improvement to inefficient branches, irrespective of the context of the environment.

5. A closer look into the performance profile of the three networks

In this section we address a number of questions related to the performance results obtained from the within- and between-country efficiency results.

5.1 Technology profile on the assessment of efficiency

By examining the virtual weights of the inputs and outputs, important information on the product or resource structure of the different branch networks can also be obtained. For example, insights on the product structure which deems the branches of a network more efficient than others can be obtained. Table 7 presents descriptive statistics on the average relative importance for the different inputs and outputs of inefficient units, when the DEA model was run separately for the branches of each Bank [4]. The choice of inefficient units was made because efficient units have multiple weight solutions. Furthermore, the choice of weights by inefficient units will still place the efficient units on their corresponding frontier.

Table 7
Mean virtual weights of inefficient branches
(Separate frontiers for each branch network, VRS, input minimization,)

Inputs	**Cyprus branches (Total inefficient 65%)**	**Greek branches (Total inefficient 80%)**	**U.K. branches (Total inefficient 60%)**
Space	9.36	20.62	10.92
Personnel Cost	72.86	59.39	29.47
Computers	17.78	19.99	59.61
Outputs			
Current Accounts	21.61	2.95	5.93
Savings Accounts	24.07	31.16	55.98
Company Accounts	12.79	22.19	2.05
Credit Accounts	41.53	43.70	36.07

[4] In the input minimization case, the relative importance of the inputs corresponds to their virtual weights, since they must all sum up to one. To obtain the relative importance of each output, we divided the virtual weight of the output by the total efficiency obtained by the virtual weights of the remaining outputs.

Mann-Whitney tests were conducted to assess differences in the mean weights within each frontier. As Table 7 suggests, the U.K. branches appear to place more emphasis on the technology compared to their space and personnel ($p<0.001$). On the other hand, the branches in Greece and Cyprus place more emphasis on their personnel compared to their other inputs ($p<0.001$), in their attempt to appear as efficient as possible within their network. These results are not surprising considering that the UK branches enjoy the benefits of higher technology (see also Table 2). Greek and Cyprus branches appear to emphasize a similar product mix and resource structure. Since the weights obtained are branch network specific, no further cross-country analysis can be conducted before a common frontier for all networks is constructed.

Next, we examined whether the importance given on product mix and resource structure changed when branches from different countries were pooled in the analysis, and a common frontier for all countries was constructed. Mann-Whitney tests were also conducted for assessing the mean weights differences shown in Table 8, which presents the resulting average relative importance given to inputs and outputs.

Table 8
Mean virtual weights of inefficient branches
(VRS, input minimization, single frontier for all countries)

Inputs	**Cyprus branches (Total inefficient 86%)**	**Greek branches (Total inefficient 77%)**	**U.K. branches (Total inefficient 69%)**
Space	26.75	23.87	13.39
Personnel Cost	58.92	50.31	51.48
Computers	14.32	25.83	35.12
Outputs			
Current Accounts	2.28	7.42	13.84
Savings Accounts	84.03	44.49	36.72
Company Accounts	8.90	2.44	10.07
Credit Accounts	4.70	45.64	39.35

On the input side, the most interesting observation is that now that the UK branches, "compete" with branches from Greece and Cyprus, they increase the emphasis

they place on personnel cost and decrease the emphasis on technology. Nevertheless, the importance given by UK branches on technology still remains higher than what is observed by the branches in Greece and Cyprus ($p<0.01$). Overall the UK branches have demonstrated a greater flexibility regarding their efficient input mix. That is, it was possible for them to swift emphasis from the technology to the labor cost items but still remain dominant on the efficiency comparisons. It is noteworthy that the technology selection of the three branch networks has shown considerable variation in view of the within- and between-country differences. Yet, the UK branches have demonstrated balanced weighting profile on their outputs in the between country efficiency comparisons. Both the Cyprus and Greek branches, on the contrary, have given most emphasis on their savings, and savings and credit accounts, respectively. Overall, the output side was mostly affected in the between-country efficiency comparison with the UK network demonstrating the most robust profile.

5.2 Within- and between- country scale efficiency and returns to scale effects

Scale efficiency can be assessed by comparing the efficiency ratings obtained when CRS and VRS were considered. A more detailed look at Tables 3 and 5 reveals that scale inefficiencies are observed in all three branch networks. Table 9 presents within- and between-country scale efficiency results.

Table 9
Scale efficiency descriptive statistics

	No. of branches	Mean	Median	StDev	Min	Max
		Separate frontier for each country				
Cyprus branches	126	83.07	94.01	22.04	17.45	100
Greek branches	185	92.37	97.20	11.29	38.86	100
UK branches	196	80.29	83.84	17.99	27.72	100
		Single frontier for all countries				
Cyprus branches	126	77.79	85.71	19.45	27.81	100
Greek branches	185	90.92	95.30	11.65	38.85	100
UK branches	196	94.49	97.34	6.95	58.51	100

When separate frontiers are considered for each country, the UK network exhibits high scale inefficiencies, compared to the branches in Cyprus and Greece. This may be explained by the market penetration strategy they follow. The scale inefficiencies observed at the Cyprus branch network, for example, can be attributed to their strategy towards market presence and customer service.

Table 9 suggests that when a single frontier is constructed for all branch networks, the scale efficiency of the Cyprus branches, on average, further drops. This may be a further indication that structural problems which are not management related exist in both the within- and between- country assessment. The UK branches retain their overall efficiency dominance even in the case of scale inefficiencies, while the Greek branches exhibit a similar scale efficiency pattern in both the within- and between- country assessment.

In all cases the magnitude of the scale inefficiencies needs to be explored further by considering whether these correspond to increasing or descreasing returns to scale. We next proceed in analyzing returns to scale effects. In Data Envelopment Analysis the assessment of economies of scale effects is a frontier property regarding the position of scale inefficient branches on the VRS efficient frontier. Therefore, one characterizes returns to scale for branches located on the VRS efficient frontier who are also inefficient under the assumption of constant returns to scale. Results related to the three branch networks in the study are listed in Table 10.

Table 10
Number of branches exhibiting returns to scale
in the within- and between-country comparisons

	Increasing Returns No. of branches		Decreasing Returns No. of branches		Constant Returns No. of branches	
	Within*	**Between****	**Within**	**Between**	**Within**	**Between**
Cyprus branches	54	41	6	16	36	6
Greek branches	34	35	34	41	37	16
UK branches	104	53	1	25	48	24

* Within-country returns to scale effects

** Between-country returns to scale effects.

A χ^2 statistic rejected the hypothesis of independence between returns to scale and country membership in both the case of between- and also within-country efficiency ($p<0.05$). That is,

- economies of scale for the Cyprus branches lie in the area of increasing returns which indicates that larger sized branches outperform the smaller ones. A similar picture also holds in the case of the between-country assessment which enforces the previous indication of local increasing returns to scale.
- A balanced picture between local increasing and decreasing returns to scale appears in the case of the Greek branches. This case is slightly enforced in favor of the decreasing returns to scale in the case of the between-country efficiency assessment. The message here is that there is great variability in size and performance in the Greek branches and thus different sized branches performed at high and/or low performance levels.
- For the UK branches the within-country assessment revealed strong increasing returns to scale effects. That is to say larger branches (in this case city center branches) perform better in terms of cost productivity. The noticeable effect is that

in the between-country results we have a relatively higher proportion of UK branches operating under local decreasing returns to scale. The latter indicates the presence of Greek and Cyprus efficient branches of small sizes which outperform some large UK branches. This phenomenon is attributable to the different local markets' sizes suggesting that city center (mostly productive) branches from Greece and Cyprus having relatively smaller size outperform the corresponding larger UK branches[5].

Overall, the scale size of branch operations bears many exogenous factors primarily related to space and target markets. That is, the selection of branch-sites is not always discretional even at the higher levels of bank management due to the difficulty of finding available sites with desirable location and size characteristics. Furthermore, the capital required to maintain branch positions (at the level of depreciation or rent) is highly variable even for branches with similar market profile. The lack of full control on the size of individual branches has also operational bearings since a very large branch will need to be staffed appropriately if it were to provide adequate service levels. Finally, the question of returns to scale has a dynamic character. As a result, future market prospects in the vicinity of each branch must be anticipated prior to conclussive judgments regarding its scale size viability.

6. Concluding remarks

In this paper we present a framework which focuses on the benefits from micro-analytic studies of international comparisons of financial services. The methodological requirements for this type of analysis are discussed and the applicability of the

[5] Recall here that the efficiency assessment is done on a sole productivity basis ignoring differences in service quality and customer satisfaction.

framework is demonstrated using data from major Banks in three countries operating in different financial environments.

Clearly, one of the limitations of this study, is that the individual branch networks used may not provide a fair representation of the industry structure of each country. Each firm carries forward its own resources and capabilities and therefore the relative efficiency of the branch networks is influenced by the specifics of each bank. On the other hand, however, the banks operate within particular market conditions and therefore are expected to comply with more general propositions and hypotheses similar to those that were discussed in the previous sections of the paper.

Irrespective of the environment bank branches operate in, such international studies can provide useful insights and direction for improvement to the Bank's management. These will vary depending on the financial environment. For example, branch networks operating in highly protected markets with centralized regulatory regimes, such as the case of the Cyprus branch network, may exhibit high internal consistency due to the internal capabilities of the bank and its internal controls. The source of disadvantage for these banks is merely the local market structure and limited competition under which they operate. The balk of the activities of these concentrated banking markets lies in the relatively larger branches which aside of their central location, they more actively market the diverse products of the bank.

Furthermore, benchmarking bank branch networks operating in such restrictive regimes against branch networks in more liberalized financial environments, can be extremely important for banks operating in countries expecting changes in their financial environments. Examples include Eastern European countries, Cyprus and other countries anticipating entrance to the European Union. Such international benchmarks

can provide the means to prepare for the forthcoming changes and survive in the resulting highly competitive environment.

Different insights can be gained for branch networks operating in more liberalized environments. The results obtained from the Greek branches characterize banking regimes of non-planned deregulation or top-down transition to full scale market conditions. The progressive deregulation of the highly protected banking environments was partly the result of central decisions that did not make any provisions for the wave of reorganization that ought to take place on the operating profile of individual branch networks. As was mentioned earlier, the within-country efficiency variability is mainly due to the absence of systematic internal controls which undermine the viability of individual branches to supporting the banks goals.

For the banks operating in deregulated market economies the message is twofold. On the one hand they exhibit performance dominance which is clearly demonstrated in the results of the assessment. On the other hand, the market research orientation that characterizes the internal market in the UK has inevitable competitiveness costs when the bank is compared to branch networks from less liberal markets. That is, UK branches can be outperformed by Cyprus or Greek branches in terms of cost efficiency.

Overall, the disentanglement of within- and between-country efficiency differences can provide an empirical benchmark upon which banking institutions can assess their performance. This has profound operational implications since the proposed between-country efficiency framework demonstrates a quasi market environment of efficiency focus. The current theoretical and empirical literature does not suffice to inform the international banking industry about the micro-analytic competitiveness of branch networks. The importance that is given to distribution

channels in the financial services sector necessitates continuous research concerning the competitiveness of branch networks.

Further research should look into the development of sufficient data base networks whereby information will be shared and comparisons will be enabled in order to develop a financial services benchmarking community. Aside of the banking institutions themselves the international comparative basis should also target the customers' needs which is the ultimate outlet of financial services. Therefore, the international comparisons should not convey information solely on economic performance but also on elements of customer satisfaction and value added activities.

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