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Evaluating the Productive Efficiency of Islamic Banking in GCC: A Non Parametric Approach

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Abstract

The purpose of this paper is to propose a method to evaluate the productive performance of Islamic banks operating in the GCC region, over the period 2005-2008. Thus, we evaluate the productive performance of Islamic banks with the technique of productive efficiency proposed by Farrell (1957). We use the method of data envelopment analysis (DEA) to decompose the productive efficiency into technical efficiency, allocative efficiency and cost efficiency. The application of this technique on a sample of 23 Islamic banks reveals that the technical inefficiency and allocative inefficiency increased bank costs, on average, by about 14% and 29% respectively. In addition, the results show that internal and external factors seem to contribute significantly to the evolution of efficiency scores of Islamic banks operating in the GCC region.

Keywords: Efficiency, Islamic Banking, Data Envelopment Analysis

1. Introduction

The distinguishing feature of Islamic finance is its prohibition of interest (usury). The Islamic financial system opposes all forms of investment involving activities that are deemed to be incompliant with « Sharia law ». Islamic banks are the fundamental components of the Islamic financial system, carrying out the full range of banking activities in accordance with Islamic law.

The principle of the rejection of « *Riba* » – a loan with interest – is a fundamental feature of the Islamic banking system. But there are other aspects in which Islamic banking differs from conventional banking, in particular by virtue of the specific role of Islamic banks within the system. The notion underlying the activities of Islamic banks is the principle of risk-sharing, known as « al-Ghunm bi al-Ghurm ». The principle is that a lender is committed to sharing both the benefits and the risks of the loan with the borrower. To this extent Islamic banks act as partners, sharing both the gains and the losses generated by their customers. Banks will guarantee their continued role over time by multiplying the number of customers (in order to share the risk) and by providing advice and support services in management.

While Islamic banks offer simple deposit accounts for individuals, of which the management costs are covered by depositors, their main function is to provide financial services for entrepreneurs, which commonly take the following forms:

- **Mudharabah or « passive partnership »**: a bank provides the entire funds for an entrepreneur and shares the resulting profit (assuming there is any) with the entrepreneur, based on a fixed percentage determined by contract. The sole source of revenue for the borrower is their own profit share; they do not receive a salary. The bank is entirely liable for any potential losses.
- **Mousharaka or « active partnership »:** in this type of contract the bank acts as a shareholder, with both the profits and the losses shared between the bank and the borrower in accordance with the level of ownership of the company's assets.
- **Mourabaha or « commercial funding with profit margin »:** the bank acquires merchandise for its customer in return for a profit margin defined by contract. The bank transfers the ownership of the merchandise to its customer once the latter has paid both the cost of the merchandise and the margin defined by contract. This type of contract differs from loans with interest insofar as the margin is fixed and does not increase in line with the term of payment.

The first attempts to create Islamic financial institutions were made in the 1960s, with the rural savings banks « MitGrammar » in Egypt and the « Pilgrim's Management Fund » in Malaysia. The aim of these institutions was to reduce the level of banking exclusion and to promote the development of underprivileged sectors of the population. While not ignoring these initial experiences, many economists agree that the early 1970s are the real birth date of modern Islamic finance. In 1973, the Organization of the Islamic Conference (OIC) created the Islamic Development Bank (IsDB), whose function (as the name suggests) is to meet the needs of economic development in Muslim countries and to maintain equilibrium in their balance of payments, in line with the principles of Islamic law. The same year witnessed the creation of a new commercial bank – the Islamic Bank of Dubai. Subsequently new banks began to emerge at an ever-increasing rate. Over a ten-year period (between 1975 and 1985), more than ten Islamic banks were created in the Muslim world, the majority as a result of private initiatives. From the 1990s onwards, the world of Islamic banks underwent a process of internationalization, with the creation in Switzerland of the Islamic Finance House (Dar al-Mal al-Islami), after which several groups followed suit by setting up branches all throughout the world, including two Saudi groups, Al-Baraka and Al-Rajihi, and the Kuwait Finance House.

The growth of the Islamic banking and financial sector originally coincided with the surplus of revenue of Islamic oil-exporting countries. More recently, the globalization of economy, the liberalization of capital flow and privatization have paved the way for the expansion of the Islamic financial sector. The majority of recent studies of Islamic finance have commented on the spectacular growth of Islamic assets. While the volume of Islamic financial assets at the turn of the millennium was estimated to be in excess of 150 billion dollars (Niquet, 2008), it is currently deemed to be in excess of 700 billion dollars, including nearly 300 billion dollars of assets and over 400 billion dollars of financial investments managed by Islamic banks. The growth rate of assets owned by Islamic banks, which increased from 15% in 2000 to 23% in 2008, is significantly higher than the growth rate of assets owned by conventional banks. Another remarkable and exceptional fact is that in countries such as the United Kingdom, Islamic assets have continued to grow in spite of the severity of the subprime crisis and the subsequent credit crunch (Jouini & Pastré, 2008).

Islamic banking remains highly concentrated geographically, since nearly two thirds of Islamic financial assets are located in the Gulf, while almost 20% are located in South-East Asia (Hassoune & Satel, 2008). The available studies and statistics indicate that the growth rate of Islamic assets is approximately 39% in the GCC zone as opposed to just 15-20% in the rest of the world (MIFC 2009).

Another remarkable fact is apparent from the wide range of publications in the field, i.e. the good financial health of Islamic financial institutions. To cite just two examples, the average ROE of the "Kuwait Financial House" and the "Al Rajhi Bank" over the course of the last ten years is approximately 30%. There are two reasons which account for this high level of financial performance. In terms of resources, Islamic banks have access to a vast amount of relatively cheap deposits (the current total amount of available savings in the Gulf and south-east Asia is estimated at around 5000 billion dollars). In the realm of employment, the price of Islamic products remains relatively high. The level of risk on the main market of Islamic banks – the retail market – is relatively low.

The remarkable development of the Islamic banking sector throughout the world calls for an analysis of the degree of performance of Islamic banks. This study will focus solely on the evaluation of the performance of banks operating within the GCC zone. The choice of this particular focus is justified by the fact that the GCC zone has experienced a significant increase of the number of Islamic banks, a high growth rate of Islamic assets and sound financial health. The spectacular increase of Islamic banking activities within the GCC zone may be attributed to several factors (Jouini & Pastré, 2008): a spiritual and religious renewal, which has generated an increasing demand for Islamic financial products, and above all the emergence of considerable pockets of savings in the Gulf linked to oil price trends. The increase of liquidity in the GCC zone is intimately connected with the growth of oil revenue linked with oil price trends, solid economic growth in countries within the GCC zone, and the repatriation of Muslim capital after 11 septembre 2001 (Olson & Zoubi, 2009).

The evaluation of Islamic banking performance is an important issue at several levels. First of all, the improvement of performance in Islamic banks should result in a decrease of the prices of Islamic products offered to customers, and ought therefore to generate increased investments. Secondly, performance is a crucial determining factor for the future regional and international growth of Islamic banks. The range of opportunities for entering foreign countries alongside higher performing competitors would be more limited if Islamic banks were to perform at a lower level. A lower level of performance would also potentially facilitate the entry of conventional banks into the Islamic banking market.

The performance assessment of any given unit of production is usually based on partial productivity ratios and indices. While analyses using this method have the advantage of being easier to implement, such methods are problematic to the extent that they are founded on a single production factor and prevent a consideration of the multidimensional nature of banking activities. The imperfections of traditional methods calls for the adoption of new approaches that are better suited to the specific context of the banking sector and that help to avoid the issues outlined above. The use of efficiency scores serves to go beyond the criticisms levelled at these methods.

2. Methodology

2.1. An Outline of the Concepts of Production Efficiency

The economic theory provides an intuitive interpretation of the notion of efficiency by interpreting the production function not merely as the relation between inputs and outputs, but also as the frontier of the entire production process that maximises the level of outputs when production factors are given. The analysis involves determining for every bank (construed as a decision-making unit or DMU) the optimal virtual bank, the characteristics of which, in terms of relative amounts of outputs and inputs, constitute the solutions of a linear optimization program. The distinction between the DMUs located (or not) on the productivity frontier serves to identify efficient and inefficient DMUs. A DMU with a production plan located on the production frontier is deemed to be efficient. Conversely, a DMU with a production plan located below the frontier is deemed to be inefficient.

The earliest studies of productive efficiency were conducted by Koopmans (1951), Debreu (1951) and Farrell (1957). Farrell (1957) was the first to provide a breakdown of productive efficiency into two components: technical efficiency and allocative efficiency. According to Debreu's resource-use coefficient, technical efficiency is achieved when a given output is produced with the smallest technically possible quantities of factors. Allocative efficiency measures the capacity of a DMU to combine its inputs in optimal proportions given their relative price on the market and the budget allocated to purchase them. The combination of technical efficiency and allocative efficiency helps to determine global (or total) economic efficiency.

Studies in the field use two different approaches to measure productive efficiency: a parametric methods and a non-parametric methods. The non-parametric approach uses linear programming, specifically the data envelopment analysis (DEA), to construct the productivity frontier, although it

imposes the hypothesis of the convexity of the entire production. It is therefore not necessary to impose *a priori* a particular specification of the production function, the cost function or the profit function – a distinct advantage of this particular approach. However the efficiency scores obtained by the DEA method are sensitive to errors that may affect the data. The econometric approach takes account of errors in data by introducing two types of hazards in the specification of production functions, cost functions and profit functions. The first hazard is the common symmetric error, while the second is an asymmetric hazard representing inefficiency. By contrast, it is important to impose a particular specification for the parametric frontier and a particular distribution for the error terms, which is one weakness of this approach. This study privileges the non-parametric approach (DEA) since the weakness of one is the strength of the other (and vice versa).

2.2. The Construction of an Efficiency Frontier using the DEA

Charnes, Cooper and Rhodes (1978) extend the approach used by Farrell (1975) to the context of multi-outputs and multi-inputs by taking the case of a technology with constant returns to scale. They elaborated a mathematical optimization programme with a solution that provides a measurement of the relative efficiency of *DMUs* in Farrell's sense of the term.

The presentation of the CCR model is based on the assumption that there are n *DMUs* in the total number of observations conducted as part of this study. A DMU_j can use quantities of m different inputs (x_{ij} is the quantity observed of the i input used by the decision-making unit j, $i = 1,...,m$) to produce s different outputs (y_{rj} is the observed quantity of the output r produced by the decision-making unit j, $r = 1,...,s$). The Charnes, Cooper et Rhodes (CCR) model is based on the optimization of the weighted amount of outputs related to the weighted amount of inputs (or the optimization of the weighted amount of inputs related to the weighted amount of outputs). The issue is to maximize the efficiency score for every DMU while taking account of the constraint of an efficiency score lower than or equal to the total number of observed *DMUs*, assuming that the weightings are all positive.

Model 1	**Model 2**
$\max h_k = \dfrac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}$ $s.t \quad \dfrac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \le 1 \qquad \text{for } j = 1,...,n$ $u_r \ge 0, \quad v_i \ge 0$	$\text{Min } h_k$ $\sum_{j=1}^{n} u_j y_{rj} \ge y_{rk} \qquad \forall\, r = 1,..., p$ $\sum_{j=1}^{n} u_j x_{ij} \le h_k x_{ik} \quad \forall\, i = 1,...,m$ $u_j \ge 0 \qquad \forall\, j = 1,...,n$

Model (1) shows that the efficiency of the *k-th* DMU will be obtained as a ratio between outputs and inputs with the provison that the same ratio will be equal to or lower than 1 for the total number of remaining *DMUs* observed. The optimization model (1) is non-convex and non-linear, and provides an infinite number of optimal solutions. It can be transformed into a dual linear program. The focus here is not the respective individual values of weighted amounts of outputs and inputs but their relative significance. We may therefore focus either on maximizing the weighted amount of outputs by fixing the weighted amount of inputs or on minimizing the weighted amount of inputs by fixing the weighted amount of outputs. In model (2), h_k represents the technical efficiency of the assessed DMU

(the *k-th* observation will be efficient if and only if $h_k = 1$). The assessed DMU_k is represented by its output vector and input vector. Y_{rj} and X_{ij} represent the input and output vectors of the efficient $DMUs$. The n, p, m parameters represent respectively the number of compared $DMUs$, the dimension of the output vector and the dimension of the input vector. The u_j (pairs) indicate the way in which the decision-making units are combined to form the efficiency frontier to which the *k-th* is compared.

The CCR programmes presented above exclusively measure global technical efficiency by taking account of the hypothesis of constant returns to scale. Banker, Charnes and Cooper (1984) extend the measurement of efficiency to the case of variable returns to scale by introducing an additional constraint in model (2) developed by CCR. The convexity constraint $\left(\sum_{j=1}^{n} u_j = 1 \right)$ in model (3) guarantees that the assessed DMU is only compared to $DMUs$ of a similar size. By solving model (3) for all the $DMUs$, the DEA method determines a production frontier that enables an assessment of the productive efficiency of each DMU by generating an efficiency score situated between 0 and 1. A score equal to the unit (respectively below 1) indicates the efficiency (respectively the inefficiency) of the assessed DMU.

Model 3	**Model 4**
$\text{Min } h_k$ $\sum_{j=1}^{n} u_j y_{rj} \geq y_{rk} \quad \forall r = 1,..., p$ $\sum_{j=1}^{n} u_j x_{ij} \leq h_k x_{ik} \quad \forall i = 1,..., m$ $\sum_{j=1}^{n} u_j = 1, \quad u_j \geq 0 \quad \forall j = 1,..., n$	$\min \sum_{i=1}^{m} c_{ik} x_{ik}$ $s.t$ $x_{ik} \geq \sum_{j=1}^{n} u_j x_{ij}$ $y_{rk} \leq \sum_{j=1}^{n} u_j y_{rj}$ $\sum_{j=1}^{n} u_j = 1, \quad u_j \geq 0$

The DEA models (1, 2 and 3) do not allow for a calculation of the allocative (or price) efficiency of the different $DMUs$. As noted above, the measurement of the allocative efficiency refers to the capacity of the producer to choose the right combination of given inputs and outputs, or conversely to the capacity to choose the right combination of given outputs and inputs in the light of the prevailing prices at the moment of production. The hypothesis of cost minimization serves to incorporate the classical behavioural hypotheses of microeconomic theory and therefore to estimate technical efficiency, allocative efficiency and cost efficiency. The hypothesis of profit maximization helps to establish dual relations between the profit function and the functions of input distance and output distance. It measures the distance between the actual profit generated by a DMU and the optimal potential (or observed) profit given the price of inputs and the price of outputs. Unfortunately, since the data concerning the different outputs are all available, the assessment of allocative efficiency is based in this paper on the hypothesis of the minimization of banking costs.

In model (4), c_{ik} represents the unit cost of the decision-making unit k analyzed in the optimization programme. Solved for every observation, model (4) assesses the cost efficiency of every DMU, represented by the relation between the minimal potential or observed cost and the actual cost faced by the DMU under study:

$$CE_k = \frac{c_k x^*}{c_k x_k}$$

Using this approach, allocative efficiency can be measured by the relation between cost efficiency (CE_k) and technical efficiency (TE_k).

3. Data and Statistics Describing Variables

The focus of the empirical analysis is a panel Data sample of Islamic banks operating in the GCC region. A sample of 23 Islamic banks was selected over the 2005-2008 period. The banking data was drawn from the international BVD-IBCA Bankscope database, which has the advantage of providing individual statistical series (i.e. for every individual bank). Furthermore, Bankscope operates as far as possible using corrections of results communicated by banks and a harmonization of data facilitating international comparative analyses. Annual accounting data (balance sheets, income statement) for a sufficiently representative number of Islamic banks operating within the GCC region over the 2005-2008 period is therefore available.

Table 1: Descriptive statistics of Islamic banks for the 2005-2008 period (in 1 000 of USD).

	Av.	Max	Min	SD	CV
2005					
Total Earning Assets	3 623 914	22 824 593	57 500	5 691 063	1.57
Net Commissions Revenue	38 167	386 515	500	82 234	2.15
Total deposits	2 607 821	20 249 694	20 889	4 958 462	1.90
Total fixed Assets	65 482	368 836	100	109 455	1.67
Interest Expense	58 937	419 863	100	99 515	1.69
Personnel Expenses	39 965	211 696	2 500	51 035	1.28
Other Operating Expenses	35 940	210 761	1 600	53 074	1.48
2006					
Total Earning Assets	4731402	25032498	175400	6788094	1.43
Net Commissions Revenue	55604	443578	1181	102021	1.83
Total deposits	3308263	21189747	12363	5901767	1.78
Total fixed Assets	139225	1386871	100	299114	2.15
Interest Expense	107102	720758	100	179288	1.67
Personnel Expenses	60262	299332	3200	78492	1.30
Other Operating Expenses	51136	251435	1900	68698	1.34
2007					
Total Earning Assets	6 214 651	29 116 715	251 648	8 616012	1.39
Net Commissions Revenue	54 903	280 881	247	76 416	1.39
Total deposits	4 443 018	25 460 427	14 659	7 558 517	1.70
Total fixed Assets	167 950	1 492 674	100	329 553	1.96
Interest Expense	146 669	1 128 938	900	259 663	1.77
Personnel Expenses	80 877	388 331	3 500	96 297	1.19
Other Operating Expenses	64 095	278 388	2 200	76 954	1.20
2008					
Total Earning Assets	7 721 716	40088749	176 800	10 591 635	1.37
Net Commissions Revenue	67 415	35 1387	604	90 725	1.35
Total deposits	5 673 737	34 186 456	16 954	9 381 855	1.65
Total fixed Assets	202 727	2 142 779	100	456 207	2.25
Interest Expense	143 226	1 079 906	1 000	233 365	1.63
Personnel Expenses	98 196	440 453	3 200	111 997	1.14
Other Operating Expenses	90 129	360 210	1 800	90 680	1.01
2005-2008					
Total Earning Assets	5 572 921	40 088 749	57 500	8 151 580	1.46
Net Commissions Revenue	54022	443 578	247	87 536	1.62
Total deposits	4 008 210	34 186 456	12 363	7 129 115	1.78
Total fixed Assets	143 846	2 142 779	100	321 992	2.24
Interest Expense	113 983	1 128 938	100	202 227	1.77
Personnel Expenses	69 825	440 453	2 500	88 748	1.27
Other Operating Expenses	60 325	360 210	1 600	75 109	1.25

NB: AV, MAX, MIN, SD and CV represent respectively: average, maximum, minimum, standard deviation, and coefficient of variation.

The intermediation approach devised by Sealey and Lindley (1977) was used to measure outputs and inputs. It is based on the hypothesis that a bank collects deposits with a view to transforming them into loans by using labor and capital factors in the transformation process. The alternative approach is the production approach. Here, the bank is assumed to use the labor factor and the capital factor to produce loans and deposits. Some studies (Wheelock & Wilson, 1995; Berger, Leusner & Mingo, 1997) have shown that the approach chosen for the definition of banking inputs and banking outputs has an impact on the level of efficiency scores but does not entail any major changes in the ranking of efficiency scores.

Banking production is measured by two outputs: total earning assets and net commissions indicative of off-balance sheet activity. The retained production factors include bank deposits, physical capital (measured by fixed assets) and labor (measured by staff costs). The price of physical capital (measured by the general operating costs divided by fixed assets), the cost of the labor factor (measured by staff costs divided by total number of employees) and the cost of the financial capital (measured by the financial charges divided by the total amount of deposits) are used to estimate a cost frontier.

Table 1 provides an overview of the descriptive statistics for the values of variables used in the assessment of efficiency scores of Islamic banks. The statistics indicate that the sample is homogeneous since the coefficient of variation remains stable over time. The coefficient of variation, represented by the σ/μ , is included in a narrow interval: [1.25; 2.24] over the studied period. The interval is [1.28; 2.15] for 2005, [1.30; 2.15] for 2006, [1.19; 1.96] for 2007 and [1.01; 2.25] for 2008. Note that over the four studied years, the level of dispersion is significantly low for staff costs and operating costs (excluding staff costs). The highest level of dispersion was for the fixed assets. The other variables are characterized by an average level of dispersion.

A two-stage approach was used to achieve the two objectives outlined above, i.e. the evaluation of the performance of Islamic banks operating in the GCC region and the identification of the explanatory factors of efficiency. The first stage involved elaborating a non-parametric frontier using the DEA method for the assessment of the various components of productive efficiency. The second stage involved explaining the differences in performance.

4. Empirical Results

4.1. Efficiency Scores

Table (2) provides an overview of the productive efficiency scores of Islamic banks obtained by estimating a non-parametric frontier (DEA) aimed at the minimization of inputs based on the hypothesis of variable returns to scale. The choice of this type of model is justified by the fact that the hypothesis of variable returns to scale is indisputably the most appropriate hypothesis in the case of banks: the focus on the minimization of inputs has the advantage of emphasizing the reduction of the quantity of inputs used in the production process to increase efficiency, which reflects the behaviour of the majority of banks in a context of deregulation and open competition.

The use of the DEA method shows that the average technical efficiency of Islamic banks is 80% over the 2005-2008 period. Despite the slight drop of technical efficiency in 2006, the general trend over the 2005-2008 period shows to be an improvement of technical efficiency. This component of productive efficiency is included in a narrow interval (84%-88%) and shows that a proportional decrease of the production factors used by banks in the region by 16% to 12% would have enabled them to reduce their inefficiency over the studied period. These results match the findings of Hamim *et al.* (2006) and Batchelor & Wadud (2004) on a sample of Islamic banks operating in Malaysia.

The results of the present analysis show that the average value of the allocative efficiency of Islamic banks is 70%, which means that their average allocative inefficiency stands at approximately 30%. On average management errors in terms of the allocation of resources therefore generate allocative inefficiencies of approximately 30%. An analysis of the evolution of allocative efficiency

shows that it varies (on average) between 67% and 72%, and the general trend shows to be an improvement of allocative efficiency, since the efficiency score increased from 67% in 2005 to 71% in 2008. The results of this study are similar to those obtained by Kabir (2006) based on a sample of Islamic banks operating in 21 countries.

Table 2: Technical, allocative and cost efficiencies of Islamic banks operating in the GCC region

		TE	AE	CE
2005	**Av.**	0.86	0.67	0.61
	Max	1.00	1.00	1.00
	Min	0.54	0.24	0.18
	SD	0.18	0.22	0.27
	CV	0.20	0.34	0.45
2006	**Av**	0.84	0.72	0.62
	Max	1.00	1.00	1.00
	Min	0.49	0.38	0.21
	SD	0.19	0.22	0.27
	CV	0.22	0.30	0.43
2007	**Av**	0.86	0.70	0.60
	Max	1.00	1.00	1.00
	Min	0.50	0.39	0.29
	SD	0.15	0.15	0.20
	CV	0.17	0.22	0.33
2008	**Av**	0.88	0.71	0.64
	Max	1.00	1.00	1.00
	Min	0.53	0.39	0.31
	SD	0.14	0.21	0.25
	CV	0.16	0.29	0.38
Period Average		**0.86**	**0.69**	**0.61**

Finally, the cost efficiency of Islamic banks operating in the GCC is 61% over the 2005-2008 period, which means that the cost inefficiency of the Islamic banks included in our sample is 40%. This result does not match the results outlined by Hamim *et al.* (2006) and Kabir (2006), who obtained cost efficiency scores varying between 80% and 87%. By contrast, the results of the present analysis show that cost efficiency tends to increase over the 2005-2008 period since the inefficiency scores increased from 60% in 2005 to 64% in 2008. From a cost perspective, this results shows that the 2005-2008 period was marked by a slight improvement of the conditions of use of production factors by the Islamic banks included in the sample.

Based on the coefficient of variation, the results presented in Table (2) for the dispersion of efficiency scores indicate a high level of dispersion of the efficiency scores over the studied period. The ratio remains within a relatively narrow interval: [0.16; 0.22] for the technical efficiency score, [0.22; 0.34] for the allocative efficiency score, and [0.33; 0.54] for the cost efficiency score. Whatever the included productive efficiency component, it can be observed that the differences of performance between the most efficient banks and the least efficient ones are significant, which means that the studied Islamic banks are not relatively close in terms of efficiency.

Evaluations of the productive performance of Islamic banks can be influenced by two types of factors: a) external factors, which are entirely exogenous to the management of every bank and are related to the economic, legal and regulatory environment; b) factors are exclusively related to the managerial strategy of every bank, which the production factors do not capture directly in the estimation of the technical frontier. These factors need to be emphasized in any account of the degree of efficiency of banks since they are related to the management practices used by bank managers at all levels of the production process of the different banking outputs.

4.2. Explanatory Factors of the Degree of Productive Efficiency of Islamic Banks

Using Berger (1993), Mester (1993), Allen & Rai (1996), Mester (1996), Casu & Molyneux (2000), Drake *et al.* (2006), Das & Gosh (2006), and Pasiouras *et al.* (2007), this paper will assess the impact of efficiency on a range of different internal and external characteristics that are not necessary to be taken into account in the estimation of the non-parametric frontier. The internal determinants are based on the accounting statements of every bank, such as the loss and profits account, the balance sheet and the off-balance sheet activities. These can be described as managerial or microeconomic variables, while the external determinants reflect the economic, financial and legal environments that affect the performance of banking institutions. The following variables are therefore included:

- The growth rate of the economy measured by the growth rate of the Gross Domestic Product;
- The inflation rate (INF) measured by the growth rate of the Consumer Price Index (CPI);
- The equity to asset ratio (CAP)
- The size of the bank measured by the logarithm of the total asset $(LnASSET)$;
- The credit risk which is measured by the doubtful loans-to-assets ratio $(RISK)$;
- The profitability of the bank, measured by the return on assets (ROA).

Table 1: Relationship between efficiency scores and managerial and environmental variables

	C	*CAP*	*INF*	*GDP*	*LnASSET*	*RISQ*	*ROA*	R^2
TEF	1.803 (a) (11.97)	-0.619 (a) (-15.21)	-0.035 (-0.11)	-0.564 (-1.45)	-0.047 (a) (-5.24)	-4.80 (a) (-3.46)	0.114 (a) (3.64)	0.50
AEF	1.13 (a) (7.10)	0.004 (0.056)	1.10 (c) (1.73)	-0.38 (-0.70)	-0.02 (b) (-2.45)	-1.03 (-0.631)	-1.50 (a) (-4.93)	0.42
CEF	1.68 (a) (23.97)	-0.446 (a) (-6.58)	1.29 (c) (1.92)	-1.21 (b) (-2.11)	-0.05 (a) (-10.30)	(-4.43) (a) (-4.22)	(-1.15) (a) (-3.89)	0.81

(a) (b) and (c) represent the 1%, 5% and 10% significance level.

A general overview of Table (3) shows that the explanatory power is potentially high in the three estimations. The empirical results tend to suggest a negative and significant relationship at 1% significance level between capitalization and productive efficiency. This result matches the findings of Sufian *et al.* (2007), who found a negative and significant relation between efficiency and capitalization. This result could be explained by the fact that the increase of capitalization is deemed to have a negative impact on the efficiency of banks since, by increasing this ratio, banks tend to realise a minimal fructification of the available capital. Another possible explanation could be that the increase of capitalization is inefficient for the least capitalized banks while it results in efficiency gains for the highly capitalized. Those banks that seek to increase their capitalization take more risks, which generates an increase of doubtful loans and banking costs, thereby making them less efficient. By contrast, the highly capitalized banks can increase their performance and therefore their productive efficiency by taking fewer risks.

The results outlined in Table (3) show a negative and significant relation between size and productive efficiency. In the relevant literature, the relation between size and efficiency is a controversial issue. Berger & Humphrey (1992) conclude that efficiency is related positively to the size of large American banks. Kabir finds a positive relation between size and banking efficiency. Small banks can benefit from economies of scale by merging that enable them to reduce their costs, thereby improving their performance. In the context of Islamic banks operating in the GCC, the relation obtained between efficiency and size implies that the increase of the size of banks is a source of additional costs and tends to reduce the efficiency of large banks. In other words, the negative relation

observed between efficiency and size shows that economies of scale have stimulating and positive effects on the production performance of small banks and a negative impact on the efficiency of large banks such as those included in our sample. However, it is important to note that the relation between the size and the efficiency of Islamic banks does not mean that large banks have attained their optimal size. It is conceivable that the banks included in the sample are in fact undergoing increasing returns-to-scale (i.e. that they are too small to make use of all the economies of scale) or decreasing returns (i.e. that they are too big – although this appears to be less likely). In other words, a proportion of their productive inefficiency is probably the result of an inadequate size.

Non-performing loans to total assets are negatively and significantly related to the efficiency of the Islamic banks included in the sample used in this study, which is in line with the findings of other studies in the field (Kwan & Eisenbeis, 1995 ; Berger & De Young's, 1997 ; Resti, 1997; De Young's & Hasan, 1998; Sufian *et al.* 2007). The negative relation observed between risk and the productive efficiency of Islamic banks shows that the decline of economic activity, which is often accompanied by an increase of the probability of bankruptcy, affects the revenues of banks and increases the number of non-performing loans. This results in an increase of the total cost incurred by banks (as a result of the need to increase oversight), an increase of risk provisions, an increase of the costs associated with non-performing loans, a decrease of financial capital (as a result of revenue losses) and a decrease of production performance. If Islamic banks are to improve their productive efficiency, they will need to reform their credit policy by adopting more advanced assessment and scoring methods that would enable them to detect creditor insolvency in advance.

The relation between banking profitability measured by ROA and productive efficiency shows that the estimated coefficients are statistically significant at a 1% level in the three specifications. The changing positive and negative sign of the coefficients means that it is impossible to establish the impact of the ROA variable on productive efficiency. The positive relation observed between technical efficiency and profitability means that a high level of production performance (indicative of a good organization of production) ought in theory to reflect a high level of profitability. This means that the more a bank seeks to improve its profitability, the more it tends to choose its production factors efficiently, to lower its costs and therefore improve its productive efficiency. The negative relation observed between profitability, allocative efficiency and cost efficiency can be explained by the X-inefficiency hypothesis (Leibenstein, 1970) inspired by management theory. The hypothesis postulates that inefficiency is indicative of organizational issues. Organizational issues therefore explain why some banks, though well-established on their markets (demonstrating for instance good profitability), are less effective than others at solving issues of reorganization characteristic of the banking industry in a period of innovation and restructuring. Furthermore, banks that possess a reserve of profit or a market power would have fewer incentives than others to increase productivity and to control production costs. The second possible explanation of this result is drawn from the theory of imperfect competition. If there is a high level of competition, well-established banks in terms of costs can choose – or be compelled to choose – a (probably aggressive) marketing policy preventing them from achieving a high level of profitability. In other words, some banks that seek to increase productivity, select inputs efficiently and are effective at controlling their costs, appear to struggle to increase their margins because they operate within a competitive market, and do not have the market power that would enable them to achieve significant profits.

The relation between economic growth and efficiency is negative. This seemingly unexpected result is not in line with the findings outlined by Sufian *et al.* (2007), who found a positive relation between economic growth and efficiency based on a sample of Malaysian banks. In the context of banks operating in the GCC region, the negative relation between economic growth and efficiency could be explained by the fact that the instability of economic growth is accompanied by a decrease of the demand for financial services and an increase of defaults in payment, which has a negative impact on the performance of banking production. One possible explanation is that banks have sought to improve the quality of the services offered to customers, to innovate, and to adopt more costly production techniques that generate a decrease of productive efficiency.

Finally, the results indicate a positive and significant relation at the 10% level between inflation and the productive efficiency of Islamic banks in our sample, which suggests that the increase of inflation tends to favour an increase of banking efficiency. Admittedly, inflationist pressures generate an extension and over-estimation of banking costs (which will ultimately be covered by depositors and borrowers), but they also result in high lending rates, which enables banks to increase the size of lending, revenues, profits and finally productive efficiency.

5. Conclusion

This article has tried to provide a measure of the technical efficiency, allocative efficiency and cost efficiency of 23 Islamic banks operating in the GCC using the DEA method. The empirical results of this study indicate an increase of production efficiency of the Islamic banks included in the sample. By contrast, the results suggests that the efficiency scores were highly dispersed over the 2005-2008 period since the gap between the highest-performing and lowest-performing banks is well above 75% irrespective of the efficiency measure used. In addition to the simple measure of productive efficiency, this study examined the explanatory factors of efficiency differences among the banks included in the sample. The results indicate that internal factors and exogenous factors such as inflation appear to contribute significantly in the evolution of efficiency scores. The results produced by this research certainly call for greater methodological subtlety. The use of the Distance Function, which appears to be a promising avenue for the parametric estimation of multi-input multi-output technologies, and the use of the Bootstrap method, which attributes statistical properties to the estimations generated by the DEA method, will undoubtedly need to be explored to complete and extend this research.

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