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Evaluating the Productive Efficiency of Islamic and Conventional Banks in GCC Countries

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Abstract

The purpose of this study is measuring the productive efficiency of Islamic and conventional banks operating in the GCC over the period 2005-2010. Data Envelopment Analysis was used to measure technical efficiency, allocative efficiency and cost efficiency. No significant differences were found between Islamic and conventional banks in terms of productive efficiency. Besides, the findings indicate that the efficiency of banks in our sample is determined by internal and external factors such as size, risk, profitability and the economic environment.

Keywords: Productive efficiency, Islamic bank, Conventional bank, Data envelopment analysis

1. Introduction

The banking sector in the GCC changed significantly since early 1990s as a result of reforms that aimed at changing the institutional framework of banking (and in particular the regulatory framework). The reforms recognized that prudential regulation has an impact on public welfare. The assumption is that an unstable banking sector and a lack of investor and depositor confidence have a negative impact on the economy as a whole. The need to reform the banking sector in the GCC pushed the authorities to introduce measures aimed at reforming prudential regulation with a view of ensuring the stability of the banking sector and improving the functioning of the banking system. The major reforms implemented in the GCC countries have involved lifting most of the price controls and quantitative limits on banks (gradual relaxation of obligatory lending, liberalization of deposit and lending rates),

strengthening banking supervision and prudential regulation[1] (adoption of Basel I and Basel II Accords, introduction of deposit insurance systems), opening access to the banking market (removal of entry restrictions on foreign institutions) and lifting foreign exchange controls. In addition to reducing the problems of monetary control, the reforms were also designed to increase the performance, efficiency and productivity of the banking and financial sector in the GCC by promoting competition and removing the imbalances affecting resource allocation. The second purpose of the reforms was to improve the efficiency of financial intermediation. Similarly to other countries that have restructured their banking sector and engaged in a process of financial liberalization, this objective has many dimensions. Beside the need to channel savings into productive investments, an efficient banking and financial system promotes innovation and low-cost services, while offering a wide range of financial instruments. As a result of these measures, the banking environment in the GCC has changed significantly. Competition to secure funds and offer credit has intensified, and the opportunities for foreign banks to enter the market have increased market contestability.[2]

The reform of conventional banking in the GCC has also been accompanied by a significant expansion of Islamic banking activities. In 2010, the total assets of Islamic banks were estimated to be 223.372 billion, compared to 22.5 billion in 1998. Islamic banks have also been able to increase the deposit growth rate by increasing their efficiency and expanding geographically. As a result, bank deposits have increased significantly in recent years, from 16.494 billion dollars in 1998 to 150.345 billion dollars in 2010. In terms of profitability, the available data show that net profits increased significantly between 1998 and 2010, from 686 million dollars in 1998 to almost 3.23 billion dollars in 2010[3]. Several factors account for the growth of Islamic banking in the GCC. The first factor is the inflow of petrodollars generated by the oil industry, resulting in a growth of investment demand in the GCC. The second factor is the renewed interest in Islamic finance and the rising demand for Sharia-compliant financial services. The third factor is the disappointment caused by the failure of Western financial capitalism in respond to economic, social and financial problems in the GCC.

Previous research has shown that banks are a key factor of economic development. Since direct financing remains relatively limited in the GCC because of the limited size of financial markets, it is primarily up to the banking system to regulate investment flows and funding economic growth. The question that arises is the capacity of Islamic and conventional banks to perform these roles in an environment characterized by significant information asymmetry (i.e. moral hazard and adverse selection) between lenders (banks) and borrowers. Information asymmetry and compliance with prudential requirements can have a negative impact on production financing through credit contraction or higher loan interest rates, but may also affect the productive efficiency of conventional and Islamic banks.

The purpose of this study is to compare the productive efficiency of conventional and Islamic banks operating in the GCC. The study focuses on regulators (as opposed to banks). While the main objective of banks is to maximize profit, regulators aim to improve the productive efficiency of banks in order to increase consumer well-being by promoting low prices, resulting in an increase in consumer surplus but also, potentially, in increased investment growth and, therefore, increased economic growth.

Data envelopment analysis was used in this paper to measure the productive efficiency of conventional and Islamic banks. Compared to standard performance indicators, DEA scores generate an efficiency score indicating the performance of each bank compared to a group of similar banks. While the DEA method has been widely applied in the banking sector, little use has been made on

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[1] Prudential regulation has traditionally been justified by the presence of positive externalities related to currency and the role of banks in ensuring the effective functioning of the system of payments and negative externalities associated with bank failures. In addition to the importance of information asymmetry affecting banking contracts and preventing depositors from correctly estimating bank solvency.

[2] The theory of contestable markets describes a market in which companies are unable to exploit their market power because there are no entry or exit barriers in the industry. For further details, see Baumol, Panzar and Willig (1982).

[3] Sources: Research Unit, Institute of Banking Studies, Kuwait.

GCC countries (see Saad and EL-Moussawi [2006] on banks in Kuwait, Saad and EL-Moussawi [2007] on all MENA countries, and EL-Moussawi and Obeid [2010] on all banks operating in the GCC). However, some studies have been conducted on banking sectors in these areas using econometric techniques such as the stochastic frontier approach and the distribution-free approach (Al-Obaidan [2008], Abderrazek Sriri [2010]).

This paper has two objectives: (1) comparing the productive efficiency of conventional and Islamic banks operating in the GCC, and (2) identifying the determinants of this efficiency. The paper will proceed in two stages. Firstly, it will construct a non-parametric frontier based on data envelopment analysis to measure the different components of productive efficiency. A distinction between conventional and Islamic banks will be made in the analysis of the productive efficiency of banks based on separate estimations (i.e. separate frontier) for each category of bank. Performing separate estimations is based on an assumption that the efficiency scores of conventional and Islamic banks differ. The second stage involves accounting for the differences between conventional banks and Islamic banks in terms of productive efficiency. The aim will be to account for the differences between conventional and Islamic banks in terms of performance and efficiency. The results show that the performance differences between conventional and Islamic banks may result from differences in size or structure of activity rather than better management.

2. Construction of an Efficiency Frontier Based on Data Envelopment Analysis (DEA)

Data envelopment analysis (DEA) is a non-parametric method used to measure the efficiency of decision-making units. Developed by Charnes, Cooper and Rhodes [1978], the DEA method is used to measure the efficiency of a decision-making unit by comparing it to the most efficient decision-making units, thus providing relative performance measures. Two approaches are used to measure productive efficiency: non-parametric methods and parametric methods. The non-parametric approach uses linear programming, and in particular data envelopment analysis, to construct the frontier, but requires the assumption of convexity of the production set[4]. A major advantage of this approach is that there is no need to choose a specific functional form for production, cost or profit functions. However, the efficiency scores obtained using the non-parametric approach, are sensitive to data errors. The second approach – the parametric or econometric approach[5] – takes into account data errors by introducing two types of errors in the specification of the production, cost or profit functions. The first type of error is the usual symmetric error, while the second type of error is an asymmetric error representing inefficiency. However, a major drawback of this approach is that it requires choosing a specific functional form for the parametric frontier and the distribution of the error terms. In short, the weakness of one method is the strength of the other, and vice versa.

The overall technical efficiency of banks is measured using two linear programming models. Firstly, the model developed by Charnes, Cooper and Rhodes [1978] (the CCR model) is used to measure the overall technical efficiency by estimating a production frontier under the assumption of constant returns to scale. The CCR model is defined as follows:

[4] The Free Disposal Hull (FDH) approach proposed by Deprins, Simar and Tulkens (1984) has the advantage of relaxing the convexity assumption. However, one drawback of this approach is that production scale is no longer considered as a source of inefficiency. Another drawback of this method is that it does not allow studying the different types of productive efficiency, notably allocative efficiency and cost efficiency.

[5] For a complete overview, see Lovell (1993).

$$
\begin{aligned}
&Min\ \theta \\
&\theta, \lambda \\
&s.t. \qquad (i)\ Y.\lambda \geq Y_k \\
&\qquad\quad (ii)\ \theta \cdot X_k - X \cdot \lambda \geq 0 \\
&\qquad\quad (ii)\ \lambda \geq 0.
\end{aligned}
$$

Y_k is the vector with *m* dimensions of output produced by a particular bank, X_k is the vector with *n* dimensions of input used by a bank, Y is the matrix of outputs where *k* represents the number of banks, X is the matrix of inputs, and λ is the vector of weighting parameters associated with each bank in determining the minimum level of inputs. The measure of overall technical efficiency is given by θ.

Secondly, the model developed by Banker, Charnes and Cooper [1984] (BCC model) was used to measure the pure technical efficiency based on estimating a production frontier with variable returns to scale. The BCC model enables this decomposition by adding a constraint to the weighting parameters of the CCR model:

$$
\begin{aligned}
&Min\ \theta \\
&\theta, \lambda \\
&s.t. \qquad (i)\ Y.\lambda \geq Y_k \\
&\qquad\quad (ii)\ \theta \cdot X_k - X \cdot \lambda \geq 0 \\
&\qquad\quad (iii)\ \lambda \geq 0. \\
&\qquad\quad (iv)\ I \cdot \lambda = 1
\end{aligned}
$$

The measure of technical efficiency is given by θ. The scale efficiency score is obtained residually as the ratio of overall efficiency to pure technical efficiency. The CCR model is used to measure overall technical efficiency, while the BCC model is used to measure allocative efficiency. Scale efficiency is obtained residually.

It is important to note that the DEA models presented above take account only of the physical quantities of inputs and outputs and cannot be used to measure the allocative efficiency of the decision-making units (DMUs). In fact, allocative efficiency is the ability of the producer to select the best ratio of inputs to outputs or, conversely, the best ratio of outputs to inputs, based on prevailing prices at the time of production. This theory is based on an assumption that producers behave rationally. The cost minimization assumption can be used to incorporate the traditional behavioral hypotheses of microeconomic theory and, therefore, to estimate technical efficiency, allocative efficiency, and cost efficiency. The profit maximization assumption is used to determine the relationships between the profit function and the input and output distance functions and measures the gap between the actual efficiency of a decision-making unit and its potential efficiency given the prices of inputs and outputs. The data relating to the different outputs are not all available. Allocative efficiency is measured based on the cost minimization assumption. The linear program is given by:

$$
\begin{aligned}
&Min \sum_{i=1}^{m} c_{ik} x_{ik} \\
&s.t. \qquad x_{ik} \geq \sum_{j=1}^{n} x_{ij} \lambda_j \\
&\qquad\quad Y_{rk} \leq \sum_{j=1}^{n} y_{rj} \lambda_j \\
&\qquad\quad \sum_{j=1}^{n} \lambda_j = 1 \\
&\qquad\quad \lambda_j \geq 0 \quad \forall\ j
\end{aligned}
$$

c_{ik} is the unit cost of the input of DMU_k, a benchmark projection that may vary from one bank to another. Model (3) is used to measure the cost efficiency of each DMU, represented by the ratio of the potential minimum cost to the actual cost faced by the DMU:

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

A final comment about the measures of efficiency is in order. The move from the assumption of constant returns to scale to the assumption of variable returns to scale has an impact on the way efficiency is measured. Two measures of efficiency are possible according to whether output maximization or input minimization is emphasized. A measure of efficiency based on output maximization gives the highest output growth that can be obtained based on a constant level of inputs. A measure of efficiency based on input minimization gives the maximum proportional reduction of the input vector yielding the same output level. Under the assumption of constant returns to scale, the two measures of efficiency are equivalent (measured on the same expansion ray). By contrast, under the assumption of variable returns to scale, the results vary according to the chosen emphasis. The model used in this study is based on the assumption of variable returns to scale and input minimization since the assumption of variable returns to scale is more appropriate for measuring bank efficiency. A focus on input minimization has the advantage of emphasizing the reduction in the quantity of inputs used in the production process to increase efficiency, reflecting the practices of most banks in a deregulated and competitive market.

3. Descriptive Statistics of the Variables

The empirical analysis was based on a non balanced panel data of conventional and Islamic banks operating in the GCC. The data were collected from the BVD-IBCA Bankscope database, which has the advantage of providing individual statistical series (i.e. for each individual bank). Annual financial data (balance sheet, income statement) on a representative sample of banks operating in the GCC over the period 2003-2010 were therefore available.

We used the intermediation approach proposed by Sealey and Lindley (1977) to measure the outputs and inputs required to estimate the efficiency scores. The intermediation approach is based on the assumption that a bank collects deposits in order to transform them into loans, using labor and capital inputs in the conversion process[6]. The alternative approach is the production approach, in which banks are assumed to use labor and capital as inputs to generate loans and deposits. Some studies have shown that the approach used to define the bank's inputs and outputs has an impact on efficiency scores, but has no significant impact on the ranking of efficiency scores (Wheelock and Wilson, 1995; Berger, Leusner, and Mingo, 1997).

Bank production was measured by three outputs: earning assets, other earning assets and off-balance sheet items. The three production factors used were deposits, physical capital (measured by fixed assets) and labor (measured by personnel expenses). The price of fixed assets (measured by the ratio of operating expenses to capital expenditures), the price of labor (measured by the ratio of personnel expenses to total assets) and the price of financial capital (measured by the ratio of financial costs to deposits) were used to estimate the cost frontier.

Table (1) presents the descriptive statistics for the output values, the input prices and the other variables used in the analysis. The statistics show that conventional banks are on average larger than Islamic banks. The results also show that the mean input and output levels of conventional banks are slightly higher than the mean levels of Islamic banks. The ratios indicating the input prices were found

[6] The treatment of deposits as output was tested and did not affect the results of the study. This finding is consistent with the results of a study by Wheelock and Wilson [1995]. Based on a sample of American banks, Wheelock and Wilson found that the treatment of deposits had no impact on the rankings of the efficiency scores obtained using the DEA method.

to be higher in Islamic banks compared to conventional banks. Despite this difference, the results show that for both types of banks, the distribution of variables is relatively homogeneous. The coefficient of variation is within a narrow range for both samples over the selected period: [0.94; 2.33]. The interval was [1.02; 1.50] for 2003, [.094; 2.14] for 2006 and [1.01; 2.33] for 2010.

Table 1: Descriptive statistics (in thousands of dollars)

	Total Assets	Total Earning Assets	Other Earning Assets	Off Balance Sheet	Deposits	Fixed Assets	Personnel Expenses	Other Operating Expenses	PDEP	PPHY	PTR
Conventional banks											
2010											
Av.	19023236	16910400	5641608	6328935	14866123	175458	131931	102267	0.02	0.68	0.01
SD	20060168	17785643	6936805	7530729	15916794	171185	132709	113252	0.01	0.38	0.004
CV	1.05	1.05	1.23	1.19	1.07	0.98	1.01	1.11	0.49	0.56	0.42
2006											
Av.	11024186	10217192	4081675	4561740	8663129	86952	82429	58254	0.04	1.08	0.01
SD	10399127	9710054	4458982	7356393	8353018	96876	84239	59735	0.01	1.01	0.004
CV	0.94	0.95	1.09	1.61	0.96	1.11	1.02	1.03	0.24	0.94	0.43
2003											
Av.	6902937	6479507	3114419	2171883	5712789	69077	54180	39112	0.01	0.97	0.01
SD	7740472	7252991	4080994	2823638	6581873	103315	60576	46900	0.01	1.05	0.004
CV	1.12	1.12	1.31	1.30	1.15	1.50	1.12	1.20	0.36	1.08	0.40
Islamic banks											
2010											
Av.	11567181	10155325	3339718	1903096	8942111	265763	113377	132287	0.03	8.08	0.01
SD	14193018	12196704	3622889	2608901	11185718	618669	131932	168975	0.02	25.74	0.00
CV	1.23	1.20	1.08	1.37	1.25	2.33	1.16	1.28	0.84	3.19	0.46
2006											
Av.	6142566	5498671	1969918	943656	4543824	154914	68890	55571	0.05	2.29	0.01
SD	8100788	7114288	2288164	1409879	6298370	331894	85987	75492	0.04	4.51	0.01
CV	1.32	1.29	1.16	1.49	1.39	2.14	1.25	1.36	0.85	1.97	0.63
2003											
MOY	2596386	2341179	757087	431501	2096457	33915	25185	27531	0.04	1.13	0.02
SD	3160367	2943810	1058902	465905	2573592	44129	25583	36863	0.04	0.64	0.01
CV	1.22	1.26	1.40	1.08	1.23	1.30	1.02	1.34	1.01	0.57	0.73

Av., SD, and CV represent, respectively, the mean, standard deviation and coefficient of variation of the variables.
PDEP, PPHY, and PTRA represent, respectively, the price of deposits, the price of fixed assets and the price of labor. The sample included 51 commercial banks and 19 Islamic banks.

4. Empirical Results

Table (2) shows the efficiency scores of conventional and Islamic banks operating in the GCC based on the estimation of a non-parametric frontier (DEA), input minimization and the assumption of variable returns to scale. The results show that conventional banks were slightly more efficient than Islamic banks in all three components of productive efficiency. The study also found that the three components of productive efficiency decreased and subsequently increased, irrespective of the type of bank.

Based on data envelopment analysis, conventional and Islamic banks were found to have similar average levels of technical efficiency. The average technical efficiency of conventional banks was 95%, compared to 93% in the case of Islamic banks (2% difference in favor of conventional banks). Between 2003 and 2010, technical efficiency ranged between 93% and 96% in the case of conventional banks and between 88% and 98% in the case of Islamic banks. The results indicate that an increase in outputs between 4% and 6% for conventional banks and between 12% and 2% for Islamic banks would have enabled all of the banks to reduce their technical inefficiency. The dispersion of the technical efficiency scores was high and varied from one type of banks to another. The results show that the coefficients of variation of conventional banks (6% to 8%) were significantly lower than the coefficients of variation of Islamic banks (6% to 18%). However, it is important to note that the performance differences between the least efficient banks and the most efficient banks in both categories were high and above 30% in the case of conventional banks and around 60% in the case of Islamic banks.

The results shown in table (2) indicate that the average allocative efficiency of conventional banks was 71%, compared to 69% in the case of Islamic banks (2% difference in favor of conventional banks). Allocative efficiency varied between 64% and 74% in the case of conventional banks and between 57% and 79% in the case of Islamic banks. The results suggest that a mismanagement of resource allocation and of the amount of production factors used results in allocative inefficiencies in both types of banks (30%). In other words, the allocative inefficiency of Islamic and conventional banks is explained by the fact that some banks use incorrect combinations (i.e. ratios) of production factors, which prevents them from minimizing their production costs. Finally, the results indicate that the dispersion of average allocative efficiency was high in both types of banks. The coefficient of variation ranged from 30% to 36% in the case of conventional banks and from 26% to 49% in the case of Islamic banks. The performance differences between the most efficient banks and the least efficient banks were significant, indicating that the conventional and Islamic banks included in the sample differ in terms of efficiency.

Table 2: Efficiency Scores

		Conventional Banks			**Islamic Banks**		
		TE	**AE**	**CE**	**TE**	**AE**	**CE**
2003	Av.	0.96	0.72	0.70	0.97	0.74	0.72
	MIN	0.78	0.26	0.24	0.76	0.34	0.33
	MAX	1	1	1	1	1	1
	SD	0.06	0.22	0.24	0.07	0.29	0.29
	CV	0.06	0.31	0.34	0.08	0.39	0.40
2004	Av.	0.95	0.71	0.67	0.98	0.64	0.63
	MIN	0.75	0.29	0.26	0.80	0.26	0.26
	MAX	1	1	1	1	1	1
	SD	0.07	0.23	0.24	0.06	0.31	0.31
	CV	0.07	0.32	0.35	0.06	0.48	0.50
2005	Av.	0.94	0.74	0.70	0.90	0.57	0.53
	MIN	0.77	0.30	0.30	0.59	0.30	0.25
	MAX	1	1	1	1	1	1
	SD	0.07	0.22	0.24	0.14	0.28	0.30
	CV	0.07	0.30	0.34	0.15	0.49	0.57

Table 2: Efficiency Scores - continued

2006	Av.	0.93	0.69	0.65	0.88	0.61	0.54
	MIN	0.73	0.21	0.18	0.56	0.35	0.25
	MAX	1	1	1	1	1	1
	SD	0.09	0.23	0.24	0.16	0.21	0.25
	CV	0.09	0.33	0.37	0.18	0.35	0.45
2007	Av.	0.94	0.73	0.69	0.91	0.66	0.60
	MIN	0.74	0.23	0.19	0.65	0.28	0.28
	MAX	1	1	1	1	1	1
	SD	0.08	0.23	0.24	0.13	0.25	0.25
	CV	0.08	0.31	0.35	0.14	0.39	0.42
2008	Av.	0.95	0.74	0.71	0.93	0.79	0.74
	MIN	0.75	0.29	0.23	0.43	0.41	0.39
	MAX	1	1	1	1	1	1
	SD	0.08	0.22	0.24	0.15	0.21	0.24
	CV	0.08	0.30	0.33	0.16	0.26	0.32
2009	Av.	0.94	0.66	0.63	0.95	0.76	0.73
	MIN	0.76	0.22	0.22	0.68	0.34	0.30
	MAX	1	1	1	1	1	1
	SD	0.08	0.24	0.25	0.09	0.24	0.26
	CV	0.08	0.36	0.40	0.09	0.31	0.35
2010	Av.	0.96	0.69	0.67	0.97	0.75	0.74
	MIN	0.71	0.21	0.17	0.76	0.31	0.31
	MAX	1	1	1	1	1	1
	SD	0.07	0.24	0.25	0.06	0.25	0.26
	CV	0.08	0.34	0.37	0.06	0.33	0.35
Av. (2003-2010)		0.95	0.71	0.68	0.93	0.69	0.65
MIN (2003-2010)		0.71	0.21	0.17	0.43	0.26	0.25
MAX (2003-2010)		1	1	1	1	1	1
SD (2003-2010)		0.07	0.23	0.24	0.12	0.26	0.27
CV (2003-2010)		0.08	0.32	0.35	0.13	0.37	0.42

Av., MIN, MAX, SD, and CV represent, respectively, the mean, minimum, maximum, standard deviation and coefficient of variation. TE, AE and CE represent, respectively, technical efficiency, allocative efficiency and cost efficiency.

5. Factors Explaining the Productive Efficiency of Conventional and Islamic Banks

The efficiency scores shown in Table 2 can be used to compare the efficiency of banks. The scores are not only a sign of mismanagement, but are also a reflection of the broader economic environment. Previous research has shown that the productive efficiency of banks is determined by two types of factors:

a) Structural environmental factors that are external and related to the economic, legal and regulatory environment.
b) Factors related solely to the bank's management strategy and not captured by production factors in the estimation of the technological frontier.

It is important to note that the number of variables included in the estimation may be significant. No precise model of this type of relationship has been provided by the literature. The impact of a number of internal and external factors on efficiency that may not be included in estimating the production frontier was assessed based on the results of studies by Berger (1993), Mester (1993), Allen and Rai (1996), and Mester (1996). The following variables were used:

- Economic growth rate measured by GDP growth (*GDP*);
- Inflation rate measured by the consumer price index (*INF*);
- Capital ratio measured by the ratio of equity to total assets (*CAP*);

- Asset size measured by the logarithm of total assets (*LnASSET*);
- Credit risk measured by the ratio of provisions for bad debts to total asset (*RISQ*);
- Return on assets measured by the ratio of net income to total assets (*ROA*);
- Liquidity (*LIQ*) as measured by the ratio of liquid assets to total assets.

The aim is to determine the relationship between the level of efficiency and various structural variables (i.e. organizational, strategic and economic variables). This method is widely used in the analysis of productive efficiency and varies according to the chosen approach (parametric or non-parametric). In the parametric approach, the factors determining efficiency (one-step estimation) are directly incorporated into the specifications (deterministic or stochastic). In the non-parametric approach, it is significantly more difficult to simultaneously estimate the cost frontier and identify the determinants of efficiency. Most studies involve two stages: the first stage estimates the efficiency scores using data envelopment analysis, while the second stage explains the scores using regression. This two-stage approach raises a number of statistical issues since non-parametric methods provide a measure of performance of each bank compared to all the banks in the efficient frontier. The interdependence of efficiency scores means that any statistical inference based on the standard tests is difficult (if not impossible), thus requiring appropriate methods that have yet to be developed.

Table (3) shows the ordinary least squares results.

Table 3: Factors determining the efficiency of conventional and Islamic banks operating in the GCC

	Conventional banks			**Islamic banks**		
	AE	*CE*	*TE*	*AE*	*CE*	*TE*
C	69.499* (5.95)	61.7009* (4.54)	77.2990* (12.01)	1.2329* (5.79)	1.3292* (6.12)	1.0942* (12.36)
CAP	0.1981*** (1.89)	0.2834** (2.01)	0.1544* (3.16)	0.1873*** (1.75)	-0.2062 (-0.82)	0.3799** (2.09)
RISK	-0.0978* (-3.02)	-0.1160** (-3.60)	-0.0159* (-2.65)	-1.0332 (-0.631)	-4.4305* (-4.22)	-4.80* (-3.46)
LIQ	-0.0206*** (-1.86)	-0.0268*** (-1.93)	-0.0054*** (-1.71)	-0.5874* (-7.71)	-0.6911* (-10.10)	-0.1287* (-2.79)
ROA	0.8866*** (1.69)	0.6635*** (1.81)	-0.2672*** (-1.89)	-2.7345** (-2.49)	(-1.1502) * (-3.89)	1.9461** (2.50)
LnASSET	1.1420*** (1.76)	1.5665*** (1.83)	1.3293* (2.88)	-0.02** (-2.45)	-0.05* (-7.30)	-0.037* (-4.24)
INF	-0.0883 (-0.39)	-0.3359 (-1.19)	0.0383 (0.99)	-0.7167 (-0.73)	-0.7580 (-0.68)	-0.1102 (-0.25)
GDP	0.2749*** (1.77)	0.3852** (1.97)	-0.0955 (-1.50)	-0.3825 (-0.70)	-1.2104** (-2.11)	-0.5641 (-1.45)
R^2	0.75	0.79	0.55	0.61	0.69	0.55
F-statistic Prob (F-statistic)	31.49 (0.0000)	32.89 (0.0000)	28.67 (0.0000)	21.87 (0.0000)	21.99 (0.0000)	19.68 (0.0000)

(*), (**), and (***) indicate that the coefficients are significant at the 1% level, 5% level and 10% level, respectively.

Table (3) suggests a significant explanatory power of the estimated models since the coefficient of determination R^2 is relatively high and above 0.50 in the different estimations.

The results shown in Table (3) indicate a positive and significant relationship between the productive efficiency scores and the capital ratio. The best capitalized banks are also the most efficient ones. This is consistent with the results of Cook et al. (2000) aimed at assessing the impact of financial reforms on Tunisian banks over the period 1992-1997, and is also consistent with studies conducted in other countries such as the United States (Kwan and Eisenbeis, 1997), transition economies (Stavarek, 2004), Turkey (Isik and Hassan, 2003a), Italy (Casu and Girardone, 2004) and the United Arab Emirates (Rao, 2005). These studies found that the relationship between the level of capitalization and

efficiency was positive. Compliance with a minimum solvency requirement serves to limit excessive risk-taking, which may have a negative impact on bank profitability. Maintaining an adequate level of equity also reflects the added pressure of shareholders on managers, who will be required to manage the bank more efficiently.

The ratio of provisions for loan losses to total assets is significantly and negatively related to the productive efficiency of conventional and Islamic banks operating in the GCC, which is consistent with the literature (Kwan and Eisenbeis, 1995; Berger and De Youngs, 1997; Resti, 1997; De Youngs and Hasan, 1998; Barr et al., 2002; Kwan, 2006). The negative relationship between risk and productive efficiency shows that decreased economic activity, often accompanied by an increased probability of bankruptcy, affects the results of banks and increases the number of non-performing loans. For banks, the result is increased costs (associated with increased surveillance), increased provisions for loan losses, increased costs associated with non-performing loans, reduced capital (as a result of losses) and, finally, lower productive efficiency. In order to improve their productive efficiency, conventional and Islamic banks should change their credit policy by adopting more sophisticated assessment and rating methods.

The results show that the level of liquidity is negatively correlated with the productive efficiency of conventional and Islamic banks. Therefore, high cash reserves may be a sign of inefficiency in converting resources. This result could be explained by the fact that banks prefer to direct their resources toward less profitable with low-risk investments (e.g. the purchase of government securities) than loans to clients.

The relationship between bank profitability measured by ROA and productive efficiency, shows that the estimated correlations are statistically significant in the different specifications. Because the coefficients are sometimes positive and sometimes negative, it is impossible to determine the contribution of the ROA variable to productive efficiency. The positive relationship between efficiency and profitability means that, theoretically, high productive efficiency (indicating effective production organization) should translate in good profitability – in other words, the greater the tendency of a bank to seek to improve its profitability, the greater its tendency to choose its production factors efficiently, to reduce its costs and, therefore, to increase its productive efficiency. The negative relationship between profitability, allocative efficiency and cost efficiency can be explained by the X-inefficiency hypothesis (Leibenstein, 1970), inspired by managerial theory. According to the X-inefficiency hypothesis, inefficiency is a sign of organizational problems. The assumption is that organizational problems account for the fact that some banks, though highly profitable, are less efficient than others in solving the restructuring issues affecting the banking industry in a period of restructuring and innovation. Banks with high profits or market power have less incentive to increase their productivity and control their production costs compared to other banks. The second possible explanation is based on the theory of imperfect competition. If there is significant competition, banks that are well-positioned in terms of costs can choose – or be forced to choose – a (probably aggressive) lending policy that will prevent them from being efficient (in terms of profitability). In other words, banks that seek to increase their productivity, to use their inputs efficiently and to control their costs more effectively will struggle to increase their margins, since they operate in a competitive market and do not have the market power to achieve higher profits.

Based on the results shown in Table (3), there is no clear evidence of the impact of size on the efficiency of conventional and Islamic banks. Out of the six estimations, only three show a positive and significant relationship between size and efficiency, while the other estimations are negative and significant. The positive relationship between size and efficiency confirms that conventional banks have increasing returns to scale and indicates that the larger the size of the bank, the better its capacity to use its production factors efficiently, therefore, the greater its ability to increase its productive efficiency. The negative relationship between size and efficiency means that increased size is a source of costs and tends to reduce the efficiency of large banks. In other words, the negative relationship between size and efficiency shows that economies of scale have a positive impact on the productive

efficiency of small banks and a negative impact on that of large banks (such as those included in the sample). However, it is important to note that the relationship between size and efficiency in Islamic banks does not necessarily mean that larger banks have achieved an optimal size. It is conceivable that the banks included in the sample have increasing returns to scale (i.e. they are too small to take advantage of all economies of scale) or decreasing returns to scale (i.e. they are too large to take advantage of all economies of scale), although the latter seems unlikely. In other words, part of their productive inefficiency is probably explained by an inappropriate size.

Inflation does not appear to be a determinant of the efficiency of banks. No conclusion can be drawn from the estimations since the estimated coefficients have opposite signs and are not significant.

Finally, the relationship between economic developments and the efficiency of conventional banks was found to be positive and significant. The implication is that a period of economic growth accompanied by an increase in economic activity, increased profitability, and a decrease in non-performing loans should result in an efficient management of production factors, decreased costs and, therefore, an increase in bank efficiency. By contrast, the relationship between the economic growth and the efficiency of Islamic banks was found to be negative. This finding is not consistent with the results of Sufian et al. (2007), who found a positive relationship between economic growth and efficiency of a sample of Malaysian banks. In the case of Islamic banks operating in the GCC, the negative relationship between economic growth and efficiency can be explained by the fact that unstable economic growth is often accompanied by a decrease in the demand for financial services and increase in defaults, which have a negative impact on the productive efficiency of banks. One possible explanation is that in periods of economic growth, banks seek to improve the quality of their services, to innovate and to use more expensive production techniques, resulting in lower productive efficiency.

5. Conclusion

The purpose of this study was to measure the productive efficiency of Islamic and conventional banks operating in the GCC. The results showed that the technical efficiency, allocative efficiency and cost efficiency scores of conventional banks were not higher than the efficiency scores of Islamic banks. The results obtained using the non-parametric DEA method were consistent with the results of other empirical studies that have used parametric approaches to measure the productive efficiency of Islamic and conventional banks. The results also showed that internal factors and macroeconomic conditions are determinants of productive efficiency. However, it is important to note that since this study used data envelopment analysis, the results may be sensitive to outliers. The use of a larger sample and of other techniques for measuring efficiency (such as the bootstrap method) may increase the robustness of the results.

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