The Efficiency of Islamic Banks: Empirical Evidence from the MENA and Asian Countries Islamic Banking Sectors

Sufian, Fadzlan and Mohamad, A.M Noor and Muhamed-Zulkhibri, Abdul Majid

University of Putra, University of Malaya, Central Bank of Malaysia, University of Nottingham

June 2008

The Efficiency of Islamic Banks: Empirical Evidence from the MENA and Asian Countries Islamic Banking Sectors

Fadzlan Sufian
University of Malaya
Mohamad A M Noor
University of Malaya
Muhamed-Zulkhibri Abdul Majid
Central Bank of Malaysia
University of Nottingham

Abstract

The paper investigates the efficiency of the Islamic banking sectors in 16 MENA and Asian countries during the period of 2001-2006. The efficiency estimates of individual banks are evaluated using the non-parametric Data Envelopment Analysis (DEA) method. The results suggest that the MENA Islamic banks have exhibited higher mean technical efficiency relative to their Asian Islamic bank counterparts.with pure technical inefficiency outweighs scale inefficiency in both the MENA and Asian countries banking sectors. The empirical findings also indicate that banks from the MENA region were the most efficient banks by dominating the top part of efficiency frontier over the period.

JEL Classification: G21; G28
Keywords: Islamic Banks, Data Envelopment Analysis (DEA)

1. Introduction

Islamic banks today exist in all parts of the world, and are looked upon as a viable alternative system which has many things to offer. While it was initially developed to fulfill the needs of Muslims, Islamic banking has now gained universal acceptance. Islamic banking is recognized as one of the fastest growing areas in banking and finance. Since the opening of the first Islamic bank in Egypt in 1963, Islamic banking has grown rapidly all over the world. The number of Islamic financial institutions worldwide has risen to over 300 today in more than 75 countries concentrated mainly in the Middle East and Southeast Asia (with Bahrain and Malaysia are the biggest hubs), but are also appearing in Europe and the United States. The Islamic banking total assets worldwide are estimated to have exceed $250 billion and are growing at an estimated pace of 15 percent a year. Zaher and Hassan (2001) suggested that Islamic banks are set to control some 40-50 percent of Muslim savings by 2009/10.

Islamic banking operations started out as a mere deposit taking and lending facility and has since transformed into all aspects of banking,

money and capital market operations, including fully fledged stock exchanges. The Islamic resurgence in the late 1960's and 1970's, further intensified by the 1975 oil price boom, which introduced a huge amount of capital inflows to Islamic countries has initiated the call for a financial system that allows Muslim to transact in a system that is in line with their religious beliefs. Before the re-emergence of the Islamic financial system, Muslims throughout the world only have the conventional financial system to fulfill their financial needs.

Islamic financial products are aimed at investors who want to comply with the Islamic laws (*syaria'*) that govern a Muslim's daily life. *Syaria'* law forbids the giving or receiving of *riba'*[1] (because earning profit from an exchange of money for money is considered immoral); mandate that all financial transactions be based on real economic activity; and prohibit investment in sectors such as tobacco, alcohol, gambling, and armaments. Despite that, Islamic financial institutions are providing an increasingly broad range of financial services, such as fund mobilization, asset allocation, payment and exchange settlement services, and risk transformation and mitigation.

Among other reasons which attributed to the rapid growth of the Islamic banking and finance industry are the growing oil wealth, with demand for suitable investments soaring in the Gulf region and the competitiveness of many of the products, attracting strong demand from Muslim and non-Muslim investors. Despite the growing interest and the rapid growth of the Islamic banking and finance industry, analysis of Islamic banking at a cross-country level is still at its infancy. This could partly be due to the unavailability of data, as most of the Islamic financial institutions particularly in the Asian region are not publicly traded.

The aim of this paper is to fill a demanding gap in the literature by providing the latest empirical evidence on the performance of Islamic banks in 16 MENA and Asian countries during the period 2001 to 2006. The efficiency estimate of each Islamic bank is computed by using the non-parametric Data Envelopment Analysis (DEA) method. The method allows us to distinguish between three different types of efficiency measures, namely technical, pure technical, and scale. Unlike the previous analysis of Islamic bank efficiency, we have constructed and analyzed the results derived from dynamic panels, which is critical in a dynamic business environment as a bank may be the most efficient in one year but may not be

[1] *Riba'* the English translation of which is *usury* is prohibited in Islam and is acknowledged by all Muslims. The prohibition of *riba'* is clearly mentioned in the Quran, the Islam's holy book and the traditions of Prophet Muhammad *(sunnah)*. The Quran states: "Believers! Do not consume *riba',* doubling and redoubling…" (3.130); "God has made buying and selling lawful and *riba'* unlawful… (2:274).

in the following year (s). A dynamic panel analysis will also highlight any significant changes taking place in the Islamic banking sector during the period of study.

This paper unfolds as follows. Section 2 provides an overview of the related studies in the literature, followed by a section that outlines the method used and choice of input and output variables for the efficiency model. Section 4 reports the empirical findings. Section 5 concludes and offers avenues for future research.

2. REVIEW OF THE LITERATURE

While there have been extensive literatures examining the efficiency features of the contemporary banking sector, particularly the U.S. and European banking markets, the work on Islamic banking is still in its infancy. Typically, studies on Islamic bank efficiency have focused on theoretical issues and the empirical work has relied mainly on the analysis of descriptive statistics rather than rigorous statistical estimation (El-Gamal and Inanoglu, 2004). However, this type of research is gradually changing as a number of recent studies have sought to apply various frontier techniques to estimate the efficiency of Islamic banks.

Hussein (2003) provides an analysis of the cost efficiency features of Islamic banks in Sudan between 1990 and 2000. Using the stochastic cost frontier approach, he estimates cost efficiency for a sample of 17 banks over the period. The interesting contribution of this paper is that specific definitions of Islamic financial products are used as outputs. In addition, the analysis is also novel as Sudan has a banking system based entirely on Islamic banking principles. The results show large variations in the cost efficiency of Sudanese banks with the foreign owned banks being the most efficient. State owned banks are the most cost inefficient. The analysis is extended to examine the determinants of bank efficiency. Here, he finds that smaller banks are more efficient that their larger counterparts. In addition, banks that have higher proportion of *musharakah* and *mudharabah* finance relative to total assets also have efficiency advantages. Overall, the substantial variability in efficiency estimates is put down to various factors, not least the highly volatile economic environment under which Sudanese banks have had to operate over the last decade or so.

Hassan and Hussein (2003) examined the efficiency of the Sudanese banking system during the period of 1992 and 2000. They employed a variety of parametric (cost and profit efficiencies) and non-parametric DEA techniques to a panel of 17 Sudanese banks. They found that the average cost and profit efficiencies under the parametric were 55% and 50% respectively, while it was 23% under the non-parametric approach. During the period of study, they found that the Sudanese banking system have exhibited 37% allocative efficiency and 60% technical efficiency, suggesting that the overall cost inefficiency of the Sudanese Islamic banks

were mainly due to technical (managerially related) rather than allocative (regulatory).

El-Gamal and Inanoglu (2004) used the stochastic frontier approach to estimate the cost efficiency of Turkish banks over the period 1990-2000. The study compared the cost efficiencies of 49 conventional banks with four Islamic special finance houses (SFHs). The Islamic firms comprised around 3% of the Turkish banking market. Overall, they found that the Islamic financial institutions to be the most efficient and this was explained by their emphasis on Islamic asset-based financing which led to lower non-performing loans ratios. It is worth mentioning that the SFH achieved high levels of efficiency despite being subjected to branching and other self-imposed constraints such as the inability to hold government bonds.

Hassan (2005) examined the relative cost, profit, X-efficiency, and productivity of the world Islamic Banking industry. Employing a panel of banks during 1993-2001, he used both the parametric (Stochastic Frontier Approach) and non-parametric (Data Envelopment Analysis) techniques as tools to examine the efficiency of the sample banks. He calculated five DEA efficiency measures namely cost, allocative, technical, pure technical, and scale and further correlated the scores with the conventional accounting measures of bank performance. He found that the Islamic banks are more profit efficient, with an average profit efficiency score of 84% under the profit efficiency frontier compared to 74% under the stochastic cost frontier. He also found that the main source of inefficiency is allocative rather than technical. Similarly, his results suggest that the overall inefficiency was output related. The results suggest that on average the Islamic banking industry is relatively less efficient compared to their conventional counterparts in other parts of the world. The results also show that all five efficiency measures are highly correlated with ROA and ROE, suggesting that these efficiency measures can be used concurrently with the conventional accounting ratios in determining Islamic banks performance.

Samad (1999) was among the first to investigate the efficiency of the Malaysian Islamic banking sector. In his paper, he investigates the relative performance of the full-fledged Malaysian Islamic bank compared to its conventional bank peers. During the period of 1992 to 1996 he found that the managerial efficiency of the conventional banks was higher than that of the full-fledged Islamic bank. On the other hand, the measures of productive efficiency revealed mixed results. He suggests that the average utilization rate of the Islamic bank is lower than that of the conventional banks. Similarly, he found that profits earned by the full-fledged Islamic bank either through the use of deposit or loanable funds, or used funds are also lower than the conventional banks, reflecting the weaker efficiency position of the full-fledged Islamic bank. In contrast, the productivity test by loan recovery criterion indicate that the efficiency position of the full-fledged Islamic bank

seems to be higher and bad debts as a percentage of equity, loans, and deposits also show a clear superiority over the conventional bank peers.

More recently, Sufian (2006) examined the efficiency of the Malaysian Islamic banking sector during the period 2001-2004 by using the non-parametric Data Envelopment Analysis (DEA) method. He found that scale efficiency outweighs pure technical efficiency in the Malaysian Islamic banking sector, implying that Malaysian Islamic banks have been operating at non-optimal of operations. He suggests that the domestic Islamic Banking Scheme banks have exhibited a higher technical efficiency compared to their foreign Islamic Banking Scheme bank peers. He suggests that during the period of study the foreign Islamic Banking Scheme Banks inefficiency were mainly due to scale rather than pure technical.

3. METHODOLOGY

A non-parametric Data Envelopment Analysis (DEA) is employed with variable return to scale assumption to measure input-oriented technical efficiency of Singapore banking groups. DEA involves constructing a non-parametric production frontier based on the actual input-output observations in the sample relative to which efficiency of each firm in the sample is measured (Coelli, 1996). Let us give a short description of the Data Envelopment Analysis[2]. Assume that there is data on K inputs and M outputs for each N bank. For ith bank these are represented by the vectors x_i and y_i respectively. Let us call the K x N input matrix – X and the M x N output matrix – Y. To measure the efficiency for each bank we calculate a ratio of all inputs, such as $(u'y_i/v'x_i)$ where u is an M x 1 vector of output weights and v is a K x 1 vector of input weights. To select optimal weights we specify the following mathematical programming problem:

$$\begin{aligned} &\min_{u,v} (u'y_i/v'x_i), \\ &u'y_i/v'x_i \leq 1, \qquad j = 1, 2, \ldots, N, \\ &u, v \geq 0 \end{aligned} \tag{1}$$

The above formulation has a problem of infinite solutions and therefore we impose the constraint $v'x_i = 1$, which leads to:

$$\begin{aligned} &\min_{\mu,\varphi} (\mu'y_i), \\ &\varphi'x_i = 1 \\ &\mu'y_i - \varphi'x_j \leq 0 \qquad j = 1, 2, \ldots, N, \end{aligned}$$

[2] A good reference book on efficiency measures are Thanassoulis (2001), Cooper et al. (2000), and Avkiran (2002).

$$\mu,\varphi \geq 0 \qquad (2)$$

where we change notation from u and v to μ and φ, respectively, in order to reflect transformations. Using the duality in linear programming, an equivalent envelopment form of this problem can be derived:

$$\begin{aligned} &\min_{\theta,\lambda} \theta, \\ &y_i + Y\lambda \geq 0 \\ &\theta x_i - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (3)$$

where θ is a scalar representing the value of the efficiency score for the ith bank which will range between 0 and 1. λ is a vector of N x 1 constants. The linear programming has to be solved N times, once for each bank in the sample. In order to calculate efficiency under the assumption of variable returns to scale, the convexity constraint ($N1'\lambda = 1$) will be added to ensure that an inefficient bank is only compared against banks of similar size, and therefore provides the basis for measuring economies of scale within the DEA concept. The convexity constraint determines how closely the production frontier envelops the observed input-output combinations and is not imposed in the constant returns to scale case. The variable returns to scale technique therefore forms a convex hull which envelops the data more tightly than the constant returns to scale, and thus provides efficiency scores that are greater than or equal to those obtained from the constant returns to scale model.

3.1: Data Sample, Inputs-Outputs Definition, and the Choice of Variables

It is commonly acknowledged that the choice of variables in efficiency studies significantly affects the results. The problem is compounded by the fact that variable selection is often constrained by the paucity of data on relevant variables. The cost and output measurements in banking are especially difficult because many of the financial services are jointly produced and prices are typically assigned to a bundle of financial services. Two approaches dominate the banking theory literature: the production and intermediation approaches (Sealey and Lindley, 1977).

Under the production approach, pioneered by Benston (1965), banks are primarily viewed as providers of services to customers. The input set under this approach includes physical variables (e.g. labour, material) or their associated costs, since only physical inputs are needed to perform transactions, process financial documents, or provide counselling and

advisory services to customers. The output under this approach represents the services provided to customers and is best measured by the number and type of transactions, documents processed or specialized services provided over a given time period. This approach has primarily been employed in studying the efficiency of bank branches.

Under the intermediation approach, financial institutions are viewed as intermediating funds between savers and investors. In our case, Islamic banks produce intermediation services through the collection of deposits and other liabilities and in turn these funds are invested in productive sectors of the economy, yielding returns uncontaminated by usury (*riba'*). This approach regard deposits, labour and physical capital as inputs, while loans and investments are treated as output variables.

Following among others, Hassan and Hussein (2003), Hassan (2005), and Sufian (2006), a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) will be adopted in the definition of inputs and outputs used in this study. Furthermore, as at most times bank branches are engaged in the processing of customer documents and bank funding, the production approach might be more suitable for branch efficiency studies (Berger and Humphrey, 1997).

Due to entry and exit factor, the efficiency frontier is constructed by using an unbalanced sample of 37 Islamic banks operating in the MENA and Asian countries during the period 2001-2006 (see Appendix 1) yielding 145 bank year observations. We are able to collect data on three outputs and two input variables. Data for the empirical analysis is sourced from individual bank's annual balance sheet and income statements. The Islamic banks are modelled as multi-product firms producing three outputs namely, *Total Loans* (*y1*), which include loans to customers and other banks, *Income* (*y2*), which include income derived from investment of depositors' funds and other income from Islamic banking operations, and Investments (*y3*), which include investment securities held for trading, investment securities available for sale (AFS), and investment securities held to maturity, by engaging two inputs namely, *Total Deposits* (*x1*), which include deposits from customers and other banks and *Assets* (*x2*). All variables are measured in millions of US Dollars (US$) and are deflated against the respective countries inflation rates.

Table 1: Summary Statistics of the Variables Employed in the DEA Model (in million of USD)

	Outputs	Mean	Min	Max	Std. Dev.
2001	Financing (y1)	2,072,602.20	41.73	10,127,108.75	2,858,233.51
	Investments (y2)	6,691,818.63	113.79	98,658,773.96	23,748,897.10
	Income (y3)	760,628.07	20.71	9,124,336.72	2,185,785.00
2002	Financing (y1)	436,725,814.92	71.43	5,464,190,981.43	1,403,710,407.37
	Investments (y2)	75,476,773.68	8.73	1,193,633,952.25	265,332,610.34
	Income (y3)	18,521,780.54	4.75	379,620,106.10	82,744,260.85
2003	Financing (y1)	26,572,480.58	2,009.60	416,601,653.92	92,380,809.38
	Investments (y2)	6,518,317.11	194.15	93,618,349.20	19,429,432.20
	Income (y3)	1,451,191.71	650.65	24,832,529.26	5,032,611.17
2004	Financing (y1)	18,135,724.37	5,224.93	323,001,142.04	67,651,398.47
	Investments (y2)	6,707,779.89	756.78	43,835,869.28	14,487,455.74
	Income (y3)	2,302,795.89	351.84	25,098,976.78	6,619,554.55
2005	Financing (y1)	14,044,631.95	277.97	311,078,473.37	55,650,834.74
	Investments (y2)	14,361,269.97	2.68	201,638,954.33	46,536,727.74
	Income (y3)	3,057,397.21	14.69	51,332,114.52	10,182,399.79
2006	Financing (y1)	13,057,215.55	608.50	238,726,790.45	46,704,970.74
	Investments (y2)	18,498,465.31	191.34	260,950,844.15	57,148,112.49
	Income (y3)	1,849,348.31	0.06	18,062,628.65	4,835,066.26
	Inputs	**Mean**	**Min**	**Max**	**Std. Dev.**
2001	Deposits (x1)	8,267,557.40	115.12	100,794,576.43	24,113,054.41
	Assets (x2)	12,826,816.98	460.00	137,966,754.66	33,304,908.22
2002	Deposits (x1)	5,980,134.28	40.47	57,721,407.81	13,404,907.36
	Assets (x2)	394,190,262.99	111.16	8,108,073,819.63	1,767,562,290.72
2003	Deposits (x1)	3,481,569.09	6,961.74	27,186,513.93	7,612,158.24
	Assets (x2)	30,061,673.61	10,952.30	632,102,153.22	125,771,372.95
2004	Deposits (x1)	5,814,208.50	5,861.32	40,606,842.97	11,409,513.78
	Assets (x2)	42,203,902.57	14,154.81	523,513,391.86	123,458,218.74
2005	Deposits (x1)	11,050,531.60	190.89	232,074,760.72	41,164,029.17
	Assets (x2)	39,202,139.38	375.66	521,518,425.02	114,739,713.41
2006	Deposits (x1)	14,250,404.28	497.19	304,246,781.34	58,669,598.79
	Assets (x2)	35,838,563.77	1.70	381,024,893.90	99,967,808.74

Source: Banks Annual Reports

4.0 RESULTS

In this section, we will discuss the technical efficiency change (TE) of the MENA and Asian Islamic banking sectors, measured by the DEA method and its decomposition into pure technical efficiency (PTE) and scale efficiency (SE) components. In the event of the existence of scale inefficiency, we will attempt to provide evidence on the nature of the returns to scale of each Islamic bank. The Islamic banks' efficiency is first examined for each year under investigation before we proceed to examine the MENA and the Asian Islamic banks' efficiency results separately.

As suggested by Bauer et al. (1998), DeYoung and Hasan (1998), and Isik and Hassan (2002), constructing an annual frontier specific to each year is more flexible and thus more appropriate than estimating a single multiyear frontier for the banks in the sample. Following the earlier studies, for the purpose of the study, we prefer to estimate separate annual efficiency frontier for each year. In other words, there were six separate frontiers constructed for the study. Isik and Hassan (2002) contended that the principal advantage of having panel data is the ability to observe each bank more than once over a period of time. The issue is also critical in a continuously changing business environment because the technology of a bank that is most efficient in one period may not be the most efficient in another. Furthermore, by doing so, we alleviate, at least to an extent, the problems related to the lack of random error in DEA by allowing an efficient bank in one period to be inefficient in another, assuming that the errors owing to luck or data problems are not consistent over time (Isik and Hassan, 2002).

4.1 Efficiency of the MENA and Asian Islamic Banking Sectors

Table 2 presents the mean efficiency scores of the Islamic banks for the years 2001 (Panel A), 2002 (Panel B), 2003 (Panel C), 2004 (Panel D), 2005 (Panel E), 2006 (Panel F), and All Years (Panel G). The results seem to suggest that the Islamic banks' mean technical efficiency has been on a declining trend during the years 2001 to 2003, increased during the year 2004, before declining again in years 2005 and 2006. It is clear from Table 2 that during the period of study, the Islamic banks have exhibited mean technical efficiency of 65.4%. The results suggest that the Islamic banks could have saved 34.6% of the inputs to produce the same amount of outputs that they produced. In other words, the Islamic banks could have produced the same amount of outputs produced by using only 65.4% of the amount of inputs used. The decomposition of technical efficiency into its pure technical and scale efficiency components suggest that pure technical inefficiency dominates scale inefficiency of the Islamic banks during all years except for the year 2006 when pure technical efficiency was higher compared to scale efficiency. Overall the results imply that during the period of study, although the Islamic banks have been operating at a

relatively optimal scale of operations, they were managerially inefficient to exploit their resources to the fullest.

Table 2: Summary Statistics of Efficiency Scores

The table presents mean, minimum, maximum, and standard deviation of the Islamic banks technical efficiency (TE), and its mutually exhaustive pure technical efficiency (PTE) and scale efficiency (SE) components derived from the DEA. Panel A, B, C, D, E, and F shows the mean, minimum, maximum and standard deviation of TE, PTE, and SE of the Islamic banks for the years 2001, 2002, 2003, 2004, 2005, and 2006 respectively. Panel G presents the Islamic banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores for all years. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: All Banks 2001				
Technical Efficiency	0.869	0.255	1.000	0.189
Pure Technical Efficiency	0.907	0.266	1.000	0.188
Scale Efficiency	0.961	0.745	1.000	0.082
Panel B: All Banks 2002				
Technical Efficiency	0.545	0.217	1.000	0.259
Pure Technical Efficiency	0.607	0.217	1.000	0.286
Scale Efficiency	0.929	0.441	1.000	0.164
Panel C: All Banks 2003				
Technical Efficiency	0.231	0.028	1.000	0.320
Pure Technical Efficiency	0.334	0.057	1.000	0.349
Scale Efficiency	0.759	0.092	1.000	0.321
Panel D: All Banks 2004				
Technical Efficiency	0.842	0.251	1.000	0.196
Pure Technical Efficiency	0.909	0.621	1.000	0.126
Scale Efficiency	0.920	0.397	1.000	0.156
Panel E: All Banks 2005				
Technical Efficiency	0.817	0.440	1.000	0.183
Pure Technical Efficiency	0.825	0.458	1.000	0.183
Scale Efficiency	0.990	0.896	1.000	0.021
Panel F: All Banks 2006				
Technical Efficiency	0.640	0.237	1.000	0.255
Pure Technical Efficiency	0.798	0.329	1.000	0.209
Scale Efficiency	0.790	0.405	1.000	0.186
Panel G: All Banks All Years				
Technical Efficiency	0.654	0.028	1.000	0.324
Pure Technical Efficiency	0.727	0.057	1.000	0.307
Scale Efficiency	0.889	0.092	1.000	0.199

Note: Detailed results are available from the authors upon request

Table 3 presents the results of the MENA Islamic banks. It is clear that the MENA Islamic banks' efficiency was on a declining trend from the years 2001 to 2003, increased in year 2004, before declining again during the years 2005 and 2006. The results seem to suggest that the MENA Islamic banks have exhibited mean technical efficiency of 66.7%, suggesting mean input waste of 33.3%. This implies that the Islamic banks in the MENA countries could have produced the same amount of outputs by only using 66.7% of the amount of inputs it employed. From Table 3 it is also clear that pure technical inefficiency outweighs scale inefficiency in determining the total technical efficiency of the MENA Islamic banks during the period of study.

During the period of study, we find that banks from Iran were the most efficient from the MENA region, exhibiting a mean efficiency score of 85.4%, followed by banks from Bahrain and Qatar with a mean efficiency score of 77.8% and 71.1% respectively. On the other hand, the results seem to suggest that the Kuwaiti banking sector were the least efficient, recording a mean efficiency of 44.8%, followed by Yemen, and Sudan banks with a mean efficiency levels of 47.8% and 49.3% respectively.

It is interesting to note that while pure technical inefficiency outweighs scale inefficiency in Bahrain, Qatar, Saudi Arabia, UAE, Yemen, Egypt, and Kuwait Islamic banking sectors, the results seem to suggest that scale inefficiency outweighs pure technical inefficiency in the Gambia, Iran, and Sudan Islamic banking sectors. In essence, the findings imply that while the Islamic banks in Bahrain, Qatar, Saudi Arabia, UAE, Yemen, Egypt, and Kuwait were managerially inefficient in controlling their operating costs and utilize their resources to the fullest, the Islamic banks in Gambia, Iran, and Sudan were found to have been operating at a relatively non-optimal scale of operations i.e. either they were too small or too large to be scale efficient

Table 3: Summary Statistics of Efficiency Scores

The table presents mean, minimum, maximum, and standard deviation of the MENA Islamic banks technical efficiency (TE), and its mutually exhaustive pure technical efficiency (PTE) and scale efficiency (SE) components derived from the DEA. Panel A, B, C, D, E, and F shows the mean, minimum, maximum and standard deviation of TE, PTE, and SE of the Islamic banks for the years 2001, 2002, 2003, 2004, 2005 and 2006 respectively. Panel G presents the MENA Islamic banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores for all years. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Banks	Mean	Minimum	Maximum	Std. Dev.
Panel A: MENA Banks 2001				
Technical Efficiency	0.914	0.695	1.000	0.112
Pure Technical Efficiency	0.946	0.695	1.000	0.098
Scale Efficiency	0.968	0.745	1.000	0.081
Panel B: MENA Banks 2002				
Technical Efficiency	0.529	0.217	1.000	0.255
Pure Technical Efficiency	0.602	0.217	1.000	0.297
Scale Efficiency	0.922	0.441	1.000	0.181
Panel C: MENA Banks 2003				
Technical Efficiency	0.228	0.028	1.000	0.313
Pure Technical Efficiency	0.356	0.069	1.000	0.350
Scale Efficiency	0.723	0.092	1.000	0.347
Panel D: MENA Banks 2004				
Technical Efficiency	0.836	0.251	1.000	0.210
Pure Technical Efficiency	0.913	0.631	1.000	0.121
Scale Efficiency	0.906	0.397	1.000	0.175
Panel E: MENA Banks 2005				
Technical Efficiency	0.823	0.440	1.000	0.197
Pure Technical Efficiency	0.831	0.458	1.000	0.194
Scale Efficiency	0.989	0.896	1.000	0.024
Panel F: MENA Banks 2006				
Technical Efficiency	0.700	0.398	1.000	0.229
Pure Technical Efficiency	0.825	0.522	1.000	0.185
Scale Efficiency	0.840	0.558	1.000	0.149
Panel G: MENA Banks All Years				
Technical Efficiency	0.667	0.028	1.000	0.235
Pure Technical Efficiency	0.741	0.069	1.000	0.183
Scale Efficiency	0.890	0.092	1.000	0.078

Note: Detailed results are available from the authors upon request

Next we discuss the findings of the efficiency for the Asian Islamic banks. Similar to their MENA Islamic banks peers, the results from Table 4 seem to suggest that the Islamic banks in the Asian countries have exhibited a declining trend during the earlier part of the study, increased in 2004, before declining again in years 2005 and 2006. During the years, the Asian Islamic banks have exhibited a lower mean technical efficiency of 61.4% (MENA Islamic banks – 66.7%). It is also clear from Table 4 that pure technical inefficiency outweighs scale inefficiency in determining the total technical inefficiency of the Asian Islamic banks.

During the period of study, we find that banks in Indonesia were the most efficient from the Asian region, exhibiting a mean efficiency score of 92.3%, followed by banks in Pakistan and Bangladesh with a mean efficiency score of 64.3% and 57.45 respectively. On the other hand, we find that the Islamic banks in Malaysia were the least efficient, recording a mean efficiency score of 50.5%.

Unlike their counterparts in the MENA region, the empirical findings seem to suggest that pure technical inefficiency outweighs scale inefficiency in determining the total technical inefficiency in all of the Asian Islamic banking sectors. Thus, the findings imply that although the Asian Islamic banking sectors have been operating at a relatively optimal scale of operations, they were relatively managerially inefficiency in controlling their operating costs and utilizing their resources to the fullest.

4.2 Composition of the Efficiency Frontier

While the results above highlight the sources of technical inefficiency of the Islamic banks, we next turn to discuss the sources of the scale inefficiency of the Islamic banks. As have been mentioned earlier, a bank can operate at CRS or VRS where CRS signifies that an increase in inputs results in a proportionate increase in outputs and VRS means a rise in inputs results in a disproportionate rise in outputs. Further, a bank operating at VRS can be at increasing returns to scale (IRS) or decreasing returns to scale (DRS). Hence, IRS means that an increase in inputs results in a higher increase in outputs, while DRS indicate that an increase in inputs results in lesser output increases.

To identify the nature of returns to scale, first the CRS scores (obtained with the CCR model) is compared with VRS (using BCC model) scores. For a given bank, if the VRS score equals to its CRS score, the bank is said to be operating at constant returns to scale (CRS). On the other hand, if the scores are not equal, a further step is needed to establish whether the bank is operating at IRS or DRS. To do this, the DEA model is used under the non-increasing returns to scale assumptions (NIRS). If the score under VRS equals the NIRS score, then the bank is said to be operating at DRS.

Table 4: Summary Statistics of Efficiency Scores

The table presents mean, minimum, maximum, and standard deviation of the Asian Islamic banks technical efficiency (TE), and its mutually exhaustive pure technical efficiency (PTE) and scale efficiency (SE) components derived from the DEA. Panel A, B, C, D, E, and F shows the mean, minimum, maximum and standard deviation of TE, PTE, and SE of the Islamic banks for the years 2001, 2002, 2003, 2004, 2005, and 2006 respectively. Panel G presents the Asian Islamic banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores for all years. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Banks	Mean	Minimum	Maximum	Std. Dev.
Panel A: Asian Banks 2001				
Technical Efficiency	0.658	0.255	0.900	0.351
Pure Technical Efficiency	0.722	0.266	1.000	0.398
Scale Efficiency	0.925	0.818	1.000	0.095
Panel B: Asian Banks 2002				
Technical Efficiency	0.597	0.372	1.000	0.296
Pure Technical Efficiency	0.622	0.372	1.000	0.279
Scale Efficiency	0.952	0.763	1.000	0.106
Panel C: Asian Banks 2003				
Technical Efficiency	0.239	0.057	1.000	0.374
Pure Technical Efficiency	0.264	0.057	1.000	0.367
Scale Efficiency	0.875	0.475	1.000	0.204
Panel D: Asian Banks 2004				
Technical Efficiency	0.865	0.602	0.995	0.152
Pure Technical Efficiency	0.894	0.621	1.000	0.157
Scale Efficiency	0.967	0.927	0.995	0.026
Panel E: Asian Banks 2005				
Technical Efficiency	0.804	0.605	1.000	0.159
Pure Technical Efficiency	0.812	0.605	1.000	0.164
Scale Efficiency	0.991	0.952	1.000	0.015
Panel F: Asian Banks 2006				
Technical Efficiency	0.496	0.237	1.000	0.268
Pure Technical Efficiency	0.736	0.329	1.000	0.259
Scale Efficiency	0.670	0.405	1.000	0.219
Panel G: Asian Banks All Years				
Technical Efficiency	0.614	0.057	1.000	0.254
Pure Technical Efficiency	0.685	0.057	1.000	0.296
Scale Efficiency	0.889	0.405	1.000	0.048

Note: Detailed results are available from the authors upon request

Alternatively, if the score under VRS is different from the NIRS score, than the bank is said to be operating at IRS (Coelli et al., 1998). Table 5 shows the banks that lie on the efficiency frontier. The composition of the efficiency frontier suggests that the 100% efficient banks vary between six to 19 banks. During the period of study, MENA Islamic banks seem to have dominated the efficiency frontier, while two MENA Islamic banks have failed to appear at least once on the frontier. It is also clear from the results that four MENA Islamic banks namely, Abu Dhabi Islamic Bank, Al-Baraka Islamic Bank, Arab Banking Corporation, and Bahrain Islamic Bank were the global leaders by appearing the most on the efficiency frontier.

In general, the table indicates that while the small banks tend to operate at CRS or IRS, the large banks tend to operate at CRS or DRS, the findings which are similar to the earlier studies by among others McAllister and McManus (1993) and Noulas et al. (1990). To recap, McAllister and McManus (1993) have suggested that while the small banks have generally exhibited IRS, the large banks on the other hand tend to exhibit DRS and at best CRS. As it appears, the small Islamic banks have experienced increasing returns to scale (IRS) in their operations during the period of the study. One implication is that for the small Islamic banks, a proportionate increase in inputs would result in more than a proportional increase in outputs. Hence, the small Islamic banks which have been operating at IRS could achieve significant cost savings and efficiency gains by increasing its scale of operations. In other words, substantial gains can be obtained from altering the scale via internal growth or further consolidation in the sector. In fact, in a perfectly competitive and contestable market, the efficient banks should absorb the scale inefficient banks, in order to exploit cost advantages. Thus, the banks that experience IRS should either eliminate their scale inefficiency or will become a prime target for acquiring banks, which can create value from underperforming banks, and thus streamlining their operations and eliminating their redundancies and inefficiencies (Evanoff and Israelvich, 1991). On the other hand, the results seem to suggest that further increase in size would only result in a smaller increase of outputs for every proportionate increase in inputs of the large banks, resulting from the fact that the large banks have been operating at declining returns to scale (DRS) during the period. Hence, decision-makers ought to be more cautious in promoting mergers among the large banks as a means to enjoying efficiency gains.

Table 5: Evolution of Efficiency Scores over the Years

Bank	Region	2001	2002	2003	2004	2005	2006	Count Bank
Abu Dhabi Islamic Bank	MENA	CRS	CRS	IRS	CRS	CRS	DRS	4
Al-Amin Bank	MENA				CRS	CRS	CRS	3
Al-Arafah Islami Bank	ASIA			CRS	DRS	CRS		2
Al-Baraka Islami Bank B.S.C	MENA		CRS	CRS	CRS	CRS		4
Al-Baraka South Africa	MENA	CRS	IRS	IRS	IRS	IRS	DRS	1
Al-Baraka Sudan	MENA			IRS	IRS	CRS	DRS	1
Al-Rajhi Banking	MENA	CRS	DRS	CRS	CRS			3
Al-Salam Bank	MENA						CRS	1
Al-Baraka Islamic Bank B.S.C.	ASIA					IRS	DRS	0
Arab Banking Corporation	MENA	CRS	CRS	IRS	CRS	CRS	DRS	4
Arab Gambian Islamic Bank	MENA				DRS	CRS		1
Bahrain Islamic Bank	MENA	CRS	CRS	CRS		CRS	DRS	4
Bank Al-Jazira	MENA	DRS	CRS	IRS		DRS		1
Bank Islam Malaysia Berhad	ASIA	DRS	CRS	IRS	DRS	DRS		1
Bank Mellat	MENA					IRS	CRS	2
Bank Muamalat Indonesia	ASIA					CRS	CRS	2
Bank Muamalat Malaysia Berhad	ASIA	CRS	CRS	IRS	DRS	DRS	DRS	2
Bank Refah	MENA	CRS	IRS			IRS		1
Dubai Islamic Bank	MENA	CRS	CRS	IRS	DRS	DRS	DRS	2
EG Saudi Financial Bank	MENA				IRS	CRS		1
Emirates Islamic Bank	MENA					CRS	DRS	1
Faisal Islamic Bank	MENA		CRS	IRS	CRS	CRS		3
Gulf Finance House	MENA			IRS	CRS	CRS	CRS	3
Islamic Bank Bangladesh	ASIA					CRS	DRS	1
Ithmaar Bank	MENA					CRS	DRS	1
Kuwait Finance House	MENA	CRS	DRS	IRS	DRS	DRS	DRS	1
Kuwait Finance House (Turkey)	MENA	CRS	IRS	IRS				1
Kuwait Finance House (Malaysia)	ASIA					CRS	DRS	1
Mashreq Bank	MENA	CRS	CRS	IRS	DRS	CRS	DRS	3
Meezan Bank	ASIA	IRS	IRS	IRS	IRS	IRS	DRS	0
Qatar International Islamic Bank	MENA			IRS	IRS	CRS	CRS	2
Shah Jalal Islami Bank	ASIA		DRS	CRS	DRS	DRS	DRS	1
Shamil Bank	MENA	DRS	CRS	IRS	DRS	DRS	DRS	1
Sharjah Islamic Bank	MENA	IRS	CRS	IRS				1
Standard Chartered Modharaba	ASIA		CRS	CRS		CRS	DRS	3
Tadhamon International Islamic Bank	MENA	IRS	IRS	IRS	IRS		DRS	0
Taib Bank	MENA			IRS	DRS	IRS	DRS	0
Count Year		11	13	6	7	19	6	

Note: CRS – (Constant Returns to Scale); DRS – (Decreasing Returns to Scale); IRS – (Increasing Returns to Scale).
The banks corresponds to the shaded regions have not been efficient in any year in the sample period (2001-2006) compared to the other banks in the sample.
'Count Year' denotes the number of banks appearing on the efficiency frontier during the year.
'Count Bank' denotes the number of times a bank has appeared on the efficiency frontier during the period of study.

5.0 Conclusions and Directions for Future Research

In this paper, we examine the performance of the MENA and Asian Islamic banks during the period 2001-2006. The efficiency estimates of individual banks are evaluated using the non-parametric Data Envelopment Analysis (DEA) approach.

The empirical findings suggest that pure technical inefficiency outweighs scale inefficiency in the Islamic banking sector implying that the Islamic banks have been managerially inefficient in exploiting their resources to the fullest extent. The empirical findings seem to suggest that the MENA Islamic banks have exhibited higher technical efficiency compared to their Asian Islamic banks counterparts. During the period of study we find that pure technical inefficiency has greater influence in determining the total technical inefficiency of the MENA and the Asian Islamic banking sectors.

Due to its limitations, the paper could be extended in a variety of ways. Firstly, the scope of this study could be further extended to investigate changes in cost, allocative, and technical efficiencies over time. Secondly, it is suggested that further analysis into the investigation of the Islamic banking sector efficiency to consider risk exposure factors. Thirdly, future research into the efficiency of the Islamic banking sector efficiency could also consider the production function along with the intermediation function. Finally, investigation of changes in productivity over time as a result of technical change or technological progress or regress by employing the Malmquist Total Factor Productivity Index could yet be another extension to the paper.

References

Avkiran, N.K. (2002) *Productivity Analysis in the Service Sector with Data Envelopment Analysis*. Camira: N.K. Avkiran.

Benston, G.J. (1965) Branch Banking and Economies of Scale, *Journal of Finance* 20 (2), 312-331.

Bauer, P.W., Berger, A.N., Ferrier, G. D. and Humphrey, D.B. (1998), Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods, *Journal of Economics and Business* 50 (2), 85-114.

Berger, A.N. and Humphrey, D.B. (1997) Efficiency of Financial Institutions: International Survey and Directions for Future Research, *European Journal of Operational Research* 98 (2), 175-212.

Coelli, T. (1996) A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer Program), *Working Paper*, CEPA, University of New England, Armidale.

Coelli, T., Rao, D.S.P. and Batesse, G.E. (1998) *An Introduction to Efficiency and Productivity Analysis*. Boston, MA: Kluwer Academic Publishers.

Cooper, W.W., Seiford, L. M. and Tone, K. (2000) *Data Envelopment Analysis.* Boston: Kluwer Academic Publishers.

DeYoung, R. and Hasan, I. (1998), The Performance of De Novo Commercial Banks: A Profit Efficiency Approach, *Journal of Banking and Finance* 22 (5), 565-587.

El-Gamal and Inanoglu (2004) Islamic Banking in Turkey: Boon or Bane for the Financial Sector, *Proceedings of the Fifth Harvard University Forum on Islamic Finance*, Cambridge: Center for Middle Eastern Studies, Harvard University.

Hassan, M.K. (2005) The Cost, Profit and X-Efficiency of Islamic Banks, Paper Presented at the 12th ERF Annual Conference, 19th-21st December, Egypt.

Hassan, M.K and Hussein, K.A. (2003) Static and Dynamic Efficiency in the Sudanese Banking System, *Review of Islamic Economics* 14, 5-48.

Hussein, K.A. (2003) Operational Efficiency in Islamic Banking: The Sudanese Experience, *Working Paper No. 1*, Islamic Research and Training Institute (IRTI), Islamic Development Bank.

Isik, I. and Hassan, M.K. (2002), Technical, Scale and Allocative Efficiencies of Turkish Banking Industry, *Journal of Banking and Finance* 26 (4), 719-766.

Evanoff. D.D. and Israelvich, P.R. (1991) Productive Efficiency in Banking, *Economic Perspectives* Federal Reserve Bank of Chicago (July/August), 11-32.

McAllister, P.H. and McManus, D.A. (1993) Resolving the Scale Efficiencies Puzzle in Banking, *Journal of Banking and Finance* 17 (2-3), 389-405.

Noulas, A.G. Ray, S.C. and Miller, S.M. (1990) Returns to Scale and Input Substitution for Large U.S. Banks, *Journal of Money, Credit and Banking* 22 (1), 94-108.

Samad, A. (1999) Comparative Efficiency of the Islamic Bank vis-à-vis Conventional Banks in Malaysia, *IIUM Journal of Economics and Management* 7 (1), 1-25.

Sealey, C. and Lindley, J.T. (1977) Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions, *Journal of Finance* 32 (4), 1251-1266.

Sufian, F. (2006) Size and Returns to Scale of the Islamic Banking Industry in Malaysia: Foreign Versus Domestic Banks, *IIUM Journal of Economics and Management* 14 (2), 147-175.

Thanassoulis, E. (2001) *Introduction to the Theory and Application of Data Envelopment Analysis: A Foundation Text with Integrated Software*. Boston: Kluwer Academic Publishers.

Zaher, T.S. and Hassan, M.K. (2001) A Comparative Literature Survey of Islamic Finance and Banking, *Financial Markets, Institutions & Instruments* 10 (4), 155-199.

APPENDIX 1

Country / Year	2001	2002	2003	2004	2005	2006
Bahrain	3	4	6	6	8	8
Bangladesh		1	2	2	3	2
Egypt		1	1	1	1	
Gambia				1	1	
Indonesia					1	1
Iran	1	1			2	1
Kuwait	1	1	1	1	1	1
Malaysia	2	2	2	2	3	2
Pakistan	1	2	2	1	3	3
Saudi Arabia	2	2	2	2	2	1
Turkey	1	1	1			
United Arab Emirates	4	4	4	3	4	4
Qatar			1	1	1	1
South Africa	1	1	1	1	1	1
Sudan			1	1	1	1
Yemen	1	1	1	1		1
Total	**17**	**21**	**25**	**23**	**32**	**27**