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SIZE AND RETURNS TO SCALE OF THE ISLAMIC BANKING INDUSTRY IN MALAYSIA: FOREIGN VERSUS DOMESTIC BANKS

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ABSTRACT

This paper investigates the efficiency of the Malaysian Islamic banking sector during the period of 2001-2004. The efficiency estimates of individual banks are evaluated using the non-parametric Data Envelopment Analysis (DEA) method. The method allows for the decomposition of the technical (overall) efficiency into its pure technical and scale efficiency components. In accordance with Islamic financial system principles, the intermediation approach is applied to the specification of input-output variables. The findings suggest that scale inefficiency dominates pure technical inefficiency in the Malaysian Islamic banking sector, implying that Malaysian Islamic banks have been operating at the wrong scale of operations. We have also found that the domestic Islamic banks have exhibited higher technical efficiency compared to that of their foreign peers. Although the findings suggest that the foreign Islamic banks' technical efficiency is lower compared to its domestic counterparts, the results seem to suggest that the foreign Islamic banks have been relatively more efficient in controlling their operating costs, thus implying that the foreign banks' inefficiency was mainly attributed to scale.

JEL classification: G21, G28

Key words: Islamic banks efficiency, Data envelopment analysis (DEA), Malaysia

*All findings, interpretations, and conclusions are solely of the author and do not necessarily represent the views of the institution.

1. INTRODUCTION

Since the opening of the first Islamic bank in Egypt in 1963, Islamic banking has grown rapidly all over the world. 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. This was further intensified by the 1975 oil price boom, which introduced a huge amount of capital inflows to Islamic countries. In fact, two Islamic nations, Iran and Pakistan, completely abandoned the conventional banking system and converted their entire financial operations to Islamic practices and claim to be devoid of conventional interest based financial transactions.

Islamic banking in Malaysia differs from Islamic banking in the Gulf and the rest of the world (Samad, Gardner, and Cook, 2005). The country's first Islamic bank, Bank Islam Malaysia Berhad (BIMB), was established in July 1983. A decade later, the government introduced the Interest Free Banking Scheme, which made Malaysia among the first to have a full-fledged Islamic system operating side-by side with the conventional banking system.[1] Under this framework, conventional banking institutions were allowed to provide Islamic banking services within their existing banking establishment known as the Islamic Banking Scheme (IBS). From only three banks offering Islamic financing in March 1993, the number of conventional banks that offered Islamic financing has increased to 15, of which 4 are foreign banks (see Table 1).

Today, the Malaysian Islamic banking system is becoming an effective means of financial intermediation reflected by its extensive distribution networks comprising 152 full-fledged Islamic banking branches and more than 2,000 Islamic banking counters. The ability of the Islamic banking institutions to arrange and offer products with attractive and innovative features at prices that are competitive with conventional products, has appealed to both the Muslim and non-Muslim customers. This has spurred the efforts by other non-bank financial institutions such as the development financial institutions, savings institutions and housing credit institutions to introduce Islamic banking schemes and instruments to meet their customer demands.

TABLE 1
Conventional Banks Offering Islamic Banking Window Services in Malaysia

Banks	2001			2002		
Input Variables	Deposits	Loans	Asset	Deposits	Loans	Asset
Domestic Banks						
Affin Bank Berhad	2,386,741	1,384,147	3,143,792	3,920,668	1,317,700	4,192,584
Alliance Bank	311,353	57,564	386,465	642,187	63,589	723,479
Arab-Malaysian Bank	1,138,656	581,214	1,197,277	984,443	556,229	1,097,936
EON Bank	1,584,571	1,227,941	1,776,449	2,549,525	1,889,178	2,867,071
Hong Leong Bank	2,099,076	1,098,533	2,489,101	2,812,932	1,682,525	3,543,413
Maybank	9,064,966	6,409,411	10,358,576	12,166,584	8,253,532	13,204,458
Public Bank	3,088,373	1,698,577	3,389,161	4,127,821	3,659,941	4,750,734
RHB Bank	3,197,795	1,849,272	3,736,258	3,646,507	1,999,090	4,295,069
Southern Bank	633,319	339,528	811,913	605,877	505,961	762,104
Foreign Banks						
Standard Chartered Bank	112,941	26,377	140,156	62,266	20,796	93,056
Hong Kong Bank	79,679	112,322	150,136	197,152	223,314	243,985
OCBC	470,301	169,856	1,307,448	1,037,315	216,906	1,096,332
Citibank	186,785	196,494	225,695	122,946	148,452	167,869
Full-Fledged Islamic Banks						
Bank Islam Malaysia	9,027,099	5,033,050	10,335,296	10,929,881	5,689,002	12,130,915
Bank Muamalat	4,965,251	1,968,617	5,438,666	6,133,357	2,160,042	6,561,482

TABLE 1 (continued)

Banks	2003			2004		
Input Variables	Deposits	Loans	Asset	Deposits	Loans	Asset
Domestic Banks						
Affin Bank Berhad	3,188,862	1,321,520	3,509,064	2,287,365	1,170,625	3,158,467
Alliance Bank	891,149	161,482	966,868	1,104,485	643,763	1,231,948
Arab-Malaysian Bank	898,370	675,365	986,041	1,096,310	766,434	1,329,375
EON Bank	2,568,746	2,411,725	3,075,361	3,463,843	3,337,485	3,935,118
Hong Leong Bank	2,877,670	1,807,037	3,354,981	3,244,083	2,164,828	3,805,322
Maybank	12,577,435	11,703,438	15,578,265	15,965,833	14,581,517	15,578,265
Public Bank	5,189,352	5,805,126	6,514,721	7,076,968	6,179,167	8,208,568
RHB Bank	5,212,964	2,794,834	6,013,309	4,957,027	3,755,595	6,221,575
Southern Bank	712,191	564,208	852,280	969,256	601,768	1,050,524
Foreign Banks						
Standard Chartered Bank	149,331	17,096	190,415	627,564	11,480	1,088,447
Hong Kong Bank	722,531	717,137	1,854,076	2,014,402	1,778,087	3,208,574
OCBC	1,565,941	346,292	1,643,753	1,397,541	865,927	1,576,225
Citibank	97,797	141,737	150,511	761,356	216,273	838,956
Full-Fledged Islamic Banks						
Bank Islam Malaysia	12,397,134	6,890,765	13,717,155	11,618,023	7,640,474	12,958,514
Bank Muamalat	6,846,533	2,140,966	7,315,942	7,459,031	2,703,321	8,070,831

Throughout the years, Islamic banking in Malaysia has gained significance, and has been on a progressive upward trend. Since 2000, the Islamic banking industry has been growing at an average rate of 19 percent per annum in terms of assets against the global growth rate of 15 percent (Rosly, 2005). As at end of 2005, total assets of the Islamic banking sector has increased to RM111.8 billion, which accounted for 11.7 percent of the banking system's total assets, while the market share of Islamic deposits and financing has increased to 11.7 percent and 12.1 percent of total banking sector deposits and financing respectively and is set to command a 20 percent market share by the year 2010 (Rosly, 2005). The rapid progress of the domestic Islamic banking system, accentuated by the significant expansion and developments in Islamic banking and finance has increasingly become more important in meeting the changing requirements of the new economy (Bank Negara Malaysia, 2004).

Over the years, while there has been extensive literature examining the efficiency of the conventional banking industries, empirical works on Islamic bank efficiency, particularly in Malaysia is still in its infancy. Typically, studies on Islamic banks have focused on theoretical issues and empirical work has relied mainly on the analysis of descriptive statistics rather than rigorous statistical estimation (El-Gamal and Inanoglu, 2005). In addition, several studies devoted to assess the performance of Islamic banks have generally examined the relationship between profitability and Islamic banks' characteristics (Bashir, 1999; Samad and Hassan, 1999; Bashir, 2001). This study therefore attempts to fill the gap in the literature by providing new empirical evidence on the relative operating performance of domestic and foreign conventional banks offering Islamic banking products and services by using a non-parametric frontier based Data Envelopment Analysis (DEA) approach. Although there are currently a few studies that have examined the performance of Islamic banks in Malaysia, we are not aware of any study that has analysed the efficiency of Malaysian Islamic banks employing a non-parametric DEA method.

Since its introduction by Charnes, Cooper and Rhodes (1978), researchers have welcomed DEA as a methodology for performance evaluation (Gregoriou and Zhou, 2005). DEA has many advantages over traditional parametric techniques such as regression techniques.

While regression analysis approximates the efficiency of banks under investigation relative to the average performance, DEA in contrast, focuses on the yearly observations of individual banks and optimises the performance measure of each bank. Constructing a separate frontier for each of the years under study is a critical issue in a dynamic business environment because a bank may be the most efficient in one year but may not be in the following year. In the Malaysian context, it becomes more important, as there is an ongoing liberalisation in the banking sector over the estimation period. A separate frontier will highlight any significant changes taking place in the sector that are induced by Bank Negara Malaysia's (BNM) supervisory policies.

As Malaysia is currently vying for recognition as the capital or hub of Islamic banking worldwide, the government has taken measures, among others, to further liberalise the sector. The strategy is to create more competition, to tap new growth opportunities and to raise the efficiency of the Islamic banking industry as a whole. The Malaysian government's commitment is evidenced by the issuance of three more new full-fledged Islamic banks licenses to foreign banks from the Middle East namely, Kuwait Finance House, Al-Rajhi Banking and Investment Corporation and Asian Finance Bank. Given the ongoing liberalisation in the sector, further investigations on the performance of the Islamic banking sector are thus warranted. The study in this nature could thus help the regulatory authorities and bank managers in determining the future course of action to be pursued to further strengthen the Islamic banking sector in Malaysia, particularly the domestic incorporated Islamic banks to meet the challenges of foreign banks entry from 2007 onwards.[2] Nevertheless, the study also has important public policy implications, particularly with respect to the principal aim of the Malaysia's Financial Sector Master Plan (FSMP), a long-term development plan charting the future direction of the financial services industry in Malaysia to achieve a more competitive, resilient and efficient financial system (see BNM Financial Sector Master Plan, 2001).

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 has been extensive literature examining the efficiency features of the U.S. and European banking markets over recent years, the work on Islamic banking is still in its infancy. Typically, studies on Islamic banks' efficiency have focused on theoretical issues and the empirical works have mainly relied on the analysis of descriptive statistics rather than rigorous statistical estimation (El-Gamal and Inanoglu, 2005). However, this is gradually changing as a number of recent studies have sought to apply various frontier techniques to estimate Islamic banks' efficiency.

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 percent 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.

El-Gamal and Inanoglu (2005) substantially extended their earlier study by providing an alternative method for evaluating bank efficiency scores. Again they examined the cost efficiency of Turkish banks throughout the 1990s. They distinguished between groups of banks that had different production technologies. They found that the Islamic financial firms had the same production technology as conventional banks (mainly domestic banks) and using standard stochastic cost frontier estimates, they showed that the Islamic firms were among the most efficient.

Employing both the parametric Stochastic Frontier Approach (SFA) and non-parametric DEA techniques to a panel of banks during 1993-2001, Hassan (2005) examined the relative cost, profit, X-efficiency and productivity of the world Islamic banking industry. He further correlated the efficiency scores obtained from the DEA estimation with the conventional accounting measures of bank performance. He

found that under the profit efficiency frontier, Islamic banks are relatively more efficient with an average efficiency of 84 percent compared to 74 percent under the stochastic cost frontier estimates. He found that the main source of inefficiency was allocative rather than technical and suggested that the overall inefficiency was output related. Islamic banks were also found to be relatively less efficient compared to their conventional counterparts. All efficiency measures derived from DEA were found to be highly correlated with profitability measures used, namely return on asset (ROA) and return on equity (ROE), implying that the efficiency measures derived from the DEA estimation could be used concurrently with the conventional accounting ratios in determining Islamic banks' performance.

Hussein (2003) provided an analysis of the cost efficiency features of Islamic banks in Sudan between 1990 and 2000. Using the stochastic cost frontier approach, he estimated 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 was also novel as Sudan has a banking system based entirely on Islamic banking principles. The results showed large variations in the cost efficiency of Sudanese banks with the foreign owned banks being the most efficient. State owned banks were the most cost inefficient. The analysis was extended to examine the determinants of bank efficiency. He found that smaller banks were more efficient that their larger counterparts. In addition, banks that had higher proportion of *mushŒrakah* and *muèŒrabah* finance relative to total assets also had efficiency advantages. Overall, the substantial variability in efficiency estimates was 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 techniques were 55 percent and 50 percent respectively, while it was 23 percent under the non-parametric approach. During the period of study, they found that the Sudanese banking system had exhibited 37 percent

allocative efficiency and 60 percent technical efficiency, suggesting that the overall cost inefficiency of the Sudanese Islamic banks were mainly due to technical factors (managerial related) rather than allocative (regulatory).

Employing a series of parametric and non-parametric techniques, Isik and Hassan (2002) investigated the impact of different ownership and organisational structures on the efficiency of the Turkish banking industry over the period 1988-1996. They found that during the period of study, the overall cost and profit efficiencies of the Turkish banks were 72 percent and 83 percent respectively. They suggested that the overall cost inefficiency was mainly due to technical rather than allocative inefficiency. In the second stage regression analysis, they found a strongly negative relationship between bank size and efficiency. They also found that foreign banks operating in Turkey were relatively more efficient compared to their domestic counterparts, while private banks were found to be more efficient relative to public banks for all efficiency measures. Likewise, they found that the publicly traded banks were relatively technically more efficient compared to privately owned banks.

While the above outlines literature that used advanced modelling techniques to evaluate bank efficiency, one should also note that there is also a growing body of literature that covers the general performance features of Islamic banks. Such studies include those by Hassan and Bashir (2003) who look at the determinants of Islamic bank performance and show Islamic banks to be just as efficient as conventional banks, if one uses standard accounting measures such as cost-to-income ratios. Other studies that take a similar approach are those by Sarker (1999) who looked at the performance and operational efficiency of Bangladeshi Islamic banks, while Bashir (1999) examined the risk and profitability of two Sudanese banks. Overall, the general finding from this literature was that Islamic banks were at least as efficient as their conventional bank counterparts, and in most cases, were more efficient.

There are also several studies examining the relationship between profitability and Islamic banks' characteristics. Bashir (1999) and Bashir (2001) performed regression analyses to determine the underlying determinants of Islamic bank performance by employing bank level data in the Middle East. His results indicate that the performance of

banks, in terms of profits, was mostly generated from overheads, customer short term funding, and non-interest earning assets. Furthermore, Bashir (2001) claimed that since deposits in Islamic banks were treated as shares, reserves held by banks propagate negative impacts such as reducing the amount of funds available for investment. Samad and Hassan (1999) applied financial ratio analysis to investigate the performance of a Malaysian Islamic bank over the period 1984-1997. Their results suggested that in general, the managements' lack of knowledge was the main reason for slow growth of loans under profit sharing. Despite that, the bank was found to perform better compared to its conventional counterparts in terms of liquidity and risk measurement (lower risks).

3. METHODOLOGY

Charnes, Cooper and Rhodes (1978, hereafter CCR) introduced the term Data Envelopment Analysis (DEA), to measure the efficiency of Decision Making Units (DMUs), that is obtained as a maximum of a ratio of weighted outputs to weighted inputs. This denotes that the more the output produced from given inputs, the more efficient is the production. The weights for the ratio are determined by a restriction that the similar ratios for every DMU have to be less than or equal to, unity. This definition of efficiency measure allows multiple outputs and inputs without requiring pre-assigned weights. Multiple inputs and outputs are reduced to single 'virtual' input and single 'virtual' output by optimal weights. The efficiency measure is then a function of multipliers of the 'virtual' input-output combination.

The CCR model presupposes that there is no significant relationship between the scale of operations and efficiency by assuming constant returns to scale (CRS) and it delivers the overall technical efficiency (TE). The CRS assumption is only justifiable when all DMUs are operating at an optimal scale. However, firms or DMUs in practice might face either economies or diseconomies of scale. Thus, if one makes the CRS assumption when not all DMUs are operating at the optimal scale, the computed measures of technical efficiency will be contaminated with scale efficiencies.

Banker, Charnes, and Cooper (1984) extended the CCR model by relaxing the CRS assumption. The resulting "BCC" model was used to assess the efficiency of DMUs characterised by variable returns to scale (VRS). The VRS assumption provides the measurement of pure technical efficiency (PTE), which is the measurement of technical efficiency devoid of the scale efficiency (SE) effects. If there appears to be a difference between the TE and PTE scores of a particular DMU, then it indicates the existence of scale inefficiency.

To arrive at the basic specification of a linear-programming model underlying the DEA, 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:

$\varphi' \boldsymbol{x}_i = \mathbf{1}$

$$(1) \qquad \max_{u,v}\left(\frac{u'y_i}{v'x_i}\right)$$

subject to

$$\frac{u'y_j}{v'x_j} \le 1 \qquad j = 1,\ldots,N.$$

The above formulation has a problem of infinite solutions and therefore we impose the constraint which leads to:

$$(2) \qquad \max_{\mu,\varphi}(\mu'y_i)$$

subject to

$$\mu'y_i - \varphi'x_j \le 0 \qquad j = 1,\ldots,N,$$

where we change the 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:

(3)

subject to

$$y_i + Y\lambda \geq 0$$

$$\theta x_i - X\lambda \geq 0$$

where θ is a scalar representing the value of the efficiency score for the *i*th decision-making unit 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 DMU in the sample. In order to calculate efficiency under the assumption of VRS, the convexity constraint ( ) will be added to ensure that an inefficient firm is only compared against firms 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 VRS technique therefore forms a convex hull which envelops the data more tightly than the CRS, and thus provides efficiency scores that are greater than or equal to those obtained from the CRS model.

Five useful features of DEA are first, each DMU is assigned a single efficiency score, hence allowing ranking amongst the DMUs in the sample. Second, it highlights the areas of improvement for each single DMU. For example, since a DMU is compared to a set of efficient DMUs with similar input-output configurations, the DMU in question is able to identify whether it has used input excessively or its output has been under-produced. Third, there is possibility of making inferences on the DMUs general profile. We should be aware that the technique used here is a comparison between the production performances of each DMU to a set of efficient DMUs. The set of efficient DMUs is called the reference set. The owners of the DMUs may be interested to know which DMU frequently appears in this set. A DMU that appears more than others in this set is called the global leader. Clearly, this information gives huge benefits to the DMU owner, especially in positioning its entity in the market. Fourth, DEA does not require a preconceived structure or specific functional form to be imposed on

the data in identifying and determining the efficient frontier, error and inefficiency structures of the DMUs[3] (Evanoff and Israelvich, 1991; Grifell-Tatje and Lovell, 1997; Bauer et al., 1998). Finally, Avkiran (1999) acknowledges the edge of DEA by stating that this technique allows researchers to choose any kind of input and output of managerial interest, regardless of different measurement units. There is no need for standardisation.[4]

The main weakness of DEA, the procedure adopted in this study, is that it assumes no random error, thus implying that all deviations from the estimated frontier actually constitute X-inefficiencies. Furthermore, since efficiency is measured in a relative way, its analysis is confined to the sample set used. This means that an efficient DMU found in the analysis cannot be compared with other DMUs outside of the sample.

DEA can be used to derive measures of scale efficiency by using the VRS, or the BCC model, alongside the CRS, or the CCR model. Coelli, Prasada-Rao and Battese (1998) noted that the BCC model have been most commonly used since the beginning of the 1990s. A DEA model can be constructed either to minimise inputs or to maximise outputs. An input orientation aims at reducing the input amounts as much as possible while keeping at least the present output levels, while an output orientation aims at maximising output levels without increasing use of inputs (Cooper, Seiford and Tone, 2000). The focus on costs in banking and the fact that outputs are inclined to be demand determined, means that input-oriented models are most commonly used (Kumbhakar and Lozano-Vivas, 2005).

As we are looking at relative efficiency, it is important that the DMUs should be sufficiently similar, so that comparisons are meaningful. This is particularly the case with DEA, where Dyson et al. (2001) have developed what they describe as a series of homogeneity assumptions. The first of these is that the DMUs, the performance of which is being compared, should be undertaking similar activities and producing comparable products and services so that a common set of outputs can be defined. The second homogeneity assumption is that a similar range of resources is available to all the units and they operate in a similar environment.

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., labor and 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 specialised 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 *ribā*.[5] This approach regard deposits, labour and physical capital as inputs, while loans and investments are treated as output variables.

Following among others, Charnes et al. (1990), Bhattacharyya, Lovell and Sahay (1997) and Sathye (2001), 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.[6] 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).

The efficiency frontier is constructed using a balanced sample of 15 Malaysian banks offering Islamic banking products and services during the period 2001-2004 yielding 60 bank year observations. We are able to collect data on three input and two output variables. Data for the empirical analysis is sourced from the individual bank's Islamic Banking Scheme's (IBS) annual balance sheet and income statements.[7] Malaysian Islamic banks are modelled as multi-product firms producing two outputs namely, *Total Loans* ($y1$), which include loans to customers and other banks; and *Income* ($y2$), which include income derived from investment of depositors' funds and other income from Islamic banking operations by engaging three inputs namely, *Total Deposits* ($x1$), which include deposits from customers and other banks, *Total Assets* ($x2$) and *Labour* ($x3$), which is inclusive of total expenditures on employees such as salaries, employee benefits and reserve for retirement pay.[8] All variables are measured in millions of Ringgit (RM).

The summary statistics of the input and output variables used to construct the efficiency frontier are presented in Table 2. It is clear that during the period of study, the Malaysian Islamic banking operations average total assets have expanded by more than 70 percent, increasing from RM2.82 trillion in 2001 to RM4.82 trillion in 2004. It is also apparent that during the period of study, there has been increasing preference among the Malaysian public for Islamic banking and finance products and services substantiated by the growth in the average total loans (financing) to the domestic economy and deposits from the Malaysian public. During the years (2001-2004), total loans and deposits grew by 115 percent and 79 percent, respectively. The favourable economic conditions during the period of study has also spurred higher demand for financial services, as the economy expands and society becomes wealthier. This has allowed Malaysian Islamic banks to benefit from higher demand for their financial services, reduce loan defaults and thus earn higher income. The favourable economic conditions have helped the Malaysian Islamic banks to rake in higher income from a mere RM87,122 billion in 2001 to RM193,769 billion in 2004, a more than 120 percent increase.

TABLE 2
Descriptive Statistics for Inputs and Outputs

	2001 (RMm)	2002 (RMm)	2003 (RMm)	2004 (RMm)
Outputs				
Total Loans (y1)				
Min	26,377	20,796	17,096	12,023
Mean	1,441,734.71	1,873,301	2,499,915.20	3,094,485.80
Max	6,409,411	8,253,532	117,03438	14,581,517
S.D.	1,937,174.37	2,442,768.01	3,263,292.70	3,868,114.68
Income (y2)				
Min	3,407	3,961	5,917	10,802
Mean	87,122.43	107,506.93	159,752.20	193,769.33
Max	431,401	490,847	571,711	611,655
S.D.	127,206.77	153,407.31	166,571.12	193,355.08
Inputs				
Total Deposits (x1)				
Min	79,679	62,266	97,797	627,564
Mean	2,384,403.93	3,117,977.21	3,726,400.40	4,269,593.13
Max	9,064,966	12,166,584	12,577,435	15,965,833
S.D.	3,019,347.63	3,833,396.16	4,094,701.14	4,510,658.40
Labour (x2)				
Min	389	743	895	653
Mean	7,737.71	8,703.93	14,726.2	16,115.47
Max	72,398	75,172	88,137	93,865
S.D.	18,798.22	19,579.20	26,396.60	27,972.43
Assets (x3)				
Min	140,156	93,056	150,511	834,447
Mean	2,817,694.50	3,512,071.79	4,381,516.13	4,821,954.73
Max	10,358,576	13,204,458	15,578,265	15,578,265
S.D.	3,415,938.21	4,222,744.81	4,757,408.56	4,570,657.78

4. RESULTS

In this section, we will discuss the Malaysian Islamic banking sector's TE change, measured by the DEA method and the decomposition of its mutually exhaustive PTE and SE components. In the event of the

existence of scale inefficiency, we will attempt to provide evidence on the nature of returns to scale of the Malaysian Islamic banks. By applying a common frontier, the efficiency of domestic and foreign Islamic banks operating in Malaysia will be examined using the DEA method for each year under investigation. To shed light on the relative efficiency among 'peer groups', we extend the analysis to examine the efficiency of domestic and foreign Islamic banks separately.

Table 3 presents mean efficiency scores of Malaysian Islamic banks for the years 2001 (Panel A), 2002 (Panel B), 2003 (Panel C), 2004 (Panel D), Domestic Banks All Years (Panel E), Foreign Banks All Years (Panel F) and All Banks All Years (Panel G). During the period of study, the results seem to suggest that the domestic Malaysian Islamic banks' TE has been on a declining trend during the earlier part of the study, before gradually increasing in the latter years. From Table 3 it is clear that, while scale inefficiency dominates pure technical inefficiency of the domestic Islamic banks in years 2002 and 2004, the domestic Islamic banks' technical inefficiency was found to be largely due to pure technical inefficiency in years 2001 and 2003.[9] In contrast to their domestic peers, the findings seem to suggest that the foreign Islamic banks' TE has been on an upward trend in the earlier years, before gradually declining during the latter years. The results suggest that during the period of study, scale inefficiency dominates pure technical inefficiency of the foreign Islamic banks, implying that while the foreign banks were managerially efficient in controlling their operating costs, they have been operating at the wrong scale of operations.

During the period of study, the results from Table 3 (Panel E) suggest that the domestic Islamic banks offering Islamic window banking services in Malaysia have exhibited mean TE of 83.5 percent. The decomposition of TE into its PTE and SE components suggest that on average, the domestic Islamic banks' technical inefficiency was largely due to pure technical rather than scale inefficiency. This implies that although the domestic Islamic banks have been operating at a more optimal scale of operations, they were relatively managerially inefficient in controlling their operating costs. On the other hand, the results from Table 3 (Panel F) seem to suggest that the foreign banks have been relatively technically inefficient compared to their domestic counterparts

during the period of study. It is also clear that the foreign banks' inefficiency were mainly attributed to scale rather than pure technical inefficiency albeit at a higher degree of 24.8 percent (domestic banks , 9.0 percent). The findings also suggest that foreign banks have exhibited higher PTE of 94.8 percent (domestic banks, 90.7 percent), suggesting that although foreign banks were more managerially efficient in controlling their costs, they have been operating at the wrong scale of operations during the period of study.

The findings are interesting in that, although the foreign banks have exhibited lower TE compared to that of their domestic counterparts, the results suggest that the foreign banks were relatively more pure technically inefficient and that the foreign banks' technical inefficiency was mainly due to scale. During the period of study our results suggest that all the foreign banks were experiencing economies of scale (operating at Increasing Returns to Scale, IRS) suggesting that the foreign banks were relatively small compared to their domestic counterparts.[10] Given that the foreign banks have limited capabilities to expand its operations (number of branches, ATMs, etc.), the results do not seem surprising.[11]

The results for all banks in all years (Table 3 Panel G) have in general confirmed our overall findings that scale is the dominant factor influencing Malaysian Islamic banks' technical inefficiency. During the period 2001-2004, our results from Table 3 Panel G suggest that, Malaysian Islamic banks have exhibited mean TE of 80.2 percent. The decomposition of the TE into its PTE and SE components suggests that the Malaysian Islamic banks' inefficiency could be attributed mainly to scale (13.8 percent) rather than pure technical (7.5 percent).

Since the dominant source of the total technical inefficiency in the Malaysian Islamic banking sector seems to be scale related, it is worth further examining the trend in the returns to scale of the Malaysian Islamic banks. As Panel 1 of Table 4 shows, the number of Malaysian Islamic banks experiencing economies of scale (operating at IRS) has increased dramatically from 26.7 percent in year 2001 to 60.0 percent in year 2004, confirming the fact that during the period of study, the majority of Malaysian Islamic banks have been operating at the wrong scale of operations, i.e., too small to be scale efficient. The share of scale efficient banks (operating at constant returns to scale, CRS),

TABLE 3
Summary Statistics of Efficiency Measures

Banks	Mean		Minimum		Maximum		Std. Dev.	
Panel A: 2001	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**
Technical Efficiency	0.872	0.774	0.436	0.518	1.000	1.000	0.189	0.262
Pure Technical Efficiency	0.908	0.897	0.637	0.586	1.000	1.000	0.145	0.207
Scale Efficiency	0.951	0.876	0.677	0.518	1.000	1.000	0.095	0.239
Panel B: 2002								
Technical Efficiency	0.770	0.777	0.295	0.360	1.000	1.000	0.207	0.302
Pure Technical Efficiency	0.886	0.961	0.590	0.844	1.000	1.000	0.158	0.078
Scale Efficiency	0.857	0.794	0.500	0.426	1.000	1.000	0.144	0.272
Panel C: 2003								
Technical Efficiency	0.812	0.713	0.245	0.350	1.000	1.000	0.230	0.313
Pure Technical Efficiency	0.890	0.936	0.629	0.844	1.000	1.000	0.138	0.068
Scale Efficiency	0.898	0.753	0.390	0.377	1.000	1.000	0.190	0.295
Panel D: 2004								
Technical Efficiency	0.888	0.585	0.621	0.330	1.000	0.935	0.122	0.295
Pure Technical Efficiency	0.983	1.000	0.869	1.000	1.000	1.000	0.042	0.000
Scale Efficiency	0.904	0.585	0.621	0.330	1.000	0.935	0.123	0.295

TABLE 3 (continued)

Banks	Mean	Minimum	Maximum	Std. Dev.
Panel E: Domestic Banks All Years				
Technical Efficiency	0.835	0.245	1.000	0.205
Pure Technical Efficiency	0.907	0.590	1.000	0.139
Scale Efficiency	0.910	0.390	1.000	0.148
Panel F: Foreign Banks All Years				
Technical Efficiency	0.712	0.330	1.000	0.275
Pure Technical Efficiency	0.948	0.586	1.000	0.111
Scale Efficiency	0.752	0.330	1.000	0.270
Panel G: All Banks All Years				
Technical Efficiency	0.802	0.245	1.000	0.221
Pure Technical Efficiency	0.925	0.586	1.000	0.126
Scale Efficiency	0.862	0.330	1.000	0.194

Notes: The table presents mean, minimum, maximum and standard deviation of Malaysian Islamic banks technical efficiency (TE) scores and its mutually exhaustive pure technical efficiency (PTE) and scale efficiency (SE) components. Panel A, B, C, and D show the mean, minimum, maximum and standard deviation of TE, PTE and SE of the domestic and foreign Islamic banks for the years 2001, 2002, 2003 and 2004 respectively. Panel E and F present the domestic (DB) and foreign (FB) Islamic banks mean, minimum, maximum and standard deviation of TE, PTE and SE scores, respectively. Panel G shows the mean, minimum, maximum and standard deviation of TE, PTE and SE of all banks during 2001-2004. The TE, PTE and SE scores are bounded between a minimum of 0 and a maximum of 1.
Detailed results are available from the author upon request.

declined from 40.0 percent in year 2001, to 26.7 percent in year 2002, recording an increase in year 2003 to 33.3 percent before falling again to 26.7 percent in year 2004. The share of Malaysian Islamic banks experiencing diseconomies of scale (operating at Declining Return to Scale (DRS)) increased from 33.3 percent in year 2001 to 46.7 percent in year 2002 and 2003 before falling sharply to 13.3 percent in year 2004.

Panel 2 of Table 4 displays the returns to scale by size measured in billions of RM. Panel 2 presents the overall summary results from the sample of 60 bank year observations over the four-year period. Examination of the panel reveals that while on average, 31.7 percent of Malaysian Islamic banks have been operating at CRS, the majority, 68.3 percent, are scale inefficient (operating at DRS or IRS). Of the scale inefficient banks, 38.3 percent are small banks, 18.3 percent are medium banks and 11.7 percent are large banks. Of the banks experiencing DRS, only 13.3 percent are small banks and the majority, 21.7 percent are medium and large banks (11.7 percent due to medium banks and 10.0 percent due to large banks). Whereas, of the banks experiencing IRS, the majority, 25 percent, are small banks, 6.7 percent are medium banks and only 1.7 percent are large banks. As observed, the convexity of the frontier assures that banks experiencing IRS are more frequently the smaller banks. Our results are similar with earlier findings such as those of Miller and Noulas (1996) and McAllister and McManus (1993). McAllister and McManus (1993) suggest that while small banks have generally exhibit IRS, the large banks on the other hand tend to exhibit DRS, and at best, CRS.

5. CONCLUSION

The paper attempted to empirically analyse the efficiency of the Malaysian Islamic banking sector during the period of 2001-2004. The analysis used the non-parametric DEA method, which has allowed us to distinguish TE and its mutually exhaustive PTE and SE components. We have also attempted to provide evidence on the returns to scale of the Malaysian Islamic banking sector.

The results suggest that the domestic and the foreign Islamic banks have exhibited mean TE of 83.5 percent and 71.2 percent respectively.

TABLE 4
Returns to Scale (RTS) in Malaysian Islamic Banks

Panel 1: Developments in RTS[a]

RTS	Year							
	2001		2002		2003		2004	
	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share
CRS	6	40.0	4	26.7	5	33.3	4	26.7
DRS	5	33.3	7	46.7	7	46.7	2	13.3
IRS	4	26.7	4	26.7	3	20.0	9	60.0
Total	15	100.0	15	100.0	15	100.0	15	100.0

Notes: [a]Panel 1 presents the trend in the RTS of the Malaysian Islamic banks by year. RTS are the increase in output that results from increasing all inputs by the same percentage. There are three possible cases. (1) Constant returns to scale (CRS), which arise when percentage change in outputs = percentage change in inputs; (2) Decreasing returns to scale (DRS), which occur when percentage change in outputs < percentage change in inputs; (3) Increasing returns to scale (IRS), which occurs when percentage change in outputs > percentage change in inputs. Over the years, 19 observations (31.7% of total 60 bank year observations) belonged to the banks that experienced CRS, 21 observations (35.0% of total 60 bank year observations) belonged to the banks that experienced DRS and 20 observations (33.3% of total 60 bank year observations) belonged to the banks that experienced IRS.

TABLE 4 (continued)

Panel 2: RTS by Size [b]

Size	CRS		DRS		IRS		Total	
	No. of Bank Year Observations	% Share	No. of Bank Year Observations	% Share	No. of Bank Year Observations	% Share	No. of Bank Year Observations	% Share
SML_BNKS	5	8.3	8	13.3	15	25.0	28	46.7
MED_BNKS	9	15.0	7	11.7	4	6.7	20	33.3
LAR_BNKS	5	8.3	6	10.0	1	1.7	12	20.0
Total	19	31.7	21	35.0	20	33.3	60	100.0

Notes: [b] Panel 2 provides the summary of overall RTS according to various size groups over the years 2001-2004. SML_BNKS is defined as banks with total assets < industry's mean, MED_BNKS is defined as banks with total assets in the mean range, while LRG_BNKS is defined as banks with total assets > industry's mean. Over the years studied, 28 observations (46.7% of total 60 bank year observations) belonged to SML_BNKS of which 5 or 8.3% of 28 SML_BNKS observations experienced CRS, 8 (13.3%) experienced DRS and 15 (25.0%) experienced IRS. 20 observations (33.3% of total 60 bank year observations) belonged to MED_BNKS, of which 9 or 15.0% of 20 MED_BNKS observations experienced CRS, 7 (11.7%) experienced DRS and 4 (6.7%) experienced IRS. 12 observations or 20.0% of total 60 bank year observations belonged to LAR_BNKS, of which 5 or 8.3% of 12 LAR_BNKS observations experienced CRS, 6 (10.0%) experienced DRS and 1 (1.7%) experienced IRS.

In other words, during the period of study, the domestic Islamic banks could have produced the same amount of outputs by only using 83.5 percent of the inputs they currently employed. Similarly, the foreign banks could have reduced 28.8 percent of the amount of inputs they employed without affecting the amount of outputs that they produced. Overall, our results suggest that scale inefficiency dominates the pure technical inefficiency effects in determining Malaysian Islamic banks' overall or technical inefficiency.

The results suggest that the number of Malaysian Islamic banks experiencing economies of scale (operating at IRS) has increased dramatically from 26.7 percent in year 2001 to 60.0 percent in year 2004, confirming the fact that during the period of study, the majority of Malaysian Islamic banks have been operating at the wrong scale of operations. The share of scale efficient banks (operating at CRS), declined from 40.0 percent in year 2001 to 26.7 percent in year 2004, while Malaysian Islamic banks experiencing diseconomies of scale (operating at DRS) declined sharply from 33.3 percent in year 2001 to 13.3 percent in year 2004. Examination of the sample of 60 bank year observations over the four-year period reveals that while, on average, 31.7 percent of Malaysian Islamic banks were operating at CRS, the majority, 68.3 percent, or more than two-thirds, were scale inefficient (operating at either DRS or IRS). Of the scale inefficient banks, 38.3 percent were small banks, 18.3 percent were medium banks and 11.7 percent were large banks. We have also found that the convexity of the frontier has assured that banks experiencing IRS are more frequently the smaller banks.

It should be acknowledged that the scope of this paper is limited and several interesting questions are not answered. It is suggested that further analysis on the efficiency of the Malaysian Islamic banking sector to investigate changes in cost, allocative and technical efficiencies over time be undertaken. In addition, the paper modelled Malaysian Islamic banks according to the intermediation function. Given that Islamic banks are multi-output firms, considering the production function along with the intermediation function at the same time could be another extension of the paper. Finally, the non-parametric frontier analysis used in this paper could be combined with the stochastic frontier analysis method of estimating the frontier. This should testify to the robustness of the results against alternative estimation methods.

ENDNOTES

1. The first country to implement the dual banking system is United Arab Emirates (UAE) where the Dubai Islamic Bank was established in 1973 with a paid up capital of US$14 million (Metwally, 1997).

2. This is part of Malaysia's World Trade Organisation (WTO) commitment to further liberalise the banking sector and to give foreign banks complete open access to the Malaysian markets by end-2006.

3. Avkiran (1999) provides a relatively thorough discussion of the merits and limits of the DEA.

4. An additional advantage according to Canhoto and Dermine (2003) is that the DEA technique is preferred to parametric methods when the sample size is small.

5. *Rib*Œ is prohibited in Islam and is acknowledged by all Muslims. The prohibition of *rib*Œ 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 *rib*Œ, doubling and redoubling…" (*al-Qur'*Œ*n*, 3:130); "God has made buying and selling lawful and *rib*Œ unlawful…" (*al-Qur'*Œ*n*, 2:274).

6. Humphrey (1985) presents an extended discussion of the alternative approaches of what a bank produces.

7. Only data from Islamic Banking Scheme (IBS) accounts are used. Malaysian conventional banks offering Islamic banking window services are required to maintain a separate IBS account so that the data used are not contaminated with that of conventional banking operations.

8. As data on the number of employees is not readily made available, personnel expenses have been used as a proxy.

9. We have also re-run the test by excluding domestic Malaysian full-fledged Islamic banks, namely Bank Islam (M) Bhd. and Bank Muamalat (M) Bhd. The results did not significantly change our earlier findings. The results are available from the author upon request.

10. For the purpose of brevity, we do not report the full results here but is available from the author upon request.

11. To this extent, further investigations into the issue of the impact of financial repression and Liability of Foreignness (LoF) in the Malaysian Islamic banking sector would be extremely beneficial.

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