The Efficiency of the Islamic Banking Industry in Malaysia: Foreign *vs.* Domestic Banks

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Abstract: This paper attempts to investigate relative efficiency between domestic and foreign Islamic banking operations in the Malaysian Islamic finance sector over the period 2001-2004. Data Envelopment Analysis (DEA) is utilised to analyse the data. The results suggest that scale efficiency dominated over the pure technical efficiency effects. The results further indicate that the number of Malaysian Islamic banks experiencing economies of scale increased dramatically from 28.6% in year 2001 to 60.0% in year 2004, confirming the fact that during the period of study, the majority of Malaysian Islamic banks were operating at the wrong scale of operations. Moreover, the study confirms that the dominant effect of scale efficiency over pure technical efficiency in determining overall efficiency during the period of study. Furthermore, the results suggest that market share had a positive and significant effect on bank efficiency. Finally, the results also suggest that efficiency leads to profitability.

I. Introduction

In recent years, financial institutions have experienced a dynamic, hectic, and competitive environment at a cross-border scale. One of the fastest

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growing areas is the 'Islamic banking' sector, which remarkably has captured the interest of both conventional and Islamic economists. A recent survey states that there are more than 160 Islamic financial institutions around the world (Dar and Presley, 2003). Despite the fact that most Islamic banks are found within the emerging economies and/or Middle East countries, many multi-national banks in developed countries have begun to value the massive demand for Islamic financial products.

The main difference between Islamic and conventional banks is that, while the latter operate on the basis of the conventional interest, the former follow a principle of interest-free financing based on profit and loss sharing (PLS) (Ariff, 1988). Many Islamic economics studies have discussed in depth the rationale behind the prohibition of interest (Chapra, 2000) and the importance of PLS in Islamic banking (Dar and Presley, 2000). Furthermore, under the terms of Islamic PLS, the relationship between borrower, lender and intermediary is rooted in financial trust and partnership. The importance of the interest-free financing in Islamic banking has created an innovative environment among practitioners in which an alternative to interest is anticipated. Dar and Presley (2003) classified four types of financing acting as alternatives to interest: investment-based, sale-based, rent-based and service-based.

The existing research on Islamic banking and finance has focused primarily on the conceptual issues underlying interest-free financing (Ahmed, 1981, Karsen, 1982), such as the viability of Islamic banks and their ability to mobilize savings, pool risks and facilitate transactions. Few studies have focused on the policy implications of a financial system without interest payments (Khan, 1986; Khan and Mirakhor, 1987). It is striking that so little empirical work evaluating the performance of Islamic banks has been done. The lack of complete data has impeded any comprehensive analysis of the experiences of the last three decades. To date, empirical work done on this question has yielded inconclusive results (Bashir *et al.*, 1993; Bashir, 1999).

The Malaysian banking system is somewhat unique in that conventional banks are allowed to offer Islamic banking and finance products alongside conventional products. This dual banking system provides an interesting setting in which to investigate the efficiency of domestic and foreign banks. As Malaysia is one of the countries implementing dual banking system, this study would be the first empirical investigation of the efficiency of domestic *vs.* foreign banks, both of which provide Islamic banking services alongside the traditional conventional banking services.

By employing a non-parametric Data Envelopment Analysis (DEA) method, we analyse the overall, pure technical and scale efficiencies of the universe of Malaysian contemporary banks, which offered Islamic banking window services over the period of 2001-2004. The preferred non-parametric DEA methodology has allowed us to distinguish three different types of efficiency, namely technical, pure technical and scale efficiencies. Additionally, we have performed a series of parametric and non-parametric tests to examine whether the domestic and foreign banks were drawn from the same population. Finally, we have employed the Spearman Rho Rank-Order and the Parametric Pearson correlation coefficients to investigate the association between the efficiency scores derived from the DEA results with the traditional accounting ratios.

We found that the mean overall or technical efficiency has been 86.1% and 85.1% for the domestic and the foreign Islamic banks, respectively. In other words, during the period of study, the domestic Islamic banks could have produced the same amount of outputs by only using 86.1% of the inputs that they currently employed. Similarly, the foreign banks could have reduced 14.9% of the amount of inputs they employed currently without affecting the amount of outputs that they currently produce. Overall, our results suggest that scale efficiency dominates the pure technical efficiency effects in determining Malaysian Islamic banks' overall or technical efficiency. Further, our results from the parametric and non-parametric tests could not reject the null hypothesis that the foreign and domestic Malaysian Islamic banks were drawn from the same population, which carries the implication that it is appropriate to construct a single frontier for both the domestic and foreign banks.

The findings in this study suggest that the number of Malaysian Islamic banks experiencing economies of scale (IRS) has increased dramatically from 28.6% in year 2001 to 60.0% in year 2004, confirming the fact that during the period of study, the majority of Malaysian Islamic banks were operating at the wrong scale of operations. The share of scale efficient banks operating at constant return to scale (CRS), declined from 35.7% in year 2001 to 26.7% in year 2004, while Malaysian Islamic banks experiencing diseconomies of scale (DRS) declined sharply from 35.7% in year 2001 to 13.3% in year 2004. Examination of the sample of 58 observations over the four-year period reveals that while, on average, 31.0% of all Malaysian Islamic banks were operating at CRS, the majority, 69.0%, were scale inefficient (DRS or IRS). Of the scale inefficient banks, 39.7% were small

banks, 19.0% were medium banks and 10.3% 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.

To further complement the results of the efficiency measures, following Bauer *et al.* (1998), the consistency of the DEA based efficiency scores were checked by examining their relationship with three traditional non-frontier based performance indicators. Our results from both the Spearman and the Pearson correlation coefficients suggest that overall efficiency is positively and significantly associated with all the accounting measures of performance. It further confirmed the dominant effect of scale efficiency over pure technical efficiency in determining Malaysian Islamic banks' overall efficiency during the period of study.

The next section of the paper provides some background on the Islamic banking system in Malaysia. Section 3 reviews studies relevant to the Islamic banking industry. Section 4 describes the data, sources and model specification, employed in the study. Empirical results are presented in section 5. Section 6 provides some conclusions.

II. Background

In Malaysia, Islamic finance traces its roots to 1963, with the establishment of the Pilgrims Fund Board or Lembaga Tabung Haji (LTH). This was a savings mechanism under which devout Malaysian Muslims set aside regular funds to cover the costs of performing the annual pilgrimage. These funds were in turn invested in productive sectors of the economy, aimed at yielding a return uncontaminated by *ribā*.

As a country with a population dominated by Muslims, Malaysia was also affected by the resurgence that had taken place in the Middle East. Many parties were calling for the establishment of an Islamic bank in Malaysia. For example, in 1980, the Bumiputera Economic Congress had proposed to the Malaysian Government to allow the establishment of an Islamic bank in the country. Another effort was the establishment of the National Steering Committee in 1981 to undertake a study and make recommendations to the Government on all aspects of the setting up and operation of an Islamic bank in Malaysia, including the legal and religious, as well as operational, aspects. The study concluded that such a bank in Malaysia would be viable and profitable. The first Islamic bank in Malaysia, Bank Islam Malaysia Berhad (BIMB) was established in July 1983, with an initial paid up capital of RM80 million.

It marked a new milestone on the road to the development of the Islamic financial system in Malaysia. BIMB carries out banking business similar to other commercial banks, but in line with the principles of *Sharīʿah*. The bank offers deposit-taking products such as current and savings deposit under the concept of *Al-Wadiah Yad Dhamanah* (guaranteed custody) and investment deposits under the concept of *Al-Muḍārabah* (profit-sharing). The bank grants financing facilities such as working capital financing under *Al-Murābaḥah* (cost-plus), house financing under *Bayʿ Bi-thaman Ājil* (deferred payment sale), leasing under *Al-Ijārah* (leasing) and project financing under *Al-Mushārakah* (profit and loss sharing).

It has been the aspiration of the Government to create a vibrant and comprehensive Islamic banking and finance system operating alongside the conventional system. A single Islamic bank does not fit the definition of a system. An Islamic banking and finance system requires a large number of dynamic and pro-active players, a wide range of products and innovative instruments, and a vibrant Islamic money market. The first step toward realizing the vision was to disseminate Islamic banking on a nationwide basis with as many players as possible and within the shortest period possible. This was achieved through the introduction of *Skim Perbankan Islam* (SPI) in March 1993. SPI allows conventional banking institutions to offer Islamic banking products and services using their existing infrastructure, including staff and branches. The scheme was launched on 4 March 1993 on a pilot basis involving three banks. Following the successful implementation of the pilot-run, Bank Negara Malaysia (BNM) has allowed other commercial banks, finance companies and merchant banks to operate the scheme in July 1993 subject to the specific guidelines issued by the central bank. From only three banks offering Islamic financing in March 1993, the number of commercial banks doing so has increased to 15 (of which four are foreign banks).

The Islamic banking system, which forms the backbone of the Islamic financial system, plays an important role in mobilizing deposits and providing financing to facilitate economic growth. The Malaysian Islamic banking system is currently represented by 15 banking institutions comprised of nine domestic commercial banks, four foreign commercial banks and two Islamic banks offering Islamic banking products and services under the Islamic Banking Scheme (IBS). These Islamic banking institutions offer a comprehensive and broad range of Islamic financial products and services ranging from savings, current and investment deposit products to

financing products such as property financing, working capital financing, project financing, plant and machinery financing, *etc.*

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 Muslim and non-Muslim customers, reflecting the capacity of the Islamic banking system as an effective means of financial intermediation, with extensive distribution networks of Islamic banking institutions, comprising 152 full-fledged Islamic banking branches and more than 2,000 Islamic banking counters. Islamic banking has also spurred the efforts of other non-bank financial intermediaries such as the development financial institutions, savings institutions and housing credit institutions to introduce Islamic schemes and instruments to meet their customer demands.

Malaysia has succeeded in implementing a dual banking system and has emerged as the first nation to have a full-fledged Islamic system operating alongside the conventional banking system. Throughout the years, Islamic banking has gained significance, and has been on a steadily upward trend. Since 2000, the Islamic banking industry has been growing at an average rate of 19% per annum in terms of assets. As at end-2004, total assets of the Islamic banking sector increased to RM94.6 billion, which accounted for 10.5% of the total assets in the banking system. The market share of Islamic deposits and financing increased to 11.2% and 11.3% of total banking sector deposits and financing, respectively. The rapid progress of the domestic Islamic banking system, accentuated by the significant expansion and developments in Islamic banking and finance, has become increasingly more important in meeting the changing requirements of the new economy (Bank Negara Malaysia, 2004).

III. Survey of the Related Studies

Despite the considerable development of the Islamic banking sector, there has been only very limited research into the efficiency of Islamic banks. Several studies directed at assessing the performance of Islamic banks generally examined the relationship between profitability and banking characteristics. Bashir (1999 and 2001) performs regression analyses to identify the underlying determinants of Islamic performance by employing bank level data in the Middle East. His results indicate that the performance of banks, in terms of profits, is mostly generated from overhead, customer short-term funding, and non-interest earning assets. Furthermore, Bashir

(2001) claims that since deposits in Islamic banks are 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 suggest that in general, the managements' lack of knowledge was the main reason for slow growth of PLS loans. Despite that, the bank was found to perform better compared to its conventional counterparts in terms of liquidity and risk management (lower risks). Although the study was based only on a single Islamic bank in Malaysia, the result shed some light on the experience from outside the Middle East area. Another study, Sarker (1999), utilised a banking efficiency model to examine Islamic banks' efficiency in Bangladesh. He claimed that, Islamic banks could survive even within a conventional banking architecture in which profit and loss modes of financing were less dominant. Sarker (1999) further argued that Islamic products have different risk characteristics and consequently different prudential regulation should be implemented.

More recently, Hassan (2005) examined the relative cost, profit, X-efficiency and productivity, of the Islamic banking industry in the world. 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 went on to correlate the scores with the conventional accounting measures of 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 indicate that, on average overall, the Islamic banking industry is relatively less efficient compared to its conventional counterparts in other parts of the world. The results also show that all five efficiency measures are highly correlated with ROA (Return on Assets) and ROE (Return on Equity), suggesting that these efficiency measures can be used concurrently with conventional accounting ratios in determining Islamic banks' performance.

IV. Methodology

The term Data Envelopment Analysis (DEA) was first introduced by Charnes *et al.* (1978), (hereafter CCR), 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 means 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 has 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 CRS, and it delivers the overall technical efficiency (OTE). The CRS assumption is only justifiable when all DMUs are operating at an optimal scale. However, in practice, firms or DMUs 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 *et al.* (1984) extended the CCR model by relaxing the CRS assumption. The resulting 'BCC' model was used to assess the efficiency of DMUs characterized 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 effects. If there appears to be a difference between the TE (Technical Efficiency) and PTE (Pure Technical Efficiency) scores of a particular DMU, then it indicates the existence of scale inefficiency.

$$min\lambda_0\ \theta_0 \qquad (1)$$

subject to

$$\sum_{j=1}^{n}\lambda_{0j}y_{rj} \geq y_{r0} \qquad (r = 1,\ldots..,s)$$

$$\theta_0 x_{i0} \geq \sum_{j=1}^{n}\lambda_{0j}x_{ij} \qquad (i = 1,\ldots..,n)$$

$$\sum_{j=1}^{n} \lambda_{0j} = 1$$

$$\lambda_{0j} \geq 0 \qquad (j = 1, \ldots..,n)$$

The first constraint states that output of the reference unit must be at least at the same level as the output of DMU is o. The second constraint states that the efficiency corrected input usage of DMU o must be greater than or the same as the input use of the reference unit. Since the correction factor is the same for all types of inputs, the reduction in observed inputs is proportional. The third constraint ensures convexity and thus introduces variable returns to scale. If convexity requirement is dropped, the frontier technology changes from *VRS* to *CRS*. The efficiency scores always have smaller or equal values in the case of *CRS*. Efficiency can also be measured into output direction in the case of *VRS*.

Although the scale efficiency measure will provide information concerning the degree of inefficiency resulting from the failure to operate with *CRS*, it does not provide information as to whether a DMU is operating in an area of increasing returns to scale (*IRS*) or decreasing returns to scale (*DRS*). Hence, in order to establish whether scale inefficient DMUs exhibit *IRS* or *DRS*, the technical efficiency problem (1) is solved under the assumption of variable returns to scale (*VRS*) to provide

$$min \lambda_0 \ \theta_0 \qquad (2)$$

subject to

$$\sum_{j=1}^{n} \lambda_{0j} y_{rj} \geq y_{r0} \qquad (r = 1, \ldots..,s)$$

$$\theta_0 x_{i0} \geq \sum_{j=1}^{n} \lambda_{0j} x_{ij} \qquad (i = 1, \ldots..,n)$$

$$\sum_{j=1}^{n} \lambda_{0j} \leq 1$$

$$\lambda_{0j} \geq 0 \qquad (j = 1, \ldots..,n)$$

Amongst the strengths of the DEA is that it is less data-demanding as it works fine with small sample size. The feasibility of small sample size is one among other reasons leading us to DEA as the tool of choice for evaluating Malaysian Islamic banks X-efficiency. Furthermore, 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 (Evanoff and Israelvich, 1991, Grifell-Tatje and Lovell, 1997, Bauer *et al.*, 1998).[1] Hababou (2002) adds that it is better to adopt the DEA technique when it has been shown that a commonly agreed functional form relating inputs to outputs is difficult to prove or find. Such specific functional form is truly difficult to show for financial services entities. Avkiran (1999) acknowledges the edge of the DEA by stating that this technique allows the researchers to choose any kind of input and output of managerial interest, regardless of different measurement units. There is no need for standardization.[2]

Three 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. Finally, 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 'efficiency DMUs'. The set of efficiency 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 their entity in the market.

The main weakness of DEA is that it assumes data are free from measurement errors. Also, 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. The reason is simple. Each sample, separated, let us say, by year, represents a single frontier, which is constructed on the assumption of same technology. Therefore, comparing the efficiency measures of a DMU across time cannot be interpreted as technical progress; rather, it has to be taken as changes in efficiency (Canhoto and Dermine, 2003).

DEA can be used to derive measures of scale efficiency by using the variable returns to scale (*VRS*), or the *BCC* model, alongside the constant returns to scale (*CRS*), or the *CCR* model. Coelli *et al.* (1998) noted that the *BCC* model has been most commonly used since the beginning of the 1990s. A DEA model can be constructed either to minimize inputs or to maximize 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 maximizing output levels without increasing use of inputs (Cooper *et al.*, 2000). The focus on costs in banking and the fact that outputs are inclined to be demand determined means that input-oriented models are the ones 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 for comparisons to be 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 where performance 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.

4.1. Data sample, inputs-outputs definition and the choice of variables

For the empirical analysis, *all* Malaysian conventional banks that offered Islamic banking window services were incorporated in the study (see Table 1). The annual balance sheet and income statement used to construct the variables for the empirical analysis were taken from published balance sheet information in annual reports of each individual bank.

The definition and measurement of inputs and outputs in the banking function remains a contentious issue among researchers. To determine what constitutes inputs and outputs of banks, one should first decide on the nature of banking technology. In banking theory literature, there are two main approaches competing with each other in this regard: the production and intermediation approaches (Sealey and Lindley, 1977).

Under the production approach, a financial institution is defined as a producer of services for account holders, that is, it performs transactions on deposit accounts and process documents such as loans. Hence, according to this approach, the number of accounts or the related transactions are

the best measures for output, while the number of employees and physical capital is considered as inputs. Among earlier studies that adopted this approach are Sherman and Gold (1985), Ferrier and Lovell (1990) and Fried *et al.* (1993).

Table 1: Banks Offering Islamic Banking Services in Malaysia

Domestic Banks Offering Window Islamic Banking Services
Affin Bank
Alliance Bank
Arab-Malaysian Bank
EON Bank
Hong Leong Bank
Maybank
Public Bank
RHB Bank
Southern Bank
Foreign Banks Offering Window Islamic Banking Services
Standard Chartered Bank
Hong Kong Bank
OCBC
Citibank
Domestic Full-Fledged Islamic Banks
Bank Islam Malaysia
Bank Muamalat

The intermediation approach on the other hand assumes that financial firms act as intermediary between savers and borrowers, and it posits total loans and securities as outputs, while deposits along with labour and physical capital are defined as inputs. Among earlier banking efficiency studies that adopted this approach are Charnes *et al.* (1990), Bhattacharyya *et al.* (1997) and Sathye (2001).

For the purpose of this study, a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) was adopted in the definition of inputs and outputs used.[3] According to Berger and Humphrey (1997), the production approach might be more suitable for branch efficiency studies, as at most times bank branches basically process customer documents and bank funding, while investment decisions are mostly not under the control of branches.

The aim in the choice of variables for this study is to provide a parsimonious model and to avoid the use of unnecessary variables that may reduce the degree of freedom. All variables are measured in millions of Ringgit (RM). We model Malaysian Islamic banks as multi-product firms producing two outputs by employing three inputs. Accordingly, we assume Malaysian Islamic banks produce Total Loans ($y1$) and Income ($y2$) by employing Total Deposits ($x1$), Labour ($x2$) and Fixed Assets ($x3$).

Table 2 presents the summary of statistics for the outputs and inputs for Malaysian Islamic banking operations. A few conclusions can be drawn. Firstly, over the four-year period, the total assets of Malaysian Islamic banking operations grew by about 71% to RM4.82 trillion in year 2004 from RM2.82 trillion in year 2001. Secondly, it is apparent that there has been increasing awareness among the Malaysian public about Islamic banking and finance during this period substantiated by the growth in total loans (financing) to the domestic economy and deposits from the Malaysian public during this period. During the years (2001-2004), total loans and deposits grew by about 115% and about 79%, respectively. Thirdly, a conclusion could also be drawn from employment in the Islamic banking industry during this period. As is clear from Table 2, the Malaysian Islamic banking and finance industry created significant employment during this period. As data on the number of employees are not readily made available, we used personnel expenses as a proxy measure. From Table 2 it is apparent that personnel expenses expanded by approximately 108% during the four-year period. Finally, the Islamic banking and finance industry has increasingly generated awesome returns to Malaysian Islamic banks. During the period of study, we witnessed more than a 122% increase in the mean income of Malaysian Islamic banks, from a mere RM87,122.43 billion in 2001 to RM193,769.33 billion in 2004.

V. Empirical Results

The efficiency of domestic and foreign Islamic banks operating in Malaysia was first examined by applying the DEA method for each year under investigation by using a common frontier. We extended the analysis by examining the efficiency of domestic Islamic banks only, foreign Islamic banks only and a pooled common frontier for all banks, foreign and domestic, for all years. Table 3 reports the sample statistics of the various efficiency scores of Malaysian Islamic banks for the years 2001 (Panel A), 2002 (Panel B), 2003 (Panel C), 2004 (Panel D), Domestic Banks (Panel E), Foreign Banks (Panel F) and All Banks All Years (Panel G). The results

Table 2: Descriptive Statistics for Inputs and Outputs

	2001	2002	2003	2004
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

Note: All figures are in RMb.

suggest that Malaysian Islamic banks exhibited the highest mean overall efficiency score of 82.8% in year 2001 (Panel A), declined to 76.4% in year 2002 (Panel B), before gradually improving to record overall efficiency of 78.6% and 80.1% in years 2003 (Panel C) and 2004 (Panel D) respectively. The decomposition of overall efficiency into its pure technical and scale efficiency components suggests that scale inefficiency dominated over pure

technical inefficiency of Malaysian Islamic banks during all years except for the year 2001 when scale efficiency was higher compared to pure technical efficiency. This implies that during the period of study, Malaysian Islamic banks were operating at the wrong scale of operations.

Table 3: Summary Statistics of Efficiency Measures

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2001				
Overall Efficiency	0.828	0.436	1.000	0.206
Pure Technical Efficiency	0.898	0.586	1.000	0.159
Scale Efficiency	0.919	0.519	1.000	0.145
Panel B: 2002				
Overall Efficiency	0.764	0.295	1.000	0.234
Pure Technical Efficiency	0.899	0.590	1.000	0.145
Scale Efficiency	0.837	0.426	1.000	0.189
Panel C: 2003				
Overall Efficiency	0.786	0.245	1.000	0.247
Pure Technical Efficiency	0.902	0.629	1.000	0.122
Scale Efficiency	0.859	0.377	1.000	0.221
Panel D: 2004				
Overall Efficiency	0.801	0.284	1.000	0.234
Pure Technical Efficiency	0.982	0.740	1.000	0.067
Scale Efficiency	0.818	0.284	1.000	0.239
Panel E: Domestic Banks Only				
Overall Efficiency	0.861	0.245	1.000	0.186
Pure Technical Efficiency	0.967	0.712	1.000	0.081
Scale Efficiency	0.892	0.245	1.000	0.179
Panel F: Foreign Banks Only				
Overall Efficiency	0.851	0.356	1.000	0.229
Pure Technical Efficiency	0.990	0.844	1.000	0.390
Scale Efficiency	0.858	0.356	1.000	0.224
Panel G: All Banks All Years				
Overall Efficiency	0.795	0.245	1.000	0.226
Pure Technical Efficiency	0.921	0.586	1.000	0.129
Scale Efficiency	0.858	0.284	1.000	0.201

Note: Detailed results are available from the authors upon request.

During the period of study, we found that the domestic Malaysian Islamic banks (Panel E) exhibited mean overall efficiency of 86.1%, suggesting mean input waste of 13.9%. In other words, the domestic banks could have

produced the same amount of outputs by only using 86.1% of the amount of inputs they were then using. From Table 3 (Panel E) it is clear that scale inefficiency dominated over pure technical inefficiency of the domestic Malaysian Islamic banks[4].

Our results from Table 3 (Panel F) suggest that foreign banks that offered Islamic banking services in Malaysia exhibited mean overall efficiency of 85.1%, slightly lower compared to their domestic counterparts. Similar to the domestic banks, our results suggest that the foreign banks' inefficiency were mainly attributable to scale rather than pure technical efficiency, albeit at a higher degree of 14.2% (domestic banks – 11.8%). On the other hand, our findings suggest that foreign banks exhibited higher pure technical efficiency of 99.0% (domestic banks – 96.7%), suggesting that although foreign banks were more managerially efficient in controlling costs, they too were mainly operating at the wrong scale of operations during the period of study.

Our findings are interesting in that, although the foreign banks exhibited lower technical (overall) efficiency compared to their domestic counterparts, the results suggest that the foreign banks were almost pure technically efficient and that their inefficiency was mainly attributable to scale. During the period of study our results suggest that all the foreign banks were experiencing economies of scale (IRS) suggesting that the foreign banks were relatively small compared to their domestic counterparts.[5] Given that the foreign banks have limited capabilities to expand their operations (number of branches, ATMs, etc.), hence, these results do not seem surprising.[6]

The results for all banks in all years (Table 3, Panel G) in general confirm our earlier findings that scale is the dominant factor influencing Malaysian Islamic banks efficiency. During the period 2001-2004, our results from Panel F suggest that, Malaysian Islamic banks exhibited mean overall (technical) efficiency of 79.5%. The decomposition of the overall efficiency into its pure technical and scale components suggest that the inefficiency could be attributed mainly to scale (14.2%) rather than pure technical (7.9%).

Since the dominant source of the total technical inefficiency in the Malaysian Islamic banking seems to be scale related, it is worth further examining the trend in the returns to scale of Malaysian Islamic banking. As Panel 1 of Table 4 shows, the number of Malaysian Islamic banks experiencing economies of scale (*IRS*) increased dramatically from 28.6% in year 2001 to 60.0% in year 2004, confirming the fact that during the period of study, the

majority of Malaysian Islamic banks were operating at the wrong scale of operations i.e. too small to be efficient. The share of scale efficient banks (operating at CRS), declined from 35.7% in year 2001, to 28.6% in year 2002, recording an increase in year 2003 to 33.3%, before falling again to 26.7% in year 2004. The share of Malaysian Islamic banks experiencing diseconomies of scale (*DRS*) increased from 35.7% in year 2001 to 42.8% in year 2002 and 46.7% in year 2003, before falling sharply to 13.3% 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 58 observations over the four-year period. Examination of the panel reveals that while, on average, 31.0% of all Malaysian Islamic banks were operating at *CRS*, the majority, 69.0%, were scale inefficient (*DRS* or *IRS*). Of the scale inefficient banks, 39.7% are small banks, 19.0% are medium banks and 10.3% are large banks. Of the banks experiencing DRS, only 13.8% are small banks and the majority, 20.7% are medium and large banks (12.1% due to medium banks and 8.6% due to large banks). Whereas, of the banks experiencing *IRS*, the majority (25.9%) are small banks, 6.9% are medium banks and only 1.7% are large banks. As observed, the convexity of the frontier assures that banks experiencing *IRS* are more frequently smaller banks. Our results correlate well with earlier findings by, among others, Miller and Noulas (1996) and McAllister and McManus (1993). McAllister and McManus (1993) suggest that while small banks generally exhibit *IRS*, the large banks on the other hand tend to exhibit *DRS* and at best *CRS*.

After examining the efficiency results, the issue of interest now is whether the two samples are drawn from the same population and whether the foreign and domestic banks possess the same banking technology. The null hypothesis tested is that the domestic and foreign banks are drawn from the same population or environment. We tested the null hypothesis that domestic and foreign banks are drawn from the same population and have identical technologies by using a series of parametric (ANOVA and *t*-test) and non-parametric (Kolmogorov-Smirnov and Mann-Whitney [Wilcoxon Rank-Sum]) tests. Based on most of the results presented in Table 4, we failed to reject the null hypothesis at the 0.05 levels of significance that the domestic banks and foreign banks come from the same population and have identical technologies. This implies that there is no significant difference between the domestic and foreign bank's technologies (frontiers), and that it is appropriate to construct a combined frontier. Our findings corroborate the findings of among others, Sathye (2001) and Isik and Hassan (2002).

Table 4: Returns to Scale (RTS) in Malaysian Islamic Banks

Panel 1: **Developments in RTS** [a]								
RTS	**Years**							
	2001		2002	2003		2004		
	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share
CRS	5	35.7	4	28.6	5	33.3	4	26.7
DRS	5	35.7	6	42.8	7	46.7	2	13.3
IRS	4	28.6	4	28.6	3	20.0	9	60.0
Total	14	100.0	14	100.0	15	100.0	15	100.0
Panel 2: **RTS by Size** [b]								
Size	**CRS**		**DRS**		**IRS**		**Total**	
	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share	No. of Banks	% Share
SML_BNKS	5	8.6	8	13.8	15	25.9	28	48.3
MED_BNKS	9	15.5	7	12.1	4	6.9	20	34.5
LAR_BNKS	4	6.9	5	8.6	1	1.7	10	17.2
Total	18	31.0	20	34.5	20	34.5	58	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 result 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, 18 observations (31.0% of total 58 observations) belonged to the banks that experienced CRS, 20 observations (34.5% of total 58 observations) belonged to the banks that experienced DRS and 20 observations (34.5% of total 58 observations) belonged to the banks that experienced IRS.

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 (48.3% of total 58 observations) belonged to SML_BNKS of which 5 or 8.6% of 28 SML_BNKS observations experienced CRS, 8 (13.8%) experienced DRS and 15 (25.9%) experienced IRS. 20 observations (34.5% of total 58 observations) belonged to MED_BNKS, of which 9 or 15.5% of 20 MED_BNKS observations experienced CRS, 7 (12.1%) experienced DRS and 4 (6.9%) experienced IRS. 10 observations or 17.2% of total 58 observations belonged to LAR_BNKS, of which 4 or 6.9% of 10 LAR_BNKS observations experienced CRS, 5 (8.6%) experienced DRS and 1 (1.7%) experienced IRS.

Table 5: Summary of Parametric and Non-Parametric Tests for the Null Hypothesis that Domestic (*d*) and Foreign (*f*) Banks Possess Identical Technologies (Frontiers)

	Test Groups			
	Parametric Test		**Non-Parametric Test**	
Individual Tests	Analysis of Variance (ANOVA) test	*t*-test	Kolmogorov-Smirnov [K-S] test	Mann-Whitney [Wilcoxon Rank-Sum] test
Hypotheses	$\text{Mean}_d = \text{Mean}_f$		$\text{Distribution}_d = \text{Distribution}_f$	$\text{Median}_d = \text{Median}_f$
Test Statistics	F (Prb > F)	t (Prb > t)	K-S (Prb > K-S)	z (Prb > z)
Overall Efficiency	3.200 (0.079)	1.789 (0.079)	1.165 (0.132)	-1.157 (0.247)
Pure Technical Efficiency	0.973 (0.328)	-0.986 (0.033)	0.760 (0.611)	-0.848 (0.397)
Scale Efficiency	7.082 (0.010)	2.661 (0.010)	1.216 (0.104)	-1.298 (0.194)

Note: Test methodology follows among others, Aly *et al.* (1990), Elyasiani and Mehdian (1992) and Isik and Hassan (2002). Parametric (ANOVA and t-test) and Non-Parametric (Kolmogorov-Smirnov and Mann-Whitney) tests test the null hypothesis that domestic and foreign banks are drawn from the same efficiency population (environment). The numbers in parentheses are the *p*-values associated with the relative test.

5.1. Consistency of the DEA efficiency scores

As suggested by Bauer *et al.* (1998), for the frontier based efficiency scores to be useful, the estimated scores should be positively correlated with the traditional non-frontier based measures of performance used by regulators, managers and industry consultants. Bauer *et al.* (1998) stated that positive rank-order correlations with these measures would give assurance that the frontier measures are not simply artificial products of the assumptions made regarding the underlying optimization concept. In the spirit of Bauer *et al.* (1998), in order to complement the results of the efficiency measures, we correlated various accounting measures of bank performance with various efficiency scores namely, the *ROA* (Net Income/Total Assets) as a proxy of banks profitability, *LOGASS* (Log of Total Assets) and *LOGLOANS* (Log of Total Loans) as a proxy of banks' size. Following among others, Isik and Hassan (2002) and Hassan (2005), we calculated both the rank-order Spearman and the parametric Pearson correlation coefficients to

examine the possible relationship among the *X*-efficiency measures and accounting measures of performance. Both the Spearman and Pearson correlation coefficients are presented in table 5. The null hypothesis is that the correlation coefficient between two variables is zero.

As the results indicate, the Spearman (*s*) and the Pearson (*p*) correlation coefficients are all significantly different from zero, indicating that there is a strong association among the *X*-efficiency measures and accounting measures of performance.[7] Generally, the Pearson coefficient results confirm all the relationships found with the Spearman in the direction (positive or negative) and significance.[8] The results from the Spearman correlation coefficients show that overall efficiency is highly positively and statistically significantly associated with other X-efficiency measures, namely, *PTE* and *SE* ($\rho OE - PTE = 0.600$, $\rho OE - SE = 0.903$). The results also suggest that SE is more related to *OE* than *PTE*, confirming the dominant effect of scale efficiency in determining the overall efficiency of Malaysian Islamic banks. Our results from the Pearson correlation coefficients have also confirmed the relationship and its significance.

The results from the Spearman correlation coefficients indicate that *LOGASS* as a proxy for size is positively and significantly related to *OE* and *LOGLOANS*, which is further confirmed by the results from the Pearson correlation coefficients. If anything can be derived from the results, it is that the more efficient banks tend to utilize their resources more efficiently by disbursing more loans. Larger banks tend to make more loans and in the process become more efficient. Similarly, the results from the Spearman correlation coefficients suggest that *LOGLOANS*, which is a proxy measure for market share, is positively and significantly related with all efficiency measures, namely, *OE*, *PTE* and *SE* (ρ *LOGLOANS*-OE=0.439, ρ*LOGLOANS*-*PTE*=0.308, ρ*LOGLOANS*-*SE*=0.356), which is further confirmed by the results from the Pearson correlation coefficients. Our results are in line with Sathye (2001) in that market share has significantly positive effects on Malaysian Islamic banks' efficiency.

From Table 6 it is apparent that both proxies of bank size and market share, namely *LOGASS* and *LOGLOANS* respectively, are negatively associated with the proxy measure for profitability, *ROA*, although not statistically significant. The results suggest that, during the period of study, although the larger banks tended to make more loans and become more efficient, the smaller Malaysian Islamic banks tended to be more profitable. Despite that, the results should be interpreted with caution given the low

negative coefficients and insignificantly different from zero (in the case of Spearman correlation coefficients).

Table 6: Spearman Rho Rank Order (*s*) and Parametric Pearson (*p*) Correlation Coefficients among Efficiency Estimates and Proxy-Measures of Performance

Variables	Overall Efficiency	Pure Technical Efficiency	Scale Efficiency	LOGASS	LOGLOANS	ROA
Overall Efficiency						
(*s*)	1.000	0.600**	0.903**	0.305*	0.439**	0.547**
(*p*)	1.000	0.595**	0.881**	0.289*	0.559**	0.412**
Pure Technical Efficiency						
(*s*)	0.600**	1.000	0.294*	0.227	0.308*	0.353**
(*p*)	0.595**	1.000	0.165	0.153	0.284*	0.288*
Scale Efficiency						
(*s*)	0.903**	0.294*	1.000	0.245	0.356**	0.467**
(*p*)	0.881**	0.165	1.000	0.273*	0.527**	0.307*
LOGASS						
(*s*)	0.305*	0.227	0.245	1.000	0.952**	-0.182
(*p*)	0.289*	0.153	0.273*	1.000	0.903*	-0.292*
LOGLOANS						
(*s*)	0.439**	0.308*	0.356*	0.952**	1.000	-0.041
(*p*)	0.559**	0.284*	0.527**	0.903**	1.000	-0.094
ROA						
(*s*)	0.547**	0.353**	0.467**	-0.182	-0.041	1.000
(*p*)	0.412**	0.288*	0.307*	-0.292*	-0.094	1.000

Note: *LOGASS* is Log of Total Assets; *LOGLOANS* is Log of Total Loans; *ROA* is return on assets (Net Income/Total Assets); Spearman [*s*] correlation coefficient – first row of each cell; Parametric Pearson [*p*] correlation coefficient – second row of each cell; (*) indicates significant at the 0.05% level (2-tailed); (**) indicates significant at the 0.01% level (2-tailed).

Finally, there is also statistically strong correlation between profitability ratio (*ROA*) and efficiency measures. The results from the Spearman correlation coefficients suggest that *ROA* is significant and positively correlated with *OE*, *PTE* and *SE* (ρ*ROA-OE*=0.412, ρ*ROA-PTE*=0.288, ρ*ROA-SE*=0.307) at the 0.01 levels of significance. Again, the results from the Spearman correlation coefficients are confirmed by the Pearson correlation coefficients albeit at a different level of significance. This finding supports

among others, Miller and Noulas (1996), Hasan and Marton (2000) and Isik and Hassan (2002), the proposition that the most profitable banks are also the most efficient.

In sum, the statistically and significantly different from zero correlation coefficients suggest that our *X*-efficiency measures are strongly associated with conventional proxy measures of performance, *i.e.* they are robust and are not 'meaningless' from the technique used.

VI. Conclusion

This paper attempts to investigate the efficiency of Malaysian Islamic banks during the period of 2001-2004. The chosen non-parametric Data Envelopment Analysis (DEA) methodology allowed us to distinguish between three different types of efficiency - technical, pure technical and scale. Additionally, we performed a series of parametric and non-parametric tests to examine whether the domestic and foreign banks were drawn from the same population. Finally, we employed Spearman Rho Rank-Order and the Parametric Pearson correlation coefficients to investigate the association between the efficiency scores derived from the DEA results with the traditional accounting ratios.

We found that the mean overall or technical efficiency was 86.1% and 85.1% for domestic and foreign Islamic banks, respectively. In other words, during the period of study, the domestic Islamic banks could have produced the same amount of outputs by only using 86.1% of the inputs that they then employed. Similarly, the foreign banks could have reduced 14.9% of the amount of inputs they then employed currently without affecting the amount of outputs produced. Overall, our results suggest that scale efficiency dominated over the pure technical efficiency effects in determining Malaysian Islamic banks' overall or technical efficiency. Further, our results from the parametric and non-parametric tests could not reject the null hypothesis that the foreign and domestic Malaysian Islamic banks were drawn from the same population, suggesting that it is appropriate to construct a single frontier for both the domestic and foreign banks.

Our results indicate that the number of Malaysian Islamic banks experiencing economies of scale (*IRS*) increased dramatically from 28.6% in year 2001 to 60.0% in year 2004, confirming the fact that during the period of study, the majority of Malaysian Islamic banks were operating at the wrong scale of operations. The share of scale efficient banks (operating

at *CRS*), declined from 35.7% in year 2001 to 26.7% in year 2004, while Malaysian Islamic banks experiencing diseconomies of scale (*DRS*) declined sharply from 35.7% in year 2001 to 13.3% in year 2004. Examination of the sample of 58 observations over the four-year period reveals that while, on average, 31.0% of all Malaysian Islamic banks were operating at *CRS*, the majority, 69.0%, were scale inefficient (*DRS* or *IRS*). Of the scale inefficient banks, 39.7% were small banks, 19.0% medium banks, and 10.3% large banks. We have also found that the convexity of the frontier assured that banks experiencing *IRS* are more frequently the smaller banks.

To further complement the results of the efficiency measures, we correlated various accounting measures of bank performance with the efficiency scores derived from the DEA. Our results from both the Spearman and the Pearson correlation coefficients suggest that overall efficiency is positively and significantly associated with all the accounting measures of performance. Our results from both the Spearman and the Pearson correlation coefficients confirm the dominant effect of scale efficiency over pure technical efficiency in determining Malaysian banks' overall efficiency during the period of study. We found that the larger Malaysian Islamic banks tended to disburse more loans and were more efficient compared to their smaller counterparts. Our results suggest that market share had a positive and significant effect on Malaysian Islamic banks efficiency. The results also suggest that the more efficient banks tended to be the more profitable.

Lastly, due to its limitations, the work undertaken in this paper could be extended in a variety of ways. It is suggested that further analysis into the investigation of Malaysian Islamic banks efficiency be done to consider the risk exposure factors. In order to establish overall bank performance, risk exposure factors should be taken into consideration along with productive efficiency measures. The best bank may not just be the most efficient producer of loans, but also the one that balances high efficiency with low risk assumptions. Future research into the efficiency of Malaysian Islamic banks in particular and Islamic banks in general could also consider the production function along with the intermediation function. 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 worthwhile extension.

Notes

1. Hababou (2002) and Avkiran (1999) provide a relatively thorough discussion of the merits and limits of the DEA.
2. 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.
3. Humphrey (1985) presets an extended discussion of the alternative approaches over what a bank produces.
4. We also re-ran 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 authors upon request.
5. For the purpose of brevity, we do not report the full results here but they are available from the authors on request.
6. The results discussed are from the 'Foreign Banks Only' panel. The results from the 'All Banks All Years' panel, however, suggest that the foreign banks mean technical (overall) efficiency was declining from 77.4% in year 2001 to 57.7% in year 2004. To this extent, further investigations into the issues of the impact of financial repression and Liability of Foreignness (LoF) in the Malaysian Islamic banking sector would be extremely beneficial.
7. With the exception of *LOGASS*, that is not significantly correlated with *PTE* and *SE* in the case of Spearman and PTE in the case of Pearson correlation coefficients.
8. In the case that the relationship is found significant with the Spearman rank correlation and is not supported by the Pearson correlation, the results obtained by the Spearman correlation should be used, as the results obtained by the latter are more credible due to the less stringent assumptions required (Isik and Hassan, 2002). The difference could be attributed to the assumptions underlying each method.

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