Bank Ownership, Characteristics and Performance: A Comparative Analysis of Domestic and Foreign Islamic Banks in Malaysia

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ABSTRACT

The paper investigates the performance of Malaysian Islamic banking sector during the period of 2001-2005. Several efficiency estimates of individual banks are evaluated using non-parametric Data Envelopment Analysis (DEA). Two different approaches have been employed to differentiate how efficiency scores vary with changes in inputs and outputs. The analysis links the variation in calculated efficiencies to a set of variables, i.e. bank size, ownership, capital, non-performing loans and management quality. The findings suggest that during the period of study, scale inefficiency dominates pure technical inefficiency in the Malaysian Islamic banking sector. We found that foreign banks have exhibited higher technical efficiency compared to its domestic peers. The second stage empirical results based on multivariate Tobit model also suggest that technically more efficient banks are larger, have greater loans intensity, and on average have less non-performing loans.

JEL Classification: G21; G28

Keywords: Islamic Banks, Data Envelopment Analysis (DEA), Tobit Regression Analysis

1.0 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 conventional banking and converted their entire financial operations to Islamic practices and are currently devoid of conventional interest based financial transactions.

The Islamic banking in Malaysia differs from Islamic banking in the Gulf and the rest of the world (Samad *et al*., 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 nation to have a full-fledged Islamic system operating side-by side with the conventional banking system[1]. Under this framework, conventional banking institutions are 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 17 (of which 4 are foreign banks).

Today, the Malaysia 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 both the Muslim and non-Muslim customers. This has spurred the efforts by other non-bank financial intermediaries such as the development financial institutions, savings institutions and housing credit institutions to introduce Islamic banking schemes and instruments to meet their customer demands.

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

[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).

average rate of 19% per annum in terms of assets against the global growth rate of 15% (Rosly, 2005). As at end-2005, total assets of the Islamic banking sector has increased to RM111.8 billion, which accounted for 11.7% of the banking system's total assets, while the market share of Islamic deposits and financing has increased to 11.7% and 12.1% of total banking sector deposits and financing respectively and is set to command a 20% market share by the year 2010 (Rosly, 2005; Hasan, 2004). 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).

Over the years, while there has been extensive literature examining the efficiency of the conventional banking industries, empirical works on Islamic banks 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 that have been devoted to assess the performance of Islamic banks generally examined the relationship between profitability and banking characteristics (Bashir, 1999; Samad and Hassan, 1999; Bashir, 2001). The 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. Despite there are currently a few studies that have examined the performance of Islamic banks in Malaysia, we are not aware of any study that have analysed the efficiency of Malaysian Islamic banks employing a non-parametric DEA method.

Since its introduction by Charnes *et al.* (1978), researchers have welcomed Data Envelopment Analysis (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 Al-Barakah Islamic 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 have 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).

In effect, the paper addresses five important issues relating to the efficiency of the Malaysian Islamic banking sector. First, what do data suggest regarding the convergence of performance/efficiency of Malaysian Islamic banks resulting from the increased competition brought by the further liberalisation of the banking sector? Second, does efficiency vary across ownership patterns? Third, does banks' capital position impinge upon efficiency? Fourth, how does efficiency correlate with profitability? Fifth, does the quality of banks' assets affect their efficiency levels? The paper also examines how efficiency differs among peer groups. Furthermore, the paper explores the proximate sources of (in) efficiency under both univariate

2 As part of Malaysia's World Trade Organisation (WTO) commitment to further liberalised the banking sector and to give the foreign banks completely open access to the Malaysian markets by the end of 2006.

and multivariate framework and relates the findings to the ongoing liberalisation undertaken within the Malaysia Islamic banking sector.

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.

2.0 REVIEW OF THE RELATED LITERATURE

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

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

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

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

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

While the above outlines the literature that uses advanced modelling techniques to evaluate bank efficiency, it is worth highlighting the growing body of literature that covers 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 measure such as cost-to-income ratios. Other studies that take a similar approach are those by Sarker (1999) who looks at the performance and operational efficiency of Bangladeshi Islamic banks, while Bashir (1999) examines the risk and profitability of two Sudanese banks. Overall, the general finding from this literature is that Islamic banks are at least as efficient as their conventional bank counterparts and in most cases are more efficient.

Despite the considerable development of Islamic banking sector, there are still limited studies focusing on the efficiency of Islamic banks, particularly the Malaysian Islamic banking industry. Several studies that have been devoted to assess the performance of Islamic banks have generally examined the relationship between profitability and banking characteristics. Bashir (1999) and Bashir (2001) performed regression analyses to determine 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) claimed 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 (2000) 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 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).

3.0 METHODOLOGY

3.1 Data Envelopment Analysis

The present study employs the non-parametric frontier DEA approach to estimate the input-oriented technical efficiency of conventional banks offering Islamic banking products and services in Malaysia. This approach measures the efficiency of a decision-making unit (DMU) relative to other similar DMUs with the simple restriction that all DMUs lie on or below the efficiency frontier. The purpose of DEA is to empirically characterise the so-called efficient frontier (surface) based on the available set of DMUs and project all DMUs onto this frontier. If a DMU lies on the frontier, it is referred to as an efficient unit; otherwise it is labelled as inefficient. The data are enveloped in such a way that radial distances to the frontier are minimised. In practice, efficiency scores are calculated by solving a linear programming problem (see Appendix A and B).

The analysis under DEA is concerned with understanding how each DMU is performing relative to others, the causes of inefficiency, and how a DMU can improve its performance to become efficient. In that sense, DEA calculates the relative efficiency of each DMU in relation to all other DMUs by using the actual observed values for the inputs and outputs of each DMU. It also identifies, for inefficient DMUs, the sources and level of inefficiency for each of the inputs and outputs. The DEA is carried out by assuming either constant returns to scale (CRS) or variable returns to scale (VRS). The estimation with these two assumptions allows the overall technical efficiency (TE) to be decomposed into two collectively exhaustive components: pure technical (PTE) and scale efficiency (SE) i.e. TE = PTE x SE. The former relates to the capability of managers to utilise firms' given resources, whereas the latter refers to exploiting scale economies by operating at a point where the production frontier exhibits constant returns to scale.

A useful feature of VRS models as compared to the CRS models is that it reports whether a decision-making unit (DMUs) is operating at increasing, constant or decreasing returns to scale. Constant returns to scale will apply when CRS and VRS efficiency frontiers are tangential with each other; in other words, when the slope of the efficiency frontier is equal to the ratio of inputs to outputs (Cooper *et al*., 2000). Increasing returns to scale must apply below that level, as the slope of the efficient frontier, which reflects the marginal rate of transformation of inputs to outputs) will be greater than the average rate of conversion. Likewise, decreasing returns to scale must apply above the zone in which constant returns to scale apply. DMUs not on the efficient frontier must first be projected onto the efficient frontier before their returns to scale status can be assessed.

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). 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. Finally, Avkiran (1999) acknowledges the edge of 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 standardisation[4]. The main weakness of DEA is that it assumes data are free from measurement errors. 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.

3.2 Multivariate Tobit Regression Analysis

It is also a considerable interest to explain the determinants of technical efficiency scores derived from the DEA models. As defined in equations (A1) and (A2), the DEA score falls between the interval 0 and 1 ($0 < h^{*} \leq 1$) making the dependent variable a limited dependent variable. A commonly held view in previous studies is that the use of the Tobit model can handle the characteristics of the distribution of (in) efficiency measures and thus provide results that can provide important policy guidelines to improve performance. As the dependent variable efficiency score is bounded between 0 and 1, an appropriate theoretical specification is a Tobit

3 Hababou (2002) and Avkiran (1999) provide a relatively thorough discussion of the merits and limits of the DEA.

model with two side censoring. However, firms with inefficiency score of 1 will never be observed in practice. Therefore, the results of the empirical analysis will not be different if one specifies a one or two side Tobit model. Accordingly, DEA inefficiency scores obtained in the first stage are used as a dependent variables in the second stage one side censored Tobit model in order to allow for the restricted [0, 1] range of inefficiency values.

Coelli *et al*. (1998) have suggested several ways in which environmental variables can be accommodated in a DEA analysis. The term "environmental variables" is usually used to describe factors, which could influence the efficiency of a firm. In this case, such factors are not traditional inputs and are assumed to be outside the control of the manager. Hence, the two-stage method used in this essay involves the solution of DEA problem in the first stage analysis, which comprises mainly the traditional outputs and inputs. In the second stage, the efficiency scores obtained from the first stage analysis are regressed on the environmental variables.

The standard Tobit model can be defined as follows for observation (bank) i :

$$y_i^* = \beta' x_i + \varepsilon_i \tag{1}$$

$$y_i = y_i^* \text{ if } y_i^* \geq 0 \text{ and}$$

$$y_i = 0, \text{ otherwise}$$

where $\varepsilon_i \sim N(0, \sigma^2)$, x_i and β are vectors of explanatory variables and unknown parameters, respectively, while y_i^* is a latent variable and y_i is the DEA score[5].

The first product is over the observations for which the banks are 100 percent efficient (y = 0) and the second product is over the observations for which banks are inefficient (y >0). F_i is the distribution function of the standard normal evaluated at $\beta' x_i / \sigma$.

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

5 The likelihood function (L) is maximised to solve β and σ based on 74 observations (banks) of y_i and x_i is $L = \prod_{y_i=0}(1-F)\prod_{y_i>0}\frac{1}{(2\Pi\sigma^2)^{1/2}} \times e^{-[1/(2\sigma^2)](y^i-\beta x_i)^2}$ where, $F_i = \int_{-\infty}^{\beta x_i/\sigma} \frac{1}{(2\Pi)^{1/2}} e^{-t^2/2} dt$

The first product is over the observations for which the banks are 100 percent efficient (*y* = 0) and the second product is over the observations for which banks are inefficient (*y* >0). F_i is the distribution function of the standard normal evaluated at $\beta' x_i / \sigma$.

Using the efficiency scores as the dependent variable, we estimate the following regression model:

$$\Theta_{jt} = \beta_0 + \beta_1 LNDEPO_{jt} + \beta_2 LOANS/TA_{jt} + \beta_3 LNTA_{jt} + \beta_4 LLP/TL_{jt}$$
$$+ \beta_5 NIE/TA_{jt} + \beta_6 EQUITY/TA_{jt} + \beta_7 ROA_{jt} + \beta_8 LOGGDP$$
$$+ \beta_9 DUMFORB_{jt} + \beta_{10} DUMFFIB_{jt} + \varepsilon_j$$

where, Θ_{jt} is the technical, pure technical and scale efficiency of the *j*th bank in period *t* obtained from DEA Model A and DEA Model B, $LNDEPO_{jt}$ is a natural logarithm of total deposits of bank *j* in period *t*; $LOANS/TA_{jt}$ is total loans to total assets of bank *j* in period *t*; $LNTA_{jt}$ is natural logarithm of total assets of bank *j* in period *t*; LLP/TL_{jt} is total loan loss provisions divided by total loans of bank *j* in period *t*; NIE/TA_{jt} is total non-interest expenses divided by total assets of bank *j* in period *t*; $EQUITY/TA_{jt}$ is total shareholders equity divided by total assets of bank *j* in period *t*; ROA_{jt} is profit after tax divided by total assets of bank *j* in period *t*; *LOGGDP* is natural logarithm of gross domestic product; $DUMFORB_{jt}$ and $DUMFFIB_{jt}$ are dummy variables indicating the ownership of the *j*th bank in period *t* (equal to 1 if a bank is a foreign bank and full-fledged Islamic bank respectively, 0 otherwise).

3.2 Specification of Bank Inputs, Outputs and Data

The definition and measurement of inputs and outputs in the banking function remains a contentious issue among researchers. Banks are typically multi-input and multi-output firms. As a result, defining what constitutes ‘input’ and ‘output’ is fraught with difficulties, since many of the financial services are jointly produced and prices are typically assigned to a bundle of financial services. Additionally, banks may not be homogeneous with respect to the types of outputs actually produced. To determine what constitutes inputs and outputs of banks, one should first decide on the nature of banking technology. In the 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, they perform transactions on deposit accounts and process documents such as loans. Hence, according to this approach, the number of accounts or its related transactions is the best measures for output, while the number of employees and physical capital is considered as inputs. Previous studies that adopted this approach are among others by Sherman and Gold (1985), Ferrier and Lovell (1990) and Fried *et al.* (1993).

The intermediation approach on the other hand assumes that financial firms act as an intermediary between savers and borrowers and posits total loans and securities as outputs, whereas deposits along with labour and physical capital are defined as inputs. Previous banking efficiency studies research that adopted this approach are among others 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) will be adopted in the definition of inputs and outputs used[6]. 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[7]. All variables are measured in billion of Malaysian Ringgit (MYR). Given the sensitivity of efficiency estimates to the specification of outputs and inputs, we have estimated two alternative models. Malaysian Islamic banks are regarded as an intermediary between savers and borrowers in DEA Model A, producing two outputs namely, *Total Loans* (*y1*), which include loans to customers and other banks and *Investments* (*y2*), which include investment securities held for trading, investment securities available for sale (AFS) and investment securities held to maturity by employing two inputs, namely, *Total Deposits* (*x1*), which include deposits from customers and other banks, and *Total Assets* (*x2*). To examine the productive efficiency of labour in the Malaysian Islamic banking industry, *Labour* (*x3*), inclusive of total expenditures on employees such as salaries, employee benefits and reserve for retirement pay is included as an input variable in DEA Model B. Accordingly, Malaysian Islamic banks are regarded to employ *Total Assets* (*x2*) and *Labour* (*x3*) to produce *Total Loans* (*y1*) and *Investments* (*y2*)[8].

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

7 For a detailed discussion on the optimal number of inputs and outputs in DEA, see Avkiran (2002) .

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

Table 1 presents summary statistics of the output and input variables used in the DEA models, measured in billions of Malaysian Ringgit (RM). It is 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 total loans (financing) to the domestic economy. During the years (2001-2005), total loans and deposits grew by 132% and 84% respectively for the domestic banks, while the rate is significantly higher for the foreign banks, which recorded more than eightfold increase in total loans and sevenfold increase in total loans. It is clear from Table 1, the Malaysian Islamic banking and finance industry has created significant employment opportunities during this period witnessed by the more than 100% increase in personnel expenses during the five-year study period. As a result of the growing demand for Islamic financial services, the total assets of the Malaysian Islamic banks have significantly expanded during the period. In 2001, the average domestic banks held RM1,092 billion in total assets, before increasing to RM7,385 billion in 2005. Likewise, the average foreign banks held RM454 billion in total assets during 2001, before increasing to RM1,988 billion in 2005. Similar expansions were also observed in the proportion of banks assets held in investments.

[Insert Table 1]

Several bank and industry specific attributes may influence a particular bank's efficiency level. Some of these factors may neither be inputs nor outputs in the production process, but rather circumstances faced by a particular bank. The independent variables are grouped under three main characteristics. *Banks Structure* represents firm-specific attributes, *Economic Conditions* encompass market conditions in effect over the period examined and *Ownership* examines the relationship between bank's ownership and efficiency. *Banks Structure* can further be divided into two other characteristics namely, *Banks Market Structure* and *Banks Risk Structure* and *Capitalisation*.

Under *Banks Market Structure* three independent variables are examined namely, *LNDEPO* (log of total deposits) as a proxy of market share, *LNTA* (log of total assets) as a proxy of size to capture the possible cost advantages associated with size (economies of scale). In the efficiency literature, the relationship between size and efficiency has been mixed and in some cases a U-shaped relationship is observed. *LNTA* is also used to control for cost differences related to bank size and for the greater ability of larger banks to diversify. In essence, *LNTA* may lead to positive effects on bank efficiency if there are significant economies of scale. On the other hand, if increased diversification leads to higher risks, the variable may have negative effects.

The ratio of overhead expenses to total assets, *NIE/TA*, is used to provide information on variation in operating costs across the banking system. It reflects employment, total amount of wages and salaries as well as the cost of running branch office facilities. A high *NIE/TA* ratio is expected to impact performance negatively because efficient banks are expected to operate at lower costs. On the other hand, the usage of new electronic technology, like ATMs and other automated means of delivering services, has caused the wage expenses to fall (as capital is substituted for labour). Therefore, a lower *NIE/TA* ratio may impact performance positively.

Under *Banks Risk Structure* we have also examined three independent variables namely, *LOANS/TA* (total loans divided by total assets) as a proxy of lending intensity, *LLP/TL* (loan loss provisions divided by total loans) is used as a proxy measure for risk and EQUITY/TA (book value of stockholders equity divided by total assets). Bank loans are expected to be the main source of revenue and are expected to impact profits positively. However, since most of the Islamic banks' loans are in the form of profit and loss sharing (loans with equity features), the loan-performance relationship depends significantly on the expected change of the economy. During a strong economy, only a small percentage of the profit and loss sharing loans will default, and the bank's profit will rise. On the other hand, the bank could be severely damaged during a weak economy, because borrowers are likely to default on their loans. Ideally, banks should capitalise on favourable economic conditions and insulate themselves during adverse conditions.

The coefficient of *LLP/TL* is expected to be negative because bad loans reduce profitability and efficiency. *EQUITY/TA* is included in the model because, as noted, domestic and foreign banks may use different degrees of leverage. Furthermore, lower capital ratios in banking imply higher leverage and risk, and therefore greater borrowing costs. Berger and Mester (1997) have pointed out that, it is an important control variable used to account for differences in risk among banking institutions[9]. We expect *EQUITY/TA* to have a negative

9 See Berger and Mester (1997) for a detailed discussion of this point.

coefficient because an increase in equity is a reduction in leverage, which reduces return on equity.

We have included *Economic Conditions* variables to capture the association between economic growths on Malaysian Islamic banks' efficiency. The *LOGGDP* independent variable represents the growth rate of the country's gross domestic product and is used as a proxy for economic conditions. Favourable economic conditions will affect positively on the demand and supply of banking services, but will either impact positively or negatively on bank efficiency.

Agency issues associated with different types of firm ownership are an area of concern in many banking systems. In an attempt to examine the association between corporate governance and Malaysian Islamic banks efficiency, we have included two *Ownership* variables, namely *DUMFORB* (dummy variable that takes a value of 1 if a bank is a foreign bank, 0 otherwise) and *DUMFFIB* (dummy variable that takes a value of 1 if a bank is a full fledged Islamic bank, 0 otherwise). The ownership variable *DUMFORB* is expected to have a negative association with inefficiency i.e. foreign banks is expected to exhibit higher efficiency levels, while the dummy variable *DUMFFIB* may have positive or negative impacts on banks' efficiency levels.

4.0 EMPIRICAL FINDINGS

In this section, we will discuss the technical efficiency change (TE) of the Malaysian Islamic banking sector, measured by the Data Envelopment Analysis (DEA) method and its decomposition into pure technical efficiency (PTE) and scale efficiency (SE) components. In the event of the existence of scale inefficiency, we will attempt to provide evidence on the nature of returns to scale of the Malaysian Islamic banks. The efficiency of Malaysian Islamic banks was first examined by applying the DEA method for each year under investigation. To substantiate the results under the DEA approach, a multivariate regression framework is employed to relate bank level efficiency scores to bank characteristics.

4.1 Efficiency of the Malaysian Islamic Banking Sector

Table 2 presents mean efficiency scores of Malaysian Islamic banks for the years 2001 (Panel A), 2002 (Panel B), 2003 (Panel C), 2004 (Panel D), 2005 (Panel E), Domestic Banks

(Panel F) and Foreign Banks (Panel G). The results from DEA Model A seems to suggest that Malaysian Islamic banks mean technical efficiency has been on a declining trend during the earlier part of the studies, increasing during the latter years, before declining again in the final year under observation. The decomposition of technical efficiency into its exhaustive components of pure technical and scale efficiency suggest that scale inefficiency dominates pure technical inefficiency of the Malaysian Islamic banks during all years except for the year 2002 in the case of the domestic banks and year 2005 in the case of the foreign banks. Overall the results seem to imply that Malaysian Islamic banks have been inefficient in exploiting the economies of scale given their scale of operations.

[**Insert Table 2**]

During the period of study, the results seem to suggest that the domestic Malaysian Islamic banks (Panel F) have exhibited mean technical efficiency of 77.7%, suggesting mean input waste of 22.3%. In other words, the domestic banks could have produced the same amount of outputs by only using 77.7% of the amount of inputs it uses. From Table 2 (Panel F) it is also clear that scale inefficiency dominates pure technical inefficiency of the domestic Malaysian Islamic banks. On the other hand, the results from Table 2 (Panel G) suggest that foreign banks that offered Islamic banking services in Malaysia have exhibited higher mean technical efficiency of 86.9% compared to its domestic counterparts. Likewise, the results also suggest that the foreign banks inefficiency were mainly attributed to scale rather than pure technical albeit at a lower degree of 8.1% (domestic banks 12.8%). Overall the findings suggest that foreign banks were more managerially efficient in controlling their costs and have been operating at a relatively more optimal scale of operations compared to their domestic peers.

[**Insert Table 3**]

Since the dominant source of total technical (in) efficiency in the Malaysian Islamic banking seems to be scale related, it is worth further examining the trend in the returns to scale of the Malaysian Islamic banks. Table 3 shows the composition of banks that lie on the efficiency frontier under DEA Model A. The composition of the efficiency frontier for DEA Model A suggests that the number banks that span the efficiency frontier varies between three to six banks. During the period of study, foreign banks seem to have dominated the efficiency frontier under DEA Model A. It is also apparent from Table 3 that, all foreign banks have appeared at least once on the frontier. It is also clear from the results that, two foreign banks namely, Citibank and HSBC are the global leaders i.e. appeared the most times on the efficiency frontier. On the other hand, the results seem to suggest that only two domestic banks have managed to appear on the frontier, while eight have never made it to the efficiency frontier throughout the period of study.

[**Insert Table 4**]

Table 4 presents the results derived from DEA Model B. The results from DEA Model B seems to suggest that Malaysian Islamic banks mean technical efficiency has been on a declining trend during the earlier part of the studies, increasing during the latter part of the study, before declining again in the latter years. The decomposition of technical efficiency into its exhaustive components of pure technical and scale efficiency suggest that pure technical inefficiency dominates domestic Malaysian Islamic banks scale inefficiency during the earlier years. The trend however changed during the latter part of the studies when domestic Malaysian Islamic banks have exhibited higher pure technical efficiency. The foreign banks on the other hand were managerially efficient during all years except for the year 2004, when scale efficiency was higher.

[**Insert Table 5**]

The composition of the efficiency frontier and the nature of the returns to scale in the Malaysian Islamic banking sector are discussed next. Table 5 presents the results of the nature of returns to scale in Malaysian Islamic banking sector derived from DEA Model B. The composition of the efficiency frontier for DEA Model B suggests that the number of banks operating at CRS has almost doubled to between three and nine banks. Unlike the results from DEA Model A, two domestic banks took over as the global leaders from their foreign counterparts by appearing the most times on the efficiency frontier. Likewise, the number of domestic banks that failed to appear on the frontier declined to only five under DEA Model B. It is also interesting to note that all foreign banks have managed to appear at least once on the frontier.

It is worth highlighting the differences in the results obtained from the two DEA models. Under DEA Model A, when Total Deposits and Total Assets are used as input vectors, the efficiency gap between the domestic and foreign banks seems large at 9.2%. Despite using the same output vectors, when Labour and Total Assets are used as input vectors under DEA Model B, the efficiency gap between domestic and foreign banks converged to only 4.3%. The results clearly suggest that DEA analysis is sensitive to the choice of variables. Nevertheless, this is also the strength of the technique as it provides management with specific information on where to start improving the efficiency of DMUs under scrutiny (Avkiran, 1999). It allows efficiency measurement from various perspectives depending on the decision-making requirements. For instance, if management is interested in the contribution of labour to a particular set of outputs, personnel expenses or staff numbers become an input variable.

Overall, the results from both the DEA models seems to suggest that in the case of Malaysian Islamic banks, technical inefficiencies have much more to do with the scale of production rather than the inefficient utilisation of resources. The dominant effect of the scale inefficiency indicates that most of the Malaysian Islamic banks operate at this 'incorrect' scale. They either experience economies of scale (i.e. increasing returns to scale (IRS)) due to being at less than optimum size or diseconomies of scale (i.e. decreasing returns to scale (DRS)) due to being at more than the optimum size. Thus, decreasing or increasing the scale of production could result in cost savings or efficiencies. The scale inefficiency due to IRS might be attributed to small banks, whereas, the scale inefficiency due to DRS might be related to large banks (Miller and Noulas, 1996; Noulas *et al*., 1990).

The composition of the efficiency frontier for both the DEA models shows that the majority of Malaysian Islamic banks, particularly the domestic ones, have experienced diseconomies of scale (DRS), ranging from 27% to 60% for DEA Model A, and 27% to 40% for DEA Model B, suggesting the extra production costs faced by rapidly growing Malaysian banks. The results seem to suggest that the share of scale efficient banks i.e. operating at CRS has declined from 40% in 2001 to 20% in 2005 for DEA Model A and from 60% in 2001 to 40% in 2005 for DEA Model B, signalling worsening scale efficiency over time. On the other hand, the share of the banks experiencing economies of scale i.e. operating at IRS rose from 7% in 2001 to

47% in 2004, before declining again to 33% in 2005 for DEA Model A. Likewise, the share of the banks experiencing economies of scale rose from 13% in 2001 to 53% in 2004, before declining again to 33% in 2005 for DEA Model B.

4.2 Univariate Test Results

Assessing the domestic and foreign banks efficiency under a common frontier may be biased, given that foreign banks could have quite different goals from domestic banks, as they may be inclined to trade-off between efficiency and market share in order to penetrate a local market (Isik and Hasssan, 2002). Further, foreign banks may have relied heavily on purchased funds in the inter-bank market, which is costlier. Alternatively, foreign banks might possess some distinct advantages, stemming mainly from their asset portfolios. Relative to domestic banks, foreign banks' asset portfolios are more skewed to investment securities, whose administrative and transactional costs are much lower than loans. Also, lack of exposure in a lesser-known market may manifest itself in the form of extra information gathering costs for clients.

[**Insert Table 6**]

Following the procedures outlined in Aly *et al.* (1990), Elyasiani and Mehdian (1992) and Isik and Hassan (2002) among others, the null hypothesis of identical frontiers between the foreign and domestic banks efficiency for each year under study is tested. The hypothesis is tested using a series of parametric (ANOVA and *t*-test) and non-parametric (Kolmogorov-Smirnov and Mann-Whitney [Wilcoxon Rank-Sum]) tests. Overall, both the parametric and non-parametric test statistics given in Table 6 failed to reject the null hypothesis at the 5% levels of significance that the domestic and foreign banks came from the same population and have identical technologies[10,11]. This implies that, there is no significant difference between the domestic and foreign banks technologies (frontiers). The results imply that we could assume the

10 With the exception of TE which is significant at the 5% level in year 2001, while SE is significant at the 5% level for all the non-parametric tests during the same year.

11 The results from DEA Model B are not altered in any significant way in terms of the signs, magnitude and statistical significance and are therefore not reported here.

variances among the domestic and foreign banks to be equal and it is appropriate to construct production frontiers by pooling data on domestic and foreign banks.

4.3 The Determinants of Malaysian Islamic Banks Efficiency

It is of public interest to know what firms can do to improve their efficiency so that scarce resources are allocated to their best uses and not wasted during the production of services and goods (Isik and Hassan, 2003). For this purpose, we investigate whether any aspects of the firms are related to their degree of efficiency. Also, it is equally important to examine which ownership type or organisational form produces stronger incentives to control inputs and/or boost outputs. The conventional way to accomplish such analysis is a two-step procedure, whereby a point estimate of X-efficiency is obtained for each firm and then the estimated efficiency scores are regressed against a set of explanatory variables (Worthington, 2000; Rezitis, 2006).

Table 7 reports the results derived from the Tobit regression analysis. The findings suggest that all explanatory variables have the expected signs, while seven are statistically different from zero. The exception is the coefficients of LLP/TL and LOGGDP, which are not statistically different from zero in any of the regressions. Thus, the variables are not significant determinants of any efficiency measures. The proxy for market power, LNDEPO, measured by individual bank's deposits divided by total assets reveals a negative relationship to all efficiency measures (statistically significant to PTE DEA Model A at the 5% level and SE DEA Model B at 10% levels), suggesting that the more efficient banks are associated to the banks with lower market share, thus diminishing the market leadership argument. The results imply that banks with small market share, like foreign banks, can be at least as efficient as market dominant banks because maintaining or expanding market share might involve extra costs and inputs that might exacerbate inefficiency.

The proxy of bank's loan intensity, LOANS/TA, reveals a positive and statistically significant relationship with all efficiency measures (except for SE DEA Model B). The findings imply that banks with higher loans-to-asset ratios tend to have higher efficiency scores. Thus, bank loans seem to be more highly valued than alternative bank outputs i.e. investments and securities. The positive relationship found between technical efficiency and LOANS/TA may be supporting the efficient market hypothesis. Market power in loan markets may be a result of efficient operations. Due to their ability to manage operations more productively, relatively efficient banks might have lower production costs, which enable them to offer more reasonable loan terms and ultimately gaining larger market shares over inefficient banks. LNTA, as a proxy of bank's size, shows positive coefficients, suggesting that the larger the bank, the more efficient the bank will be, purely because of the economies of scale arguments. Thus, assuming that the average cost curve for Malaysian Islamic banks is U-shaped, the recent growth policies of medium and large Malaysian Islamic banks seem to be consistent with cost minimisation.

As expected, the proxy of risk, LLP/TL, shows a negative relationship with efficiency scores indicating increase in inefficiency. The finding is consistent with earlier findings by among others, Kwan and Eisenbeis (1995), Resti (1997) and Barr *et al.* (2002) have found a negative relationship between problem loans and banks efficiency. Furthermore, most research conducted on explaining the causes of bank or thrift industry failures have found that failing institutions carried a large proportion of non-performing loans in their books prior to failure (Dermiguc-Kunt, 1989; Whalen, 1991; Barr and Siems, 1994). Berger and Humphrey (1992), Barr and Siems (1994) and Wheelock and Wilson (1995) have found that banks approaching failure tend to have low cost efficiency and experiencing high ratios of problem loans and that failing banks tend to be located far from the best practice frontiers.

The findings seem to suggest that management quality, as measured by NIE/TA, appears to have consistently negative and significant impact on efficiency estimates. Furthermore, the elasticity of technical efficiency with respect to NIE/TA is quite high i.e. –1.486 in the case of DEA Model A (significant at the 1% level) and –1.152 in the case of DEA Model B (significant at the 5% level). This finding is in consonance with the 'bad management hypotheses' of Berger and DeYoung (1997). Low measure of technical efficiency is a signal of poor senior management practices, which apply to input-usage, day-to-day operations and managing the loan portfolio. Sub par managers do not sufficiently monitor and control their operating expenses. Managers in these banks might not practice adequate loan underwriting, monitoring and control. This implies that the major risks facing Malaysian Islamic banks could be caused internally.

As expected, EQUITY/TA has a negative relationship with TE and PTE (significant at the 1% level), which is in line with the findings of Akhigbe and McNulty (2005). The findings seem to suggest that, the more efficient banks, *ceteris paribus*, use more leverage (less equity) compared to its peers. The results seems to suggest that the less efficient banks involved in riskier operations and in the process tend to hold more equity, voluntarily or involuntarily, i.e., the reason might be banks' deliberate efforts to increase safety cushions and in turn decrease the cost of funds, or perhaps just regulatory pressures that mandate riskier banks to carry more equity.

It was observed that profitability, as measured by ROA, had a positive relationship with all efficiency measures. These findings indicate that the more profitable banks have lower inefficiency, which corroborates similar findings of some previous studies (Miller and Noulas, 1996; Hasan and Marton, 2003; Isik and Hassan, 2002). Banks reporting higher profitability ratios are usually preferred by clients and therefore attract the biggest share of deposits as well as the best potential creditworthy borrowers. Such conditions create a favourable environment for the profitable banks to be more efficient from the point of view of intermediation activities.

Another factor, which explains growth in Malaysian Islamic banks efficiency, is the relatively high rates of national income growth recorded during the period of analysis measured by LOGGDP, which has a positive relationship with all efficiency measures but statistically insignificant at any conventional levels. Demand for financial services tends to grow as economies expand and societies become wealthier. During the period, the Malaysian economy grew at an average rate of 4.5% per year, which was reflected by the increase in GDP per capita from RM13,378 in 2000 to RM17,687 in 2005. The economic expansion allowed banks to benefit from higher demand for their financial services, reduces loan defaults and thus greater output.

DUMFORB is positive and significant as expected in our estimations. The findings imply that banks with controlling share of foreign ownership are more likely to be efficient than their domestically owned counterparts. This should come as no surprise because of the ability of foreign owned banks to capitalise on their access to better risk management and operational techniques, which is usually made available through their parent banks abroad. In addition, since foreign ownership is likely to be concentrated, foreign owned banks are less prone to typical corporate governance conflicts (dispersed) owners and the management. The evidence seems to suggest that foreign owned banks are more likely to cherry-pick the best borrowers available in the market (especially those from their own countries of origin), thereby improving the quality of their portfolio and increasing efficiency. The empirical observation that foreign banks perform better than domestic banks in developing countries also implies the technical savvy of banks from developed countries generally overcomes the home field advantage in developing countries, especially when the domestic economy has relatively unsophisticated financial markets and institutions (Jeon and Miller, 2005). The results are in accordance with earlier findings by Sathye, (2003) on Indian banks, Hassan and Marton, (2003) on Hungarian banks and Isik and Hassan, (2003) on Turkish banks, whom found that foreign banks tend to exhibit higher efficiency levels compared to their domestic counterparts.

DUMFFIB, a dummy variable for full-fledged Islamic banks has negative relationship with all efficiency measures (statistically significant to TE and PTE at 10% and 5% level for DEA Model A and 1% level for DEA Model B respectively). The findings suggest that, the full-fledged Islamic bank significantly underperformed compared to their foreign counterparts and to a lesser extent the domestic peers. The results for full-fledged Islamic banks should however be interpreted with caution because of the small sample size.

[**Insert Table 7**]

5.0 CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

In this paper, we examined the comparative performance of foreign and domestic Islamic banks in Malaysia during the period 2001-2005. Several efficiency estimates of individual banks are evaluated using the non-parametric Data Envelopment Analysis (DEA) approach. Two different models have been employed to differentiate how efficiency scores vary with changes in inputs and outputs. To further complement the results of the efficiency measures derived from the DEA models, we have analysed the determinants of the foreign and domestic banks efficiency using various accounting measures of bank performance. The preceding empirical analysis allows us to shed some light on the relationship between banking characteristics and performance measures in Islamic banks.

The empirical findings suggest that during the period of study, scale inefficiency dominates pure technical inefficiency in the Malaysian Islamic banking sector implying that the Malaysian Islamic banks have been inefficient in exploiting the economies of scale given their scale of operations. The results suggest that foreign banks have exhibited higher technical efficiency compared to its domestic peers, which is mainly attributed to higher pure technical efficiency. Overall, during the period of study, the findings seem to suggest that the foreign banks are relatively more managerially efficient in controlling their costs.

The findings suggest that technical efficiency is positively and significantly associated with loans intensity and bank's size, suggesting that the larger banks tend to be more efficient compared to its smaller peers. The Islamic banks' profitability measure, ROA, is related positively to all efficiency measures, indicating that the more efficient banks are more profitable. The results also suggest that economic conditions, measured by change in the national GDP, have positive but insignificant relationship with Islamic banks efficiency. The result suggests that favourable macroeconomic environment seems to stimulate higher efficiency. Consistent with earlier findings, higher growth rate of GDP seem to have a strong positive impact on the performance measures, suggesting that demand for financial services tends to grow as economies expand and societies become wealthier. On the other hand, the findings suggest that technical efficiency is negatively related to market power, risk, management quality and capitalisation. In contrast to the findings by Kabir and Bashir (2003), it appears that the expense preference behaviour appears not to be holding in the Malaysian Islamic banking market, thus supporting the 'bad management' hypothesis.

During the period of study, the results suggest that foreign banks are relatively more efficient compared to its domestic counterparts. The evidence seems to suggest that foreign owned banks are more likely to cherry-pick the best borrowers available in the market, especially those from their own countries of origin, thereby improving the quality of their portfolio and increasing efficiency. The empirical observation that foreign banks perform better than domestic banks in developing countries also implies the technical savvy of banks from developed countries generally overcomes the home field advantage in developing countries, especially when the domestic economy has relatively unsophisticated financial markets and institutions. Interestingly, the findings suggest that efficiency is negatively related to the full-fledged Islamic banks. However due to the small observations of the full-fledged Islamic banks during the period of study, the results need to be interpreted with caution.

Due to its limitations, the paper could be extended in a variety of ways. Firstly, the scope of this study could be further extended to investigate changes in cost, allocative and technical efficiencies over time. Secondly, it is suggested that further analysis into the investigation of

Malaysian Islamic banks efficiency to consider risk exposure factors. Finally, future research into the efficiency of Malaysian Islamic banks could also consider the production function along with the intermediation function.

Despite these limitations, the findings of this study are expected to contribute significantly to the existing knowledge on the operating performance of the Malaysian Islamic banking industry. Nevertheless, the study have also provide further insight to bank specific management as well as the policymakers with regard to attaining optimal utilisation of capacities, improvement in managerial expertise, efficient allocation of scarce resources and most productive scale of operation of the banks in the industry. This may also facilitate directions for sustainable competitiveness of future banking operations in Malaysia.

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Table 1: **Summary Statistics of the Variables Employed in the DEA Models (in billion of Ringgit)**

	Domestic		**Foreign**	
	Mean	**S.D.**	**Mean**	**S.D.**
Outputs				
2001				
Total Loans (y1)	1,967,986.73	1,976,784.14	126,262.25	75,286.80
Investments (y2)	1,092,748.09	804,200.13	260,398.25	453,683.63
2002				
Total Loans (y1)	2,525,162.64	2,471,994.80	152,367.00	94,030.16
Investments (y2)	1,788,555.64	1,711,153.96	206,365.00	359,831.82
2003				
Total Loans (y1)	3,297,960.55	3,500,591.92	305,565.50	306,106.83
Investments (y2)	1,547,236.91	1,308,132.42	512,945.75	556,976.22
2004				
Total Loans (y1)	3,958,634.27	4,204,438.27	717,941.75	795,103.21
Investments (y2)	1,142,359.00	1,140,943.73	737,046.25	291,378.52
2005				
Total Loans (y1)	4,559,123.18	473,2843.20	1,161,446.50	1,262,479.59
Investments (y2)	1,162,148.73	1,267,558.66	662,793.25	313,357.54
Inputs				
2001				
Total Deposits (x1)	3,408,836.36	3,076,784.90	212,426.5	177,647.60
Labour (x2)	14,705	25,013.61	799.25	350.99
Total Assets (x3)	3,914,814	3,493,378.91	455,858.75	569,009.15
2002				
Total Deposits (x1)	1,3215,032.64	31,531,022.91	354,919.75	458,261.93
Labour (x2)	16,035.64	25,717.98	948.00	165.72
Total Assets (x3)	4,920,840.46	4,241,331.03	400,310.50	468,087.59
2003				
Total Deposits (x1)	4,850,946.00	4,256,388.72	633,900.00	682,829.75
Labour (x2)	19,643.55	29,592.04	1,203.50	446.18
Total Assets (x3)	5,625,817	5,004,797.12	959,688.75	915,500.44
2004				
Total Deposits (x1)	5,385,656.73	4,819,090.13	1,200,215.75	638,321.87
Labour (x2)	21,521.91	31,383.77	1,396.50	1,041.51
Total Assets (x3)	5,958,955.18	4,853,470.76	1,678,050.50	1,065,298.47
2005				
Total Deposits (x1)	6,275,245.55	5,894,714.12	1,827,051.75	1,450,907.66
Labour (x2)	27,359.82	42,510.44	1,641.00	1,270.78
Total Assets (x3)	7,385,547.55	6,847,539.08	2,421,044.75	1,988,063.52

Source: Banks Annual Reports

Table 2: **Summary Statistics of Efficiency Scores – DEA Model A**

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

Banks	**Mean**		**Minimum**		**Maximum**		**Std. Dev.**	
Panel A: 2001	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**
Technical Efficiency	0.848	1.000	0.636	1.000	1.000	1.000	0.123	0.000
Pure Technical Efficiency	0.927	1.000	0.754	1.000	1.000	1.000	0.104	0.000
Scale Efficiency	0.916	1.000	0.730	1.000	1.000	1.000	0.084	0.000
Panel B: 2002								
Technical Efficiency	0.618	0.694	0.374	0.334	1.000	1.000	0.205	0.356
Pure Technical Efficiency	0.723	0.846	0.418	0.385	1.000	1.000	0.228	0.308
Scale Efficiency	0.956	0.828	0.707	0.443	1.000	1.000	0.082	0.264
Panel C: 2003								
Technical Efficiency	0.804	0.840	0.573	0.581	1.000	1.000	0.159	0.202
Pure Technical Efficiency	0.952	0.962	0.788	0.848	1.000	1.000	0.076	0.076
Scale Efficiency	0.844	0.874	0.587	0.581	1.000	1.000	0.150	0.199
Panel D: 2004								
Technical Efficiency	0.818	0.915	0.525	0.783	1.000	1.000	0.141	0.106
Pure Technical Efficiency	0.916	0.976	0.705	0.903	1.000	1.000	0.128	0.049
Scale Efficiency	0.902	0.936	0.735	0.867	1.000	1.000	0.090	0.075
Panel E: 2005								
Technical Efficiency	0.796	0.897	0.290	0.826	1.000	1.000	0.210	0.073
Pure Technical Efficiency	0.949	0.943	0.774	0.835	1.000	1.000	0.085	0.078
Scale Efficiency	0.843	0.953	0.290	0.885	1.000	1.000	0.215	0.053
Panel F: Domestic Banks All Years								
Technical Efficiency	0.777		0.290		1.000		0.184	
Pure Technical Efficiency	0.893		0.418		1.000		0.157	
Scale Efficiency	0.872		0.290		1.000		0.133	
Panel G: Foreign Banks All Years								
Technical Efficiency	0.869		0.334		1.000		0.200	
Pure Technical Efficiency	0.945		0.385		1.000		0.142	
Scale Efficiency	0.918		0.443		1.000		0.150	

Table 3: **Composition of Production Frontiers – DEA Model A**

The table shows the evolution of returns to scale in the Malaysian Islamic banking sector during the period 2001-2005 derived from DEA Model A. *CRS*, *DRS* and *IRS* denote constant returns to scale, decreasing returns to scale and increasing returns to scale respectively. *DB* indicates domestic banks; *FB* indicates foreign banks. *Count* denotes the number of times a bank appeared on the efficiency frontier during the period of study. The banks corresponds to the shaded regions have not been efficient in any year in the sample period compared to the other banks in the sample.

Bank	Type	2001	2002	2003	2004	2005	Count
Affin Bank	Domestic	DRS	DRS	DRS	IRS	IRS	0
Alliance Bank	Domestic	DRS	IRS	CRS	IRS	CRS	2
Arab-Malaysian Bank	Domestic	IRS	DRS	DRS	IRS		0
EON Bank	Domestic	CRS	CRS	DRS	CRS	IRS	3
Hong Leong Bank	Domestic	DRS	DRS	DRS	IRS	DRS	0
Maybank	Domestic	DRS	DRS	DRS	CRS	DRS	1
Public Bank	Domestic	DRS	DRS	DRS	DRS	CRS	1
RHB Bank	Domestic	DRS	DRS	DRS	DRS		0
Southern Bank	Domestic	CRS	DRS	CRS	IRS	IRS	2
Bank Islam Malaysia	Domestic	DRS	DRS	DRS	DRS	DRS	0
Bank Muamalat	Domestic	DRS	DRS	DRS	DRS	DRS	0
RHB Islamic Bank Berhad	Domestic					DRS	0
Commerce TIJARI Bank Berhad	Domestic					IRS	0
Citibank	Foreign	CRS	CRS	CRS	IRS	CRS	4
Hong Kong Bank	Foreign	CRS	CRS	CRS	CRS	DRS	4
OCBC	Foreign	CRS	IRS	DRS	IRS	DRS	1
Standard Chartered Bank	Foreign	CRS	IRS	IRS	CRS	IRS	2
Number of Banks	**n = 17**	**6**	**3**	**4**	**4**	**3**	

Table 4: **Summary Statistics of Efficiency Scores – DEA Model B**

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

Banks	**Mean**		**Minimum**		**Maximum**		**Std. Dev.**	
Panel A: 2001	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**	**DB**	**FB**
Technical Efficiency	0.890	1.000	0.682	1.000	1.000	1.000	0.134	0.000
Pure Technical Efficiency	0.931	1.000	0.754	1.000	1.000	1.000	0.103	0.000
Scale Efficiency	0.955	1.000	0.730	1.000	1.000	1.000	0.083	0.000
Panel B: 2002								
Technical Efficiency	0.756	0.779	0.408	0.335	1.000	1.000	0.229	0.307
Pure Technical Efficiency	0.842	1.000	0.451	1.000	1.000	1.000	0.187	0.000
Scale Efficiency	0.893	0.779	0.530	0.335	1.000	1.000	0.144	0.307
Panel C: 2003								
Technical Efficiency	0.902	0.889	0.573	0.557	1.000	1.000	0.151	0.222
Pure Technical Efficiency	0.984	1.000	0.855	1.000	1.000	1.000	0.043	0.000
Scale Efficiency	0.917	0.889	0.587	0.557	1.000	1.000	0.149	0.222
Panel D: 2004								
Technical Efficiency	0.790	0.885	0.525	0.763	1.000	1.000	0.117	0.133
Pure Technical Efficiency	0.917	0.936	0.714	0.797	1.000	1.000	0.095	0.096
Scale Efficiency	0.860	0.946	0.735	0.808	1.000	1.000	0.086	0.092
Panel E: 2005								
Technical Efficiency	0.817	0.816	0.277	0.560	1.000	1.000	0.227	0.185
Pure Technical Efficiency	0.975	0.949	0.805	0.839	1.000	1.000	0.060	0.075
Scale Efficiency	0.839	0.866	0.277	0.563	1.000	1.000	0.225	0.206
Panel F: Domestic Banks All Years								
Technical Efficiency	0.831		0.277		1.000		0.181	
Pure Technical Efficiency	0.930		0.451		1.000		0.117	
Scale Efficiency	0.893		0.277		1.000		0.148	
Panel G: Foreign Banks All Years								
Technical Efficiency	0.874		0.335		1.000		0.192	
Pure Technical Efficiency	0.977		0.797		1.000		0.057	
Scale Efficiency	0.896		0.335		1.000		0.191	

Table 5: **Composition of Production Frontiers – DEA Model B**

The table shows the evolution of returns to scale in the Malaysian Islamic banking sector during the period 2001-2005 derived from DEA Model B. *CRS*, *DRS* and *IRS* denote constant returns to scale, decreasing returns to scale and increasing returns to scale respectively. *DB* indicates domestic banks; *FB* indicates foreign banks. *Count* denotes the number of times a bank appeared on the efficiency frontier during the period of study. The banks corresponds to the shaded regions have not been efficient in any year in the sample period compared to the other banks in the sample.

Bank	Type	2001	2002	2003	2004	2005	Count
Affin Bank	DB	CRS	IRS	CRS	DRS	IRS	2
Alliance Bank	DB	IRS	IRS	CRS	IRS	CRS	2
Arab-Malaysian Bank	DB	IRS	DRS	DRS	IRS		1
EON Bank	DB	CRS	CRS	DRS	IRS	CRS	3
Hong Leong Bank	DB	CRS	CRS	CRS	IRS	CRS	5
Maybank	DB	CRS	CRS	CRS	CRS	CRS	5
Public Bank	DB	DRS	DRS	DRS	IRS	CRS	1
RHB Bank	DB	DRS	DRS	DRS	DRS		0
Southern Bank	DB	CRS	DRS	CRS	IRS	IRS	2
Bank Islam Malaysia	DB	DRS	DRS	DRS	DRS	DRS	0
Bank Muamalat	DB	DRS	DRS	DRS	DRS	DRS	0
RHB Islamic Bank Berhad	DB					DRS	0
Commerce TIJARI Bank Berhad	DB					IRS	0
Citibank	FB	CRS	IRS	CRS	CRS	CRS	4
Hong Kong Bank	FB	CRS	CRS	CRS	IRS	DRS	3
OCBC	FB	CRS	IRS	CRS	IRS	IRS	2
Standard Chartered Bank	FB	CRS	IRS	IRS	CRS	IRS	2
Number of Banks	**n = 17**	**9**	**4**	**8**	**3**	**6**	

Table 6: **Summary of the Null Hypothesis Tests of Identical Technologies between Domestic and Foreign Banks**

The table presents the results from the parametric (ANOVA and *t*-test) and nonparametric (Kolmogorov-Smirnov, Mann-Whitney and Kruskall-Wallis) tests. The tests are performed to test the null hypothesis that domestic and foreign banks are drawn from the same population (environment). Test methodology follows among others, Aly *et al.* (1990), Elyasiani and Mehdian (1992) and Isik and Hassan (2002). The numbers in parentheses are the *p*-values associated with the relative tests. ** indicates significant at the 5% level.

	Test Groups				
	Parametric Tests		**Non-Parametric Tests**		
Individual Tests	**Analysis of Variance (ANOVA) test**	***t*-test**	**Kolmogorov-Smirnov [K-S] test**	**Mann-Whitney [Wilcoxon Rank-Sum] test**	**Kruskall-Wallis Equality of Populations test**
Hypotheses	$\text{Mean}_{db} = \text{Mean}_{fb}$		$\text{Distribution}_{db} = \text{Distribution}_{fb}$	$\text{Median}_{db} = \text{Median}_{fb}$	
Test Statistics	F (Prb > F)	t (Prb > t)	K-S (Prb > K-S)	z (Prb > z)	χ^2 (Prb > χ^2)
Panel A: 2001					
(TE)	5.822**	-2.413**	1.401**	-2.427**	5.891**
	(0.031)	(0.031)	(0.039)	(0.015)	(0.015)
(PTE)	1.893	-1.376	0.778	-1.555	2.417
	(0.192)	(0.192)	(0.579)	(0.120)	(0.120)
(SE)	3.877	-1.969	1.401**	-2.427**	5.891**
	(0.071)	(0.071)	(0.039)	(0.018)	(0.015)
Panel B: 2002					
(TE)	0.279	-0.529	0.701	-0.262	0.069
	(0.606)	(0.606)	(0.710)	(0.793)	(0.793)
(PTE)	0.716	-0.846	0.817	-0.876	0.768
	(0.413)	(0.413)	(0.516)	(0.381)	(0.381)
(SE)	0.113	0.336	0.701	-0.655	0.429
	(0.742)	(0.742)	(0.710)	(0.512)	(0.512)

Panel C: 2003					
(TE)	0.127	-0.356	0.545	-0.527	0.278
	(0.727)	(0.727)	(0.928)	(0.598)	(0.598)
(PTE)	0.047	-0.216	0.350	-0.589	0.347
	(0.832)	(0.832)	(1.000)	(0.556)	(0.556)
(SE)	0.100	-0.317	0.545	-0.527	0.278
	(0.757)	(0.757)	(0.928)	(0.598)	(0.598)
Panel D: 2004					
(TE)	1.522	-1.234	0.662	-1.186	1.406
	(0.239)	(0.239)	(0.774)	(0.236)	(0.236)
(PTE)	0.803	-0.896	0.506	-0.920	0.847
	(0.386)	(0.386)	(0.960)	(0.357)	(0.357)
(SE)	0.447	-0.669	0.623	-0.857	0.735
	(0.515)	(0.515)	(0.823)	(0.391)	(0.391)
Panel E: 2005					
(TE)	0.853	-0.924	0.934	-1.049	1.101
	(0.372)	(0.372)	(0.347)	(0.294)	(0.294)
(PTE)	0.014	0.120	0.389	-0.442	0.195
	(0.906)	(0.906)	(0.998)	(0.659)	(0.659)
(SE)	0.976	-0.988	0.778	-0.787	0.619
	(0.341)	(0.341)	(0.579)	(0.431)	(0.431)

Note: The results from DEA Model B are not altered in any significant way in terms of the signs, magnitude and statistical significance and are therefore not reported here.

TABLE 7: **Censored TOBIT Regression Analysis of Bank's Efficiency**

$$\Theta_{jt} = \alpha + \beta_1 LNDEPO + \beta_2 LOANS/TA + \beta_3 LNTA + \beta_4 LLP/TL + \beta_5 NIE/TA + \beta_6 EQUITY/TA + \beta_7 ROA + \beta_8 LOGGDP + \beta_9 DUMFORB + \beta_{10} DUMFFIB + \varepsilon_j$$

The dependent variable is bank's efficiency scores derived from DEA Model A and DEA Model B; *LNDEPO* is a measure of bank's market share calculated as a natural logarithm of total bank deposits; *LOANS/TA* is a measure of bank's loans intensity calculated as the ratio of total loans to bank total assets; *LNTA* is the size of the bank's total asset measured as the natural logarithm of total bank assets; *LLP/TL* is a measure of banks risk calculated as the ratio of total loan loss provisions divided by total loans; *NIE/TA* is a measure of bank management quality calculated as total non-interest expenses divided by total assets; *EQUITY/TA* is a measure of banks leverage intensity measured by banks total shareholders equity divided by total assets; *ROA* is a proxy measure for bank profitability calculated as bank profit after tax divided by total assets; *LOGGDP* is natural logarithm of gross domestic product; *DUMFORB* and *DUMFFIB* are dummy variables that take a value of 1 if a bank is a foreign bank and full-fledged Islamic bank respectively, 0 otherwise. TE, PTE and SE refer to Technical, Pure Technical and Scale Efficiency respectively. DEA A refers to DEA Model A, DEA B refers to DEA Model B.

Values in parentheses are standard errors. ***, **, and * indicate significance at 1, 5 and 10% levels.

Explanatory Variables	**TE**		**PTE**		**SE**	
	DEA A	**DEA B**	**DEA A**	**DEA B**	**DEA A**	**DEA B**
CONSTANT	-0.349	-4.093	-3.372	-2.761	-2.748	-0.409
	(2.186)	(2.503)	(3.201)	(3.038)	(2.645)	(1.979)
Bank Characteristics						
LNDEPO	-0.053	-0.063	-0.125**	-0.116**	-0.092	-0.072*
	(0.043)	(0.049)	(0.063)	(0.060)	(0.033	(0.039)
LOANS/TA	0.050**	0.066***	0.078**	0.056*	0.036***	0.005
	(0.022)	(0.026)	(0.033)	(0.032)	(0.033)	(0.021)
LNTA	0.023	0.045	0.098	0.099	0.095	0.072*
	(2.550)	(0.055)	(0.071)	(0.067)	(0.039)	(0.044)
LLP/TL	-1.568	-0.416	-0.209	-0.007	-1.409	-0.389
	(1.006)	(-1.115)	(1.473)	(1.398)	(0.934)	(0.910)
NIE/TA	-1.486***	-1.152**	-1.076	-0.372	-0.309	0.772*
	(0.482)	(0.522)	(0.706)	(0.670)	(0.625)	(0.436)
EQUITY/TA	-1.050***	-1.342***	-0.433	-0.982**	0.635***	0.343
	(0.351)	(0.401)	(0.513)	(0.487)	(0.284)	(0.317)
ROA	0.149***	0.116**	0.108	0.038	0.031	0.077*
	(0.048)	(0.055)	(0.071)	(0.067)	(0.062)	(0.043)
Economic Conditions						
LOGGDP	0.144	0.227	0.371	0.128	0.286	0.105
	(0.182)	(0.208)	(0.266)	(0.252)	(0.217)	(0.165)
Ownership						
DUMFORB	0.011	0.056	0.074	0.101**	0.066	0.051*
	(0.036)	(0.046)	(0.061)	(0.052)	(0.053)	(0.030)
DUMFFIB	-0.091*	-0.175***	-0.132**	-0.259***	-0.047	-0.101
	(0.049)	(0.046)	(0.063)	(0.056)	(0.076)	(0.069)

No. of Observations	74	74	74	74	74	74
Log likelihood	59.598	49.579	31.367	35.236	41.720	66.950
R^2	0.386	0.389	0.306	0.321	0.213	0.206
Adj. R^2	0.277	0.280	0.183	0.201	0.101	0.098

APPENDIX A

DEA CCR Model

The term Data Envelopment Analysis (DEA) was first introduced by Charnes, Cooper and Rhodes (1978), (hereafter CCR), to measure the efficiency of each 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. Formally, the efficiency measure for DMU_j can be calculated by solving the following mathematical programming problem:

$$\max_{\lambda_0} \theta_0 \tag{A1}$$

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

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

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

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

where x_{ij} is the observed amount of input of the ith type of the jth DMU ($x_{ij} > 0$, $i = 1,2\ldots, n$, $j = 1,2\ldots,n$) and y_{rj} is the observed amount of output of the rth type for the jth DMU ($y_{rj} > 0$, $r = 1,2\ldots, s$, $j = 1,2,\ldots n$).

APPENDIX B

DEA BCC Model

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 (OTE). 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 *et al*. (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 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. The input oriented BCC model for the DMU_j can be written as:

$$\max_{\lambda_0} \theta_0 \qquad \text{(A2)}$$

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

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

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

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

The BCC efficiency scores are obtained by running the above model for each DMU. These scores are called 'pure technical efficiency scores', since they are obtained from the model that allows variable returns to scale and hence eliminates the 'scale part'. Generally, the CCR efficiency score for each DMU will not exceed the BCC efficiency score, which is intuitively clear since the BCC model analyses each DMU locally rather than globally. Once 'pure technical efficiency' (PTE) estimates are available, scale efficiency (SE) is computed from the following formula:

SE = Technical Efficiency (CRS)/ Pure Technical Efficiency (VRS).