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Revenue Efficiency and Returns to Scale in Islamic Banks: Empirical Evidence from Malaysia

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The paper provides new empirical evidence on the revenue efficiency and returns to scale in the Malaysian Islamic banking sector. The sample comprised of 17 domestic and foreign Islamic banks during the period of 2006 to 2010. We employ the Data Envelopment Analysis (DEA) method to compute the revenue efficiency levels. The results indicate that the domestic Islamic banks have exhibited lower revenue efficiency levels compared to their foreign bank peers. In essence, revenue efficiency seems to be the main factor influencing domestic and foreign Islamic banks' profit efficiency levels. The empirical findings indicate that the large domestic Islamic banks tend to operate at constant returns to scale (CRS) or decreasing returns to scale (DRS). On the other hand, the small foreign Islamic banks tend to operate at CRS or increasing returns to scale (IRS).

1. Introduction

The globalization era has changed the landscape of financial intermediation activities attributed to greater deregulation and liberalization. In a competitive financial landscape, the Islamic banking sector is expanding at a rapid pace. The practice of Islamic banking has now spread worldwide, from Malaysia to Bahrain to Europe and the USA. Global Islamic Finance Forum (2012) reported that the number of Islamic financial institutions increased from 75 in 1975 to more than 600 in 2012, covering more than 75 countries. The total assets of the Islamic

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financial institutions hit US$1 trillion in 2011, increasing by 150% and are growing at 50% faster than the overall banking sector. According to World Islamic Banking Competitiveness Report (2012; 2013), the Islamic banking assets are forecast to grow beyond the milestone of US$2 trillion by 2014.

In accordance with its rapid growth rate, it is reasonable to expect that Islamic banks to behave in an efficient manner. Berger and Humphrey (1997) suggest that the efficiency of financial institutions has become an important part of the banking literature since the early 1990s. Berger et al. (1993b) points out that, efficient banks tend to exhibit improvement in profitability levels, could offer better prices and service quality for consumers, and should intermediate greater amounts of funds. In essence, the general concept of efficiency covers three main components, namely cost, revenue, and profit efficiency (Adongo et al. 2005; Bader et al. 2008). However, previous studies have mainly focused on the efficiency of cost, profit, or both cost and profit efficiency (Bader et al. 2008). On the other hand, only a handful of studies provide comprehensive empirical evidence on the three efficiency concepts simultaneously.

By employing the Data Envelopment Analysis (DEA) method, the present paper analyze the cost, revenue, and profit efficiency of the Malaysian Islamic banking sector over the period of 2006 to 2010. The preferred method allows us to distinguish between three different types of efficiency, namely cost, revenue, and profit efficiency. In addition to the DEA method, we also perform a series of parametric (*t*-test) and non-parametric (Mann-Whitney [Wilcoxon] and Kruskall-Wallis) tests to examine whether the domestic and foreign banks are drawn from the same population.

The article begins with a brief overview of the Malaysian Islamic banking sector. This is followed by section 3, where we provide a brief review of related studies. Section 4 provides discussions on the methods employed in the study and variables employed to construct the efficiency frontiers. We present the empirical findings in section 5. The article concludes and provides discussions on the policy implications in section 6.

2. Brief Overview of Islamic Banking in Malaysia

As in other Muslim countries, Malaysia was affected by the Islamic resurgence movements among the intellectuals in the 1970s. There were calls from individuals and certain groups and agencies for the government to establish Islamic banks to cater for the needs of Muslims in Malaysia. During the Bumiputra Economic Congress in 1980, a resolution which required the government to allow the Pilgrimage Board (known as Lembaga Tabung Haji) to establish an Islamic bank for the purpose of collection and investing money owned by Muslims was passed. At the National Seminar in 1981, the Malaysian government was urged to promulgate a special law which allows for the establishment of banks and financial bodies whose operations would be based on Islamic principles (Haron and Azmi, 2009).

In line with these requests, the first Islamic bank was established in 1983. Ten years have to pass before the government allowed other conventional banks to offer Islamic banking services under their existing infrastructure and branches. The move to create the Islamic banking window operations allowed the country to enjoy Islamic banking services at the lowest cost and within the shortest time frame. Today, Malaysia has succeeded in implementing a dual banking system and has emerged as among the first nations to have a full-fledged Islamic banking system operating side-by side with the conventional banking system[4].

As can be seen from Table 1, as at end-2012, the Malaysian Islamic banking sector comprised of 10 domestic (ECONCAP Islamic Bank Berhad has been merged with Hong Leong Islamic Bank Bhd on November 10, 2011) and six foreign Islamic banks.

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

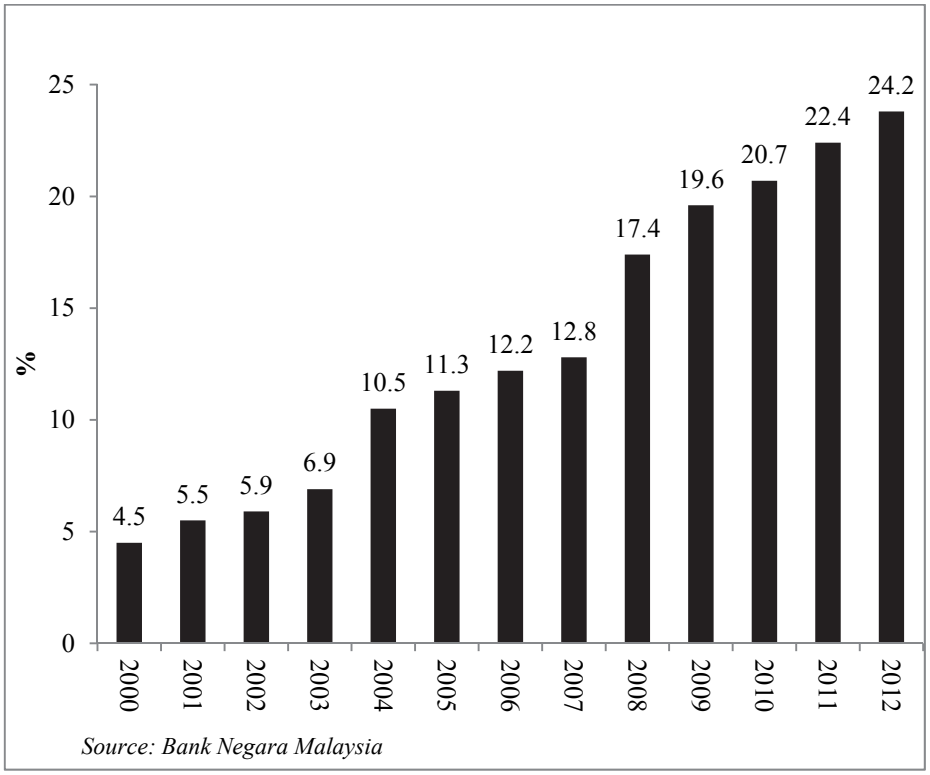
Table 1: Foreign and Domestic Malaysian Islamic Banks

Bank	Ownership	Paid Up Capital
Affin Islamic Bank Bhd	*100% Affin Holdings*	*RM360.0m*
Alliance Islamic Bank Bhd	*100% Alliance Financial Group*	*RM300.0m*
AmIslamic Bank Bhd	*100% AMMB Holdings*	*RM423.04.m*
Bank Islam Malaysia Bhd	*51% BIMB Holdings* *40% Dubai Investment Group* *9% Lembaga Tabung Haji*	*RM2265.0m*
Bank Muamalat Malaysia Bhd	*70% DRB Hicom* *30% Khazanah Nasional*	*RM1000.0m*
CIMB Islamic Bank Bhd	*100% Bumiputra Commerce Holdings*	*RM880.0m*
Hong Leong Islamic Bank Bhd	*100% Hong Leong Bank*	*RM700.0m*
Maybank Islamic Bhd	*100% Malayan Banking*	*RM138.0m*
Public Islamic Bank Bhd	*100% Public Bank*	*RM200.0m*
RHB Islamic Bank Bhd	*100% RHB Capital*	*RM773.0m*
Al-Rajhi Banking and Investment Bhd	100% Al-Rajhi Bank, Saudi Arabia	RM1000.0m
Asian Finance Bank Bhd	70% Qatar Islamic Bank 20% RUSD Investment Bank, Saudi Arabia 10% Financial Assets, Bahrain	RM533.0m
HSBC Amanah Malaysia Bhd	100% Hong Kong and Shanghai Banking Corporation	RM50.0m
Kuwait Finance House (Malaysia) Bhd	100% Kuwait Finance House, Kuwait	RM2266.0m
OCBC Al-Amin Bank Bhd	100% OCBC Bank (Malaysia)	RM 85.0m
Standard Chartered Saadiq Bhd	100% Standard Chartered Group	RM103.0m

Source: Bank Negara Malaysia and Banks' Annual Reports
Note: In italicized are domestic Islamic banks In shaded areas are foreign Islamic banks

Throughout the years, the Malaysian Islamic banking sector has gained its significance and has been on a progressive upward trend. Since 2000, the Malaysian Islamic banking industry has been growing at an average rate of 18.9 per cent per annum in terms of assets. Figure 1 illustrates that the total assets of the Malaysian Islamic banking sector has increased from a mere RM47.1 billion in 2000 to RM469.5 billion in 2012, accounting for 24.2 per cent of the banking system's total assets, while the market share of Islamic deposits and financing stood at 25.6 per cent of the total banking sector's deposits and financing. With the growth in Islamic banking far surpassing the expansion in the banking system's asset base, the Malaysian Islamic banking industry is expected to be able to achieve the government's aspiration of the Islamic banking assets making up 40 per cent of the banking system's total assets by year 2020 from about 24.2 per cent at present.

Figure 1: Islamic Banking Assets as % of Malaysian Banking System Assets – 2006-2012



Source: Bank Negara Malaysia

3. Literature Review

Despite considerable developments in the Islamic banking sector, there have been relatively limited studies focusing on the efficiency of Islamic banks. So far, there are a fair number of researches that studied banking efficiency in less developed countries (Bader et al. 2008). There are some documented studies that compare the performance of Islamic banks with their conventional counterparts. However, the focus of these studies is on profitability and is constrained by the time span and the number of Islamic banks (Samad and Hassan, 1999; Iqbal, 2001). On the other hand, previous studies investigating the efficiency of Islamic banks focuses on technical, pure technical, and scale efficiency concepts (e.g. Yudistira, 2004), while studies that address the cost, revenue, and profit efficiency of Islamic banks are relatively scarce (Yudistira, 2004; Hassan, 2005; Brown and Skully, 2005).

3.1 Technical, Pure Technical, and Scale Efficiency

The first study that employs the frontier non-parametric approach (DEA) method to assess the efficiency of Islamic banks was conducted by Yudistira (2004). The study discovered new evidence on the performance of 18 Islamic banks over the period 1997-2000 where the Islamic banks suffer slight inefficiencies during the global crisis 1998-1999. Indeed, 1998 and 1999 were the period of turmoil that hit the global economy. The level of inefficiency in 1998 was mainly due to pure technical inefficiency rather than scale inefficiency. Yudistira (2004) suggests that the large Islamic banks have exhibited the highest degree of scale inefficiency. The empirical findings suggest that in most cases the large Islamic banks have exhibited decreasing returns to scale in 1997 and 1998, while most of the large Islamic banks have been operating at constant return to scale in 1999 and 2000.

Hassan and Hussein (2003) examine the efficiency of the Sudanese banking system during the period of 1992 and 2000. They apply a variety of parametric and non-parametric methods to a panel of 17 Sudanese banks. They discover that the Sudanese banking system have exhibited 37% allocative efficiency and 60% technical efficiency, suggesting that the overall cost inefficiency of the Sudanese Islamic banks were mainly due to the technical efficiency (managerially related) rather than allocative efficiency (regulatory).

By employing the DEA method, Sufian (2007) investigates the efficiency of the Malaysian Islamic banking sector. The results from the DEA method suggest that Malaysian Islamic banks efficiency declined in year 2002 to recover slightly in years 2003 and 2004. The domestic Islamic banks were more efficient compared to the foreign Islamic banks albeit marginally. The source of inefficiency of Malaysian Islamic banks in general has been scale, suggesting that Malaysian Islamic banks have been operating at the wrong scale of operations.

In a cross country study, Sufian et al. (2008) analyze the efficiency of Islamic banks in MENA (Middle East and North Africa) and Asian countries. By using the DEA method, they estimate three different types of efficiency measures, namely technical, pure technical, and scale efficiency. The results indicate that pure technical inefficiency outweighs scale inefficiency in the Islamic banks. Although the Islamic banks have been operating at a relatively optimal scale of operations, they were managerially inefficient to exploit their resources to the fullest.

3.2 Cost, Revenue, and Profit Efficiency

The earlier studies performed on the cost and profit efficiency in the conventional banks discovered that revenue efficiency has strong influence on the cost and profit efficiency levels (e.g. Chu and Lim, 1998; Rogers, 1998; Berger and Mester, 2003). Revenue can be defined as how efficiently a bank sells its outputs. Maximum revenue is obtained as a result of producing the output bundle efficiently (Rogers, 1998). In fact, revenue efficiency is decomposed of technical and allocative efficiency which are related to managerial factors and is regularly associated with regulatory factors (Isik and Hassan, 2002). English et al. (1993) posits that in order to ascertain revenue efficiency, banks should focus on both technical efficiency (managerial operating on the production possibilities) and allocative efficiency (bank producing the revenue maximizing mix of outputs based on certain regulations).

Another way to improve revenue efficiency proposed by several studies is for banks to produce higher quality services and charge higher prices and avoid improper choice of inputs and outputs quantities and mis-pricing of outputs (Rogers, 1998). The revenue inefficiency could be well identified via the profit function because this function combines

both cost and revenue efficiency to evaluate the profit efficiency (Akhavein et al. 1997). Although cost efficiency is high, revenue efficiency would still affect the level of profit efficiency. In essence, revenue efficiency would be the main factor influencing profit efficiency.

The above literature reveals the following research gaps. First, the majority of these studies have mainly concentrated on the conventional banking sectors of the western and developed countries. Second, empirical evidence on the developing countries, particularly the Islamic banking sector, is scarce. Finally, virtually nothing has been published on the cost, revenue, and profit efficiency and its determinants in the Islamic banking sector. Furthermore, if these studies are narrowed down, there is a paucity of studies which examine the revenue efficiency of the domestic and foreign Islamic banks. In the light of these knowledge gaps, the present paper seeks to provide new empirical evidence on the cost, revenue, and profit efficiency and sources of returns to scale in the Malaysian Islamic banking sector.

4. Data and Methodology

The present study gathers data from all Malaysian Islamic banks from 2006 to 2010. The primary source of financial data is the BankScope database produced by the Bureau van Dijk which provides banks' balance sheets and income statements. Data are analyzed for banks which provides Islamic banking products and services under the Islamic Banking Scheme. We collect data from 17 Islamic banking institutions comprising of 11 domestic and six foreign full-fledged Islamic banks (see Table 2).

Table 2: List of Malaysian Islamic Banking Sector during Year 2006-2010

Domestic		Foreign	
No	**Bank**	**No**	**Bank**
1	Affin Islamic Bank Bhd	1	Al Rajhi Banking and Investment Bhd
2	Alliance Islamic Bank Bhd	2	Asian Finance Bank Bhd
3	AmIslamic Bank Bhd	3	HSBC Amanah Malaysia Bhd
4	Bank Islam Malaysia Bhd	4	Kuwait Finance House (Malaysia) Bhd
5	Bank Muamalat Malaysia Bhd	5	OCBC Al-Amin Bank Bhd
6	CIMB Islamic Bank Bhd	6	Standard Chartered Saadiq Bhd
7	EONCAP Islamic Bank Bhd		
8	Hong Leong Islamic Bank Bhd		
9	Maybank Islamic Bhd		
10	Public Islamic Bank Bhd		
11	RHB Islamic Bank Bhd		

Source: Bank Negara Malaysia

4.1 Data Envelopment Analysis

The level of revenue efficiency is measured by using the Data Envelopment Analysis (DEA) method. The DEA method constructs a frontier of the observed input-output ratios by linear programming techniques. The linear substitution is possible between observed input combinations on an isoquant (the same quantity of output is produced while changing the quantities of two or more inputs) that was assumed by the DEA method. Charnes, Cooper and Rhodes (1978) were the first to introduce the term DEA to measure the efficiency of decision making units (DMUs), obtained as a maximum of a ratio of weighted outputs to weighted inputs (hereafter referred to as the CCR model).The more the output produced from given inputs the more efficient is the production.

The CCR model presupposes that there is no significant relationship between the scale of operations and efficiency by assuming constant return 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 may 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 OTE will be contaminated with scale inefficiency.

To address this concern, the present study estimates the efficiency scores under the assumption of variable returns to scale (VRS) assumption proposed by Banker, Charnes and Cooper (1984) (hereafter referred to as the BCC model).

The BCC model extended the CCR model by relaxing the CRS assumption and provides the measurement of pure technical efficiency (PTE). PTE measures the efficiency of DMUs without being contaminated by scale effects. Hence, results derived from the VRS assumption provide more reliable information on DMUs efficiency compared to the CRS assumption (Coelli et al. 1998).

The Overall Technical Efficiency (OTE) scores obtained from the CRS DEA can be divided into two components; one is due to scale efficiency (SE) and the other is due to PTE. If there is a difference between the two OTE scores of a DMU (CRS OTE and VRS OTE), then, it indicates that the DMU has scale inefficiency and it could be measured from the difference between the PTE and OTE score (Coelli et al. 1998). Although the SE measure provides 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). This may be determined by running additional non-increasing returns to scale (NIRS) constraint imposed on the DEA model. Therefore, the nature of scale inefficiencies, due to either IRS or DRS could be determined by the difference between the NIRS OTE and VRS OTE score if the VRS OTE @ PTE ≠ NIRS OTE, then DMU is operating at IRS) and if the VRS OTE @ PTE = NIRS OTE, then DMU is operating at DRS.

The revenue, cost, and profit efficiency models are given in Equations (1) – (3) respectively. As can be seen, the revenue, cost, and profit efficiency scores are bounded within the 0 and 1 range.

Frontier Type	**Revenue Efficiency (Eq. 1)**	**Cost Efficiency (Eq. 2)**	**Profit Efficiency (Eq. 3)**
VRS	$max\sum_{r=1}^{s} q_r^o \tilde{y}_{ro}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{io} \quad i=1,2,...m;$ $\sum_{j=1}^{n} \lambda_j y_{rj} \ge \tilde{y}_{ro} \quad r=1,2,...s;$ $\lambda_j \tilde{y}_{ro} \ge 0$ $\sum_{j=1}^{n} \lambda_j = 1$	$min\sum_{i=1}^{m} p_i^o \tilde{x}_{io}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{io} \quad i=1,2,...,m$ $\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro} \quad r=1,2,...,s,$ $\lambda_j, \tilde{x}_{io} \ge 0$ $\sum_{j=1}^{n} \lambda_j = 1$	$max \sum_{r=1}^{s} q_r^o \tilde{y}_{ro} - \sum_{i=1}^{m} p_i^o \tilde{x}_{io}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{io} \quad i=1,2,...,m;$ $\sum_{j=1}^{n} \lambda_j y_{rj} \ge \tilde{y}_{ro} \quad r=1,2,...,s;$ $\tilde{x}_{io} \le x_{io}, \tilde{y}_{ro} \ge y_{ro}$ $\lambda_j \ge 0$ $\sum_{j=1}^{n} \lambda_{j=1}$

Source: Zhu (2009)

where

s	is output observation
m	is input observation
r	is the s^{th} output
i	is the m^{th} input
q_r^o	is the unit price of output r of DMU*0* (DMU*0* represents one of the n DMUs)
p_i^o	is the unit price of input i of DMU*0*
$\tilde{y}_{ro}$	is the r^{th} output that maximize revenue for DMU*0*
$\tilde{x}_{io}$	is the i^{th} input that minimize cost for DMU*0*
y_{ro}	is the r^{th} output for DMU*0*
x_{io}	is the i^{th} input for DMU*0*
n	is DMU observation
j	is n^{th} DMU
λ_j	is non-negative scalars
y_{rj}	is the s^{th} output for n^{th} DMU
x_{ij}	is the m^{th} input for n^{th} DMU

By calculating the three efficiency measures (e.g. revenue, cost, and profit), we will be able to observe robust results for the domestic and foreign Islamic banks over the period under study. However, the present study will give greater emphasize on revenue efficiency measure compared to cost and profit efficiency measures.

4.2 The Input and Output Variables in DEA

The definition and measurement of bank's inputs and outputs in the banking function remains arguable among researchers (Sufian, 2007) and has always been an arbitrary issue (Ariff and Can, 2008; Berger and Humphrey, 1997). The problem is further compounded by the fact that variable selection is often constrained by the paucity of data. Furthermore, most of financial services are jointly produced and prices of inputs and output are typically assigned to a bundle of financial services. In essence, there is 'no perfect approach' in the selection of bank inputs and outputs variables (Bader et al. 2008).

In essence, there are three main approaches that are widely used in the banking theory literature namely production, intermediation, and value-added approaches (Sealey and Lindley 1977; Frexias and Rochet 1997). The first two approaches apply the traditional microeconomic theory of the firm to banking and differ only in the specification of banking activities. The third approach goes a step further and incorporates some specific activities of banking into the classical theory and thereby modifies it.

The first approach is the production approach which assumes that financial institutions serve as producers of services for account holders, that is, they perform transactions on deposit accounts and process documents such as loans. The second is the intermediation approach which views banks as financial intermediaries whose primary role is to obtain funds from savers and in turn provide loans to others for profit (Chu and Lim, 1998). Under this approach, banks are seen as purchasing labour, materials, and deposits funds that produce outputs such as loans and investments. Finally, the value-added approach identifies those balance sheet categories (assets or liabilities) as outputs that contribute to banks' value added e.g. business associated with the consumption of real resources (Berger et al. 1987). In general, under this approach, deposits and loans are viewed as outputs because they are responsible for the significant proportion of value added.

For the purpose of this study, we chose to follow the intermediation approach for several different reasons. First, the intermediation approach normally includes a large proportion of bank's total costs (see Elyasiani and Mehdian, 1990; Berger and Humphrey, 1991; Avkiran, 1999). Second, the present study attempts to evaluate the efficiency of the banking sector as a whole and not branches of a single bank. Third, Sealey and Lindley (1977) posit that financial institutions normally employ labour, physical capital, and deposits as their inputs to produce earning assets. Finally, the intermediation approach is closely related to main principle of the Islamic financial system, which is based on equity participation e.g. employing funds on the basis of profit and loss sharing. This implies the importance of Islamic banks as an intermediary between savers and borrowers in the financial system.

Furthermore, given the underdevelopment of capital markets, the importance of banks as a financial intermediary is more prevalent in

developing economies like Malaysia. Therefore, it is reasonable to assume that the efficiency of banks in terms of their intermediation functions is crucial as an effective channel for business funding. In this vein, Jaffry et al. (2007) points out that banks play an important economic role in providing financial intermediation by converting deposits into productive investments in developing countries. The banking sector of developing countries have also been shown to perform critical roles in the intermediation process by influencing the level of money stock in the economy with their ability to create deposits (Askari, 1991).

For the purpose of the study, two inputs, two input prices, two outputs, and two output prices variables are chosen. The two input vector variables consist of $x1$: deposits and $x2$: labour. The input prices consist of $w1$: price of deposits and $w2$ price of labour. The two output vectors are $y1$: loans and $y2$: income. Meanwhile, two output prices consist of $r1$: price of loans and $r2$: price of investment. The selection of inputs, outputs, inputs prices, and output prices used in this study is being guided by the previous on bank efficiency studies which are summarized in Table 3[5].

5 Some adjustments have to be made to the selection of inputs, outputs, inputs prices, and outputs prices due to the fact that most of the previous studies are performed on the conventional banking sector, while the present study concerns the Islamic banking sector.

Table 3: Summary of Inputs and Outputs on Bank Efficiency Analysis

Study	Inputs (x)	Outputs (y)	Input Prices	Output Prices
Ariff and Can (2008)	1.Deposits 2.Number of employees 3.Physical capital	1.Loans 2.Investments (short and long-term)	1.Price of deposits (interest paid/deposits) 2.Price of labour (personnel expenses/number of employees) 3.Price of physical capital (other operating expenses/physical capital)	1.Price of loans (interest from loans/loans) 2.Price of investments (investments income/investments)
Bader et al. (2008)	1.Labour 2.Fixed assets 3.Total funds	1.Total loans 2. Investments 3.Off-balance sheet items	1. Price of labour (total personnel expenses/total funds) 2. Price of fixed assets (depreciation expenses/fixed assets) 3.Price of funds (interest expenses on deposits and non-deposits funds plus other operating expenses/total funds)	1. Price of loans (interest income/total loans) 2. Price of investments (investments/other earning assets) 3.Price of off balance sheet items (net commission revenue plus net earning income/off-balance sheet items)
Maudos and Pastor (2003)	1.Deposits and other funding 2.Number of employees 3.Physical capital	1.Loans and other earnings assets 2.Securities	1. Price of deposits (interest paid/deposits and other funding) 2.Price of labour (personnel expenses/number of employees) 3.Price of physical capital (other expenses/physical capital)	1.Price of loans and other earnings assets (interest received and other operating income/loans and other earnings assets) 2.Price of securities (profits from financial operations/securities)
Fare et al. (2004)	1.Labour 2.Capital 3.Non-transaction deposits	1.Securities 2.Real estate loans 3.Commercial and industry loans 4.Personal loans 5.Transaction deposits	1.Price of labour (total salaries and employee benefits/number of full-time equivalent employees) 2.Price of capital (expenses of premises and fixed assets/value of premises and fixed assets) 3.Price of non-transaction deposits (interest expenses on non-transaction account deposits/value of non-transaction account deposits)	1.Price of securities (interest income on securities/securities) 2.Price of real estate loans (interest income on real estate loans/real estate loans) 3.Price of commercial and industry loans (interest income on commercial and industry loans/commercial and industry loans) 4.Price of personal loans (interest income on personal loans/personal loans) 5.Price of transaction deposits (interest

				income on transaction deposits/transaction deposits)
Sufian et al. (2012b)	1.Deposits 2.Labour 3.Physical capital	1.Loans 2.Investments 3.Off-balance sheet items	1.Price of deposits (total interest expenses/deposits) 2. Price of labour (personnel expenses/total assets) 3.Price of physical capital (Other operating expenses/fixed assets)	1.Price of loans (interest income on loans and others interest income/loans) 2.Price of investments (other operating income/investments) 3.Price of off-balance sheet items (net fees and commissions/off-balance sheet items)
Devaney and Weber (2002)	1.Labour 2.Physical capital 3.Non-transaction account deposits	1.Real estate loans 2-5. Commercial and industry loans (a,b,c,d) 6.Personal loans 7.Securities 8.Transaction account deposits	1.Price of labour (total salaries and employee benefits/ number of full-time equivalent employees) 2.Price of physical capital (expenses of premises and fixed assets/value of premises and fixed assets) 3.Price of non-transaction account deposits (interest expenses on non-transaction account deposits/value of non-transaction account deposits)	1.Price of real estate (interest income on real estate loans/real estate loans) 2-5.Price of commercial and industry loans a,b,c,d (interest income on commercial and industry loans a,b,c,d/commercial and industry loans a,b,c,d) 6.Price of personal loans (interest income on personal loans/personal loans) 7.Price of securities (interest income on securities/securities) 8.Price of transaction account deposits (interest income on transaction account deposit/transaction account deposits)

Unlike the earlier bank efficiency studies, we assume that Islamic banks collect deposits, employ labour and capital and convert those resources into loans and financing and other earnings. The use of earning assets as an output measure is a novel attempt within the context of this study. We believe that earning assets is a better measurement of output for Islamic banks because only earning assets contributes to Islamic banks' revenue and not its entire financing or loan assets.

The summary of data used to construct the efficiency frontiers are given in Table 4.

Table 4: Descriptive Statistics for Inputs, Inputs Prices, Outputs, and Outputs Prices

Variables	Min	Max	Mean	Std. Dev.
	(RM mil.)	(RM mil.)	(RM mil.)	(RM mil.)
*x*1	41.862	35190.400	9018.061	7555.576
*x*2	0.600	431.000	49.027	73.043
*w*1	0.001	0.045	0.021	0.007
*w*2	0.000	2.272	0.043	0.248
*y*1	2.408	33410.200	6074.593	5981.695
*y*2	1.650	1855.600	472.455	410.672
*r*1	0.006	0.666	0.069	0.069
*r*2	0.001	15.161	0.474	1.629

Notes: *x1*: Deposits (deposits and short term funding), *x2*: Labour (personnel expenses), *w1*: Price of deposits (total interest expenses/ deposits), *w2*: Price of labour (personnel expenses/ total assets), *y1*: Loans (net loans and interbank lending), *y2*: Income (gross interest and dividend income), *r1*: Price of loans (interest income on loans and others interest income/ loans), *r2*: Price of income (other operating income/ income)

5. Empirical Results

Before proceeding with the DEA results, as suggested by Cooper et al. (2002), we first test the rule of thumb on the selection of inputs and outputs variables. Since the total number of DMUs (17 banks) in this study is more than the number of input and output variables (2 inputs x 2 outputs @ 3 [2 inputs + 2 outputs]), the selection of variables is valid and allows for the efficiency of DMUs to be measured. By calculating the three efficiency measures (e.g. revenue, cost, and profit), we obtain robust results for both the domestic and foreign Islamic banks. Table 5 illustrates the revenue efficiency estimates along with the cost and profit efficiency measures for both the domestic and foreign Islamic banks.

5.1 Efficiency of Domestic Islamic Banks

Table 5 shows the mean cost, revenue, and profit efficiency for the Malaysian domestic Islamic banks of 74.5%, 71.2%, and 62.5% respectively. In other words, the domestic Malaysian Islamic banks have

been inefficient in producing outputs by using the same inputs (revenue inefficiency) and by not fully using the inputs efficiently to produce the same outputs (cost inefficiency). Banks are said to have slacked if they fail to fully minimize the cost and maximize the revenue (profit inefficiency). The results indicate that the cost, revenue, and profit inefficiency in the Malaysian Islamic banking sector as 25.5%, 28.8%, and 37.5% respectively.

For cost efficiency, the results indicate that on average Malaysian domestic Islamic banks have utilized only 74.5% of the resources or inputs to produce the same level of outputs. In other words, on average, Malaysian domestic Islamic banks have wasted 25.5% of its inputs, or it could have saved 25.5% of its inputs to produce the same level of outputs. It is also worth noting that on average, Malaysian domestic Islamic banks have been more cost efficient in utilizing their inputs compared to their ability to generate revenues and profits. For revenue efficiency, the average Islamic bank could only generate 72.1% of revenues, less than what it was initially expected to generate. Hence, revenue is lost by 28.8%, indicating that the average Islamic bank loses an opportunity to receive 28.8% more revenues given the same amount of resources, or they could have produced 28.8% more outputs given the same level of inputs.

It is apparent that the source of inefficiency in the Malaysian domestic Islamic banks is due to revenue followed by the profit. Similarly, the average Islamic bank could have earned 62.5% of what was available, and lost the opportunity to make 37.5% more profits from the same level of inputs. Even though the cost efficiency is reportedly highest in the domestic Islamic banks, the revenue efficiency is found to be lower, and this led to higher revenue inefficiency. When both efficiency concepts (revenue and cost) are compared, the higher revenue inefficiency seems to have contributed to the higher profit inefficiency levels.

Table 5: Cost, Revenue, and Profit Efficiency of Domestic and Foreign Islamic Banks

Domestic Islamic Banks					Foreign Islamic Banks				
No.	**Bank**	**VRS CE**	**VRS RE**	**VRS PE**	**No.**	**Bank**	**VRS CE**	**VRS RE**	**VRS PE**
1	Affin Islamic Bank Bhd	0.506	0.497	0.278	1	Al-Rajhi Banking and investment Bhd	0.855	0.720	0.634
2	Alliance Islamic Bank Bhd	0.985	0.987	1.000	2	Asian Finance Bank Bhd	0.922	1.000	1.000
3	AmIslamic Bank Bhd	0.840	0.941	1.000	3	HSBC Amanah Malaysia Bhd	0.956	0.935	0.919
4	Bank Islam Malaysia Bhd	0.697	0.501	0.410	4	Kuwait Finance House (Malaysia) Bhd	0.701	0.643	0.506
5	Bank Muamalat Malaysia Bhd	0.627	0.594	0.482	5	OCBC Al-Amin Bank Bhd	0.688	0.767	0.697
6	CIMB Islamic Bank Bhd	0.632	0.516	0.423	6	Standard Chartered Saadiq Bhd	0.670	1.000	1.000
7	EONCAP Islamic Bank Bhd	0.781	0.782	0.661					
8	Hong Leong Islamic Bank Bhd	0.600	0.586	0.358					
9	Maybank Islamic Bhd	1.000	1.000	1.000					
10	Public Islamic Bank Bhd	0.873	0.807	0.752					
11	RHB Islamic Bank Bhd	0.654	0.619	0.515					
	Mean	**0.745**	**0.712**	**0.625**		**Mean**	**0.799**	**0.844**	**0.793**

Note:
CE: Cost Efficiency, RE: Revenue Efficiency, PE: Profit Efficiency

5.2 Efficiency of Foreign Islamic Banks

The empirical findings in Table 5 seem to suggest that Malaysian foreign Islamic banks have exhibited mean cost, revenue, and profit efficiency (inefficiency) of 79.9% (20.1%), 84.4% (15.6%), and 79.3% (20.7%) respectively. Furthermore, it is interesting to note that on average Malaysian foreign Islamic banks have been found to be more efficient compared to their domestic bank peers. For revenue efficiency, we find that the average foreign Islamic bank generates 84.4% of revenues out of the amount of inputs utilized. Hence, the average foreign Islamic bank lost an opportunity to receive 15.6% more revenue, given the same amount of resources.

As for the cost efficiency, the results seem to suggest that the average foreign Islamic bank has utilized only 79.9% of the resources or inputs to produce the same level of outputs. In other words, on average, foreign Islamic banks have wasted 20.1% of its inputs, or it could have saved 20.1% of its inputs to produce the same level of outputs. Therefore, there was substantial room for significant cost savings for the foreign Islamic banks if they employ their inputs more efficiently. Noticeably, the highest level of inefficiency is cost followed by profit. The average foreign Islamic bank could have earned 79.3% of what was available and lost the opportunity to make 20.7% more profits when utilizing the same level of inputs.

In summary, the empirical findings from this study seem to suggest that the foreign Islamic banks have exhibited higher efficiency levels for all three measures (e.g. cost efficiency (84.4% vs. 71.2%), revenue efficiency (79.9% vs. 74.5%), and profit efficiency (79.3% vs. 62.5%). In essence, revenue efficiency seems to play the main factor leading to the lower or higher profit efficiency levels for both the domestic and foreign Islamic banks. Besides, results for the domestic Islamic banks indicate that the level of cost efficiency is higher than profit efficiency due to the lower revenue efficiency level or higher inefficiency from the revenue side. On the other hand, the level of cost efficiency is slightly higher than profit efficiency attributed to the higher revenue efficiency level from the revenue side for the foreign Islamic banks.

5.3 Composition on the Efficiency Frontier in Malaysian Islamic Banks

As stated earlier, a bank could operate at CRS or VRS where CRS signifies that an increase in inputs results in a proportionate increase in outputs and VRS means a rise in inputs results in a disproportionate rise in outputs. Further, a bank operating at VRS could be experiencing either DRS or IRS. DRS indicate that an increase in inputs results in lesser output increases, while IRS means that increase in inputs results in a higher increase in outputs. Table 6 list the Malaysian Islamic banks that form the efficiency frontier. During the period of study, only AmIslamic Bank Bhd and Maybank Islamic Bhd seem to have dominated the efficiency frontier (CRS) compared with other Islamic banks. Interestingly, both AmIslamic Bank and Maybank Islamic are domestic Islamic banks.

In general, the domestic Islamic banks are larger than foreign Islamic banks in terms of total assets. The results indicate that the large Islamic banks (the five largest domestic Islamic banks) tend to operate at CRS or DRS. The findings from this study are similar to the earlier studies by among others McAllister and McManus (1993), Drake (2001), and Yudistira (2004). Among others, the empirical findings clearly indicate that further increase in the size of these banks would only result in a smaller increase of outputs for every proportionate increase in inputs of the large banks, resulting from the fact that they have been operating at DRS.

On the other hand, the empirical findings from this study seem to suggest that the small Islamic banks (the five smallest foreign Islamic banks) tend to operate at CRS or IRS. Among others, the implication is that the smaller foreign Islamic banks, which have been operating at IRS, could achieve significant cost savings and efficiency gains by increasing its scale of operations attributed to the fact that a proportionate increase in inputs would result in more than a proportionate increase in outputs. In other words, substantial gains could be attained from altering the scale via internal growth or through mergers and acquisitions within the foreign Islamic banks. Therefore, banks that experience IRS should either eliminate their scale inefficiency via internal expansion or should become a prime target for acquiring banks because it can create value from underperforming bank and eliminate redundancies and inefficiencies (Evanoff and Israelvich, 1991)

Table 6: Malaysian Islamic Banks on the Efficiency Frontier

Bank	Total Asset (Mil USD)	Year					Count Bank (CRS)
		2011	2010	2009	2008	2007	
Maybank Islamic Bhd	13,639	CRS	CRS	CRS	DRS	CRS	4
CIMB Islamic Bank Bhd	11,687	DRS	DRS	DRS	DRS	IRS	0
Bank Islam Malaysia Bhd	9,843	DRS	DRS	DRS	DRS	DRS	0
Public Islamic Bank Bhd	7,673	DRS	DRS	IRS	DRS	IRS	0
AmIslamic Bank Bhd	6,672	CRS	CRS	CRS	CRS	CRS	5
Bank Muamalat Malaysia Bhd	6,050	DRS	IRS	DRS	DRS	IRS	0
RHB Islamic Bank Bhd	4,252	IRS	IRS	DRS	DRS	IRS	0
Hong Leong Islamic Bank Bhd	3,077	IRS	IRS	DRS	DRS	IRS	0
Affin Islamic Bank Bhd	2,451	DRS	IRS	DRS	IRS	IRS	0
Alliance Islamic Bank Bhd	2,057	IRS	IRS	CRS	CRS	IRS	2
EONCAP Islamic Bank Bhd	2,050	DRS	IRS	DRS	DRS	IRS	0
Kuwait Finance House (Malaysia) Bhd	3,540	IRS	IRS	DRS	DRS	IRS	0
HSBC Amanah Malaysia Bhd	2,190	IRS	IRS	CRS	DRS	IRS	1
Al-Rajhi Banking and Investment Bhd	1,919	IRS	IRS	DRS	DRS	IRS	0
OCBC Al-Amin Bank Bhd	1,396	IRS	IRS	IRS	IRS	IRS	0
Standard Chartered Saadiq Bhd	1,320	CRS	IRS	IRS	IRS	IRS	1
Asian Finance Bank Bhd	727	IRS	IRS	IRS	IRS	CRS	1
Count Year (CRS)		3	2	4	2	3	14

Note: CRS: constant returns to scale, DRS: decreasing returns to scale, IRS: increasing returns to scale.
In italicized are domestic Islamic banks. In shaded areas are foreign Islamic banks

5.4 Robustness Tests

After examining results derived from the DEA method, the issue of interest now is whether the difference in the cost, revenue, and profit efficiency of the domestic and foreign Islamic banks is statistically significant. Coakes and Steed (2003) suggest that the Mann-Whitney [Wilcoxon] is a relevant test for two independent samples drawn from populations having the same distributions. The most relevant reason is that the data violate the stringent assumptions of the independent group's *t*-test. In what follows, we perform the non-parametric Mann-Whitney [Wilcoxon] test along with a series of other parametric (*t*-test) and non-parametric Kruskall-Wallis tests to obtain robust results.

The robustness tests results are given in Table 7. The results from the parametric *t*-test and non-parametric Mann-Whitney (Wilcoxon) tests suggest that the Malaysian domestic Islamic banks have exhibited a lower mean cost efficiency level compared to their foreign Islamic bank peers ($0.745 < 0.799$). Likewise, the Malaysian domestic Islamic banks have also exhibited a lower mean profit efficiency level compared to their foreign Islamic banks ($0.625 < 0.793$). The results from the parametric *t*-test are further confirmed by the non-parametric Mann-Whitney [Wilcoxon] and Kruskall-Wallis tests. Similarly, the parametric *t*-test and non-parametric Mann-Whitney [Wilcoxon] and Kruskall-Wallis tests results indicate that the domestic Islamic banks have exhibited a lower revenue efficiency level compared to their foreign Islamic bank peers ($0.712 < 0.844$).

Based on most of the results in Table 7, we failed to reject the null hypothesis that the domestic and foreign Islamic banks come from the same population and have identical technologies since the revenue efficiency levels of the domestic Islamic banks is lower than the foreign Islamic banks at the 0.01 levels of significance. The clearly indicate that revenue efficiency could significantly influence the profitability of Islamic banks due to lower profit efficiency level. Therefore, within the context of Islamic banks the empirical findings clearly suggest that revenue efficiency represent the most important efficiency measure which could lead to improvement or deterioration in profit efficiency levels.

Table 7: Summary of Parametric and Non-Parametric Tests on Domestic and Foreign Islamic Banks

	Test groups					
	Parametric test		Non-parametric tests			
Individual tests	*t*-test		Mann-Whitney		Kruskall-Wallis	
			[Wilcoxon Rank-Sum] test		Equality of Populations test	
Hypothesis			MedianDomestic =			
			MedianForeign			
Test statistics	*t(Prb>t)*		*z(Prb>z)*		*X² (Prb > X²)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*X²*
Cost Efficiency						
Domestic Islamic banks	0.745	-1.131	41.09	-0.973	41.09	0.947
Foreign Islamic banks	0.799		46.50		46.50	
Revenue Efficiency						
Domestic Islamic banks	0.712	–2.726***	37.49	–2.827***	37.49	7.992***
Foreign Islamic banks	0.844		53.10		53.10	
Profit Efficiency						
Domestic Islamic banks	0.625	–2.551**	38.46	–2.352**	38.46	5.533**
Foreign Islamic banks	0.793		51.32		51.32	

Note: *** and ** indicate significance at the 1% and 5% levels respectively.

6. Conclusions and Policy Implications

The main objective of the present paper is examine the revenue efficiency and returns to scale in the Malaysian Islamic banking sector over the period of 2006 to 2010. To date, the majority of researchers have focused on the cost and profit efficiency, while and only a few have looked on revenue efficiency. Furthermore, most of these studies are carried out on the conventional banking sectors, while empirical evidence on the Islamic banking sectors is relatively scarce. The non-parametric Data Envelopment Analysis (DEA) method is applied to distinguish between three different types of efficiency measures, namely cost, revenue, and profit. Additionally, we perform a series of parametric (*t*-test) and non-parametric (Mann-Whitney [Wilcoxon] and Kruskall-Wallis) tests to examine whether the domestic and foreign Islamic banks are drawn from the same population.

We find that there is a statistically significant difference between the domestic and foreign Islamic banks' revenue efficiency. The results show that the revenue efficiency of the domestic Islamic banks is relatively lower compared to their foreign peers due to the difference between the cost and profit efficiency levels. The superiority in revenue efficiency of the foreign Islamic banks could be attributed to distinct competitive advantages they pose compared to their domestic Islamic bank peers. It is reasonable to assume that the foreign Islamic banks have the advantage of relatively advanced technologies. In this vein, Havrylchyk (2006) discovered similar findings that foreign banks could produce higher profit due to the modern information technologies and better risk management.

The empirical findings from this study failed to reject the null hypothesis that the domestic Islamic and foreign Islamic banks are derived from the same population and have identical technologies since the revenue efficiency of the domestic Islamic banks is statistically significantly lower compared to the foreign Islamic banks. In other words, the domestic and foreign Islamic banks in Malaysia are not considered as a similar organization because of the different level of the revenue efficiency in both banks that may affect the main objective of the banks to maximize the profit and shareholder wealth. In essence, the empirical findings clearly indicate that better revenue efficiency could

improve the level of profit efficiency and consequently contribute to higher profitability levels in the Malaysian Islamic banking sector.

The analysis on the returns to scale indicates that the large Islamic banks (the five largest domestic Islamic banks) tend to operate at CRS or DRS, while the small Islamic banks (the five smallest foreign Islamic banks) tend to operate at CRS or IRS. Therefore, the foreign Islamic banks that experience IRS should either eliminate their scale inefficiency via internal expansion or should become a prime target for acquiring banks which could eliminate redundancies and inefficiencies within the inefficient banks (Evanoff and Israelvich, 1991). On the other hand, the large domestic Islamic banks which have been operating at DRS are advised not to increase their size or be involved with mergers and acquisitions event because further increase in the size of the bank would only result in a smaller increase of outputs for every proportionate increase in inputs.

The findings of this study are expected to contribute significantly to regulators, policy makers, and bank managers. First, systematic analysis on the sources of revenue efficiency is crucial because revenue efficiency is the most important efficiency concept as lower profit efficiency can be identified from it (Akhavein et al. 1997). Furthermore, since the foreign Islamic banks are more efficient than the domestic Islamic banks, regulators may have to find ways and make decisions to further improve the revenue efficiency in the domestic Islamic banks which could lead to the increase in their profitability levels. To be able to improve the performance of the domestic Islamic banks, regulators may have to employ and exercise the same information technologies, skills, and risk management which have been applied by the foreign Islamic banks.

Second, the results could also provide valuable information and guidance to the managers of the Islamic banks. Islamic banks need to have better understanding the impact of their revenue efficiency levels on their performance. Thus, the domestic and foreign Islamic banks need to consider all the potential technologies which could improve their revenue efficiency since the main motive of bank is to maximise profit and shareholders' value or wealth. Therefore, the present study provide insights to the bank's specific management with regard to attaining optimal utilization of capacities, improvement in managerial expertise,

efficient allocation of scarce resources, and the most productive scale of operations.

Finally, the results of the study may have implications for investors whose main desire is to reap higher profits from their investments. In so doing, they could concentrate mostly on the potential profitability of the banks before making investment decisions. Based on the findings from this study, the revenue efficiency is the main factor that leads to the higher or lower Islamic banks' profitability. The relatively informed investors may have to evaluate the performance of Islamic banks through the results of revenue efficiency. In essence, the findings of this study may assist the investors to plan and strategize their investment portfolio performance given that a wise decision making that investors make today will determine their level of expected returns in the future.

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