COMPARING THE EFFICIENCY OF ISLAMIC AND CONVENTIONAL BANKS BASED ON THE EVIDENCE FROM MALAYSIA

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ABSTRACT

This paper examines whether Malaysian Islamic banks are more efficient relative to conventional banks over the period of 2004 – 2013. Also, the study investigates the determinants of efficiency for Islamic and conventional banks in Malaysia during the period of observation. In doing so, we employed two stages of analysis. First, data envelopment analysis (DEA) method was used to measure technical efficiency (TE) of Islamic and conventional banks. Second, a panel data regression analysis was estimated to examine the determinants of efficiency for both types of banks. Although the non-parametric test indicates that TE of conventional banks was different and higher than Islamic banks, the regression analysis based on size of banks suggests that this is only true for small banks. However, for sample of large banks, the result reveals that Islamic banks were technically more efficient than conventional banks. Further analysis reveals that factors which have negative effect on the efficiency of Islamic and conventional banks in Malaysia were level of capitalization, asset quality, inflation and post-crisis dummy variables. In contrast, factors which have positive effect on the efficiency of both banking systems were GDP, non-interest income and pre-crisis dummy variables. In addition, several other determining factors specific for Malaysian Islamic banks were bank size which has positive effect, and non-interest expenses which has negative effect on bank efficiency. While determining factors specific for Malaysian conventional banks were bank size which has negative effect, and non-interest expenses which has positive effect on bank efficiency.

Keywords: Banks, Islamic banks, technical efficiency, data envelopment analysis, Malaysia

INTRODUCTION

The 2007 – 2009 global financial crisis (GFC) had a significantly negative impact on the resilience, profitability and growth of the conventional financial system. Of all financial institutions, conventional banking institutions were among the most hit. Relative to conventional banks, Islamic banks are found to have weathered the crisis much better. This can be evidenced from Parashar & Venkatesh (2010) study which reported that the conventional banks have suffered more than the Islamic banks in terms of return on average assets and liquidity. Further evidence can be found in Hasan & Dridi (2010) which revealed that the Islamic banks performed better in terms of credit and asset growth compared to the conventional banks during the crisis period.

In the area of bank efficiency, a number of studies has compared the efficiency of Islamic and conventional banks, and also has examined the impact of crisis on

bank efficiency. However, we found that there is a lack of studies that compare technical efficiency of Malaysian Islamic and conventional banks, at the same time, considering the impact of economic variable such as the 2007 – 2009 GFC on bank technical efficiency. The area of comparing the efficiency of Islamic banks and conventional banks is worth to explore as Islamic banking is still at its infancy in the market. Hence, the efficiency of conventional banks could be seen as a benchmark for Islamic banks. In addition, the Islamic banking system in Malaysia is among the pioneer of the Islamic banking system in the world. Therefore, the level of efficiency of Malaysian Islamic banking system portrays an example for other nations.

Based on this background, we aim to compare the technical efficiency in Malaysian Islamic and conventional banks. In addition, we investigate the determinants of efficiency in both banking sectors. In doing so, a DEA approach was employed to analyse the samples of data from 21 conventional banks and 17 Islamic banks within Malaysia over the period of 2004 – 2013. This is an interesting period in which the Malaysian banking system has experienced the following scenarios; liberalization of Islamic banks in 2004 and severe global financial crisis in 2007 to 2009. We extended the time period to understand the efficiency of Malaysian banks not only during the crisis period, but also during the post crisis period.

Our work contributes to the growing literature on efficiency in general, and to Islamic and conventional banks in Malaysia in a number of ways. First, we use an extended sample of Malaysian banks over the period of 2004 to 2013 as compared to previous literature by Mokhtar et al. (2006) and Mokhtar et al. (2007) which used sample of Malaysian banks for the period of 1997 to 2003. Therefore, our study represents the current efficiency trend of Malaysian banking system. In addition, we employed different methodology, namely the DEA, to estimate efficiency of Malaysian Islamic and conventional banks as opposed to Stochastic Frontier Analysis (SFA) which was employed by Rozzani & Rahman (2013).

Second, our work contributes to the literature by examining the determinant factors for efficiency of Malaysian Islamic and conventional banks over a full sample period. In doing so, we control for different sub-period dummy variables, namely pre-crisis, during crisis and post-crisis. There have been an increasing number of cross-country studies that focused on efficiency of Islamic banks surrounding the 2007 – 2009 global financial crisis (see e.g. Johnes, Izzeldin, & Pappas, 2014a; Mohamad Noor & Ahmad, 2011; Said, 2013; Yudistira, 2004). Nevertheless, these results are inconclusive and depend on the sample of the studies, time period under consideration and method employed in their studies. Although Abdul-Majid, Saal & Battisti (2011a, 2011b) have considered sample of Islamic banks in Malaysia, these studies only examined the efficiency of Malaysian banks during the Asian financial crisis. Our study extends their study by considering an extended sample which include the period surrounding the 2007 – 2009 global financial crisis.

When comparing the DEA results, we found that there were significant differences between Malaysian Islamic and conventional banks in terms of technical efficiency,

pure technical efficiency and scale efficiency. In terms of technical efficiency and pure technical efficiency, the result reveals that the Malaysian conventional banks were significantly more efficient than the Islamic banks. In contrast, when scale efficiency is compared, we found that the score of scale efficiency for Islamic banks were significantly greater than the conventional banks. However, results from the OLS regression analysis reveal that only the large Islamic banks were significantly more technically efficient than the large conventional banks. In contrast, the small Islamic banks were found to be less efficient than the small conventional banks.

Analysis on determinants of bank efficiency reveals that factors which have negative effect on the efficiency of Malaysian Islamic and conventional banks were the level of capitalization, asset quality, inflation and post-crisis dummy variables. In contrast, factors which affect positively the efficiency of both banking systems are the GDP, non-interest income and pre-crisis dummy variables. Besides, the results reveal that several other determining factors specific for Islamic banks were bank size which has positive effect, and non-interest expenses which has negative effect on bank efficiency. Whereby, the determining factors specific for conventional banks were bank size which has negative effect, and non-interest expenses which has positive effect on bank efficiency.

This paper comes in six (6) sections of which this is the first. Literature review is presented in section 2 while section 3 describes the methodology. Section 4 outlines the data and Section 5 presents the results. Finally, section 6 concludes the paper.

LITERATURE REVIEW

Literature which examined the efficiency of Islamic banks has increased rapidly in recent times. These involved samples of Islamic banks from cross-countries (see e.g. Abdul Rahman & Rosman, 2013; Al-Jarrah & Molyneux, 2007; Alshammari, 2003; Beck et al., 2013; Brown & Skully, 2003; Hassan, 2003; Hassan, 2006; Johnes et al., 2014a; Johnes et al., 2014b; Mohamad Noor & Ahmad, 2012; Mohamad et al., 2008; Said, 2013; Srairi, 2010; Yudistira, 2004) and samples of Islamic banks from specific countries such as Bahrain (Hussein, 2004), Turkey (El-Gamal & Inanoglu, 2005), Bangladesh (Rahman, 2011), Jordan (Zeitun & Benjelloun, 2012), Pakistan (Abbas, Hammad, Fathy & Azid, 2015; Siddique & Rahim, 2013) and Malaysia (Abdul-Majid et al., 2011a, 2011b; Ab-rahim, Kadri & Ismail, 2013; Aik & Tan, 2012; Kamaruddin, Safa & Mohd, 2008; Fadzlan Sufian, Kamarudin & Mohd Noor, 2012, 2014; Fadzlan Sufian, 2006, 2007, 2009b; Tahir, Razali & Haron, 2013).

Despite of wide sample coverage of Islamic banks in the above-mentioned studies, study which compares the efficiency of Islamic and conventional banks is limited. Nonetheless, the concern whether one banking system is more efficient than the other could not be concluded due to mixed findings. These might be due to different time-period and sample considered in each study which may attract differences in terms of policy, regulations and socio-economic structure.

On one end, literatures were found suggesting that Islamic banks are less efficient than conventional banks in terms of cost efficiency (Hassan, 2003 & 2006;

Johnes et al., 2014b; Kamarudin, Nordin, Muhammad & Hamid, 2014; Srairi, 2010), profit efficiency (Hassan, 2006; Kamarudin et al., 2014; Srairi, 2010), revenue efficiency (Kamarudin et al., 2014) and type efficiency (Johnes et al. 2014a). On the other hand, another group of study indicated that the Islamic banks are more efficient than the conventional banks in terms of cost efficiency (Ahmad & Luo, 2010; Al-Jarrah & Molyneux, 2007; Alshammari, 2003), profit efficiency (Al-Jarrah & Molyneux, 2007; Johnes et al., 2014b), technical efficiency (Ahmad & Luo, 2010) and net efficiency (Johnes et al., 2014a). Interestingly, the third group of literature revealed that there is no significant differences between the efficiency of Islamic and conventional banks in terms of cost efficiency (Mohamad et al., 2008), profit efficiency (Hussein, 2004; Mohamad et al., 2008) and gross efficiency (Johnes et al., 2014a).

Also, several studies were found to compare the efficiency of Islamic and conventional banks within the Malaysian context (Mokhtar et al., 2006; Mokhtar et al., 2007; Rozzani & Rahman, 2013). Nevertheless, we found that there is lack of study that using current data as Malaysian Islamic financial system has experienced major developments after 2004. These developments might have changed the level of efficiency of Malaysian Islamic banks. Although Rozzani & Rahman (2013) compared the level of efficiency of Malaysian Islamic and conventional banks, the focus was only on profit efficiency. Besides, their study employed the Stochastic Frontier Approach only. Hence, it is imperative for the present study to examine the efficiency of Malaysian Islamic and conventional banks by using DEA method and more recently available data.

Besides comparing the efficiency of Islamic banks and conventional banks, numerous studies involving the examination of efficiency of Islamic banks have investigated the impact of crisis on efficiency of this institutions (Abbas et al., 2015; Johnes et al., 2014b; Mohamad Noor & Ahmad, 2011; Rosman, Wahab & Zainol, 2014; Said, 2013; Yudistira, 2004; Zeitun & Benjelloun, 2012). It is found that most of these literatures revealed that crisis has a negative impact on efficiency of Islamic banks. Nevertheless, only few studies have considered Islamic banks in Malaysia (see e.g. Abdul-Majid et al., 2011a; Abdul-Majid et al., 2011b). However, these studies only examined the impact of Asian financial crisis instead of the 2007 – 2009 GFC. Therefore, we found that there is lack of study that considers this new economic variable i.e. the 2007 – 2009 GFC.

METHODOLOGY

This study involved two stages of analysis. In the first stage, the bank efficiency was measured using the DEA approach. This method was adopted in Sufian (2011), Sufian & Habibullah (2009) and Mohamad Noor & Ahmad (2011). Examination of the efficiency year by year allows a better caption ofthe variation of efficiency scores over time. Furthermore, this is more suitable in a dynamic business environment as a bank may be efficient in one year but not in the following year. In the second stage, panel data regression is employed to relate the level of bank efficiency to a set of bank specific factors, market condition and macroeconomic factors.

Data Envelopment Analysis

DEA approach was used in this study to measure the efficiency of Malaysian Islamic

and conventional banks due to several reasons. First, the DEA is less data demanding as it works fine with small sample size (Canhoto & Dermine, 2003). This is suitable for Malaysian Islamic and conventional banks which consist of less than 50 banks. Secondly, the DEA approach does not require a preconceived structure of specific functional form to be imposed on the data in identifying and determining the efficient frontier, error and inefficiency structures of the decision making unit (DMU) (Evanoff & Israelvich, 1991). Thirdly, this approach allows the researchers to choose any kind of input and output of managerial interest, regardless of different measurement units (Avkiran, 1999). Lastly, the DEA approach allows measuring the efficiency of each decision making unit (DMU). This allows ranking amongst the DMU in the sample, and can highlight the areas for improvement for each single DMU (Golany & Roll, 1989).

The variable return to scale (VRS) assumption by Banker, Charnes, & Cooper (1984) (hereafter BCC) is considered in this work. This model was developed based on the original model introduced by Charnes, Cooper & Rhodes (1978) (hereafter CCR). The BCC model allows for assumption of VRS which enables us to make a detail analysis of inefficient units and take corrective actions to improve bank's efficiency. This can be done as the VRS provides the measurement of pure technical efficiency (PTE), which is the measurement of technical efficiency devoid of the scale efficiency (SE) effects. The existence of scale inefficiency can be detected if there appears to be a difference between the TE and PTE scores of a particular DMU.

VRS version of DEA can be written as follows:

$$\text{Min} \quad l_0 - \varepsilon \left[\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_i^+\right] \qquad (1)$$

Subject to:

$$\sum_{f=1}^{N} \lambda_f \, x_{if} = l_0 x_{if_0} - S_i^-$$

where $i = 1 \ldots m$

$$\sum_{f=1}^{N} \lambda_f \, y_{rf} = S_r^+ + y_{rf_0}$$

where $r = 1 \ldots s$

$$\sum_{f=1}^{N} \lambda_f = 1$$

$$\lambda_f \geq 0, f = 1 \ldots N, S_i^-, \; S_i^+ \geq 0 \forall i \text{ and } r$$

The model includes the so-called convexity constraint, $\sum_{f=1}^{N} \lambda_f = 1$ which prevents any interpolation point constructed from the observed DMU from being scaled up or down to form a reference point which is not permissible under the VRS. In this model, the set of λ values minimize l_0 to l_0^* and identify a point within the VRS model whose input levels reflect the lowest proportion of l_0^*. At l_0^*, the input levels of DMU f_0 is pareto-efficient if $l_0^* = 1$ and $S_r^{+*} = 0, r = 1 \ldots s$, $S_i^{-*} = 0$, $i = 1 \ldots m$. Technical efficiencies assessed under VRS are referred to as PTE as they are net of any scale effects.

Under VRS assumption, the resulting SE can be measured, since in most cases, the scale of operation of the firm may not be optimal. The firm involved may be too small in its scale of operation, which might fall within the increasing returns to scale part of the production function. Likewise, a firm may be too large and operate within the decreasing returns to scale part of the production function. In both cases, efficiency of the firms may be improved by changing their scale of operation. Under VRS, TE scores can be compared. The resulting ratio illustrates SE which is the impact of scale size on the productivity of a DMU. Formally, the SE of DMU f_0 is given as (TE/PTE). Where TE and

PTE are technical efficiency and pure technical efficiency of DMU f_0, respectively.

Choices of Inputs and Outputs

In order to determine what constitute inputs and outputs, one should decide on the nature of banking technology. In this regards, banking literature have discussed two main approaches competing with each other. These are the production approach and intermediation approach (Sealey & 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. On the other hand, the number of employees and physical capital is considered as inputs. Berger & Humphrey (1997) suggests that the production approach may be suitable for evaluating the efficiencies of branches of financial institutions.

In contrast, the intermediation approach assumes that financial firms act as an intermediary between savers and borrowers. This approach considers total loans and securities as outputs, whereas deposits, labour and physical capital are defined as inputs. Berger & Humphrey (1997) suggest that the intermediation approach may be more appropriate for evaluating the efficiency of entire financial institutions. Therefore, for the purpose of this study, a variation of the intermediation approach originally adopted by Sealey & Lindley (1977) will be adopted in the definition of inputs and outputs used.

Following previous studies on efficiency which consider Islamic banks i.e. Abdul-Majid et al. (2011) and El-Gamal & Inanoglu (2005), the intermediation approach is employed to define the bank inputs and outputs as it is the most suitable with the concept of Islamic banking. In the current study, we were considering three inputs and three outputs. The outputs used in this study were loans (Y1), investments (Y2) and non-interest income (Y3). On the other hand, inputs used in this study were total deposits (X1), personnel expenses (X2) and fixed assets (X3).

Panel Regression

The second stage analysis involves estimation of OLS regression. The application of OLS regression in a 2 stage procedure involving the DEA method has been proven to yield consistent estimators for the regression coefficients (Banker & Natarajan, 2008). This is further supported by Mc Donald (2009), which is the study that provided statistical basis and proved the use of DEA and OLS as a consistent estimator. In addition, if White (1980) heteroskedastic consistent standard errors are calculated, large tests samples can be executed, which are robust to heteroskedasticity and the distribution of the disturbances.

Thus, following Banker & Natarajan (2005) and Sufian & Habibullah (2009), the second stage regressions in this study are estimated by using the OLS method, while the standard errors are calculated by using White (1980) cross-section tests to adjust for the cross-section heteroskedasticity. The regression analysis is carried out to examine the type of bank that is more efficient, and to investigate the determinants of efficiency of Malaysian Islamic and conventional banks.

In the light of the regression analysis, the technical efficiency of each bank *i* at time *t* are constructed. Based on panel data analysis, the following equation is estimated:

$$TE_{it} = \alpha + \beta_1 IBDUMMY + \beta_2 \ln(TA)_{it} + \beta_3 ETA_{it} + \beta_4 LLRGL_{it} + \beta_5 NIETA_{it} + \beta_6 NIITA_{it} + \beta_7 NLTA_{it} + \beta_8 GDP_t + \beta_9 INF_t + \beta_{10} HSTAT_t + \beta_{11} PERIOD + \varepsilon_{it} \quad (2)$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

where '*i*' denotes the bank, '*t*' denotes the time period, and ε is the disturbance term, with v_{it} capturing the unobserved bank-specific effects and u_{it} is the idiosyncratic error with independently identically distributed (i.i.d.).

The dependent variable in our study is the bank's technical efficiency estimated by using the DEA method. The technical efficiency score is between 0 and 1, where 1 constitutes an efficient bank. In contrast, the nearer the technical efficiency scores to 0, the less efficient is the bank. Also, our primary variable of interest is the IBDUMMY, where 1 constitutes Islamic banks and 0 constitutes conventional banks.

The independent variables that are used to explain bank efficiency are grouped under three main characteristics, namely, a) bank-specific variables, b) macro-economic variables and c) market structure variable. The bank-specific variables included in the regressions are natural log of total assets (ln(TA)), equity to total assets (ETA), loan loss reserve to gross loans (LLRGL), non-interest expenses to total assets (NIETA), non-interest income to total assets (NIITA) and net loans to total assets (NLTA), following Mohamad Noor & Ahmad (2012); Fadzlan Sufian & Habibullah (2009).

Whereby, the macro-economic variables that we considered in this study are the GDP and inflation (INF), following Abdul Rahman & Rosman (2013). In addition, we included the H-statistic as control for market structure, following Andries (2011), Delis & Tsionas (2009) and Koetter et al. (2013).

To investigate the effect of the 2007 – 2009 global financial crisis on the efficiency of Malaysian Islamic and conventional banks, the whole period of 2004 to 2013 was divided into three sub-periods. The sub-periods were i) 2004 to 2007, which refers to the pre-crisis period, ii) 2008 to 2009, which is considered as the crisis affected years and iii) 2010 to 2013, which represents the post-crisis period. The segregation of sub-periods is expected to capture the effects of the 2007 – 2009 GFC on the efficiency of the Malaysian Islamic and conventional banks, and to examine whether the effect has prolonged after the crisis period. The dependent variable and full set of independent variables considered in this study are outlined in **Table 1**.

Next, to examine the determinants of bank stability for Islamic and conventional banks, estimation was carried out with the following equation.

$$TE_{it} = \alpha + \beta_1 \ln(TA)_{it} + \beta_2 ETA_{it} + \beta_3 LLRGL_{it} + \beta_4 NIETA_{it} + \beta_5 NIITA_{it} + \beta_6 NLTA_{it} + \beta_7 GDP_t + \beta_8 INF_t + \beta_9 HSTAT_t + \beta_{10} PERIOD + \varepsilon_{it} \quad (3)$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Details of the variables used for equation 3 as per outlined in **Table 1**.

Table 1:

Descriptive of the variables used in the regression models

Variable	Description	Expected sign
Dependent		
Technical efficiency	Bank's efficiency scores derived from the DEA intermediation approaches	NA
Independent	***Bank characteristics***	
LN(TA)	Natural logarithm of total assets. Control for bank size.	+/-
ETA	Equity over total assets. Control for impact of capital adequacy.	+
LLRGL	Loan loss reserve to gross loans. Control for bank's credit risk.	-
NIETA	Non-interest expense over total assets. Control for bank's expenses on non-interest income.	-
NIITA	Non-interest income over total assets. Control for bank's income from non-interest sources.	+
NLTA	Net loans (financing) to total assets. Control for bank's credit exposure.	+/-
	Economic and financial market conditions	
GDP	Gross domestic products. Control for macroeconomic factor.	+
INF	Inflation. Control for macroeconomic factor.	-
H-STAT	Panzar-Rosse H-statistic (based on total revenue). Control for competitive condition of Malaysian banking sector.	+/-
PRECRIDUM	Dummy variable that takes a value of 1 for pre-crisis period, 0 otherwise. Control for different sub-periods.	+
DURCRIDUM	Dummy variable that takes a value of 1 for during crisis period, 0 otherwise. Control for different sub-periods.	-
POSTCRIDUM	Dummy variable that takes a value of 1 for post crisis period, 0 otherwise. Control for different sub-periods.	+

Data Description and Descriptive Statistics

Cross-Section of Banks

Data for the empirical analysis was extracted from financial statements of 17 Malaysian Islamic banks and 21 Malaysian conventional banks over the period 2004 – 2013. The period was chosen so as to provide a time frame, as long as possible surrounding the recent 2007 – 2009 global financial crisis. This offers longer and more recent data as compared to previous studies (Mokhtar et al., 2007; Mokhtar et al., 2006) which investigated the efficiency of Malaysian Islamic and conventional banks over the period of 1997 – 2003. Analysing bank efficiency using more recent data is desirable since the liberalisation of Islamic banks in Malaysia occurred after 2004.

The financial statements were obtained from the website of each individual bank and Bureau van Dijk's Bankscope database. We chose a sample of banks that have at least six (6) years of their latest financial statements. Table 2 describes the sample of Malaysian Islamic and conventional banks used in this study versus those available

Table 2:

Distribution of sample of banks

By type	Islamic banks	Conventional banks	Total
Number of banks	20	27	**47**
Sample of banks	17	21	**38**
Percentage of sample	85 percent	77.78 percent	**80.85 percent**

in Malaysia. It shows that our sample has good coverage, with more than 80.85 percent of all Malaysian Islamic and con- ventional banks.

Preliminary Data Analysis

The DEA results were measured using sets of inputs and outputs described in Section 3.1. The descriptive statistics for the inputs and outputs of the DEA are shown in **Table 3**.

Table 3:

Descriptive statistics of input/output variables

	Conventional		Islamic	
2004	**Mean**	**SD**	**Mean**	**SD**
Total loans	20,530,066	27,244,941	5,171,898	3,491,094
Investments	6,581,163	8,237,801	2,502,429	917,429
Non-interest income	492,166	729,472	27,018	19,855
Total deposits	27,490,205	35,761,175	9,538,527	2,940,851
Personnel expenses	254,826	342,919	80,253	19,251
Fixed assets	248,680	346,989	72,517	24,749
2005	**Mean**	**SD**	**Mean**	**SD**
Total loans	25,994,682	29,797,723	3,330,875	3,807,881
Investments	5,934,342	6,548,543	1,452,555	1,389,512
Non-interest income	571,058	997,405	28,084	41,869
Total deposits	32,562,873	36,445,638	6,322,861	6,254,531
Personnel expenses	237,179	289,833	48,518	55,969
Fixed assets	263,549	318,590	31,851	33,518
2006	**Mean**	**SD**	**Mean**	**SD**
Total loans	25,189,040	32,578,061	2,437,279	2,926,926
Investments	6,263,073	7,544,578	876,953	1,019,978
Non-interest income	424,248	539,502	28,067	33,268
Total deposits	33,249,418	40,349,537	4,780,731	5,159,556
Personnel expenses	274,446	345,801	31,583	51,036
Fixed assets	216,931	283,373	22,943	28,972
2007	**Mean**	**SD**	**Mean**	**SD**
Total loans	26,064,932	32,263,842	3,127,149	2,716,806
Investments	5,836,558	7,140,545	1,068,912	1,302,909
Non-interest income	563,501	742,954	40,753	42,622
Total deposits	39,863,475	46,325,907	5,985,002	5,211,503
Personnel expenses	337,662	396,111	39,798	53,620
Fixed assets	193,118	245,977	20,995	30,319

2008	Mean	SD	Mean	SD
Total loans	28,665,121	36,550,838	5,390,659	5,131,247
Investments	8,308,051	9,596,630	1,362,192	1,416,372
Non-interest income	524,965	602,223	30,695	35,449
Total deposits	41,203,962	49,618,845	8,459,475	6,771,694
Personnel expenses	357,489	418,723	36,623	56,474
Fixed assets	203,432	265,501	18,403	33,376
2009	**Mean**	**SD**	**Mean**	**SD**
Total loans	30,527,623	39,034,827	6,798,291	6,615,737
Investments	9,467,129	12,001,098	1,988,132	2,344,560
Non-interest income	466,381	556,250	37,567	32,692
Total deposits	45,096,464	54,233,542	10,824,310	9,331,692
Personnel expenses	397,358	521,358	49,607	60,883
Fixed assets	208,406	285,209	20,628	35,467
2010	**Mean**	**SD**	**Mean**	**SD**
Total loans	34,103,455	42,600,810	8,424,918	8,709,670
Investments	9,624,259	12,387,410	2,579,068	3,593,811
Non-interest income	600,062	853,063	44,613	44,583
Total deposits	47,555,644	56,370,493	12,568,279	11,616,363
Personnel expenses	441,415	575,024	66,454	101,668
Fixed assets	209,047	277,096	23,254	44,606
2011	**Mean**	**SD**	**Mean**	**SD**
Total loans	39,665,788	51,512,260	10,915,985	12,704,053
Investments	10,835,284	14,144,274	3,039,593	3,314,735
Non-interest income	650,845	860,429	44,873	43,919
Total deposits	55,147,248	67,342,259	16,517,251	17,040,773
Personnel expenses	428,411	477,897	62,011	81,309
Fixed assets	211,833	278,684	23,482	49,379
2012	**Mean**	**SD**	**Mean**	**SD**
Total loans	45,154,767	57,873,956	15,118,709	21,429,876
Investments	13,487,808	16,656,317	4,006,308	4,091,697
Non-interest income	846,581	1,526,771	75,160	92,588
Total deposits	60,968,124	73,484,831	19,159,512	20,727,347
Personnel expenses	574,323	758,099	72,297	93,018
Fixed assets	237,756	310,598	13,784	17,417
2013	**Mean**	**SD**	**Mean**	**SD**
Total loans	58,013,348	73,520,766	16,507,699	20,373,368
Investments	16,113,138	21,793,863	3,820,557	3,669,011
Non-interest income	808,925	1,309,399	120,038	160,651
Total deposits	76,738,458	93,936,839	22,694,531	27,416,887
Personnel expenses	758,727	1,177,431	78,755	107,188
Fixed assets	376,765	621,153	23,008	50,593
Average	**Mean**	**SD**	**Mean**	**SD**
Total loans	33,390,882	44,859,286	8,874,452	13,048,481
Investments	9,245,080	12,654,382	2,438,119	3,010,233
Non-interest income	575,299	823,194	49,232	72,536
Total deposits	45,987,587	58,550,032	13,008,518	15,917,268
Personnel expenses	406,184	593,997	56,597	78,697
Fixed assets	236,952	335,842	21,902	37,669

Source: Bank financial statement and Bankscope database. All figures are in thousands ringgit Malaysia (RM)

In general, it is clear that the trend in banking business for both Islamic and conventional banks indicated an upward trend over the period of 2004 – 2013. Furthermore, it can be observed that the average inputs and outputs for the Islamic banks were lower compared to the conventional banks.

In addition to the descriptive statistics for inputs and outputs of the DEA, **Table 4** presents the descriptive statistics of variables which were used in the second stage analysis using the OLS regression analysis.

The statistic shown in **Table 4** suggests that in most variables, conventional banks were found to be better than Islamic banks, except in terms of capitalization. For example, the mean of total assets suggests that the size of conventional banks was much bigger than Islamic banks. Furthermore, the statistic shows that conventional banks were generating higher non-interest income than Islamic banks. This can be seen in the mean score of NIITA for conventional banks which stood at 1.13 percent against 0.39 percent for Islamic banks. Moreover, the statistic suggests that Islamic banks incurred higher non-interest

Table 4:

Descriptive statistics of variables used in the regression analysis

Panel A					
Islamic banks 2004-2013	**Obs**	**Mean**	**Std.Dev.**	**Min.**	**Max.**
Technical efficiency	131	0.765	0.236	0.052	1.000
LN(TA)	132	15.864	1.397	10.154	18.644
ETA	132	12.893	17.101	-1.902	100.000
LLRGL	123	3.429	2.959	0.290	18.800
NIETA	130	1.703	2.583	0.154	29.639
NIITA	130	0.391	0.335	0.012	1.613
NLTA	128	52.399	17.144	0.830	77.740
Panel B					
Conventional banks 2004 - 2013	**Obs**	**Mean**	**Std.Dev.**	**Min.**	**Max.**
Technical efficiency	210	0.797	0.169	0.312	1.000
LN(TA)	210	16.901	1.586	13.661	19.801
ETA	210	11.311	6.844	3.570	37.239
LLRGL	210	3.469	2.476	0.300	23.100
NIETA	210	1.297	0.453	0.515	3.376
NIITA	210	1.128	0.702	0.149	6.348
NLTA	210	47.943	21.886	0.420	89.730
Market competition and macroeconomic variables					
HSTAT	380	0.453	0.246	0.148	0.902
GDP	380	5.02	2.325	-1.5	7.4
INF	380	2.48	1.292	0.6	5.4

Notes: LN(TA) is natural log of total assets. ETA is equity to total assets. LLRGL is loan loss reserve to gross loans. NIETA is non-interest expenses to total assets. NIITA is non-interest income to total assets. NLTA is net loans to total assets.

Source: - Bank financial statement
HSTAT is H-statistic based on total revenue derived from Panzar-Rosse method.
- own calculation.
GDP is gross domestic products growth. INF is inflation.
- World Bank

expenses compared to conventional banks (1.70 percent against 1.30 percent). In contrast, Islamic banks were found to be better in terms of capital where its equity to total asset was 12.89 percent compared to 11.31 percent for conventional banks. In addition, Islamic banks had higher credit risk exposure of 52.40 percent compared to conventional banks of 47.94 percent.

Summing up, all variables used for the analysis outlined in **Table 4** supported the hypothesis that the Islamic and conventional banks models are distinct, thus clearly setting the scene for the differentiated treatment with respect to the modelling and analysis of bank efficiency.

Furthermore, correlation analysis on independent variables used for regression analysis was conducted. The results for correlation analysis are presented in **Table 5**. Overall, the results suggest no serious multi-collinearity issue among independent variables used in the regression analysis.

EMPIRICAL RESULTS

In this section, we present the TE change of the Malaysian Islamic and conventional banks, measured by the DEA method and its decomposition into PTE and SE components. The efficiency for both the Malaysian Islamic and conventional banks was first examined by applying the DEA method for each year under investigation.

The results are classified into three broad heads. First, we describe the estimates of TE for the Malaysian Islamic and conventional banks over the entire period. To allow efficiency to vary over time, the efficiency frontiers were constructed for each year by solving the linear programming (LP) problems rather than constructing a single multi-year frontier. Second, series of parametric test (t-test) and non-parametric test (Mann-Whitney and Kolmogorov Smirnov) were employed to assess the differences in the mean TE, PTE and SE of the Malaysian Islamic and conventional banks over the entire period and for each year. This could help shed some light on the differences in efficiency levels of Malaysian Islamic and conventional banks. Finally, to substantiate the results under the DEA approach, a regression analysis was employed to relate bank efficiency level to a set of bank specific characteristics, macro-economic and market conditions.

DEA results

In this section, we discuss the TE change of the Malaysian Islamic banking sector and conventional banking sector, measured by the DEA method and its decomposition into PTE and SE components. The efficiency of Islamic and conventional banks was examined for each year under investigation. Thereafter, the efficiency scores of both Islamic and conventional banks were compared.

Table 6 and **Figure 1** present the trend of efficiency scores of the Islamic and conventional banks in Malaysia from 2004 to 2013. On the one hand, it is clear that the technical efficiency of the conventional banks was on a declining trend from 2004 to 2006, increased in year 2007, before declining again during the years of 2008 to 2009. During the year 2010, it increased again before declining in the last three years of the sample period i.e. 2011 to 2013. On the other hand, the trend of technical efficiency for Islamic banks showed a stable pattern during the earlier three years of the sample period. However, during the remaining sample periods (from 2007 to 2013), the efficiency for Islamic banks indicated similar declining trend which was comparable to the conventional banks.

Table 5:

Correlation matrix of independent variables

	LN(TA)	EQASS	LLRGL	NIETA	NIITA	NLTA	GDP	INF	H-STAT	Pre-crisis	During Crisis	Post crisis
LN(TA)	1.000											
ETA	-0.650	1.000										
LLRGL	-0.131	0.073	1.000									
NIETA	-0.162	0.468	0.042	1.000								
NIITA	0.177	0.023	0.096	0.006	1.000							
NLTA	0.479	-0.359	-0.232	-0.142	-0.230	1.000						
GDP	0.001	0.013	0.048	0.018	0.025	-0.015	1.000					
INF	-0.036	0.003	0.023	0.012	0.013	-0.041	0.563	1.000				
H-STAT	-0.091	0.019	0.099	0.005	0.057	-0.098	-0.168	0.563	1.000			
Pre-cisis	-0.109	0.101	0.314	0.086	0.119	-0.159	0.314	0.042	0.213	1.000		
During crisis	-0.036	-0.014	-0.009	-0.046	-0.017	-0.004	-0.721	0.207	0.577	-0.373	1.000	
Post crisis	0.133	-0.084	-0.288	-0.043	-0.098	0.153	0.307	-0.213	-0.683	-0.632	-0.484	1.000

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. GDP = Gross domestic products. INF = Inflation. H-STAT = Panzar-Rosse H-statistic (Total revenue).

Table 6:

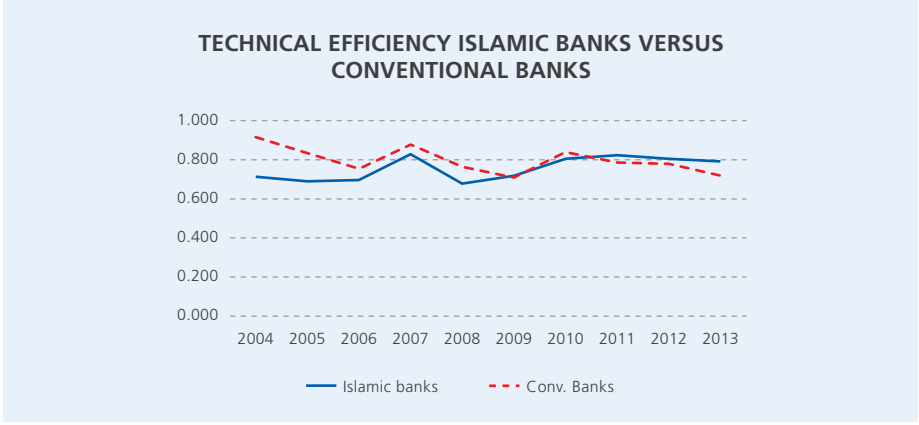
Test for difference in efficiency score between Malaysian Islamic and conventional banks

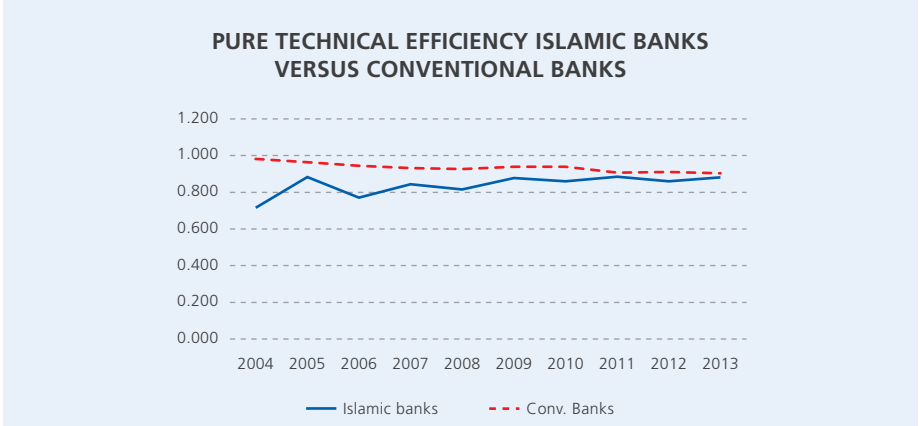
By year		TE			PTE			SE		
		CB	IB	All	CB	IB	All	CB	IB	ALL
2004	Mean	0.915	0.713	0.898	0.981	0.716	0.958	0.931	0.996	0.937
	P value (t test)	0.108			0.000***			0.573		
	Mann-Whitney	0.064*			0.003***			0.346		
2005	Mean	0.834	0.689	0.806	0.964	0.883	0.949	0.865	0.774	0.847
	P value (t test)	0.082*			0.073*			0.205		
	Mann-Whitney	0.309			0.421			0.490		
2006	Mean	0.754	0.696	0.735	0.944	0.771	0.888	0.801	0.754	0.837
	P value (t test)	0.505			0.035**			0.054*		
	Mann-Whitney	0.578			0.136			0.158		
2007	Mean	0.878	0.828	0.860	0.932	0.843	0.900	0.944	0.911	0.948
	P value (t test)	0.551			0.264			0.779		
	Mann-Whitney	0.387			0.718			0.254		
2008	Mean	0.763	0.677	0.725	0.926	0.815	0.876	0.825	0.955	0.827
	P value (t test)	0.237			0.043**			0.937		
	Mann-Whitney	0.605			0.182			0.255		
2009	Mean	0.708	0.718	0.712	0.939	0.877	0.911	0.759	0.830	0.787
	P value (t test)	0.874			0.153			0.298		
	Mann-Whitney	0.586			0.158			0.129		
2010	Mean	0.838	0.805	0.824	0.939	0.860	0.904	0.891	0.821	0.911
	P value (t test)	0.504			0.045**			0.178		
	Mann-Whitney	0.523			0.040**			0.327		
2011	Mean	0.786	0.823	0.802	0.907	0.885	0.897	0.865	0.935	0.895
	P value (t test)	0.480			0.611			0.070*		
	Mann-Whitney	0.441			0.669			0.024**		
2012	Mean	0.779	0.804	0.790	0.911	0.859	0.888	0.852	0.928	0.886
	P value (t test)	0.720			0.324			0.087*		
	Mann-Whitney	0.729			0.541			0.166		
2013	Mean	0.718	0.791	0.751	0.903	0.881	0.893	0.797	0.894	0.840
	P value (t test)	0.267			0.700			0.034**		
	Mann-Whitney	0.114			0.203			0.049**		
All periods	Mean	0.797	0.765	0.785	0.935	0.853	0.903	0.853	0.895	0.869
	P value (t test)	0.146			0.000***			0.013**		
	Mann-Whitney	0.586			0.000***			0.002***		

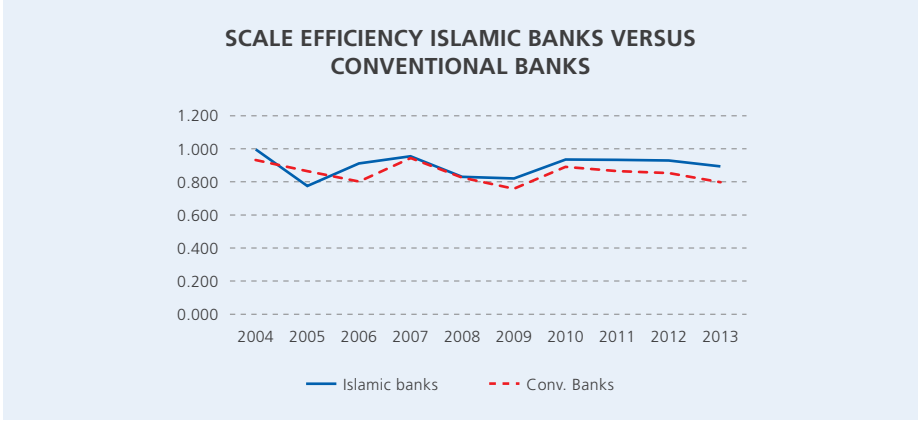
Notes: TE = technical efficiency, PTE = pure technical efficiency, SE = scale efficiency
*** = significant at 1 percent significance level; ** = significant at 5 percent significance level; * = significant at 10 percent significance level

Figure 1:

Data envelopment analysis (DEA) for Malaysian Islamic and conventional banks – mean values of 2004 to 2013







With regards to the trend of pure technical efficiency, we found that the pure technical efficiency of the Malaysian conventional banks was on a declining trend. In contrast, the trend of pure technical efficiency of the Malaysian Islamic banks was on an increasing trend. Furthermore, when the trend of scale efficiency was observed, we found that both the Malaysian Islamic and conventional banks had similar trend of scale efficiency. From 2004 to 2006, the scale efficiency of both types of banks indicates a declining trend, followed by an increase of scale efficiency in 2006 to 2007. Between the year 2007 to 2009, the trend of scale efficiency reduced again before it increased in the year 2009 to 2010. The following year of 2010 to 2013, the trend of scale efficiency of both types of institutions indicated a stable pattern.

When the mean technical efficiency of both Islamic and conventional banks are compared, the results reveal that over the entire period of observation, conventional banks exhibited higher mean of technical efficiency at 79.7 percent than the Islamic banks at 76.5 percent. Nevertheless, the results of t-test and MW test, both were not significant. Therefore, we could not reject the null-hypothesis that stated the equality of technical efficiency between Islamic and conventional banks.

In addition, the pure technical efficiency and scale efficiency between the Islamic and conventional banks were compared. On the one hand, the mean of pure technical efficiency for the conventional banks was found to be higher than the Islamic banks. Over the entire period, the pure technical efficiency score for the conventional banks was 93.5 percent while the pure technical efficiency score for the Islamic banks was 85.3 percent. This indicates that the conventional banks have higher managerial capability compared to the Islamic banks. The t-test and MW test were highly significant, thus rejecting the null-hypothesis on the equality of pure technical efficiency score for both Islamic and conventional banks.

On the other hand, the scale efficiency score indicates that the Islamic banks were more scale efficient than the conventional banks. This can be observed from the mean score of scale efficiency for the Islamic banks, which was 89.5 percent compared to the mean score of scale efficiency for the conventional banks of 85.3 percent. The t-test and MW test were highly significant, thus rejecting the null-hypothesis which states that scale efficiency of both types of banks are equal.

Also, it can be observed from **Table 6** that pure technical inefficiency seems to outweigh scale inefficiency in determining the technical inefficiency of the Malaysian Islamic banks over the entire sample period. In contrast, the empirical findings seem to suggest that scale inefficiency outweigh the pure technical inefficiency in determining the technical inefficiency of the Malaysian conventional banks.

Regression analysis

Efficiency of Islamic Versus Conventional Banks

In comparing the efficiency of Islamic and conventional banks, this study estimates regression analysis using equation (2), controlling the Islamic banks dummy variable as the primary variable of interest, bank specific, market structure and macroeconomic factors. Results are presented in **Table 7.**

Table 7:

Regression analysis all sample (with Islamic banks dummy)[a]

Estimator	OLS					
Model	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
	0.0279	0.0254	0.0372	0.0517	0.0362	0.0558
Islamic dummy	(0.0341)	(0.0348)	(0.0348)	(0.0365)	(0.0349)	(0.0361)
LN(TA)	-0.0052	-0.0076	-0.0048	-0.0014	-0.0049	-0.0004
	(0.0116)	(0.0118)	(0.0118)	(0.0120)	(0.0118)	(0.0120)
ETA	-0.0020	-0.0023	-0.0018	-0.0013	-0.0019	-0.0013
	(0.00271)	(0.00277)	(0.00280)	(0.00286)	(0.00280)	(0.00282)
LLRGL	-0.0087**	-0.0082**	-0.0096***	-0.0121***	-0.0096**	-0.0134***
	(0.00386)	(0.00394)	(0.00371)	(0.00394)	(0.00374)	(0.00402)
NIETA	-0.0249***	-0.0244***	-0.0256***	-0.0279***	-0.0253***	-0.0278***
	(0.00642)	(0.00658)	(0.00677)	(0.00693)	(0.00677)	(0.00672)
NIITA	0.0608**	0.0621**	0.0624**	0.0638**	0.0624**	0.0646**
	(0.0251)	(0.0259)	(0.0256)	(0.0259)	(0.0255)	(0.0254)
HSTAT		-0.0726*	0.0455	-0.0071	0.0327	-0.0865
		(0.0412)	(0.0526)	(0.0544)	(0.0571)	(0.0592)
GDP			0.0197***	0.0143***	0.0228***	0.0230***
			(0.00426)	(0.00466)	(0.00708)	(0.00439)
INF			-0.0264***	-0.0187*	-0.0283***	-0.0217**
			(0.00954)	(0.00990)	(0.0101)	(0.00959)
Pre-crisis dummy				0.0595**		
				(0.0263)		
During crisis dummy					0.0238	
					(0.0451)	
Post-crisis dummy						-0.0926***
						(0.0291)
Constant	0.902***	0.974***	0.839***	0.796***	0.833***	0.843***
	(0.227)	(0.236)	(0.240)	(0.243)	(0.241)	(0.236)
Obs.	333	333	333	333	333	333
R-squared	0.109	0.118	0.166	0.180	0.167	0.190

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. H-STAT = Panzar-Rosse H-statistic (Total revenue). GDP = Gross domestic products. INF = Inflation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[a] The equation:

$$TE_{it} = \alpha + \beta_1 IBDUMMY + \beta_2 \ln(TA)_{it} + \beta_3 EQASS_{it} + \beta_4 LLRGL_{it} + \beta_5 NIETA_{it} + \beta_6 NIITA_{it} + \beta_7 NLTA_{it} + \beta_8 GDP_t + \beta_9 INF_t + \beta_{10} HSTAT_t + \beta_{11} PERIOD + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Six models have been estimated using the pooled OLS regression with model 1 controls for Islamic dummy and bank-specific variables. Model 2 controls for Islamic dummy, bank-specific variables and market competition. Model 3 includes variables in model 2 and macroeconomic variables. Model 4, 5 and 6 include the sub-period dummy variables, namely the pre-crisis, during crisis and post-crisis, respectively.

Based on **Table 7**, the coefficient for Islamic banks dummy variable indicated positive sign across all models, which suggest that the Malaysian Islamic banks are more efficient than the conventional banks. This result is in contrast to Mokhtar et al. (2007) which examined efficiency of Malaysian Islamic and conventional banks between the year 1997 to 2003. Nevertheless, our result is insignificant.

We then examined whether the differences of efficiency of Islamic and conventional banks exists on samples of small and large banks. For this purpose, we estimated six models of the earlier regression model based on sample of large and small banks. Small banks are those with total assets from RM0 - 10.0 billion, whilst banks with total assets more than RM10.0 billion are considered as large banks. The results for samples of large banks are presented in **Table 8** while results for samples of small banks are presented in **Table 9**.

Table 8:
Regression analysis (large banks)[a]

Estimator	OLS					
Model	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
	0.0786*	0.0684*	0.0840**	0.121***	0.0817**	0.138***
Islamic dummy	(0.0400)	(0.0410)	(0.0388)	(0.0385)	(0.0387)	(0.0374)
LN(TA)	-0.0134	-0.0167	-0.0120	-0.00156	-0.0122	0.00445
	(0.0156)	(0.0157)	(0.0157)	(0.0162)	(0.0156)	(0.0162)
ETA	0.00429	0.00261	0.00358	0.00879	0.00263	0.00990
	(0.00649)	(0.00657)	(0.00652)	(0.00677)	(0.00651)	(0.00675)
LLRGL	-0.00843	-0.00454	-0.00830	-0.0168**	-0.00779	-0.0210***
	(0.00687)	(0.00706)	(0.00643)	(0.00680)	(0.00655)	(0.00656)
NIETA	-0.0246	-0.0310	-0.0298	-0.0192	-0.0307	-0.0146
	(0.0331)	(0.0348)	(0.0319)	(0.0317)	(0.0317)	(0.0302)
NIITA	0.0549	0.0574	0.0528	0.0474	0.0545	0.0479
	(0.0367)	(0.0390)	(0.0359)	(0.0332)	(0.0362)	(0.0314)
HSTAT		-0.0886*	0.0503	0.00171	0.00924	-0.122**
		(0.0483)	(0.0591)	(0.0576)	(0.0655)	(0.0602)
GDP			0.0207***	0.0133**	0.0291***	0.0278***
			(0.00443)	(0.00513)	(0.00768)	(0.00439)
INF			-0.0289***	-0.0172	-0.0340***	-0.0213**
			(0.0103)	(0.0109)	(0.0110)	(0.0101)
Pre-crisis dummy				0.0954***		
				(0.0311)		
During crisis dummy					0.0681	
					(0.0486)	
Post-crisis dummy						-0.155***
						(0.0321)
Constant	0.991***	1.098***	0.926***	0.710**	0.910***	0.694**
	(0.312)	(0.321)	(0.320)	(0.330)	(0.319)	(0.322)
Obs.	199	199	199	199	199	199
R-squared	0.086	0.101	0.178	0.218	0.185	0.259

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. H-STAT = Panzar-Rosse H-statistic (Total revenue). GDP = Gross domestic products. INF = Inflation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[a] The equation:

$$TE_{it} = \alpha + \beta_1 IBDUMMY + \beta_2 \ln(TA)_{it} + \beta_3 EQASS_{it} + \beta_4 LLRGL_{it} + \beta_5 NIETA_{it} + \beta_6 NIITA_{it} + \beta_7 NLTA_{it} + \beta_8 GDP_t + \beta_9 INF_t + \beta_{10} HSTAT_t + \beta_{11} PERIOD + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Table 9:
Regression analysis (small banks)[a]

Estimator	OLS					
Model	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
Islamic dummy	-0.0641	-0.0620	-0.0530	-0.0452	-0.0500	-0.0485
	(0.0607)	(0.0603)	0.926***	(0.0630)	0.910***	(0.0624)
LN(TA)	0.0640	0.0633	(0.320)	0.0787*	(0.319)	0.0783*
	(0.0396)	(0.0396)	(0.0417)	(0.0436)	(0.0420)	(0.0439)
ETA	-0.0004	-0.0004	8.56e-05	6.85e-05	0.0002	-0.0001
	(0.00390)	(0.00393)	(0.00403)	(0.00410)	(0.00411)	(0.00400)
LLRGL	-0.0116**	-0.0119**	-0.0130***	-0.0153***	-0.0130***	-0.0157***
	(0.00477)	(0.00498)	(0.00464)	(0.00506)	(0.00458)	(0.00520)
NIETA	-0.0177**	-0.0180**	-0.0183**	-0.0192**	-0.0190**	-0.0182**
	(0.00816)	(0.00815)	(0.00818)	(0.00840)	(0.00835)	(0.00811)
NIITA	0.0693**	0.0707**	0.0769**	0.0808***	0.0782**	0.0795***
	(0.0279)	(0.0284)	(0.0295)	(0.0301)	(0.0299)	(0.0299)
HSTAT		-0.0238	0.103	0.0295	0.130	-0.0278
		(0.0726)	(0.0922)	(0.102)	(0.0979)	(0.116)
GDP			0.0218***	0.0148*	0.0148	0.0248***
			(0.00802)	(0.00870)	(0.0130)	(0.00825)
INF			-0.0287*	-0.0190	-0.0241	-0.0246
			(0.0173)	(0.0181)	(0.0186)	(0.0173)
Pre-crisis dummy				0.0728		
				(0.0466)		
During crisis dummy					-0.0543	
					(0.0819)	
Post-crisis dummy						-0.0868
						(0.0543)
Constant	-0.138	-0.118	-0.355	-0.435	-0.352	-0.369
	(0.624)	(0.628)	(0.667)	(0.693)	(0.670)	(0.688)
Obs.	134	134	134	134	134	134
R-squared	0.202	0.203	0.243	0.259	0.246	0.258

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. H-STAT = Panzar-Rosse H-statistic (Total revenue). GDP = Gross domestic products. INF = Inflation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[a] The equation:

$$TE_{it} = \alpha + \beta_1 IBDUMMY + \beta_2 \ln(TA)_{it} + \beta_3 EQASS_{it} + \beta_4 LLRGL_{it} + \beta_5 NIETA_{it} + \beta_6 NIITA_{it} + \beta_7 NLTA_{it} + \beta_8 GDP_t + \beta_9 INF_t + \beta_{10} HSTAT_t + \beta_{11} PERIOD + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

On one hand, the regression results in **Table 8** reveal that the coefficient of Islamic banks dummy variable indicated a positive sign. The result was significant at minimum level of 5 percent. Therefore, we could conclude that the large Islamic banks was more efficient than large conventional banks. This result is consistent with Ahmad & Luo (2010) which involved European Islamic and conventional banks. In contrast, our result differs from Mokhtar et al. (2007) which examined the Malaysian Islamic and conventional banks. This result is possible as many large Islamic banks in Malaysia are actually a subsidiary to their parent company, which is a conventional bank. As a subsidiary, these large Islamic banks enjoy privilege in utilizing the facility, man power and branch network of their parent company. Hence, these privileges help the large Islamic banks to enhance its level of efficiency.

On the other hand, the regression results in **Table 9** reveal that the coefficient of Islamic banks dummy variable indicated a negative sign across all models. This suggests that small Islamic banks were less efficient than small conventional banks. Nevertheless, the result for small banks was insignificant at any level.

Determinants of Efficiency

Table 10 presents the regression results which focus on the relationship between efficiency of Islamic banks and its explanatory variables. On the other hand, **Table 11** presents the regression results which focus on the relationship between efficiency of conventional banks and its explanatory variables.

Table 10:

Regression analysis of technical efficiency for Malaysian Islamic banks, 2004-2013[a]

Estimator	OLS					
Model	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
LN(TA)	0.0356*	0.0358	0.0379*	0.0432*	0.0402*	0.0422*
	(0.0214)	(0.0220)	(0.0227)	(0.0238)	(0.0231)	(0.0237)
ETA	-0.0033	-0.0033	-0.0030	-0.0016	-0.0022	-0.00208
	(0.00458)	(0.00459)	(0.00483)	(0.00507)	(0.00496)	(0.00496)
LLRGL	-0.0143***	-0.0144***	-0.0148***	-0.0168***	-0.0153***	-0.0169***
	(0.00488)	(0.00492)	(0.00500)	(0.00527)	(0.00505)	(0.00530)
NIETA	-0.0067	-0.0067	-0.0075	-0.0122	-0.0102	-0.0106
	(0.0111)	(0.0111)	(0.0118)	(0.0127)	(0.0123)	(0.0123)
NIITA	0.0485	0.0488	0.0397	0.0344	0.0331	0.0404
	(0.0589)	(0.0587)	(0.0587)	(0.0614)	(0.0606)	(0.0604)
NLTA	0.0050***	0.00501***	0.00508***	0.00566***	0.0053***	0.0056***
	(0.00144)	(0.00144)	(0.00144)	(0.00139)	(0.00144)	(0.00139)
HSTAT		0.0036	0.0918	0.0126	0.202	-0.145
		(0.0705)	(0.0946)	(0.0937)	(0.147)	(0.135)
GDP			0.0127*	0.0056	-0.0023	0.0208**
			(0.00694)	(0.00710)	0.910***	(0.00818)
INF			(0.320)	-0.0088	(0.319)	(0.322)
			(0.0157)	(0.0154)	(0.0158)	(0.0153)
Pre-crisis dummy				(0.330)		
				(0.0479)		
During crisis dummy					-0.125	
					(0.108)	
Post-crisis dummy						-0.147**
						(0.0669)
Constant	0.00850	0.00346	-0.0800	-0.173	-0.0933	-0.0423
	(0.333)	(0.352)	(0.368)	(0.380)	(0.369)	(0.372)
Obs.	123	123	123	123	123	123
R-squared	0.390	0.390	0.406	0.432	0.414	0.432

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. H-STAT = Panzar-Rosse H-statistic (Total revenue). GDP = Gross domestic products. INF = Inflation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[a] The equation:

$$TE_{it} = \alpha + \beta_1 \ln(TA)_{it} + \beta_2 EQASS_{it} + \beta_3 LLRGL_{it} + \beta_4 NIETA_{it} + \beta_5 NIITA_{it} + \beta_6 NLTA_{it} + \beta_7 GDP_t + \beta_8 INF_t + \beta_9 HSTAT_t + \beta_{10} PERIOD + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Table 11:

Regression analysis of technical efficiency for Malaysian conventional banks between 2004 and 2013[a]

Estimator	OLS					
Model	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**
LN(TA)	-0.0323**	-0.0339**	-0.0301**	-0.0271*	-0.0300**	-0.0250*
	(0.0142)	(0.0144)	(0.0142)	(0.0142)	(0.0142)	(0.0142)
ETA	-0.0041	-0.0045	-0.0037	-0.0034	-0.0038	-0.0032
	(0.00310)	(0.00315)	(0.00301)	(0.00301)	(0.00301)	(0.00298)
LLRGL	-0.0048	-0.0044	-0.0073	-0.0110	-0.0073	-0.0135**
	(0.00682)	(0.00705)	(0.00650)	(0.00669)	(0.00662)	(0.00681)
NIETA	0.0094	0.0066	0.0070	0.0096	0.0057	0.0086
	(0.0340)	(0.0348)	(0.0333)	(0.0337)	(0.0330)	(0.0329)
NIITA	0.0612**	0.0636*	0.0654**	0.0651**	0.0653**	0.0647**
	(0.0309)	(0.0326)	(0.0324)	(0.0321)	(0.0320)	(0.0310)
NLTA	0.0004	0.0004	0.0003	0.0002	0.0003	4.91e-05
	(0.000816)	(0.000819)	(0.000809)	(0.000823)	(0.000804)	(0.000815)
HSTAT		(0.352)	0.0878	0.0352	0.0699	-0.0351
		(0.0437)	(0.0587)	(0.0621)	(0.0586)	(0.0633)
GDP			0.0254***	0.0193***	0.0315***	0.0278***
			(0.00483)	(0.00557)	(0.00814)	(0.00479)
INF			-0.0316***	-0.0235**	-0.0356***	-0.0264**
			(0.0105)	(0.0117)	(0.0121)	(0.0108)
Pre-crisis dummy				0.0580**		
				(0.0285)		
During crisis dummy					0.0469	
					(0.0448)	
Post-crisis dummy						-0.0954***
						(0.0323)
Constant	1.307***	1.360***	1.186***	1.160***	1.165***	1.196***
	(0.275)	(0.285)	(0.286)	(0.283)	(0.288)	(0.277)
Obs.	210	210	210	210	210	210
R-squared	0.086	0.091	0.186	0.203	0.189	0.221

Notes: LN(TA) = natural log of total assets. ETA = equity to total assets ratio. LLRGL = loan loss reserve to gross loans. NIETA = Non-interest expenses to total assets. NIITA = Non-interest income to total assets. NLTA = Net loans to total assets. H-STAT = Panzar-Rosse H-statistic (Total revenue). GDP = Gross domestic products. INF = Inflation. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[a] The equation:

$$TE_{it} = \alpha + \beta_1 \ln(TA)_{it} + \beta_2 EQASS_{it} + \beta_3 LLRGL_{it} + \beta_4 NIETA_{it} + \beta_5 NIITA_{it} + \beta_6 NLTA_{it} + \beta_7 GDP_t + \beta_8 INF_t + \beta_9 HSTAT_t + \beta_{10} PERIOD + \varepsilon_{it}$$

$$\varepsilon_{it} = v_{it} + u_{it}$$

Six models were estimated using equation (3). Model 1 included bank-specific variables while model 2 included bank-specific variables and competitive condition. In model 3, we included macroeconomic variables in addition to bank-specific variables and competitive condition. Lastly, in model 4, 5 and 6, we included pre-crisis dummy, during crisis dummy and post-crisis dummy, respectively in addition to bank-specific variables, competitive condition and macroeconomic variables.

Several general comments regarding the OLS regression results are warranted. First, the coefficient results for most variables

that we included remain consistent across the various models. Second, the results suggested that most explanatory variables indicated the expected signs which is consistent with previous literature. Therefore, in this study, the OLS regression results were reported.

Determinants of efficiency for Islamic banks

First, we report the regression results for Islamic banks as presented in **Table 10**. The coefficient of LN(TA) which is the proxy of bank size had a positive sign and significant at 10 percent level. This suggests that the larger the Islamic bank, the more efficient it will be. This supports the economies of scale arguments and coincides with Berger et al. (1993), Sufian & Habibullah (2009), Mohamad Noor & Ahmad (2012) and Srairi (2010). Hauner (2005) suggested that there are at least two potential explanations that are related to size having a positive impact on bank efficiency. The first explanation relates to the benefit of market power. In this regards, large banks should pay less for the inputs. Secondly, an increase in firm size could lead to a decline in input or output ratios as there might be increasing returns to scale.

With regards to ETA, the result indicated a negative sign across model 1-6. This suggests that an increase in level of capitalisation lead to reduction in of efficiency for Islamic banks. Our result supports previous studies of Tecles & Tabak (2010), Sufian (2009), Andries (2011) and Vu & Nahm (2013) which also found negative sign of ETA. Nevertheless, our finding was insignificant.

Next, the coefficient result of LLRGL was negative and highly significant at 1 percent level. This suggests a negative relationship between efficiency of Islamic banks and loan loss reserve which is proxy for asset quality. The result denotes that Malaysian Islamic banks should focus more on credit risk management, which has been recognised to be problematic in the recent past literature. Our result corresponds with Sufian & Habibullah (2009), Sufian (2010) and Sufian et al. (2012).

In addition, the sign of coefficient for NIETA indicated negative sign throughout model 1-6. This is expected as poor management of bank expenses certainly has negative impact of bank's efficiency. Our finding is consistent with previous literatures (see e.g. Sufian et al., 2012; Sufian, 2009; Mohamad Noor & Ahmad, 2011; Rozzani & Rahman, 2013; Sufian, 2010; Sufian & Habibullah, 2009). However, this result was insignificant.

Furthermore, the result reveals that the coefficient of NIITA indicated positive sign across all models. This suggests that an increase in share of non-interest income tends to increase the efficiency of Islamic banks. Our result supports previous literatures such as Sufian (2009), Sufian (2010) and Sufian & Habibullah (2009). Nevertheless, this result was also insignificant.

In addition, the coefficient of NLTA indicated positive sign and highly significant at 1 percent level, revealing that an increase in financing exposure contributes positively to efficiency of Islamic banks. The result seems to suggest that Islamic banks with higher financing to asset ratio tend to exhibit higher level of efficiency. This result coincides with Sufian (2009, 2010), Gardener et al. (2011), Anwar (2014) and Isik & Hassan (2003). The positive association between financing to asset ratio

and bank efficiency is possible due to the ability of the relatively efficient Islamic banks to manage their operations more productively. This enables them to have lower production costs and consequently to offer more reasonable financing terms. Therefore, allowing these Islamic banks to gain market shares in the financing market segment.

Also, the market competition is controlled by using the Panzar-Rosse H-statistic based on total revenue. The coefficient result of HSTAT indicated a positive sign across model 2-5, but negative sign in model 6. Nevertheless, all results were insignificant. On the one hand, a positive result suggeseds the benefit of competition on the efficiency of Islamic banks. This result is consistent with previous literature such as Berger & Hannan (1998), Koetter et al. (2012), Yudistira (2004), Delis & Tsionas (2009) Andries (2011). On the other hand, a negative sign in Model 6 could indicate that market competition during the post-crisis period might be less intensive, resulting in a negative relationship with bank efficiency.

Furthermore, the coefficient of GDP indicated a significantly positive sign. The positive relationship between GDP and efficiency of the Islamic banks is expected as demand for financial services is inclined to rise as economies grow. This is consistent with earlier studies (see e.g. Sufian et al., 2012; Mohamad Noor & Ahmad, 2011; Gardener et al., 2011; Vu & Nahm, 2013; Abdul Rahman & Rosman, 2013; Hanif Akhtar, 2013; Kenjegalieva et al., 2009; Sufian, 2010). However, the coefficient result of GDP indicated a negative relationship when we control for during crisis dummy variables. Similar result can also be observed in few past literatures (see e.g. Sufian & Habibullah, 2009; Sufian, 2009; Anwar, 2014). If anything could be delved, the negative relationship is possible in the case where volatility of Malaysian GDP as can be observed during the crisis period. As a result of volatile economic growth, Islamic banks could have suffered a lower demand for their financial services, increased in loan defaults, and thus lower output. In addition, a negative result can be found in the coefficient of inflation, indicating a negative effect of inflation on efficiency of Islamic banks.

With regards to the sub-period, on one hand, the result suggests that the coefficient of pre-crisis dummy variable indicated positive sign and significance at 5 percent level, suggesting that the Islamic banks' efficiency is better compared to during crisis and post-crisis periods. On the other hand, the coefficients during crisis and post-crisis indicated negative sign. The findings coincide with the past literature of Mohamad Noor & Ahmad (2011), Sufian & Habibullah (2009) and Sufian (2010). However, only the coefficient for post-crisis was significant. Therefore, the result suggests that the impact of the recent global financial crisis on efficiency of Islamic banks has prolonged even after the crisis period.

Determinants of efficiency for conventional banks

Next, we report the regression results for conventional banks (Table 11). In contrast to Islamic banks, the coefficient of LN(TA) indicated a significantly negative sign. This suggests that the larger the size, the less efficient the conventional banks. This is possible as Berger & Mester (1997) has indicated that previous studies have evidenced no consistent result on the relationship between size and efficiency. Furthermore, this result coincides with Khan (2015); Rosman et al. (2014); Abdul Rahman &

Rosman (2013); Sufian (2010). If anything could be suggested, this might be possibly due to high costs incurred by large conventional banks in conducting their business.

Similar to Islamic banks, the coefficient of ETA for conventional banks also indicated negative sign across model 1-6. However, this result is insignificant. Furthermore, the coefficient of LLRGL indicated negative sign across all models. However, only result in model 6 is significant at level of 5 percent. This suggests a decrease in asset quality tends to reduce efficiency of conventional banks. On the other hand, the coefficient of NIETA indicates positive sign across all models. However, this result was also insignificant.

Furthermore, the coefficient of NIITA was positive and significant across all models estimated. This suggests that an increase in the non-interest income leads to an increase in the efficiency of the conventional banks. The result reveals that the non-interest income played significant role in ensuring the efficiency of conventional banks. Furthermore, this result suggests that bank which diversifies their source of income using fee based income, derivatives and stock market trading tend to be more efficient in their intermediation function. Our finding is consistent with Sufian (2009), Sufian (2010) and Sufian & Habibullah (2009).

In terms of the loan growth, the coefficient of NLTA indicated positive sign across all models. Thus, an increase in the loan growth tends to increase the efficiency of conventional bank. However, this result was insignificant. In addition, the market competition in the regression analysis was controlled as well. Similar to Islamic banks, the coefficient of HSTAT indicated positive sign in Model 3 to 5, but the result indicated negative sign for Model 6.

As expected, the regression result suggests that the coefficient of GDP is positively related to efficiency of the conventional banks. The coefficient of GDP was positive and highly significant at 1 percent level. This result is similar to the Islamic banks and coincides with earlier studies (see e.g. Sufian et al., 2012; Mohamad Noor & Ahmad, 2011; Gardener et al., 2011; Vu & Nahm, 2013; Abdul Rahman & Rosman, 2013; Hanif Akhtar, 2013; Kenjegalieva et al., 2009; Sufian, 2010).

In contrast, the coefficient of INF indicated negative sign and significant, suggesting the negative relationship of inflation on efficiency of the conventional banks. This result is in accordance with previous literature (see e.g. Mohamad Noor & Ahmad, 2011; Sufian et al., 2012; Vu & Nahm, 2013; Sufian & Habibullah, 2009). If anything could be suggested, this is possible as the inflation leads to substantial rise in the general price level of goods and services. Consequently, this results in the reduction of purchasing power. Hence, this might have an impact of loan growth and bank profitability.

Similar to Islamic banks, the coefficient result for pre-crisis dummy indicated positive and significant result for the conventional banks. This suggests that the efficiency of the conventional banks during the pre-crisis period was better compared to during crisis and post-crisis period. Similarly, the coefficient of during crisis dummy variable indicated positive sign but insignificant. In contrast, the coefficient of post-crisis dummy variable showed negative sign and highly significant, suggesting that the efficiency of the conventional banks during

the post-crisis period was lower compared to the pre-crisis and during crisis.

CONCLUSION

In this chapter, we used the DEA method to examine and compare the efficiency of Malaysian Islamic and conventional banks by analysing a sample of 38 banks in Malaysia over the period of 2004 to 2013. Our findings can be summarised as follows. First, based on the results of regression analysis, we find that large Islamic banks are more efficient than large conventional banks. In contrast, we find that small Islamic banks are less efficient than small conventional banks. If anything could be suggested, this result is possible as large Islamic banks conduct their business operations by leveraging on their parent company i.e. the conventional banks. Where else, the small Islamic banks conduct business operations by themselves.

Secondly, we examined the factors that determine the efficiency of the Malaysian Islamic and conventional banks. The regression result finds that the size of a bank significantly affects bank's efficiency. The effect of bank size on efficiency is positive for the Islamic banks but negative for the conventional banks. Besides bank size, financing exposure also indicates positive effect towards the efficiency of the Islamic banks, while asset quality has negative effect on the efficiency of Islamic banks. Specifically, for conventional banks, the non-interest income indicates positive relationship with its level of efficiency.

In addition to bank specific factors, the result indicates that the macroeconomic factors are also important in determining bank's efficiency. For instance, we find that GDP has positive effect on bank's efficiency for both the Islamic and conventional banks. Furthermore, we find that the inflation rate has negative effect on the efficiency of the Islamic and conventional banks. In addition, when we control different sub-periods, the post-crisis period dummy variable indicates negative sign for both the Islamic and conventional banks. This reveals that the effect of global financial crisis on bank's efficiency has prolonged during the post-crisis period.

Based on the above finds, several recommendations can be made for bank managers and regulators. Firstly, being large does not necessarily being efficient. The negative and significant coefficient result of total assets and efficiency of the Malaysian conventional banks supports this claim. Therefore, any effort to increase the bank size, such as through merger and acquisition activity should take into account the effect on efficiency of these institutions.

Secondly, macroeconomic condition positively affects bank efficiency. Nevertheless, during the crisis period, the relationship could be negative. In order to avoid the negative impact of the crisis, the Islamic and conventional banks are encouraged to increase the amount of the non-interest income. This is because the particular variable tends to have a positive effect on the efficiency of both Malaysian Islamic and conventional banks when control is applied during the crisis period. Therefore, the non-interest income can be a good source of income for banks during the turbulence period. Therefore, it is recommended that bank manager focuses on diversifying the source of income in the future.

Our findings are important for three main reasons. First, although numerous studies have compared the efficiency of Islamic and conventional banks, to the best of our knowledge, these studies have not given specific concern to the efficiency of the Malaysian banking sector. The existing studies of Mokhtar et al. (2006, 2007) that compared the efficiency of Islamic and conventional banks in Malaysia are lacking as they utilized an old data. Therefore, our study is important as we add to the literature in this area by focusing on the Malaysian case using the DEA method using newly available data. Besides adding to the literature, this study is also beneficial to bank managers and regulators in Malaysia as we provide an analysis of bank efficiency considering latest samples of Malaysian Islamic and conventional banks.

Second, Malaysia has pioneered the introduction of Islamic bank in a dual banking system. Many countries have tried to follow the model of Malaysian Islamic banking sector. In addition, the Malaysian Islamic banks are active in innovating the Islamic banking products and services. As Malaysian Islamic banking model is being referred to by many countries, understanding the current state of efficiency of the Malaysian Islamic banks in comparison to the efficiency of conventional banks is vital as it is essential to the policy maker in those countries.

Third, our study is important as we examined the factors that determine the efficiency of Malaysian Islamic and conventional banks surrounding the global financial crisis. In addition, we included the sub-period dummy variables in order to examine the impact of the global financial crisis on the efficiency of the Malaysian Islamic and conventional banks. Existing literature that examined the level of efficiency in the Islamic banking sector did not lay any emphasis on the impact of the recent 2007 to 2009 global financial crisis. Hence, our study is imperative as we also add to the literature by examining the impact of the recent 2007 to 2009 global financial crisis on the efficiency of the Malaysian Islamic and conventional banks.

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Received Date: 22th July 2015
Acceptance Date: 4th May 2016