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Did Global Financial Crisis Impact the Islamic Banking Efficiencies? Evidence from Malaysian Islamic Banks

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Abstract: First, this paper investigated the loan and deposit efficiencies of Malaysian Islamic banks during 2008-2013 applying the non-parametric technique, Data Envelopment Analysis (DEA), and found that the average technical efficiency (TE) of loan financing was 83%, 88%, 87%, 95%, 100%, and 94% and the average technical efficiency for deposit mobilizations was 87%, 94%, 94%, 96%, 92%, and 96%. Only four banks in 2008, two bank in 2009, three banks in 2010, two banks in 2011-2013 are both technically and scale efficient in loan production. On the other hand, only four banks in 2008 and 2009, five banks in 2010 and 2011, three banks in 2012, and five banks in 2013 are both technical and scale efficient in deposit mobilizations. Second, the paper compares the efficiencies of Islamic banks between the global financial crisis (GFC) and the post global financial crisis (PGFC) in determining whether the efficiencies of banks between the GFCP and PGFCP are stable. Both parametric and non-parametric tests found no significant difference in the efficiencies between the two periods suggesting that the efficiencies of the Malaysian Islamic banks were stable.

Keywords: Malaysia, Islamic Bank Efficiency, Comparison, DEA.
JEL Classification: G21; G22.

Introduction

The Global Financial Crisis had serious impact on the world economy, banking sector in particular. The U.S. housing market collapsed, unemployment exceeded over 10 percent, and the growth rate of the economy was negative. The most devastating effect was seen in the financial sector.

In the banking sector, one hundred forty banks went bust in 2009 and 157 banks were wiped out in 2010 (Time: January 2012). Such a large scale bank failure has never occurred in the financial history of the United States since the Great Depression (Samad, 2013).

During the same period (2009-2013), there is a phenomenon growth of Islamic Banking. The deposits and assets of Islamic banks grew globally. According to the Ernest & Young firm's estimates "Islamic banking asset grew at an annual rate of 17.6% between 2009 and 2013 and will grow by an average of 19.7% to 2018" (Economist: September 13th -19th, 2014). Paul Koster, Chief Executive of DFSA said the Islamic finance industry is set to grow from $700 billion to $4 trillion by 2013, and despite the global financial crisis (GFC), Islamic banking is still projected to grow by 15-20 percent annually (Koster, 2009).

Given Ernest & Young's claim that "Islamic banking asset grew at an annual rate of 17.6% between 2009 and 2913" when there were large bank failures in the U.S. and around the world, the study of the efficiencies of Malaysian Islamic banks during the global financial crisis period and the post global financial period is an important contribution in the banking literature.

The exploration of efficiency of banks is important from both microeconomic and Macroeconomic points of view (Berger and Mester, 1997). From a microeconomic perspective,

the study of bank efficiency is important due to the increase in competition in the banking sector. The competition in the Malaysian banking industry is enhanced not only due to the entering of foreign banks but also due the increase in the number domestic banks. The growing economy of Malaysia opens the door of more conventional and Islamic banks. As a result, competition among banks in Malaysia is enhanced.

From a macroeconomic point of view, the efficiency of banks affects the structure and stability of the whole financial system (Rossi et al. 2009). The inefficiency of banks increases the cost of intermediation and harms the allocation of funds and the profitability of bank leading bank failure (Samad, 2014). The increased efficiency in deposit mobilizations and loans advancing is the to successful entrepreneur for enhancing the economic growth of a country (Schumpeter, 1911).

The efficiency of the productivity of banks including Islamic banks is of great interest to public authorities supervising and regulating banks, bank managements and bank depositors and borrowers. Each of them is interested to know the productive efficiency of banks. In a competitive market environment, bank depositors and borrowers are certainly interested to know the efficiency status of individual bank before they deposit their hard earned savings. The borrowers of bank move to the banks which are more efficient in advancing loans.

The study of the efficiency of Malaysian Islamic banks is important for several reasons. First, there are not enough studies of the efficiency of Islamic banks in Malaysia. Sufian and Majid (2006) found: "empirical work on Islamic banks efficiency, particularly in Malaysia is still in its infancy" (p. 4).

Second, Islamic banking is a dominant feature in the Malaysian banking industry. The growth of Islamic banks in Malaysia is phenomenal. The number of Islamic banks is almost the same as the number of conventional banks. There are sixteen Islamic banks competing with twenty seven conventional banks. Competition is strong and growing. Third, Malaysia is financial hub of Islamic banking in the Southeast Asia. Islamic banks provide a variety of financial products, including Murabaha, Ijara, Mudaraba, Musharaka, Al Salam and Istitsna'a, restricted and unrestricted investment accounts which have been appropriately modified to comply with Shari'a principle.

A literature survey shows that there is no empirical study on the comparative efficiency of Malaysian Islamic banks between the Global Financial Crisis period (GFCP) and the post Global Financial Crisis (PGFC). The study, thus, provides an important contribution to the banking literature informing the status of efficiency of the Islamic banks of Malaysia.

This paper is organized as: Section 2 outlines the unique characteristics of Islamic bank. Section 3 outlines a short survey of literature. Section 4 describes data, methodology, and the variable of models. Empirical results and conclusions follow in Section 5.

Islamic Banking and its Product Features

Islamic bank is a different breed of financial institution. Islamic bank is an institution whose aims and business operations are guided by the Islamic religion rule called Shariah. The features of Islamic financial institutions/ banks (IFI) are derived from it. In Islam, there is no separation of religion and everyday business-economic or/and state-political activities. First, all activities including the banking business are guided by the Quran and the Shariah law. Islam prohibits firms including Islamic banks not to finance the activities that are harmful and repugnant to the shariah law.

Second, the most unique feature of Islamic banking is the avoidance of riba (usury) in all financial transactions. This is because, the Quran, the Divine book of Islam strongly prohibits riba in business transactions. The Quran says: …"whereas Allah permitted trading and forbidden riba" (Quran: 2: 275). However, neither the Quran nor the Prophet of Islamic did

define what riba is[1]. At present, riba is interpreted as interest. The present scholars of Shariah agreed that the predetermined fixed rate of return is not permitted in Islamic banking business transactions.

The prohibition of interest in business gives rise to the development of unique financial products by the Islamic banks. Such as (i) Musharakah (ii) Muderabah (iii) Murabahah (iv) Bai Baithaman Ajil' (v) bai al-salam (vi) Ijarah (vii) Istisna.

There are two types of the financing contracts of Islamic banks. They are equity type and debt type contracts. Musharakah' (partnership) and 'Mudarabah'(trust financing) are equity type contracts (Hamwi and Aylward (1999).

Musharakha is a partnership and joint venture contract between the Islamic bank and the investor where both parties provide capital and manage funds and projects. Profits or losses accruing from the venture are distributed based on the proportion of capital and pre-determined agreement. The key features of this contract are: (i) Profit and loss sharing (PLS). Both parties share profits or loss. Unlike conventional bank equity contracts where banks do not bear the risk of financing investments, Islamic banks share the risk of investment.

(ii) Unlike conventional banks' equity contracts where banks enjoy the fixed rate of return from investments, even when there are losses for the project, there is no predetermined rate of returns on investments for Islamic banks. Thus, PLS, avoiding of fixed interest, is a key feature of Islamic financing. Justice requires that both share the risk of business.

Mudarabah is a trust financing contract between Islamic banks and investors where Islamic banks provide all funds for a project and investors provide physical labor, intellectual, and management skills. Profits from the projects are distributed based on a pre-agreed (ratio) arrangement. However, in cases of losses, banks, the provider of fund (called rab al maal), will bear the losses of fund and investor will bear the loss of his labor. The key feature of this contract is that there is no predetermined fixed rate of returns for bank; and both parties share the risk of investment.

The key features of the *Musharakha* and *Muderaba* contract are: (i) Profit and loss sharing (PLS). Both parties share profits or losses. Unlike conventional bank equity contracts where banks do not bear the risk of financing investments, Islamic banks share the risk of investment. (ii) Unlike conventional banks' equity contracts where banks enjoy the fixed rate of return from investments, even when there are losses for the project, there is no predetermined rate of returns on investments for Islamic banks. Thus, PLS, avoiding of fixed interest, is a key feature of Islamic financing. Justice requires that both share the risk of business.

Murabaha financing is a debt type contract. Murabaha mode of financing is based on a 'mark-up' arrangement in which goods or assets are purchased by the bank on behalf of a client, and are sold to the client at a price equal to the cost of the item(s) plus a profit margin. Under the Murabaha financing contract, a client wishing to buy goods or assets approaches an Islamic bank to buy them on his behalf. The Islamic bank then buys the product at the current market price and adds a profit margin to it, and then re-sells the product to the client. The key feature is that there is no fixed interest involved, although the critiques of Islamic banks do not admit it. They call it a "back door for interest-based financing" (Chong and Liu, 2009).

Bai Baithaman Ajil' is a variant of the Murabah (cost plus) financing contract. The difference is that the delivery of goods is immediate but the payment of goods is deferred. The payment may be made at installment. However, the price of the product is agreed to both parties at the time of the sale but should not include charges for the deferred payment.

Bai al-salaam is a forward sale contract where an entrepreneur sells some specific goods to the Islamic bank at a price agreed upon and paid at the time of contract but the delivery of goods is deferred for the future.

[1] [Umar b. al-Khattab said, "There are three thing:. If God'sMessenger had explained them clearly, it would have been dearer to me than the world and what it contains: (These are) *kalalah*, *riba*, and *khilafah*." (*Sunan Ibn Majah*, Book of Inheritance, Vol. 4, #2727;

Al-Ijera is a lease financing contract and is similar to a conventional bank lease contract. Under this contract, the Islamic bank purchases an asset for a customer and then leases it out to him for a fixed period at a fixed rental charge agreed upon at the time of purchase. A key difference with conventional bank leases is that the lessor i.e. Islamic bank retains the risk of property ownership. Note that Shariah permits fixed rental charges for the use of asset/property services.

Istisna is a financing contract under which a manufacturer or a producer produces specific goods for future delivery at a predetermined price.

The key feature of *Bai Baithaman Ajil', bai al-salam, Ijarah, and Istisna*[2] is that financing is fully securitized and asset based. Unlike conventional banks, Islamic banks own the ownership of the goods until full payment is made.

On the liability side, deposit accounts of Islamic banks are classified into three major categories. They are: (i) Al wadiah demand deposits (ii) Mudarabah/Al Wadiah saving deposits (iii) Muderabah investment deposits.

Al Wadiah demand deposits are current deposits and are similar to conventional banks' current deposits that provide the guarantee of the safety of deposits and the payment of money on demand. However, the key difference with conventional banks' demand deposits is that the depositors of Al Wadiah deposit contract are not entitled to fixed rate of return for their deposits. That is, depositors are not eligible to any share of profits. However, banks, at their discretion, may give a part of their profits, called hibah, to depositors for attracting deposits.

Mudarabah saving deposits of the Islamic bank are similar to conventional banks' saving deposits. The key feature of this account is the guarantee of safety and *payment. Since this is a* fixed deposit, banks guarantee the payments of some profits, if they are, to depositors, but banks do promise any fixed rate or amount.

Unlike the Al Wadiah demand deposits and the Mudarabah/Al Wadiah saving deposits, Muderabah investment deposit is a profit and loss sharing deposit. Muderabah investment depositors share the risk of investing their funds with banks for investment. Depositors get profits or losses based on agreements.

Usually the rate of returns is higher than of Al Wadiah demand deposits and Mudarabah/Al Wadiah saving deposits. The key feature of this liability contract is that Islamic banks neither guarantee the safety of depositors' capital nor any return on deposits. In this sense, Islamic banks', Muderabah investment deposits are more risky than those of conventional banks' fixed deposits. Second, the profits and losses sharing under this contract (Muderabah investment deposit) are not symmetric. Under this contract, banks share profits but share no losses. Depositors bear all losses ((Chong and Liu, 2009).

To sum, whether the key features of Islamic banks such as the profit and loss (PLS) modes of business in financing and deposit mobilizations, fully securitized financing and the control of ownership of assets (when financed) which provide Islamic banks insulated from the global financial shock needs to be empirically explored.

Survey of Literature

The empirical research on bank efficiency in the banking sector of the U.S. Europe is wide and extensive. Some of the important studies included Berger and Humphry (1992), DeYoung and Whalen (1994), Barr and Siems (1994), and Wheelock and Wilson (1994). They found the banks that failed were below the efficient frontier.

Both DeYound (1977) and Peristiani (1996) found that the productive efficient banks had less nonperformance loans.

[2] see Samad,Gardner,and Cook (2005) and (Chong and Liu, 2009) for definition and features.

Andries and Cocris (2010) analyzed the efficiency of banks for Romania, Czech Republic and Hungry during 2000-2006 and found that banks in these countries were low level of efficiency. The main factors for the low level of efficiency were asset quality, bank size, inflation rate, and the form of ownership.

There has been an increased interest on the empirical studies of Islamic banks' efficiency and performance. One of the earliest studies of the efficiency of Islamic banking includes Samad (1999). He examined the comparative efficiency of Islamic bank vis-à-vis conventional banks of Malaysia. He found that the managerial efficiency of Bank Islam Malaysia was lower than that of the conventional banks.

El-gamal and Inanoglu (2004) estimated the comparative cost efficiency of the Turkish banks for the period 1990-2000 using DEA method. They found that the Islamic banks were more efficient and their efficiency was explained by Islamic banks' asset-based financing.

Samad (2004) compared the performance of Islamic bank and conventional commercial banks of Bahrain with respect to (a) profitability (b) liquidity (c) capital management. Eleven financial ratios were compared for the period 1991-2001 and found that there was no significant difference in profitability and liquidity performance between the Islamic banks and the conventional banks of Bahrain.

Sufian and Majid (2006) investigated the comparative efficiency of the foreign and domestic banks of Malaysia during 2001-2005. They found that banks' scale inefficiency dominated pure technical efficiency during the period. They also found that foreign banks had higher technical efficiency than the domestic banks. They did not examine the efficiency of the Islamic banks of Malaysia.

Sufian (2009) examined the determinants of the efficiency of the banks of Malaysia using DEA method. He found the technical efficiency declined abruptly during the East Asian crisis. However, his study did not incorporate the efficiency of the Islamic banks of Malaysia.

Chong and Liu (2009) examined Malaysian Islamic banks and found that the profit and loss sharing mode of finance was minimum. The growth of Islamic banking was largely driven by the Islamic resurgence rather than by advantage of the profit and loss sharing mode of production.

Onour and Abdullah (2011) examined the efficiency of the twelve Islamic banks of Sudan using DEA during the period 2007-2008. They found that only two banks obtained the technical and scale efficiency and while the smallest bank in group (private ownership) attained the pure technical efficiency but not the scale efficiency.

Samad (2013) investigated the efficiency of Islamic banks using the time varying Stochastic Frontier function on the Islamic banks of 16 countries. Mean efficiencies between the pre global financial crisis and the post global crisis were estimated 39 and 38 percent respectively and the difference was not statistically significant.

Fayed (2013) compared the profitability, liquidity, credit risk, and solvency performance of three Egyptian Islamic banks with six conventional banks during 2008-2010 and found superiority of the conventional banks' performance over Islamic banks.

The survey of literature shows that no studies investigated the comparative efficiencies of the Islamic banks of Malaysia during the global financial crisis and the post global crisis. This study is, thus, an important contribution to the banking literature.

Data and methodology

Data

Data for estimating loan and deposit efficiencies for the period 2008-2014 are obtained the Website if each bank's annual reports. These variables were (i) fixed capital (FK) (ii) labor cost (wage), (iii) interest expenses (INTEX), (iv) deposit (DEPOSIT), and (v) loans. The descriptive statistics for variables are provided in Table 1 in the Appendix.

Methodology

Data Envelope Analysis (DEA)

This study applied the DEA, non-parametric method, with the variable returns to scale assumption in measuring input-output technical efficiency of the Malaysian Islamic banks. DEA is widely used in the measure of industrial efficiency since the method was originally developed by Charness, Cooper, and Rhodes (1978). The original model assumed that the DMUs were operating at their optimum scale and under the constant returns to scale (CRS). Later the DEA model was modified by Banker, Charness, and Cooper (1984) and introduced the variable returns to scale (VRS) efficiency instead of CRS. The introduction of VRS implies that a firm may have increasing returns to scale (IRS) or decreasing returns to scale (DRS) or constant returns to scale (CRS) in efficiency. Thus, the introduction of VRS allows the breakdown of efficiency into (1) technical efficiencies (TE) and (2) scale efficiencies (SE).

Technical efficiency (TE) of a DMU is the maximum (optimum) amount of output produced by the use of minimum inputs. In other words, TE can be achieved when the DMU produces a given level of outputs with the least amount of inputs. TE efficiency relates to producing outputs without wasting inputs and that cannot be deviated from the optimum scale (scale efficiency).

On the other hand, a DMU is said to be scale efficient (SE) when its size of operation is optimal so that any modification of its size will make the DMU less efficient. Kirigia and Asbu (2013) classified TE into pure TE (PTE) and SE where the SE is defined as "a measure of the extent to which a health decision making unit deviates from the optimum scale (defined as the region in which there are constant returns to scale in the relationship between inputs and outputs).

Following Charness, Cooper, and Rhodes (1978), the technical efficiency (TE) of a DMU (a bank) can be expressed as a maximum ratio of total sum of weighted outputs to the total sum of weighted inputs. In other words,

$$\text{TE}= \frac{Weigthed\ sum\ of\ bank\ outputs}{Weighted\ sum\ of\ bank\ inputs}.$$

Assuming that there are N banks (j=1, 2, 3 …N), each bank with X inputs and producing Y output. Each bank's input and output can be represented by vectors (x_j) and (y_j), respectively. Let banks' XN input matric and the YN output of be denoted as – X and – Y. The efficiency is then

$$\min_{u,y} \left(\frac{\cup yi}{v\ xi}\right) \text{ subject to } \left(\frac{\cup yi}{v\ xi}\right) \leq 1 \qquad (1)$$

Where u is a (Y x 1) vector of output weight and v is a (X x 1) vector of input weights. In other words, u and v are output and input multiplier.
Using duality, in fact the most DEA programs use the dual form, the equation (1) and can be expressed as:

$$\min_{ø,\lambda} ø \qquad (2)$$

Subject to $øx_j - X\lambda \geq 0$, $Y\lambda \geq y_i$, $\lambda \geq 0$, where λ is a semi positive vectors and ø is a real variable, scalar, representing the value of efficiency score for each DMU. The range of ø lies between 0 and 1.

Input-Output Controversy and model selection

In a single production firm such as coal mine, inputs and outputs are easy to find. The output is the amount of coal and the inputs are labor and capital. However, in the multiproduct firms such as bank which produces series of services and uses vector of inputs, deciding inputs and outputs are controversial. Which are bank's inputs and which are bank's outputs are a debatable issue for a long time.

Based on production approach (Benston, 1965), a bank is a producer of services for the bank account holders and it produces deposit accounts and loan services with labor and capital. In this sense, the number of deposit account or deposits can be used as output. Depositors' income which is equivalent to interest paid to depositors is am import factor for mobilizing total deposits.

Under the intermediation approach, bank is a financial intermediary which collects deposits from the savers and channels funds to borrowers. In this sense, loans and advances are the outputs of a bank and inputs are labor, capital and deposits.

Based on the production and intermediary approach discussed above, this paper estimates the following two models using DEA method with variable returns to scale assumption for each bank during 2008-2013.

Model A: $Deposit_j = X1 + X2 + X3$
Where X1-= Capital costs, X2 = Interest expenses, X3 = Labor cost
Model B = $Loans_j = X1+ X2 + X3$
Where X1-= Fixed capital, X2 = Deposit, X3 = Labor cost

Parametric and Non-Parametric Tests

The efficiency of the entire period 2008-2013 is divided onto two samples. Sample 1 consists of the efficiency of banks during the global financial crisis period (GFC). 2008-2010 is considered as the global financial crisis (GFC) period. Sample 2 considers the efficiency of banks during 2011-2013 as the post GFC period.

Whether the efficiency level of the Islamic banks between the global financial crisis period and the post global financial crisis period remains stable is determined using parametric tests and non-parametric test. Parametric tests include t-test, ANOVA (Analysis of Variance) F-test, and Walch-F test. On the other hand non-parametric tests include Wilcoxon/Mann-Whitney test, Kruskal-Wallis test.

Whether to apply the parametric test or the non-parametric or the both test is determined by whether the variables, efficiency level, in the sample set of GFC period and PGFC period is normally distributed. Parametric test is appropriate if the variables (efficiency) of both sample periods are normally distributed. On the other hand, both parametric and non-parametric tests are applied if the variable of one sample is normally distributed and the other is not.

Jarque Bera test is applied to determine whether the efficiency score of the DMU in the two samples (GFCP and PGFCP) is normally distributed. The failure to reject the null hypothesis of normal distribution at a probability less than 0.10 confirms that the variable is normally distributed. Otherwise, the variable is not normally distributed.

Once the variable (efficiency) is determined, whether normally distributed, two hypothesizes—null hypothesis and alternative hypothesis—will be tested in determining whether the efficiencies of the Islamic banks between the two periods, are stable. Null hypothesis, $H_{0:}\ \mu_{GFC} = \mu_{postGFC}$. Where μ_{GFC} = mean efficiency of the global crisis period and $\mu_{tpostGFC}$ =mean efficiency of the post global crisis period.

Alternative hypothesis, $H_a : \mu_{GFC} \neq \mu_{postGFC}$: There is a difference in the efficiency level between the global financial crisis and the post global financial crisis.

If the null hypothesis ($H_{0:}\ \mu_{eGFC} = \mu_{tpostGFC}$) that there no difference in the efficiencies of Islamic banks between the GFC and post GFC is rejected, it can be concluded that the efficiency level of the Islamic banks is not stable i.e. global financial crisis had has impacted on the efficiencies Malaysian Islamic banks. On the other hand, if the null hypothesis cannot be rejected, it can be concluded that the efficiencies of Islamic banks are the same between the two periods which suggest that the global financial shock has had no impact on the efficiencies of Islamic banks. The efficiencies of the Islamic banks are stable.

Empirical Results

The loans and deposits efficiency of each Islamic bank during 2008-2013 are presented in Table 1 and Table 2.

Table 1. Loan Efficiency of Islamic Banks of Malaysia during 2008-2013[3]

Banks	2008 (RTS)	2009 (RTS)	2010 (RTS)	2011 (RTS)	2012 (RTS)	2013 (RTS)	Count[4]
Affin Islamic Bank BHD	0.738 **(IRS)**	0.802 **(IRS)**	0.868 **(IRS)**	0.880 **(IRS)**	0.961 **(DRS)**	0.952 **(DRS)**	0
Alliance Islamic Bank BHD	1 **(CRS)**	1 **(IRS)**	1 **(CRS)**	1 **(IRS)**	0.996 **(IRS)**	1 **(CRS)**	3
AMIslamic Bank BHD	1 **(CRS)**	1 **(CRS)**	1 **(IRS)**	1 **(IRS)**	1 **(CRS)**	1 **(CRS)**	4
Asian Finance Bank (Isl) BHD	0.782 **(IRS)**	1.290 **(IRS)**	0.839 **(IRS)**	1.640 **(IRS)**	1 **(IRS)**	0.960 **(IRS)**	0
Public Islamic Bank Bhd	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**		1 **(IRS)**	4
CIMM Islamic Bank Bhd	0.711 **(IRS)**	0.803 **(IRS)**	1 **(DRS)**	1 **(DRS)**	1 **(DRS)**	1 **(DRS)**	0
RHB Islamic Bank Bhd	0.708 **(IRS)**	0.779 **(IRS)**	0.775 **(DRS)**	0.865 **(IRS)**	0.887 **(IRS)**	0.868 **(IRS)**	0
MayBank Islamic Bhd	0.929 **(IRS)**	0.894 **(IRS)**	1 **(DRS)**	1 **(DRS)**			0
Hong Leong Islamic Bank Bhd	0.795 **(IRS)**	0.855 **(IRS)**	0.879 **(IRS)**	0.978 **(IRS)**	0.888 **(IRS)**	0.930 **(IRS)**	0
Standard Chartered Saadiq	1 **(IRS)**	0.999 **(IRS)**	0.929 **(IRS)**	1 **(IRS)**	0.964 **(IRS)**	1 **(IRS)**	0
Al Raji (Islamic) Bank Bhd	0.709 **(IRS)**	0.788 **(IRS)**	0.765 **(IRS)**	0.817 **(IRS)**	0.955 **(IRS)**		0
Allianc Islamic Bank Bhd	1 **(IRS)**	0.942 **(IRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	0.996 **(IRS)**	3
Bank Islam Malaysia Bhd	0.632 **(CRS)**	0.713 **(IRS)**	0.712 **(DRS)**	0.754 **(IRS)**	0.856 **(IRS)**	0.871 **(DRS)**	1
Bank Muamalat Malaysia Bhd	0.667 **(IRS)**	0.744 **(IRS)**	0.703 **(IRS)**	0.779 **(IRS)**	0.888 **(IRS)**	0.856 **(IRS)**	0
Kuwait financing House Bhd	0.684 **(IRS)**	0.779 **(IRS)**	0.753 **(IRS)**	0.807 **(IRS)**	0.946 **(IRS)**	0.907 **(IRS)**	0
OCBC Al Amin Bank Berhad	1 **(IRS)**	0.855 **(IRS)**	0.808 **(IRS)**	0.862 **(IRS)**	9.956 **(IRS)**	0.909 **(IRS)**	0
HSBC Amanah Malaysia bank Bhd	0.857 **(IRS)**	0.860 **(IRS)**	0.811 **(IRS)**	0.916 **(IRS)**	0.921 **(IRS)**	0.893 **(IRS)**	0
Total	6 (4)	3 (2)	6 (3)	7 (2)	4 (2)	5 (2)	

[3]RTS in the parenthesis = returns to scale of the bank. CRS= Constant returns to scale, DRS = Decreasing returns to scale, IRS= Increasing returns to scale.

[4] Count represents the number of times a bank operated on the efficient frontier during 2008-2013

Results of loan technical efficiency, Table 1, show six banks in 2008, three banks in 2009, six banks in 2010, seven in banks 2011, four banks in 2012, and five banks in 2013 are technically efficient i.e. they do not waste resource. On the other hand, results of scale efficiency show only four banks in 2008, three banks in 2010, and two banks in 2009 and 2011-2013 were scale efficient. They operate on the CRS.

The banks that are both technical and scale efficient are Alliance Islamic Banks, AMIslamic banks berhad, Public Islamic Bank, and Bank Islam Malaysia. Alliance Islamic banks and AMIslamic banks were in the efficient frontier four times in six years. Public Islamic banks and Bank Islam Malaysia were in the efficient frontier three times and one time respectively. The rest of banks were not operating in the efficient frontier.

Table 2. Deposit Efficiency of Islamic Banks of Malaysia during 2008-2013[5]

Banks	2008 (RTS)	2009 (RTS)	2010 (RTS)	2011 (RTS)	2012 (RTS)	2013 (RTS)	Count[6]
Affin Islamic Bank BHD	0.90 **(IRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	0.895 **(DRS)**	0.901 **(DRS)**	3
Alliance Islamic Bank BHD	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	1 **(IRS)**	1 **(CRS)**	5
AMIslamic Bank BHD	1 **(CRS)**	1 **(CRS)**	1 **(IRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	5
Asian Finance Bank (Isl) BHD	0.851 **(IRS)**	0.737 **(IRS)**	1 **(IRS)**	1 **(IRS)**	1 **(IRS)**	1 **(IRS)**	0
Public Islamic Bank Bhd	0.939 **(IRS)**	1 **(IRS)**	0.877 **(IRS)**	0.898 **(IRS)**		0.967 **(IRS)**	0
CIMM Islamic Bank Bhd	0.753 **(IRS)**	0.981 **(DRS)**	1 **(DRS)**	1 **(DRS)**	1 **(CRS)**	1 (DRS)	1
RHB Islamic Bank Bhd	0.778 **(IRS)**	0.933 **(DRS)**	0.902 **(DRS)**	0.973 **(DRS)**	0.914 **(DRS)**	1 **(CRS)**	1
MayBank Islamic Bhd	0.880 **(IRS)**	0.860 **(DRS)**	1 **(DRS)**	1 **(DRS)**			0
Hong Leong Islamic Bank Bhd	0.787 **(IRS)**	0.947 **(DRS)**	0.950 **(DRS)**	**1** **(CRS)**	0.993 **(DRS)**	1 **(CRS)**	2
Standard Chartered Saadiq	1 **(CRS)**	0.988 **(IRS)**	0.892 **(CRS)**	1 **(DRS)**	0.884 **(IRS)**	1 **(IRS)**	2
Al Raji (Islamic) Bank Bhd	0.795 **(IRS)**	0.898 **(DRS)**	0.842 **(DRS)**	0.860 **(DRS)**	0.865 **(IRS)**		0
Allianc Islamic Bank Bhd	1 **(CRS)**	0.976 **(IRS)**	1 **(CRS)**	1 **(CRS)**	1 **(CRS)**	0.999 **(IRS)**	3
Bank Islam Malaysia Bhd	0.764 **(IRS)**	1 **(DRS)**	0.937 **(DRS)**	0.944 **(DRS)**	0.930 **(IRS)**	1 **(CRS)**	1
Bank Muamalat Malaysia Bhd	0.762 **(IRS)**	0.981 **(DRS)**	0.921 **(DRS)**	0.942 **(DRS)**	0.852 **(DRS)**	0.867 **(DRS)**	0
Kuwait financing House Bhd	0.749 **(IRS)**	0.863 **(DRS)**	0.821 **(DRS)**	0.855 **(DRS)**	0.799 **(IRS)**	0.869 **(IRS)**	0
OCBC Al Amin Bank Berhad	1 **(IRS)**	1 **(CRS)**	1 **(CRS)**	0.963 **(DRS)**	0.814 **(DRS)**	0.921 **(IRS)**	2
HSBC Amanah Malaysia bank Bhd	0.940 **(IRS)**	0.952 **(IRS)**	0.881 **(DRS)**	0.939 **(DRS)**	0.874 **(DRS)**	0.931 **(IRS)**	0
	5 (4)	6 (4)	8 (5)	9 (5)	5 (3)	8 (5)	

[5] RTS in the parenthesis = returns to scale of the bank. CRS= Constant returns to scale, DRS = Decreasing returns to scale, IRS= Increasing returns to scale.

[6] Count represents the number of times a bank operated on the efficient frontier during 2008-2013

Results of deposit technical efficiency, Table 2, show five banks in 2008, six banks in 2009, eight banks in 2010, eleven in banks 2011, five banks in 2012, and eight banks in 2013 are technically efficient i.e. they did not waste resources. On the other hand, results of scale efficiency show only four banks in 2008 and 2009, five banks in 2010 and 2011, and three banks in 2012 and five banks in 2013 were scale efficient. They operate on the CRS.

The banks that are both technical and scale efficient are Affin Islamic Bank, Alliance Islamic Banks, AMIslamic banks berhad, Hong Leon Islamic bank and Standard Chartered Saadiq Bank, Bank Islam Malaysia, and OCBC Al Amin Bank. Alliance Islamic banks and AMIslamic banks were on the efficient frontier five times in six years. Affin Islamic Bank was on the efficiency frontier three times during the study period. Hong Leon bank and OCBC Al Amin Bank were on the efficient frontier two times in six years. Other banks were not operating in the efficient frontier.

Descriptive statistics of loans and deposit efficiencies of the Islamic banks of Malaysia are provided in Table 3 and Table 4.

Table 3. Descriptive Statistics of the Loan Efficiency of Islamic banks

	2008	2009	2010	201111	2012	2013
Mean	0.836000	0.888412	0.873059	0.958706	1.0047867	0.942800
Median	0.795000	0.855000	0.868000	0.978000	0.961000	0.952000
Maximum	1.000000	1.290000	1.000000	1.640000	9.956000	1.000000
Minimum	0.632000	0.713000	0.703000	0.754000	0.856000	0.856000
Std. Dev.	0.142760	0.140804	0.111715	0.196837	2.326557	0.055370
Skewness	0.070519	1.316227	-0.052522	2.481181	3.471718	-0.244135
Kurtosis	1.338657	4.817349	1.512528	9.705763	13.06000	1.509504
Jarque-Bera	1.969132	7.248071	1.575056	49.29454	93.38430	1.537491
Probability	0.373601	0.026675	0.454968	0.000000	0.000000	0.463594
Sum	14.21200	15.10300	14.84200	16.29800	23.21800	14.14200
Sum Sq. Dev.	0.326086	0.317212	0.199685	0.619916	75.78018	0.042922
Observations	17	17	17	17	15	15

Table 4. Descriptive Statistics of the Deposit Efficiency of Islamic banks

	2008	2009	2010	2011	2012	2013
Mean	0.876353	0.948000	0.942529	0.963176	0.921333	0.963667
Median	0.880000	0.981000	0.950000	1.000000	0.914000	1.000000
Maximum	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Minimum	0.749000	0.737000	0.821000	0.855000	0.799000	0.867000
Std. Dev.	0.102178	0.072032	0.063307	0.050185	0.073193	0.051368
Skewness	0.053953	-1.692064	-0.510878	-1.132305	-0.179740	-0.917737
Kurtosis	1.356945	5.303276	1.859410	2.989437	1.640421	2.231402
Jarque-Bera	1.920485	11.86983	1.660994	3.632735	1.236051	2.474817
Probability	0.382800	0.002645	0.435833	0.162615	0.539008	0.290135
Sum	14.89800	16.11600	16.02300	16.37400	13.82000	14.45500
Sum Sq. Dev.	0.167044	0.083018	0.064124	0.040296	0.075001	0.036941
Observations	17	17	17	17	15	15

The examination of Table 3 shows that the mean loan efficiency increases over the years 2008-20013 except in 2013. The average loan efficiency during 2008-2013 was 0.83., 0.88, 0.87, 0.95, 1.0, and 0.94 respectively. This indicates that the average wastage of input resources for banks was 17 percent, 12 percent, 13 percent, 5 percent, 0 percent, 4 percent respectively. Banks could easily maximize loan financing without using these resources.

Similarly, the mean deposit efficiency, Table 4, shows that it increases during 2008-2013 except in 2012. The average deposit efficiency during 2008-2013 was 0.87, 0.94, 0.94, 0.96, 0.92, and 0.96 respectively. This indicates that the average wastage of input resources of Islamic banks was 13 percent, 6 percent, 6 percent, 4 percent, 8 percent, 4 percent respectively. Banks could easily maximize loan financing without using these resources.

Efficiencies of Islamic banks are divided between the global financial crisis period 2008-2010(GFC) and the post global financial crisis period 2011-2013 (PGFC) for determining whether efficiencies are stable. Descriptive statistics of the efficiencies between the GFC and the PGFC are presented in Table 5 and Table 6

Table 5. Descriptive Statistics of Loan Efficiency during the Global Financial Crisis and the Post Global Crisis

Variables	During GFC Efficiency	Post GFC Efficiency
Mean	2.597471	3.156353
Median	2.529000	2.793000
Maximum	3.000000	11.72700
Minimum	2.057000	1.000000
Std. Dev.	0.336928	2.284848
Skewness	-0.159506	3.318321
Kurtosis	1.571183	13.21472
Jarque-Bera	1.518161	105.1065
Probability	0.468097	0.000000
Sum	44.15700	53.65800
Sum Sq. Dev.	1.816332	83.52851
Observations	17	17

Table 6. Descriptive Statistics of Deposits Efficiency during the Global Financial Crisis and the Post Global Crisis

Variables	During GFC Efficiency	Post GFC Efficiency
Mean	2.766882	2.626412
Median	2.740000	2.874000
Maximum	3.000000	3.000000
Minimum	2.433000	1.000000
Std. Dev.	0.173971	0.565915
Skewness	-0.122115	-1.816672
Kurtosis	2.054387	5.259020
Jarque-Bera	0.675630	12.96559
Probability	0.713327	0.001530
Sum	47.03700	44.64900
Sum Sq. Dev.	0.484252	5.124148
Observations	17	17

The important point to notice in Table 5 is that the data of loan efficiency variable of banks during the global financial crisis is normally distributed. This is evidenced from the probability 0.468 associated with the Jarque Bera statistics 1.518. On the other hand, the efficiency of the post global financial crisis is not normally distributed. The null hypothesis of normal distribution is rejected and is evidenced by the probability 0.000 associated with the Jarque Bera statistics 105.105.

The normal distribution of efficiency variable during the GFC period and its non-normal distribution during the post GFC period suggests the application of parametric tests and non-parametric tests for determining the equality of efficiency between the two periods.

Similarly, the important point to notice in Table 6 is that the data of deposit efficiency of the Islamic banks during the global financial crisis is normally distributed. This is evidenced from the probability 0.7133 associated with the Jarque Bera statistics 0.6756. On the other hand, the efficiency variable of banks during the post global financial crisis is not normally distributed. The null hypothesis of normal distribution is rejected and is evidenced by the probability 0.0015 associated with the Jarque Bera statistics 12.965.

The normal distribution of deposit efficiency during the GFC period and the non-normal distribution during the post GFC period suggests the application of parametric tests and non-parametric tests for determining the equality of efficiency between the two periods.

Results of the parametric tests and non-parametric tests are provided in Table 7 and Table 8.

Table 7. Parametric Test Results of the Null Hypothesis

	Parametric Tests: H_0: $\mu_{GFC} = \mu_{pGFC}$								
	ANOVA F-test			**t-test**			**Welch F-test***		
Variable	df	Values	Probability	df	Values	Probability	df	Values	Probability
Loan eff	(1, 32)	0.99	0.32	32	-0.99	0.32	(1,16.69)	0.99	0.32
Deposit eff	(1,32)	0.95	0.33	32	0.97	0.33	(1,18.99)	0.95	0.34

*Test allows for unequal cell variances

The results of all parametric tests for loan and deposit efficiency fail to reject the null hypothesis of the equality mean efficiency between the global financial crisis and the post global financial crisis period. The failure to reject the null hypothesis suggests that the efficiencies of Islamic banks are the same between the global financial crisis and the post global financial crisis. It also suggests that the global financial shock has had no impact on the efficiencies of Islamic banks. The efficiencies of the Islamic banks are stable.

Table 8. Non-Parametric Test Results of the Null Hypothesis

	Non Parametric Tests: H_0: $Median_{GFC} = Median_{pGFC}$								
	Wilcoxon/Mann-Whitney			**Median Chi-square**			**Kruskal-Wallis**		
Variable	df	Values	Probability	df	Values	Probability	df	Values	Probability
Loan eff		0.79	0.42	1	1.05	0.30	1	0.65	0.41
Deposit eff		0.34	0.73	1	1.05	0.30	1	0.13	0.71

The results of all non-parametric tests for loan and deposit efficiency fail to reject the null hypothesis of the equality mean efficiency between the global financial crisis and the post global financial crisis period. The failure to reject the null hypothesis suggests that the efficiencies of Islamic banks are the same between the global financial crisis and the post global financial crisis. It also suggests that the global financial shock has had no impact on the

efficiencies of Islamic banks. The efficiencies of the Islamic banks are stable. Global financial crisis did have impacted the efficiencies of the Islamic banks of Malaysia.

Conclusions

DEA is applied in estimating the technical and scale efficiencies for the Islamic of Malaysia during 2008-2013. The results of the DEA estimate showed that the average technical efficiency of loan financing was 83 percent , 88 percent , 87 percent, 95 percent, 100 percent and 94 percent in 2008, 2009, 2010, 2011, 2012 and 2013 respectively (Table 3).

The average technical efficiency for deposit mobilizations was 87 percent, 94 percent, 94 percent , 96 percent, 92 percent, and 96 percent in 2008, 2009, 2010, 2011, and 2013 respectively (Table 4).

Results of loan technical efficiency, Table 1, show that six banks in 2008, three banks in 2009, six banks in 2010, seven in banks 2011, four banks in 2012, and five banks in 2013 are technically efficient i.e. they do not waste resource. On the other hand, results of scale efficiency show that only four banks in 2008, three banks in 2010, and two banks in 2009 and 2011-2013 were scale efficient. They operate on the CRS.

Results of deposit technical efficiency, Table 2, show that five banks in 2008, six banks in 2009, eight banks in 2010, eleven in banks 2011, five banks in 2012, and eight banks in 2013 are technically efficient i.e. they did not waste resources. On the other hand, results of scale efficiency show only four banks in 2008 and 2009, five banks in 2010 and 2011, and three banks in 2012 and five banks in 2013 were scale efficient. They operate on the CRS.

Parametric and non-parametric tests were applied in determining whether the efficiencies of the Islamic banks of Malaysia were significantly different during the global financial crisis period and the post global financial crisis period. The results of parametric and nonparametric tests for both loan and deposit efficiency showed no significant differences. There were no differences in the efficiencies of the Islamic banks of Malaysia between the global financial crisis (2008-2010) and the post global financial crisis (2011-2013). The failure to reject the null hypothesis confirmed this result. The failure to reject the null hypothesis of the equality of the mean and median of efficiencies between the global financial crisis and the post global financial crisis period suggests that the efficiencies of the Islamic banks of Malaysia are stable. The global financial crisis had no impact on the technical efficiencies of the Islamic banks of Malaysia.

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Appendix

Table 1. Descriptive Statistics of Inputs and outputs[7]

Fixed Capital (FX)

	FK2008	FK2009	FK2010	FK2011	FK2012	FK2013
Mean	90647.72	136516.0	94464.90	93817.96	39334.58	33820.62
Median	5349.243	7500.000	7822.000	5662.000	11734.00	6642.500
Maximum	1156318.	1907143.	1160265.	1170183.	222240.0	209278.0
Minimum	176.0000	464.0000	578.0000	417.0000	235.0000	146.0000
Std. Dev.	276669.4	457554.2	278412.1	281957.1	65625.29	60474.40

Interest Expenses (INTEX)

	INTEX2008	INTEX2009	INTEX2010	INTEX2011	INTEX2012	INTEX2013
Mean	413836.5	649960.4	355639.2	439183.3	176264.1	195421.6
Median	43054.00	165113.0	111139.0	152363.0	58430.00	57076.00
Maximum	5012989.	4528635.	3160604.	3654518.	1196288.	1308113.
Minimum	6604.000	27288.00	8358.000	9594.000	9957.000	1016.000
Std. Dev.	1193114.	1203876.	750951.3	869315.9	298116.5	337067.8

Wages (WAG)

	WAG2008	WAG2009	WAG2010	WAG2011	WAG2012	WAG2013
Mean	37820.58	46431.19	193529.7	220731.7	83127.44	88120.35
Median	9281.000	19123.25	43249.00	59852.00	65148.00	69048.00
Maximum	212863.0	224561.0	2184302.	2546570.	386129.0	438850.0
Minimum	614.0000	1010.000	677.0000	799.0000	1608.000	10297.00
Std. Dev.	56247.94	57393.81	522802.4	605292.1	100234.1	110872.3

Deposits

	DEP2008	DEP2009	DEP2010	DEP2011	DEP2012	DEP2013
Mean	9551287.	11077900	17113306	20100695	15453935	18471228
Median	4306094.	4431772.	4027754.	5496732.	5377039.	8853076.
Maximum	55768861	64131506	1.75E+08	2.01E+08	70984469	83017613
Minimum	34498.65	48334.11	15306.73	20029.94	181688.0	201872.0
Std. Dev.	13398271	15758539	41494349	47568326	18329346	21655959

[7] Values are =,000 Ringit

Loans and Advances

	LOAN2008	LOAN2009	LOAN2010	LOAN2011	LOAN2012	LOAN2013
Mean	8128836.	10260044	14835495	18936355	13915779	16564054
Median	4242329.	4833591.	4138867.	5298429.	8483879.	9175173.
Maximum	52574320	56947831	1.51E+08	1.82E+08	61308071	86135734
Minimum	249827.7	1911270.	2331.000	4561.000	148059.0	182405.0
Std. Dev.	12486782	14025794	35682146	43966797	15508633	20649469
Observations	17	16	17	16	17	17