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# Which Efficiencies Dominates Production: Deposit VS Loan: Evidence from the Islamic Banks Malaysia during 2008-2012

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**Abstract**
*This paper estimated the loan and the deposit efficiencies of the Islamic banks of Malaysia during 2008-2012 applying the Data Envelopment Analysis (DEA) technique. Between the two production efficiencies, the study found that the Islamic banks of Malaysia enjoyed the higher TE in deposit mobilizations than in the loan financings. The average technical efficiency of loan was 83 percent, 88 percent, 87 percent, 97 percent, and 94 percent in 2008, 2009, 2010, 2011, and 2013 respectively whereas the average technical efficiency in deposit mobilizations was 87 percent, 94 percent, 94 percent, 96 percent, 92percent, and 96 percent in 2008, 2009, 2010, 2011, and 2012 respectively. Whereas in loan financing, only four banks in 2008, two banks in 2009, three banks in 2010, two banks in 2011-2012 were efficient both technically and scale-wise. On the other hand, in deposit mobilization, four banks in 2008 and 2009, five banks in 2010 and 2011, three banks in 2012, and five banks in 2013 were efficient technically and scale-wise. Most of the Islamic banks operated below the optimum scale of production. The study is eye-opening for the banks that operated below the mean TE.*

**JEL Classification**: G21; G22
**Keywords:** Malaysia, Islamic Banks, Efficiency, loan, deposit, DEA

## 1. Introduction

A firm is technically efficient when it produces a given output with a minimum input or produces maximum outputs with a given input. In terms of isoquant, what is the highest isoquant a firm can reach with a given input or given an isoquant what is the least input that is needed to produce it.

Technical efficiency (TE), in plain language, measures only that part of the inefficiency that can be eliminated by reducing or withdrawing the factor inputs for producing a given output. The amount by which a firm lies below the efficient frontier is called the technically inefficiency. A firm is technically efficient when its efficiency score is 1 or 100 percent. If the firm's efficiency score is 95 percent, the firm is 5 percent inefficient and it is estimated as (1 -0.95= 0.05)

The difference between the TE and PTE depends on the assumption of the returns to scale. When the efficiency is measured under the constant returns to scale (CRS), the efficiency is known as TE. Firms do not always operate under the CRS i.e. outputs do not change in proportion to factor inputs. The efficiency obtained under the assumption of CRS is called TE or over all

technical efficiency (OTE) which measures inefficiencies due to the input/output configuration and as well as the size of operations (scale efficient). Under the variable returns to scale (VRS), firm/bank output may increase more than or less than the proportionate increase in factor inputs and is the normal for a business firm. The efficiency/inefficiency obtained under the assumption of VRS is called the pure technical efficiency (PTE) or managerial efficiency which measures inefficiencies due to only managerial underperformance

Scale efficiency refers to the size of the firm. When a firm size is not optimum, that is, the firm may operate above or below the optimum size. In such a case, the firm may incur either increasing or decreasing cost. The scale efficiency is obtained when the firm operates at the bottom horizontal part of the U-shaped cost curve or the top horizontal part of a long run inverted production curve. A firm is scale efficient when its size optimum i.e. when it operates under the constant return to scale i.e. operates at the bottom horizontal part of the U-shaped cost curve. So, scale inefficiency arises when it operates either under the IRS (too small size) or DRS (too big size).

Thus, the TE is decomposed into:

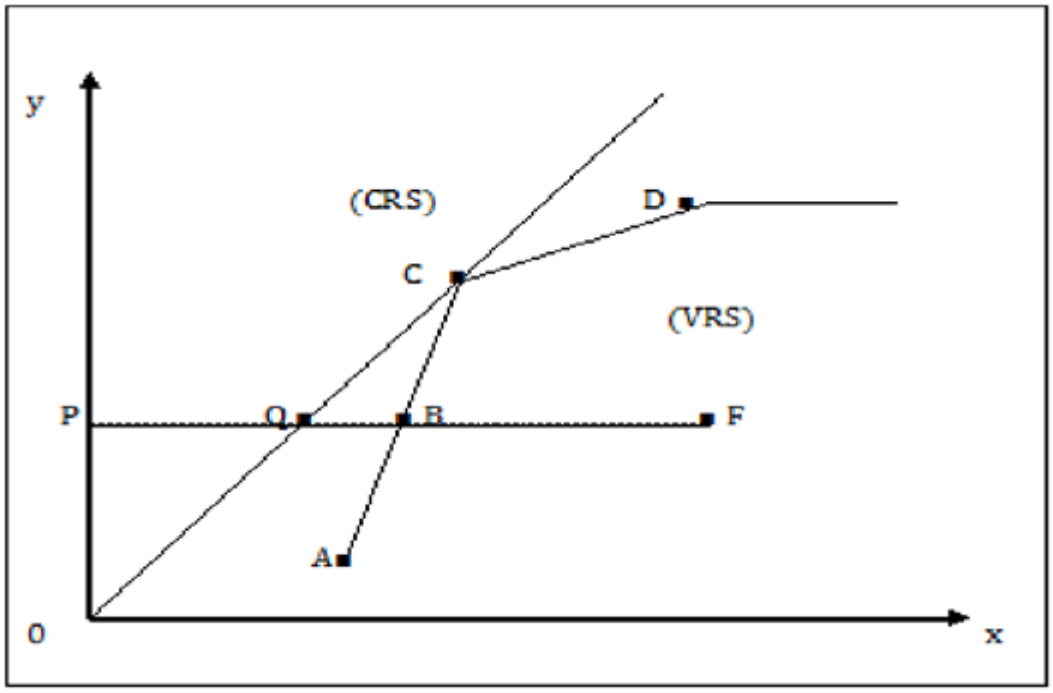
TE = PTE*SE. (1)

The two measures PTE and SE can be combined to provide a measure of TE (OTE. It is the product of the two efficiency measures.

SE = (TE/PTE) (2)

From (1) when the firm operates under the CRS, SE is 1 which implies TE=PTE. When the firm does not operate under the CRS, TE ≠ PTE. PTE is not the same as the TE.

Agraph clarifies the differences between various efficiencies.



The line through the points Q and C represents the CRS efficiency frontier and the curve (ABCD) represents the VRS efficiency frontier. Each DMU that is on the frontier is technically efficient. For this reason, the particular DMU "F" is technically inefficient. When we refer to the CRS frontier, the distance FQ measures the technical inefficiency of the DMU "F". However, when we consider the VRS frontier, the technical inefficiency of the DMU "F" is only the distance FB. The difference between the CRS and the VRS frontiers is the distance QB which is a measure of scale inefficiency.

The overall technical efficiency score (under the CRS frontier): $TE_{CRS} = PQ/PF$

The pure technical efficiency score (under VRS frontier): $TE_{VRS} = PB/PF$

The scale efficiency score: $SE = PQ/PB$

From this, we can deduce that $TE_{CRS} = TE_{VRS} \times SE$ which means that the overall technical efficiency (OTE) of a particular DMU is the product of two efficiencies: pure technical efficiency (PTE) and scale efficiency (SE).

The study of efficiency, comparative efficiency in particular, is important to bank management and bank regulators for many reasons. To bank management, the results of this study contribute to improvements of relative technical efficiency (TE) by increasing the understanding of efficiency through comparison between different banks. Monitoring efficiency might help prevent banks from failing.
Monitoring the deteriorating technical efficiency, bank regulators can issue an early alert to the management of the bank for the improvement of efficiency. Early warning prevents the bank from the failure. Bank failure has a huge economic cost. It costs billions of tax-payers money to bail out.

The cost efficiency and the waste minimization of a bank depends on the management quality. Inefficient bank management fails to generate adequate returns to bank depositors and the stockholders of the bank and the bank is, thus, likely to lose market share and eventually fail.

The efficiency in mobilizing deposits and financing loans is a key factor for bank survival. 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 of domestic banks. The growth of Malaysia's economy opened the door of more conventional and Islamic banks. As a result, not only the intra competition among the Islamic banks increased but also the extra bank completion competition between the conventional banks and the Islamic banks among the was enhanced in Malaysia. Bank resources are limited and have opportunity cost in production. In allocating bank resources in various production possibilities, the bank management must figure it out where lies their production efficiency. A bank must refrain from allocating its scarce resources if it has least production efficiency. The study of production efficiency is very important for all banks.

The efficiency of banks, from a macroeconomic point of view, 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 bank efficiency in deposits mobilization and loans advancing are sine qua non to successful entrepreneurs 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, bank depositors and borrowers are certainly interested to know the relative efficiency status of individual banks before they put their hard earned savings in deposits. The borrowers of banks are interested to know which banks are more efficient in loan financings.

The study of the efficiency of Malaysian Islamic banks is important for several reasons. First, there were not enough studies of the efficiency of Islamic banks in Malaysia. Sufian and Majid (2006) noted: "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 the financial hub of Islamic banking in 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 survey of literature shows that there was no empirical study of comparative efficiencies of Malaysian Islamic banks during 2008-2012. The study, thus, provides an important contribution to the banking literature by proving the estimates of comparative efficiencies on loan and deposit production of the Malaysian Islamic banks.

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

## 2. Islamic Banking and its Product Features

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

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 tractions gives rise to the development of unique financial products in the Islamic banking such as (i) Musharakah (ii) Muderabah (iii) Murabahah (iv) Bai Baithaman Ajil' (v) bai al-salam (vi) Ijarah (vii) Istisna. 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 investment 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 (interest), even when there are losses for the project, there is no predetermined rate of returns from the investments of Islamic banks. Thus, PLS, avoiding fixed return (interest), is a key feature of Islamic financing. Justice requires that both parties of the risky investment 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 funds (called rab al maal), will bear the losses of funds and investors will bear the loss of their labor. The key feature of this contract is that there is no predetermined fixed rate of returns for the 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 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

[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;

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.

*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 a fixed rate of return for their deposits. That is, depositors are not eligible for 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 of the Muderabah investment deposit 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 assurance of 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).

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

To sum, the key features of Islamic banks discussed above, profit and loss (PLS) mode of business, fully securitized financing and the control of ownership of assets until complete payment is made, may provide Islamic banks insulated from the global financial shock which needs to be empirically explored.

**3. Survey of Literature**

The extent of empirical research on bank efficiency in the U.S. and Europe is wide. Some of the important studies include Berger and Humphry (1992), DeYoung and Whalen (1994), Barr and Siems (1994), and Wheelock and Wilson (1994). They basically explored the bank efficiency frontier and found the bank that failed was below the efficient frontier. Both DeYoung (1977) and Peristiani (1996) found that the productive efficient banks had less nonperformance loans.

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 are low level of efficiency. The main factors for the low level of efficiency were asset quality, bank size, inflation rate, and form of ownership.

The interest in the empirical studies of Islamic banks' efficiency and performance is increasing. 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 the DEA method. They found that the Islamic banks were more efficient and their efficiency was explained by Islamic banks' asset-based financing.

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.

Sufian (2009) examined the determinants of the efficiency of the banks of Malaysia using the DEA method. He found the technical efficiency declined abruptly during the East Asian crisis. However, his study did not incorporate 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 spirit rather than by advantage of the profit and loss sharing 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.

Samad (1999), in the pioneering study of the performance of the Islamic banks of Malaysia, empirically explored the comparative efficiency of the Bank Islam Malaysia and the conventional banks. The study applied various final ratios in measuring bank performance and

found the performance of the Islamic bank of Malaysia excelled over the conventional banks in many areas of their performance.

Samad and Hassan (1999) measured the performance of the Islamic banks using profitability, liquidity, and solvency found that the Islamic banks' liquidity ratios would be higher in the early stages of their operations.

Samad (2004) compared the performance of the Islamic banking sector (with six Islamic banks with the conventional banks system (with 15 conventional banks) in Bahrain. Applying a set of measures of financial ratio representing profitability, liquidity, and credit-risk performance, the paper found no significant differences between the Islamic and the conventional banking systems in Bahrain with regard to profitability and deposit risk. The Islamic banks had higher equity and more liquidity ratio than the conventional banks. The finding suggested that the Islamic banks had lower capital and liquidity risk than those of the conventional banks.

Ariff et al. (2008), using the DEA, found that Islamic and conventional banks were equally efficient in using their resources for generating profit. The management of both groups had control over their resources while having less control over factors such as governmental rules and regulations, the GDP, and competition. They also found that the small Islamic banking system was more efficient in performance compared with the conventional banking system because of their respective capital structure.

Yang (2009), applying to the DEA, evaluated the efficiency and performance of the branches of larger banks in Canada. His study found that the large banks with more branches had more opportunities to improve their efficiency compared to banks with no branches.

Sturm and Williams (2004) examined the foreign banks and the local banks in Australia and found that foreign banks were more efficient than local banks. They also found that these banks used their financial asset (size) to prevent the potential competitors in the market. Diversity of bank types and kinds of operations increased the efficiency of the banks.

Tecles and Tabak (2010) evaluated the efficiency of 156 Brazilian banks during 2000 to 2007 using the stochastic frontier approach. Their results suggested that large banks were more cost and profit efficient than small banks. They also found that the foreign-owned banks had a higher performance through association with small local banks or by their acquisition.

Mehdian, Perry, and Rezvanian (2007) compared the efficiency of the U.S. small banks vs large and small banks with a nonparametric approach from 1990 to 2003. Their sample included 131 small banks and 131 large banks. Their study found that the large banks were more efficient than small 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 banking literature.

## 4. Data and methodology

### Data

This study covers the periods during 2008-2014. Data for estimating loan and deposit efficiencies are obtained from the Website of each bank's annual reports. The variables obtained from the balance sheet are (i) fixed capital (FK) (ii) labor cost (wage), (iii) interest expenses (INTEX), (iv) deposit (DEPOSIT), and (v) loans. The descriptive variables for the variables are provided in Table 1 in the Appendix.

### Methodology

This study uses the DEA non-parametric method with 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 Charnes, Cooper, and Rhodes, (1978). The original model assumed that the DMUs were operating at their optimum scale and under 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 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 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,

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

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 matrix and the YN output 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 $\lambda$ is a semi positive vector 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 banks which produce a series of services and use vectors 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 the 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 accounts or deposits can be used as output. Depositors' income which is equivalent to interest paid to depositors is an import factor for mobilizing total deposits.
Under the intermediation approach, first used by Sealey and Lindley (1977), the bank is a financial intermediary which collects deposits from the savers and channels funds to borrowers. It treats earning assets as outputs and deposits as inputs. In this sense, loans, investments in securities, and advances are the outputs of a bank and labor, capital, deposits, and expenses related to them are inputs of a bank

Based on Sealey and Lindley (1977), this paper estimates the following model using DEA based on the assumption of Banker, Charnes, and Cooper[3] (1984):

$$\log Dep_i = \beta_0 + \beta_1 logprem + \beta_2 logsalay + \beta_3 logintexp \quad (3)$$

$$\log loan_i = \beta_0 + \beta_1 logprem + \beta_2 logsalay + \beta_3 logDep \quad (4)$$

Where
In (3) $logDep_j$ = Log of total deposits is output and expressed in Ringgit
In (4) $logloan_i$ =log of total loans is output and expressed in Ringgit
Inputs are:
logprem= log of bank fixed capital; logsalary= log of salaries; logintexp= Log of interest expenses, log and expressed in Ringgit

The descriptive statistics of inputs and outputs is provided in Table 1 in the Appendix.

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.

## 5. Empirical results

The paper first presented the descriptive statistics of the technical efficiencies. The descriptive statistics of the technical efficiencies of loans production of all Islamic banks of Malaysia are provided in Table 1.

**Table 1**
**Descriptive Statistics of the Efficiency Loan production of Islamic banks**

| | 2008 | 2009 | 2010 | 201111 | 2012 | 2013 |
|---|---|---|---|---|---|---|
| Mean | 0.836000 | 0.888412 | 0.873059 | 0.958706 | 1.004786 7 | 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 |

[3] Banker, Charnes, and Cooper (1984) estimated the technical efficiency based on the assumption that firms normally operate under the variable returns to scale instead of the constant returns to scale assumed by Charnes, Cooper, and Rhodes (1978)

| | | | | | | |
|---|---|---|---|---|---|---|
| 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 |

The examination of Table 1 shows that the mean loan efficiency increased over the years 2008-20013 except in 2013. The mean technical efficiency in loan production was 0.83 in 2008, 0.88 in 2009, 0.87 in 2010, 0.95 in 2011, 1.00 in 2012, and 0.94 in 2013 respectively. This suggests that the average wastage of the Islamic banks' input resources was 0.17, 0.12, 0.13, 0.05, 0.00, and 0.06 during the year 2008-2013 respectively. Banks could avoid the wastage of resources and yet could produce the same amount of loan financing.

The descriptive statistics of the technical efficiencies of deposit production of all Islamic banks of Malaysia are provided in Table 2.

**Table 2**

**Descriptive Statistics of the Efficiency Deposit production 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 mean TE deposit mobilizations, Table 2, showed the average TE increased 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 the input resources of the Islamic banks was 13 percent, 6 percent, 6 percent, 4 percent, 8 percent, 4 percent respectively. Islamic banks could produce the same amount of deposit mobilizations without using these resources.

The paper, secondly, presented the estimated technical efficiency and the scale efficiency of the individual Islamic bank of Malaysia. Table 3 presented the TE and SE in the loan production of the Islamic banks of Malaysia

**Table 3**
**TE and Scale Efficiency (loan) of Islamic Banks of Malaysia during 2008-2013[4]**

| **Banks** | **2008 (RTS)** | **2009 (RTS)** | **2010 (RTS)** | **2011 (RTS)** | **2012 (RTS)** | **2013 (RTS)** | **NO[5]** |
|---|---|---|---|---|---|---|---|
| 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 |
| 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 | 0.779 | 0.753 | 0.807 | 0.946 | 0.907 | |

[4]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.

[5] NO= represents the number of times a bank operated on the efficient frontier during 2008-2013

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **(IRS)** | **(IRS)** | **(IRS)** | **(IRS)** | **(IRS)** | **(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) | |

Results of loan technical efficiency, Table 3, show six banks in 2008, three banks in 2009, six banks in 2010, seven in 2011, four banks in 2012, and five banks in 2013 are technically efficient i.e. they do not waste resources. They were operating at 100 percent TE. Other than those banks were operating below the efficient frontier. They could maximize loan financing by cutting down input resources.

The bank that operated at the lowest efficiency score, 0.63, 0.71, and 0.75 in 2008, 2009, and 2011 respectively was Bank Islam Malaysia Berhad and Bank Mumaalat Malaysia in 2010 and 2012. The efficiency score for the bank was 0.70 and 0.85 respectively.

This is an interesting findings that Bank Islam Malaysia, the first Islamic bank of Malaysia, had the lowest TE with so many years of experience. The study is an eye-opening for the management of Bank Islam Malaysis.

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 rest of the banks operate either below the optimum output capacity level (IRS) or above the optimum output capacity level (DRS).

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 4 presented the TE and SE in the deposit production of the Islamic banks of Malaysia

**Table 4**

**TE and Scale (Deposit) Efficiency of Islamic Banks of Malaysia during 2008-2013[6]**

| **Banks** | **2008 (RTS)** | **2009 (RTS)** | **2010 (RTS)** | **2011 (RTS)** | **2012 (RTS)** | **2013 (RTS)** | **Count[7]** |
|---|---|---|---|---|---|---|---|
| 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 |

[6] 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.

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

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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 |
| Total | 5 (4) | 6 (4) | 8 (5) | 9 (5) | 5 (3) | 8 (5) | |

Results of deposit efficiency, Table 4, 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 were 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 rest of the banks operate either below the optimum output capacity level (IRS) or above the optimum output capacity level (DRS).

The banks that are both technical and scale efficient are Affin Islamic Bank, Alliance Islamic Banks, AMIslamic banks berhad, Hong Leon Islamic bank, 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.

**Conclusions**

The paper, first, estimated the TE and the SE of all the Islamic banks of Malaysia during 2008-2013. DEA is applied to estimate the technical and scale efficiencies for both loan financing and deposit mobilizations of the Islamic of banks during 2008-2013. Table 1 shows that the average

technical efficiency of loans was 0.83, 0.88, 0.87, 0.97, 0.1, and 0.94 in 2008, 2009, 2010, 2011, and 2013 respectively (Table 1).
The average technical efficiency of deposit mobilization was 0.87, 0.94, 0.94, 0.96, 0.92, and 0.96 in 2008, 2009, 2010, 2011, and 2013 respectively (Table 2).
The paper then classified banks based on their efficiencies. Results of loan technical efficiency and scale efficiency, Table 3, show that six banks in 2008, three banks in 2009, six banks in 2010, seven in 2011, four banks in 2012, and five banks in 2013 are technically efficient i.e. they do not waste resources.
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. The rest of the banks operate either below the optimum output capacity level (IRS) or above the optimum output capacity level (DRS).
Results of the technical efficiency and scale efficiency for deposit mobilizations, Table 4, 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. The rest of the banks operate either below the optimum output capacity level (IRS) or above the optimum output capacity level (DRS).
The comparative analysis of the TE and SE in the production of deposit mobilizations and loan financing, revealed that the banks enjoyed the superiority efficiency in deposit mobilizations than in loan financing during the study period.
The banks with the lowest TE were Bank Islam Malaysia Berhad and Bank Mumaalat Malaysia Berhad during the study period of this paper. The study is eye-opening for the management of Banks that operated below the average TE in Malaysia.

For the robust conclusion, the paper suggests that the future study in exploring efficiency should include more input and output variables and the more extended period than the current paper used.

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# Appendix

**Table 1**
**Descriptive Statistics of Inputs and outputs[8]**
**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. | 1107790 | 1711330 | 2010069 | 1545393 | 1847122 |
| 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 |

**Loans and Advances**

| | LOAN2008 | LOAN2009 | LOAN2010 | LOAN2011 | LOAN2012 | LOAN2013 |
|---|---|---|---|---|---|---|

[8] Values are =,000 Ringit

| | | | | | | |
|---|---|---|---|---|---|---|
| Mean | 8128836. | 1026004.4 | 1483549.5 | 1893635.5 | 1391577.9 | 1656405.4 |
| Median | 4242329. | 4833591. | 4138867. | 5298429. | 8483879. | 9175173. |
| Maximum | 5257432.0 | 5694783.1 | 1.51E+08 | 1.82E+08 | 6130807.1 | 8613573.4 |
| Minimum | 249827.7 | 1911270. | 2331.000 | 4561.000 | 148059.0 | 182405.0 |
| Std. Dev. | 1248678.2 | 1402579.4 | 3568214.6 | 4396679.7 | 1550863.3 | 2064946.9 |
| Observations | 17 | 16 | 17 | 16 | 17 | 17 |