Efficiency of Islamic and Conventional Commercial Banks in Malaysia: A Data Envelopment Analysis (DEA) Study

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ABSTRACT

This paper examines the relative efficiency of Islamic Commercial Banks (ICBs) and Conventional Commercial Banks (CCBs) operating under the dual banking system in Malaysia. In addition, this also study examines the efficiency of ICBs as compared to CCBs in Malaysia and the influence of banks' specific characteristics on efficiency measures. This study seeks to examine the efficiency for the accounting year 2000 to 2004 using Data Envelopment Analysis (DEA). Eleven commercial banks in Malaysia, including 2 ICBs, were chosen as the sample of the study. In the first stage, this study applies DEA to measure the relative technical efficiency under the assumption of Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). DEA is used to examine the relative efficiency of the selected banks in intermediating inputs into outputs. The inputs chosen are operating expenses, capital, and total deposits and loanable funds, and the outputs chosen are loans and advances, and income. The second stage of the analysis of the study is to examine the influence of the banks' specific characteristics (i.e. bank size, profitability, market power, non-performing loans and bank capitalization) on the efficiency measures (i.e. technical efficiency, pure technical efficiency and scale efficiency) resulting from the DEA using linear regression tests.

The study indicates that more banks are fully efficient under the assumption of VRS. Furthermore, the main source of technical efficiency in Malaysia in 2001-2002 is scale efficiency (i.e. pure technical inefficiency) and in 2000, 2003, and 2004 it is pure technical efficiency (i.e. scale inefficiency). Overall, on average the main source of Technical Efficiency (TE) in Malaysia is pure technical efficiency (i.e. scale inefficiency). It was also found that the operational or managerial efficiency of CCBs is higher than that of ICBs. In addition, bank size is significantly positive associated to TE and Scale Efficiency (SE) and NPLs is significantly positive associated to SE. On the other hand, market power is negatively significant associated to TE and SE, and bank capitalization is negatively significant associated to PTE. Furthermore, it was also found that, there is no association between profitability and efficiency measures.

INTRODUCTION

The efficiency of financial institutions has been widely and extensively studied in the last few decades. For financial institutions, efficiency implies improved profitability, greater amount of funds channeled in, better prices and service quality for consumers and greater safety in terms of improved capital buffer in absorbing risk (Berger et al., 1993). The study on the efficiency of commercial banks is important for the Malaysian dual banking system where the Islamic banks are operating in parallel with the conventional banks. For Islamic banks, the study is important to evaluate the efficiency of their operations and in turn, may contribute towards achieving its competitive edge. This study attempts to measure the efficiency of Malaysian-owned commercial using the Data Envelopment Analysis (DEA). The study also examines the banks' characteristics that may influence the efficiency.

The study examines the efficiency for the accounting year 2000 to 2004 using the Data Envelopment Analysis (DEA). DEA is used to examine the relative efficiency of the selected banks in intermediating inputs into outputs. The inputs chosen are operating expenses, capital, and total deposits and loanable funds, and the outputs chosen are loans and advances, and income. Eleven commercial banks in Malaysia, including 2 Islamic Commercial Banks (ICBs), were chosen as the sample. In the first stage, this study applies DEA to measure the relative technical efficiency under the assumption of Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The second stage of the analysis examines the influence of the banks' specific characteristics (i.e. bank size, profitability, market power, non-performing loans and bank capitalization) on the efficiency measures (i.e. technical efficiency, pure technical efficiency and scale efficiency) resulting from the DEA by using linear regression tests.

EFFICIENCY OF MALAYSIAN COMMERCIAL BANKS: A REVIEW OF LITERATURE

Although there is a vast literature on measuring efficiency of banks internationally, there are only a few studies on efficiency of banking activities in Malaysia (e.g. Katib, 1999; Salleh et al., 2001; Guan et al., 2004; Amrizal and Wan Nursofiza; 2004; Norashfah, 2005). The efficiency of commercial banks in Malaysia for the year 1989-1995 was investigated by Katib (1999). It was found that banks in Malaysia were technically more efficient in 1989 as compared to 1994. Most of the banks are operated at VRS. Due to that, he found that scale inefficiency is relatively large for the Malaysian commercial banks. The association of size and SE exists in Malaysian commercial banks. Bank size is negatively related to TE. In addition, Katib (1999) found that market power is positively associated to efficiency, while lower cost of labour was indicated by the significant negative relationship.

A study by Okuda and Hashimoto (2004) on 19 domestic commercial banks aimed to clarify the production technology employed in Malaysian banks and indicate important policy implications for current bank consolidation policy by estimating their cost functions. It was found that there is a clear difference in production technology between large-sized banks and small or medium-sized banks. For large-sized banks, while fixed cost was higher than that for small or medium-sized banks, economies of

scale were observed. On the other hand, for small or medium-sized banks, while fixed cost was lower than those large-sized banks, economies of scale were not observed. Furthermore, for regional banks (i.e. subgroups of small or medium-sized banks), no clear differences in production technology were observed between regional banks and other small or medium-sized banks. In addition, production technology of Chinese banks was different from that of small or medium-sized banks. Furthermore, it likely that there are operational efficiencies in the domestic banks as technological progress did not bring about tangible reduction in costs over time.

Salleh et al. (2001) examined the relative efficiency rating of all domestic banks in Malaysia benchmarked against three selected foreign banks over 1997 – 1999 by using DEA. They found that there is a considerable difference in the efficiency of the local banks. Every year, almost half of the local commercial banks operate in an inefficient manner compared to local banks as well as three foreign banks. This could be due largely to the oversupply of ATM machines in most of the inefficient units. Salleh et al. (2001) suggested that the improvement of inputs factor would be easier to handle as compared to output since bank management can control its facilities, staff strength and the amount of the capital and assets acquired. The monetary inputs of capital and reserves and total assets are the core strength of almost all the efficient banks in the sample. On the other hand, it was also found that, in terms of output, the banks should improve the management of loans and advances and attracting deposits.

The study by Guan et al. (2004) seeks to assess the efficacy of strategy and, in particular, assess the strength of the anchor bank around which consolidation was to be executed. This study involves the banks in Malaysia where the data is grouped into pre-crisis (i.e. 1995-1996) and post-crisis (i.e. 2001-2002) periods. They found that PTE dominates SE across three frontiers (i.e. pre-crisis, post-crisis and pooled). This suggests that the major source of overall technical inefficiency for Malaysian banks is scale inefficiency (output related) and not pure technical inefficiency (input related). Thus, they inferred that the selection of anchor banks was governed by political influence rather than economy factors. It was found that 10 anchor banks are worse off in terms of efficiency after the mandatory consolidation programme where they conclude that more time is needed before we can draw any meaningful comparison. The main source of inefficiency was allocative in nature, rather than technical – relatively higher OTE could be due to better utilizing of resources after the financial crisis, where banks took additional measures to cut cost, streamline operations and minimize inefficiencies. In addition, RTS analysis reveals that a majority of Malaysian banks experience DRS across the three frontiers, this confirms the extra production cost faced by rapidly growing banks. A large part of the medium and large banks falls under DRS – evidence that established large banks in Malaysia might, perhaps ‘outgrow’ their optimal size, leading to excess production.

Naughton and Shanmugam (1990) examined the phenomenon of Islamic interest-free banking in the context of the non-Islamic financial system in Malaysia. By the end of 1988, it was found that BIMB’s share of total banking deposits had risen to 2.33%. Despite many of the registered commercial banks being relatively small and regional based, it was found that among the twenty-three local banks, BIMB ranked thirteenth, tenth and fifteenth in terms of assets and deposits, shareholders’ funds and profitability respectively. Furthermore, they found that the most remarkable feature of

the bank, during its six-year life, has been the spectacular growth record achieved in terms of assets and deposits. In terms of operations and facilities, BIMB is similar in many ways to a conventional bank. It is basically a fully-fledged commercial bank with financing arranged in accordance with the *Shar'iah* (i.e. Islamic Law) and a wide range of corporate and private customers.

Wilson (1995) and Wong (1995) studied the first 10 years of operations in Bank Islam Malaysia Berhad (BIMB). They found that BIMB has greater flexibility with respect to its liquid asset holdings than conventional banks. Although there is a close association between what was happening to the macro-economy and aggregate commercial bank deposits, Wilson (1995) and Wong (1995) found that there is no correlation between macro-economic performance and that of BIMB. Wong (1995) found that liberalization of the Base Lending Rate has partly contributed to the decrease in the growth of deposits. While the growth trend of the banking industry had moderated in the late 1980s, BIMB's trend is still showing a decline. In addition, BIMB had higher than average capital adequacy. Nevertheless, the achievement of BIMB is commendable.

Amrizal and Wan Nursofiza (2004) examined the x-efficiency of BIMB from 1984 to 1995 by using SFA. He found that BIMB performed below optimum level where the input element was not fully utilized as compared to deposits and capital. The operations of BIMB were highly influenced by internal and external factors, such as improper allocation of input, changes in the economy and changes in monetary policy.

Samad and Hassan (1999) assess the financial ratios of Bank Islam Malaysia Berhad (BIMB) and eight CCBs in Malaysia from 1984 until 1997. They evaluated the profitability, liquidity, risk and solvency of the institutions for the period. They found that BIMB progressed significantly on ROA and ROE. Although the liquidity performance is stagnant over the period, its risk increased from year to year. It was found that the economic participation does not show any statistical difference. When the ratios of BIMB are compared to the other conventional counterparts, it seems that there is no difference in performance in terms of ROA, ROE and economic participation. In addition, IBs are found to be statistically more liquid and less risky and solvent.

Shaari and Fadhilah (2001) conducted a study to compare the performance of Bank Islam Malaysia Berhad (BIMB) and IBS in Malaysia from 1996 to 1999. They did the study on 9 commercial banks including Bank Islam Malaysia Berhad by using cross-sectional regression analysis and ratio analysis. The cross-sectional regression analysis, where the dependent variables are Net Profit After Tax/Total Assets (ROA), Net Profit Before Tax/Equity (NPBEQ), Profit After Tax/Equity (NPAEQ) and the independent variables are loan to deposit ratio, overhead expenses as a percentage of total assets, equity to total assets, short-term assets to total assets, and total assets as a percentage of the population's total assets. It was found that BIMB is not utilizing the financing of its resources to generate more income towards strengthening shareholders' funds. BIMB was found to be giving out small amounts of financing and investment in proportion to the total Islamic banking funds, total assets and total deposits. Furthermore, BIMB showed a decline in profitability, as measured by ROA and ROE, while on average, the Islamic banking counters of other banks were

showing a rather remarkable growth. Overall, the majority of BIMB's financing was in the form of the long-term loans and it appears that the fully-fledged ICB is not as strong and profitable as the conventional IBS.

Saiful Azhar and Mohd Affandi (2003) measure the performance of Islamic banks in Malaysia as compared to the mainstream banks. They used ratio analysis to measure performance and found that the high ROA for IBS do not reflect the efficient use of resources. This finding is further supported by lower asset utilization and higher investment margin as compared to interest margin. Furthermore, they explained that higher profit margin ratio for IBS can be explained by overhead factors being funded by the mainstream banks.

The study by Samad (1999) seeks to determine the relative efficiency position, in terms of productivity and managerial efficiency of BIMB and 7 conventional banks in Malaysia from 1992 to 1996. The used the weighted ratio approach to measure efficiency and ANOVA. The profit maximization test, loan recovery test and investment utilization test are used to determine productive efficiency, while the managerial efficiency is determined by ROA and return on equity. From the study, he found that the managerial efficiency of the conventional banks is higher than that of the IBs. In terms of the productivity efficiency test, the study shows mixed results. The average fund utilization rate of Islamic bank is lower than the conventional banks. Furthermore, profit earned by the Islamic bank either through the use of deposit or loanable funds, or used funds are lower than the conventional banks. This reflects the weaker efficiency position of the Islamic bank compared to that of the conventional banks. The productivity test through loan recovery signifies that the efficiency position of the Islamic bank seems to be higher than that of the conventional banks.

Further research on the efficiency of banks that are listed on the Kuala Lumpur Stock Exchange (KLSE) 1st board from 1990-1997 was carried out by Norashfah (2005) who measured x-efficiency by examining the cost efficiency. The study used Stochastic Econometric Cost Frontier approach in measuring efficiecy. In association with the Malaysian banking environment, the x-efficiency tends to decline with total loans to assets, provision of loan loss to total loans and loans growth. The x-efficiency tends to increase with bank size and deposit to total assets. The study found that the trend of banking technology improvements in Malaysia is explained by falling x-efficiency closer to the cost frontier than before.

Mohd Zaini (2001) investigates whether there are significant differences in bank efficiency across selected countries in the ASEAN region. This study applied the SFA to measures the differences in 82, 31, 27, and 15 banks in Indonesia, Malaysia, the Philippines, and Thailand respectively from 1989 to 1996. There are significant differences in average bank efficiency across country in ASEAN. Countries with higher cost inefficient banks have more restrictive regulatory banking systems apart from having smaller bank size and higher involvement of government in the banking sector. It was also found that cost inefficiencies in the ASEAN market tend to increase over the years preceding the Asian banking crisis in 1997, suggesting that the problem of bank failures may have had something to do with inefficiency. Furthermore, although scale economies for the ASEAN banks decrease with asset size, the cost inefficiency – larger banks have lower cost inefficiency – cost inefficiency somewhat

offsets scale inefficiency for larger banks. The findings indicate that privately owned banks are more cost efficient than state-owned banks.

BACKGROUND OF THE STUDY

The objectives of this study are (1) to measure the efficiency of CCBs and ICBs in Malaysia for the year 2000-2004 by using DEA; (2) to compare the efficiency between CCBs and ICBs in Malaysia for the year 2000-2004 by using DEA; and (3) to analyze and examine factors that may influence the efficiency of CCB and ICB. The characteristics of the banks that will be tested to explore their influences on efficiency are bank size, profitability, market power, loan ratios and capitalization.

Three research questions are (1) What are the similarities and differences in terms of efficiency on efficiency levels of CCBs and ICBs in Malaysia?; (2) What is the performance of the CCB and ICB in Malaysia in terms of relative efficiency?; and (3) What are the relationships of bank size, profitability, market power, loan ratio, and capitalization with the efficiency measures of CCBs and ICBs in Malaysia?

Sample Selection

As at 2004, in Malaysia there were 41 licensed banking institutions established. The licensed banking institutions consist of 23 foreign and Malaysian-owned commercial banks, two ICBs, six finance companies and 10 merchant banks. In light of this study, the sample of 11 Malaysian owned commercial banks including two ICBs was chosen.

Table 1: List of the ICBs and CCBs in Malaysia Selected for this Study

NO.	BANK NAME	ICB/ CCB	FINANCIAL YEAR-END	ABBREVIATION USED
1	Affin Bank Berhad	CCB	31st December	AFBB
2	Ambank Berhad	CCB	31st March	AMBB
3	Bank Islam Malaysia Berhad	ICB	30th June	BIMB
4	Bank Muamalat Malaysia Berhad	ICB	31st December	BMMB
5	Bumiputra-Commerce Bank Berhad	CCB	31st December	BCBB
6	EON Bank Berhad	CCB	31st December	EON
7	Hong Leong Bank Berhad	CCB	30th June	HLBB
8	Malayan Banking Berhad	CCB	30th June	MBB
9	Public Bank Berhad	CCB	31st December	PBB
10	RHB Bank Berhad	CCB	30th June	RHB
11	Southern Bank Berhad	CCB	31st December	SBB

Research Methods

First Stage: DEA

The efficiency for this study will be measured using the DEA. Farrel (1957; as quoted by Banker et al., 1984) explained that the measures of efficiency can be classified into

two components, namely TE[1] with input[2] or output orientation[3] and AE[4]. The DEA model is an approach that was introduced by Charnes et al. (1978) and was drawn upon the efficiency concept discussed in Farrell (1957). Charnes et al. (1978) introduced the model by applying the input orientation and assuming the CRS to the model. The DEA model developed by Charnes et al. defined efficiency as the weighted sum of outputs divided by weighted sum of inputs. The weights structures are calculated by means of a mathematical program and CRS is assumed[5]. Furthermore, in considering the competitive environment where it is less likely that a firm is operating at optimum scale, Banker et al. (1984) proposed variable returns to scale (VRS) into the model.

With the added constraint in VRS, the reference set is changed from the cone in the case of the CRS model to the convex hull in the case of the VRS model. One result of this change is that the tested DMU is compared against a limited number of combinations. As such, the efficiency score in the VRS model is greater than that in the CRS (Luo, 2003). Charnes et al. (1978)'s efficiency measure can be regarded as the product of a TE measure, given by Banker et al. (1984)'s efficiency score, and an SE measure. In other words, TE is the product of PTE and SE (Schaffnit et al., 1997). Thus, under the VRS, the TE is further classified into PTE[6] and SE[7]. The estimates/measures of efficiency that can be measured by DEA are illustrated in Figure 3.1. To measure the TE and SE using DEA, it requires data on input and output quantities whereas measuring allocative and cost efficiency needs data on input and output quantities and also input price (Leong et al., 2003)

[1] The term technical efficiency is taken from the literature of economics where it is used to distinguish the technological aspects of production from other aspects (Cooper et al., 2000).
[2] Aims to minimize inputs while satisfying at least the given outputs levels (Cooper et al., 2000).
[3] Attempts to maximize outputs without requiring more of any of the observed input values (Cooper et al., 2000).
[4] Measures components of any cost inefficiency of DMU which is attributable to its use of an uneconomic mix of inputs (Thanassoulis, 2001).
[5] http://en.wikipedia.org/wiki/Data_Envelopment_Analysis
[6] Depicts the sources of inefficiency caused by the inefficient operation (Cooper et al., 2000).
[7] Depicts the sources of inefficiency caused by disadvantageous conditions displayed by the scale efficiency (Cooper et al., 2000).

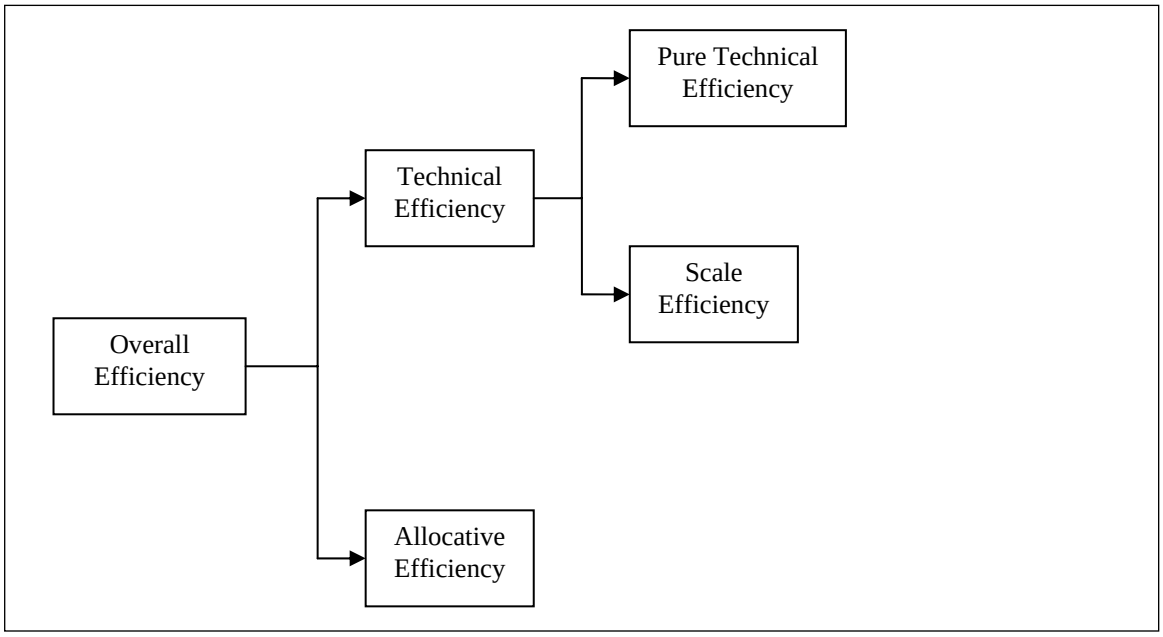

Figure 1: Dimensions of Efficiency measures/estimates of DEA

DMUs that are technically efficient under the assumption of CRS and VRS will be scale efficient whilst DMUs that are technically efficient under the VRS assumption but technically inefficient under the CRS assumption will be scale inefficient (Guan & Randhawa, 2005). The assumption of CRS allows for the comparison between small and large banks in a scenario where the frequency distribution is skewed due to the existence of small and large banks in the sample (Akhtar, 2002).

However, the CRS assumption being made is only suitable when all banks are operating at an optimal scale (Coelli, 1996). In reality, to operate at an optimal scale is not always the case. Several factors such as imperfect competition, leverage concerns, and certain prudential requirements are identified as factors that may cause banks not to operate at an optimal scale (Grigorian & Manole, 2002).

Due to the factors that will hinder the banks from operating at an optimal scale, the VRS assumption envelops the data more closely than the CRS assumption, since it tends to compare firms of similar size (Coelli, n.d.).As a result, VRS TE scores are greater than or equal to CRS TE scores (Grigorian & Manole, 2002). Thus, different DEA assumptions may generate different efficiency scores when applied to the same set of data (Guan & Randhawa, 2005; Schaffnit et al., 1997). In other words, under the VRS assumption more efficient DMUs would be identified as compared to efficient DMUs identified under the CRS assumption (Guan & Randhawa, 2005; Schaffnit et al., 1997). Furthermore, the VRS assumption raises the possibility that large banks would appear as efficient in the sample for the simple reason that there are no truly efficient banks (Berg et al., 1991; as quoted by Akhtar, 2002).

As the use of non-parametric test facilitates comparisons of efficiency scores generated from different DEA models (Brockett et al., 1999; as quoted from Guan & Randhawa, 2005), this study will run its data under the two assumptions (i.e. CRS and VRS) and will analyze the comparison of the efficiency scores generated from the different assumptions. Furthermore, examining the data using the models with VRS

assumption in this study will enable the researcher to examine the return to scale of the operation; that are DRS, IRS and CRS.

In addition to the CRS and VRS assumption, studies in this area would be based on two orientations, namely, input orientation or output orientation. The input oriented model aims to minimize inputs while satisfying at least the given output level and the output oriented model attempts to maximize outputs without requiring more of any of the observed input values (Cooper et al., 2000). This study will generate the efficiency measures by applying the input orientation in measuring the efficiency using DEA. The input orientation is a choice in most studies since the banks, in general, have no direct control over the amount of services their customer require (Schaffnit et al., 1997). Furthermore, input- and output-orientated measures will identify the same frontier and, therefore, the same set of banks will be identified as being the most efficient or best practice banks. However, if the analysis is based on the VRS assumption, the efficiency measures for the less efficient banks off the frontier may vary slightly between input and output orientated measures (Neal, 2004).

DEA is a non-parametric relationship between multiple outputs and multiple inputs (Charnes et al., 1978). Thus, this technique aims to evaluate the relative efficiency of a number of homogeneous units in transforming inputs into outputs. DEA will allow getting the target value based on the best practice DMUs for every inefficient unit. The best practice DMUs can be used as a guideline or benchmark for the inefficient DMUs to improve their performance. This study uses the software, DEAP version 2.1 that has been developed by Coelli (1996) to calculate TE, PTE and SE. Extensive discussion on the mathematical model and assumption can be found in Coelli (1996).

The TE score under the CRS assumption is called (global) TE, since it takes no account of scale effect (Cooper et al., 2000). On the other hand, the TE under the assumption of VRS expresses the (local) TE (i.e. PTE) (Cooper et al., 2000). Figure 2 demonstrates a decomposition of TE as follows;

Technical Efficiency (TE) = Pure Technical Efficiency (PTE) * Scale Efficiency (SE)

Figure 2: Decomposition of Technical Efficiency

The composition in Figure 1 depicts the source of efficiency, i.e. whether it is caused by inefficient operation (PTE) or by disadvantageous conditions displayed by the scale efficiency (SE) or by both (Cooper et al., 2000). If a DMU is fully efficient (100%) in both the CRS and VRS assumptions, it is operating in the most productive scale size (MPSS) (Cooper et al., 2000). Furthermore, if a DMU is efficient under the VRS assumption but inefficient under the CRS assumption, then it is locally efficient but not globally efficient due to the scale size of the DMU (Cooper et al., 2000).

For the purpose of this study, the intermediation approach was chosen because it is more suitable for use in evaluating the efficiency of all the financial institutions in a country (Berger & Humphrey, 1997; Molyneux & Iqbal, 2005). Furthermore, from the review of studies using DEA, most studies used the intermediation approach when measuring the efficiency of all the banking institutions in a country. Besides, it

emphasizes the functions of banks in intermediating funds and is suitable for both the conventional and Islamic aspects of banking activities. This is vital for this study because this study covers the ICB and CCB in Malaysia. The relationships of conventional intermediation and Islamic intermediation are portrayed in Figure 3. The differences are the existence of a relationship between the saver and borrower and the implicit profit and loss sharing contract (PLS) in the ICB (Elhiraika, 1999).

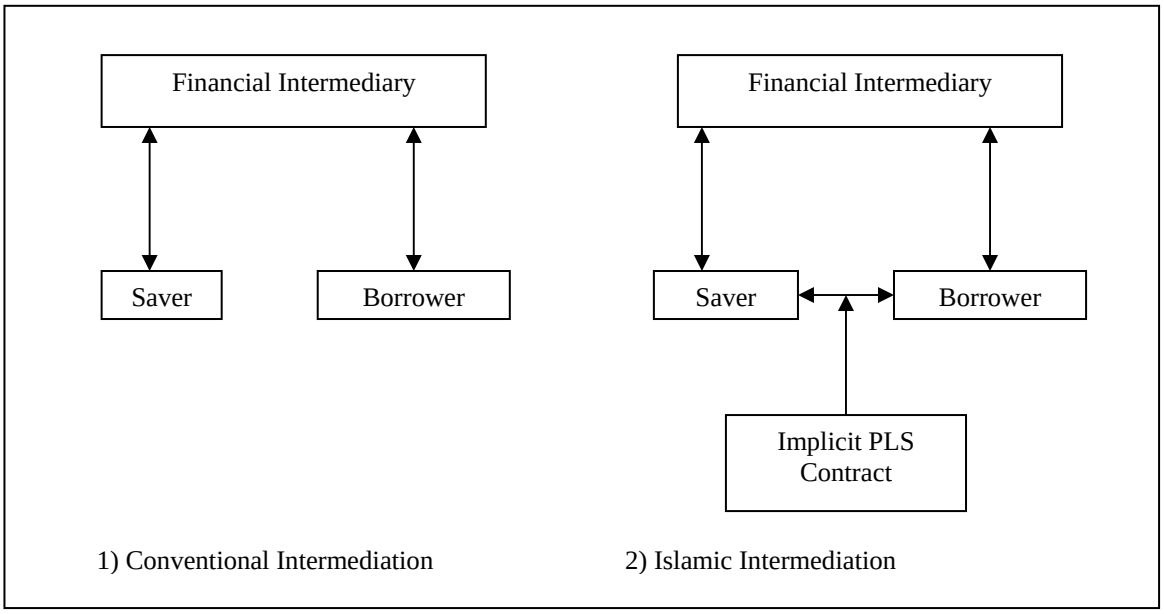

Figure 3: Conventional and Islamic Processes of Financial Intermediation

The intermediation approach somehow follows the traditional banking framework in which the bank transforms funds using labour and physical capital into interest earnings on balance sheet items such as various types of loans are also used (Isik & Hassan, 2003). Bank funds should also be within the input variables in addition to labour and capital because they are the major raw material that is transformed in the internal process (Berger & Humphrey, 1997; as quoted by Isik and Hassan, 2003). In this study, the inputs used are labour (*X1*), capital (*X2*) and total deposits and loanable funds (*X3*). Furthermore, under the intermediation approach the dollar values of loans are also used (Isik and Hassan, 2003). The outputs used are loans and advances (*Y1*) and income (*Y2*). In addition, in this study, income (i.e. interest income, non-interest income and income from IBS) is chosen as output, assuming the banks' main objective to maximize revenue (Grigorian & Manole, 2005).

The inputs and outputs selected for this study are modified from Sathye (2001), Grigorian and Manole (2002), and Fadzlan and Suraya (2005). However, this study only aims at examining the TE, PTE and SE. In defining the inputs, labour is measured by total staff cost. The net book value of premises and fixed assets (the value of premises and fixed assets less any depreciation) are used to measure the capital and loanable funds are measured by time deposits, savings deposits and other borrowed funds. These inputs are measured in millions of Ringgit Malaysia (RM). Also, the two outputs used are measured in millions of RM.

Table 2: The Inputs and Outputs of this Study.

INPUTS	OUTPUTS
Labour (total staff cost and are measured in millions of RM)	***Loans and Advances*** (are measured in millions of RM)
Capital (net book value of premises and fixed asset and are measured in millions of RM)	***Income*** (total interest income, non-interest income and income from IBS are measured in millions of RM) (Grigorian & Manole, 2002)
Total deposits and Loanable funds (time deposits, savings deposits, demand deposits and other borrowed funds and are measured in millions of RM)	

Second Stage: Regression

Table 3 provides the empirical studies on the second stage by regressing of efficiency level and bank characteristics. The regression is run using the data on efficiency from the parametric or non-parametric methods. The regression is done to serve several purposes, for instance, to identify the potential determinants of bank efficiency and to examine the efficiency level with regards to the influence of ownership and organizational structures (Aly et al., 1990; Isik & Hassan, 2002; Darrat et al., 2002; Isik & Hassan, 2003; Berger & DeYoung, 1997, Katib, 1999; Maghyereh, n.d.; Miller & Noulas, 1996; Sathye, 2001). Furthermore, Darrat et al. (2002), extend their study by examining the effect of macroeconomic and regulatory factors on efficiency level.

Table 3: Empirical Studies on Second Stage Regression of Efficiency Level and Bank Characteristics

BANK CHARACTERISTICS	RELATIONSHIP	MAIN FINDINGS AND SUPPORTED AUTHORS
Bank Size	Positive	- Size is positively and statistically significant to TE and PTE (Aly et al., 1990) - Bank size has significant positive effects on all types of efficiency (i.e. TE, PTE and SE) (Maghyereh, n.d.) - Bank size is significantly positively related to our measure of PTE (Miller & Noulas, 1996) - Larger bank size is associated with higher efficiency (Hassan, M.K., 2005)
Bank Size	Negative	- Bank size is negatively and significantly related to efficiency (Darrat et al., 2002) - Bank size is negative related to cost, technical, and SE (Isik & Hassan, 2002) - Larger size is strongly negatively associated to SE (Isik & Hassan, 2003) - Bank size (measured by number of branches) is

		negatively related to TE measure (Katib, 1999). - Total assets is negatively related to TE measure (Katib, 1999) - Large banks are less x-efficient in intermediation stage (Guan & Randhawa, 2005)
Profitability	Positive	- Profitability is significantly positive to all types of efficiency (Darrat et al., 2002) - Higher profitability banks have higher efficiency (Maghyereh, n.d.) - Bank profitability is significantly positively related to PTE (Miller & Noulas, 1996) - Larger bank size is associated with higher efficiency (Hassan, M.K., 2005)
Profitability	Negative	- Small banks are more profit efficient (Isik & Hassan, 2002)
Market Power	Positive	- - Market power in Kuwaiti banking sector leads to a significant improvement in cost and AE (Darrat et al., 2002) - Banks with larger share of a given country's market are likely to be more efficient (Grigorion & Manole, 2002) - Market power in Malaysia is positively significant to TE (Katib, 1999)

Table 3 (– *Continued.)*

BANKS' CHARACTERISTICS	RELATIONSHIP	MAIN FINDINGS AND SUPPORTED AUTHORS
Market Power	Negative	- Market power variable is significantly negatively related to all types of efficiency (i.e. TE, PTE and SE) (Maghyereh, n.d.) - Banks with more market power is significantly negatively related to PTE (Miller & Noulas, 1996) - Market power has a significant negative influence on overall, technical and allocative efficiency (Sathye, 2001)
NPLs	Positive	- Increases in measured cost efficiency are generally followed by increases in NPLs (Berger & DeYoung, 1997).
NPLs	Negative	- Strongly negative relationship between NPLs and efficiency scores (Isik & Hassan, 2003)
Capitalization	Positive	- High-capitalized banks tend to have more cost efficiency (Darrat et al, 2002) - The higher the ratio of equity to total assets, the better are the performance results of IBs (Shaari & Fadhilah, 2001) - Well capitalized banks are ranked higher in terms

		of their ability to collect deposits than their poorly capitalized counterparts (Grigorian & Manole, 2002) - Well-capitalized firms are more technically efficient, SE positive association (Isik & Hassan, 2003)
Capitalization	Negative	Not Available

Variables measurement

The dependent variables and definition of the dependent variables are addressed in Table 4 below;

Table 4: Dependent Variable and Definition of Dependent Variables in Conventional and Islamic Commercial Banks in Malaysia [Modified from Isik & Hassan (2003)]

DEPENDENT VARIABLES	DEFINITION OF THE DEPENDENT VARIABLES
TE	Technical Efficiency, OE/AE or PTE*SE, using equal or less of all inputs to produce a given output, as compared to the bank on the efficiency frontier (under management control).
PTE	Pure Technical Efficiency, TE/SE, TE under the variable returns to scale (VRS), i.e. TE that is devoid of SE effects.
SE	Scale Efficiency, TE/PTE, whether a bank has the right size, i.e. whether it produces where the long-run average curve (LRAC) is minimum, or where CRS is observed.

The independent variables and definition of the independent variables are addressed in Table 5 below;

Table 5: Independent Variables and Definition of Independent Variables

INDEPENDENT VARIABLES	DEFINITION OF THE INDEPENDENT VARIABLES
Bank Size	Total Assets (Miller & Noulas, 1996; Sathye, 2001; Darrat et al., 2002)
Profitability	Net Operating Income to Total Assets (Miller & Noulas, 1996; Darrat et al., 2002)
Market Power	Bank Deposits to Total Deposits in the State within which the bank operates (Miller & Noulas, 1996; Darrat et al., 2002; Isik & Hassan, 2003)
NPLs	The ratio of NPLs to Total Loans (Isik & Hassan, 2003)
Capitalization	Equity to Total Assets (Berger & Mester, 1997; Isik & Hassan, 2003)

Hypotheses

Bank Size

Findings from the literature show that the relationship between bank size and efficiency varies across studies. Aly et al. (1990) and Miller and Noulas (1996) found that banks size is significantly positively related to the measure of PTE. Also, Aly et al. (1990) and Guan and Randhawa (2005) found that larger banks are more technically efficient. In addition, Maghyereh (n.d.) found that bank size has significant positive effects on TE, PTE and SE. Furthermore, Maghyereh (n.d.) explained that the shakeout theory posits that smaller banks may not be able to obtain enough capital and management ability to successfully operate updates, thus suggesting a positive relation between bank size and performance.

In contrast, bank size was found to be negatively and significantly related to efficiency in the Katib (1999), Isik and Hassan (2000), Darrat et al. (2002) and Isik and Hassan (2003) studies. Furthermore, Guan and Randhawa (2005) found that larger banks are less x-efficient at the intermediation stage. The negative association between bank size and measures of efficiency explained that strong competition has intensified market discipline on small banks that particularly need to be cost efficient and more managerially aggressive in order to survive (Darrat et al., 2002). Also, the divisibility theory holds that that there will be no such operational advantage accruing to large banks, suggesting no (or a negative) association between size and efficiency (Maghyereh, n.d.). On the other hand, Berger and Mester (1997) did not find any significant relationship between bank size and OE.

Accordingly, the following hypotheses are formulated;

H_{1a}: The larger the bank size, the higher the TE.
H_{1b}: The larger the bank size, the higher the PTE.
H_{1c}: The larger the bank size, the higher the SE.

Profitability

Profitability is significantly positively related to the measure of PTE (Miller & Noulas, 1996). In addition, Darrat et al. (2002) found a significant positive relationship between the profitability of banks and all types of efficiency. Also, these findings are supported by Miller and Noulas (1996); Hassan and Marton (2000; as quoted by Darrat et al., 2002)). The findings on the relationship between profitability and efficiency could be explained by the perception that banks become more efficient as a result of enhancing their profitability (Darrat et al., 2002). Furthermore, Maghyereh (n.d.) suggested a positive relationship between profitability and performance due to the ability of larger banks to raise more capital. Figure 4.5 explained the relationship between profitability and efficiency measures. Thus, the following hypotheses are formulated;

H_{2a}: The higher the profitability, the higher the TE.
H_{2b}: The higher the profitability, the higher the PTE.

H_{2c}: The higher the profitability, the higher the SE.

Market Power

In this study, market power is measured by the bank's deposit to total deposits in Malaysia. Miller and Noulas (1996) found that bank size with more market power possessed lower TE. Furthermore, Sathye (2001) and Maghyereh (n.d.) found that market power has a significant negative relationship to overall, technical, AE. Also, Maghyereh (n.d.) found that market power is significantly associated to SE. These findings supported the 'quiet life' hypothesis and market power (structure-performance hypothesis (Sathye, 2001, Isik & Hassan, 2003). The 'quiet life' hypothesis explained that firms that enjoy greater market power and concentration will lead to inefficiency due to the relaxed environment with no incentive to minimize cost (Sathye, 2001; Isik & Hassan, 2003). Furthermore, the market power (structure-performance) hypothesis explained that banks in less competitive markets can charge a higher price for their services and eventually make supernormal profit and, on the other hand, banks in a less competitive environment might feel less pressure to control their cost and enjoy the quiet life (Isik & Hassan, 2003).

On the other hand, Darrat et al. (2002) found that market power in the Kuwaiti banking sector leads to a significant improvement in cost efficiency (i.e. OE) and AE. Other studies that found positive association between market power and efficiency are Grigorian and Manole (2002) and Katib (1990). The positive relationship between market power and efficiency is also supported by Smirlock (1985), Timme and Yang (1991), Berger (1995, as quoted by Isik & Hassan, 2003). These findings accord with efficient structure efficiency. It is where efficient firms compete aggressively, generate higher profit, and gain a larger market share due to their low costs of production (Darrat et al., 2002; Isik & Hassan, 2003). Thus it can be concluded that, cost efficiency, and not market power brings about supernormal efficiency (Isik & Hassan, 2003).

Despite the above, Isik and Hassan (2003) found that market power is not a significant factor driving efficiency differences among banks in the industry. Although there are mixed findings on the relationship between market power and efficiency, Figure 6 explains the relationship between market power and efficiency measures and thus, the following hypotheses are developed;

H_{3a}: The larger the market power, the higher the TE.
H_{3b}: The larger the market power, the higher the PTE.
H_{3c}: The larger the market power, the higher the SE.

Non-Performing Loans (NPLs)

Isik and Hassan (2003) found NPLs' significant negative association with overall, technical and AE. Based on Isik and Hassan (2003) it is not clear whether this result is supported by the bad luck hypothesis or bad luck management. Basically, the bad luck hypothesis suggests that problem loans are generally caused by uncontrollable (i.e. exogenous) factors. Due to that, the measured cost efficiency might be fallaciously low because low cost efficiency may reflect the high operating cost of managing

problem loans. Furthermore, bad management suggests that problem loans are generally caused by controllable (i.e. endogenous) factors. Bad management in the bank is due to inadequate monitoring and control of operational expenses and problems and will lead to cost inefficiency. In contrast, Berger and DeYoung, (1997) found that increases in measured cost efficiency are generally followed by increases in NPLs. Figure 7 shows the relationship between market power and efficiency measures. Thus,

H_{4a}: The higher the NPLs, the lower the TE.
H_{4b}: The higher theNPLs, the lower the PTE.
H_{4c}: The higher the NPLs, the lower the SE.

Capitalization

Capitalization measures the ratio of equity to total assets. It is an important element in banking operations, with a higher capital asset ratio implying lower financial risk (Levonian, 1991, as quoted by Bashir, 1999). Berger and Mester (1997) found that well capitalized firms are more efficient. Furthermore, Darrat et al. (2002) found that high-capitalized banks tend to be more overall efficient. The finding by Darrat et al. (2002) explained that efficient banks generate higher profits, and in turn will strengthen capitalization status. In addition, Isik and Hassan (2003) found that well-capitalized firms are more technically efficient and scale efficient. These findings are consistent with the Moral Hazard Theory where agency conflict between managers and shareholders might be exacerbated prior to bankruptcy because an owner with less capital to lose might have less incentive to make sure that the bank is running efficiently (Isik & Hassan, 2003). Also, Grigorian and Manole (2002) found that well capitalized banks are ranked higher in terms of their ability to collect deposits than their poorly capitalized counterparts. In the case of IBs, Shaari and Fadhilah, (2001) found that the higher the ratio of equity to total assets, the better are the performance results of IBs. Capitalization is also important in Islamic banking, as in the absence of regulation and deposit insurance, higher capitalization serves as a signal of the soundness of banks' liabilities (Bashir, 1999)

Thus,

H_{5a}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the TE.
H_{5b}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the PTE.
H_{5c}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the SE.

Model Development

The second stage of the analysis is to examine the influence of independent variables on the efficiency measure. Table 3 and Table 4 explain the variables used in the model. The efficiency model that will be used in the linear regression is;

$$\mathbf{Ef = \alpha + \beta_1 S + \beta_2 P + \beta_3 M + \beta_4 NPLs + \beta_5 C}$$

Where;

Ef = Overall, Technical and Allocative Efficiency, alternately.
S = Bank Size
P = Profitability
M = Market Power
NPLs = Non-Performing Loans
C = Capitalization

Data Analysis

Several analyses will be done in this study. Firstly, the efficiency measure will be calculated using the DEA method. Then, descriptive analysis, test of normality and test of multicollinearity are also undertaken. Finally, linear regression will be undertaken to examine the relationship between the efficiency measure and bank characteristics.

Three inputs and two outputs in Figure 9 were chosen to examine the efficiency using DEA. To identify the efficiency measure, this study will apply the DEAP version 2.1, developed by Coelli (1996). The efficiency measure will then be the dependent variables for the second stage analysis using the SPSS 11.5.

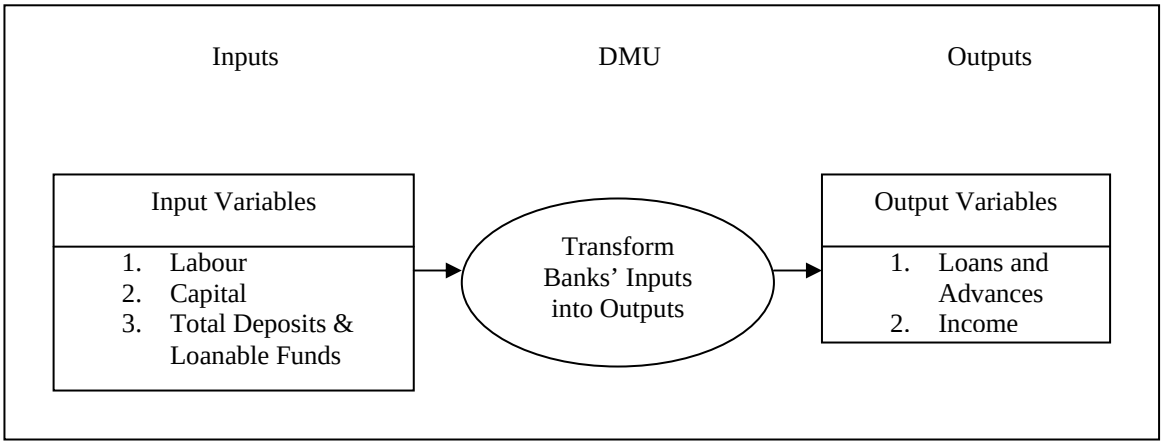

Figure 4: The three inputs and two outputs used in the DEA model – Intermediation Approach

FINDINGS OF THE STUDY

DEA: Efficiency of Islamic and Conventional Commercial Banks in Malaysia

Table 6 provides the descriptive statistics and correlation coefficients of input and output data. On average, prominent input and output are total deposits and loanable funds, and loans and advances.

Table 6: Descriptive Statistics and Correlation Coefficients of Input and Output Data

	Labour RM '000	Capital Expenditure RM '000	Total Deposits & Loanable Funds RM '000	Loans and Advances RM '000	Income RM'000
Descriptive statistics					
Maximum	974,371	1,036,796	88,195,288	86,718,412	7,708,795
Minimum	20,215	22,402	2,564,821	1,001,527	134,290
Average	255,050	299,693	23,950,225	21,647,982	2,097,070
Std. Deviation	229,208	272,149	21,677,679	21,200,367	1,987,896
Correlation coefficients					
Labour	1				
Capital expenditure	0.945**	1			
Loanable Funds	0.955**	0.941**	1		
Loan and Advances	0.967**	0.938**	0.983**	1	
Demand deposits	0.956**	0.902**	0.934**	0.960**	
Income	0.971**	0.928**	0.978**	0.977**	1

** Correlation is significant at the 0.01 level (2-tailed).

Furthermore, Table 7 shows the descriptive statistics of the efficiency measures throughout 55 observations.

Table 7: Descriptive Statistics: Efficiency Measures

	Sample	Minimum	Maximum	Mean	Standard Deviation
TE	55	0.416	1.000	0.837	0.181
PTE	55	0.445	1.000	0.918	0.136
SE	55	0.438	1.000	0.913	0.141

Efficiency Measures: Input Orientation

Table 8 provides the means of TE under the assumption of CRS, and PTE and SE under the assumption of VRS. Between 2000 and 2004, the mean TE under the assumption of CRS ranged from 82.3% and 87.8%. Taking the mean TE in 2000 as an example, the conclusion could be drawn that the banks on average could have produce the same level of output by actually using only 83.7% of the inputs mix. From another angle, in 2004, it may be said that on average the banks were still 12.2% technically inefficient. Since the banks were operating under CRS, much of their technical inefficiency was attributed to input wastage. Also, the TE score under the CRS is called (global) TE, since it did not account for scale effect (Cooper et al., 2000).

Table 8: Technical Efficiency in Malaysian Banking: 2000—2004
(Constant & Variable Returns to Scale)

Year	Sample Size	Technical Efficiency Mean of Sample	Pure Technical Efficiency Mean of Sample	Scale Efficiency Mean of Sample
		CRS	VRS	
2000	11	0.823	0.931	0.883
2001	11	0.863	0.919	0.940
2002	11	0.726	0.820	0.894
2003	11	0.895	0.955	0.938
2004	11	0.878	0.968	0.908
MEAN		0.837	0.919	0.913

Under the assumption of VRS, between 2000 and 2004 the PTE ranged between 82.0% and 96.8%. In addition, under the same assumption the SE between 2000 and 2004, ranged from 88.3% and 96.8%. VRS rating is obtained when we control for the scale size of the DMU. This is the only difference in how the two measures of efficiency are obtained and so the divergence of the measures captures the impact of scale size on the productivity of the DMU concerned (Thanassoulis, 2001).The TE under the assumption of VRS expresses the (local) PTE (Cooper et al., 2000).

The mean TE in the Malaysian banking sector seems to increase to 86.3% in 2001 as compared to the mean TE in 2000. In 2002, the TE is decreased by 3.7%. Only in 2003 does the TE increase again to a level higher than the mean TE in 2000 and 2001. However, the mean TE in 2004 slightly decreases to 87.8% as compared to 89.5% in 2003. The mean efficiency of PTE decreases in 2001 and 2002 as compared to the mean PTE in 2000 and gradually increases in 2003 to 2004. On the other hand, the mean efficiency of SE increases in 2001 as compared to the mean SE in 2000, then it further increase in 2003, before decreasing in 2004.

The main source of technical inefficiency of ICBs and CCBs in the Malaysian banking sector in 2001 – 2002 is pure technical inefficiency. It is explained by lower efficiency measures of PTE as compared to SE. Meanwhile, in 2000, 2003, and 2004

the main source of technical inefficiency is scale inefficiency, with the average SE for the sample in 2004 at 90.8%, implying that the inefficiency was due to the divergence of the actual scale of operation for the most productive scale size is about 9.2% as compared to the pure technical inefficiency of 3.2%.

Table 9 reports the frequency distribution of year-by-year TE under CRS and VRS. The lowest TE occurred under the assumption of CRS and VRS in 2002 (i.e. 41.6% and 44.5% respectively), indicating 58.4% and 55.5% potential reduction of inputs respectively. Furthermore, detailed measures of efficiency under the CRS and VRS for the individuals' banks by year in the sample are reported in Table 10. When examining the frequency distribution of VRS TE, the study found that more banks are fully efficient as compared to the number of banks that are fully efficient under the assumption of CRS, to the extent of 7 or 8 fully efficient banks in 2003 and 2004 respectively, as compared to 4 and 5 fully efficient banks under the assumptions of CRS in 2003 and 2004 respectively.

Table 9: Frequency Distribution of Technical Efficiency in Malaysian Banking under CRs and VRS: 2000—2004[a]

Technical Efficiency	2000	2001	2002	2003	2004
0.4 « 0.5	2		3		
			(1)		
0.5 « 0.6			1	1	1
			(1)		
0.6 « 0.7		2	2		
	(1)		(2)		
0.7 « 0.8	1	2	1	2	2
		(1)	(1)		(1)
0.8 « 0.9	5	1		1	2
	(3)	(3)		(3)	(1)
0.9 « 1		4		3	1
	(1)	(2)		(1)	(1)
1	3	2	4	4	5
	(6)	(5)	(6)	(7)	(8)

[a] Figures in parentheses are with references to VRS. Banks total to 11 in each year.

Table 10: DEA Technical Efficiency for Malaysian Banks from 2000-2004 (Constant Returns to Scale) – By Year

No.	Banks	TE (CRS)					
		2000	2001	2002	2003	2004	**MEAN**
1	AMBB	1.000	1.000	1.000	1.000	1.000	**1.000**
2	EON	0.862	0.885	1.000	0.987	1.000	**0.947**
3	MBB	0.816	0.955	1.000	1.000	0.873	**0.929**
4	SBB	1.000	1.000	0.628	1.000	1.000	**0.926**
5	BCBB	0.894	0.930	0.769	0.982	1.000	**0.915**
6	RHB	1.000	0.997	0.569	0.959	1.000	**0.905**
7	HLBB	0.864	0.707	1.000	1.000	0.767	**0.868**
8	AFBB	0.851	0.914	0.416	0.790	0.862	**0.767**
9	PBB	0.764	0.771	0.494	0.822	0.905	**0.751**
10	BIMB	0.498	0.694	0.668	0.791	0.751	**0.680**
11	BMMB	0.498	0.637	0.438	0.513	0.498	**0.517**
	MEAN	**0.822**	**0.863**	**0.726**	**0.895**	**0.878**	**0.837**

Table 10 and Table 11 display PTE and SE respectively, calculated using DEA under the assumption of VRS. As evidenced in the results in Table 11, MBB, AMMB, and BMBB are consistently efficient throughout the sample period. Being consistently efficient, those banks have the highest average technical efficiency at an annual average level of 1. BCBB follows with an annual average level of 99.4%, and then EON and SBB come after with an annual average level of 97.1% and 92.9% respectively. In contrast, AFBB, PBB and BIMB are the least efficient banks with an annual average level of 81.1%, 80.5% and 78.7% respectively. Overall, all the banks possess the PTE level of 91.9% each year for the period of 2000 to 2004. The results show that, on average all of the banks could have produced the same level of output by actually using only 91.9% of the inputs mix.

Table 11: DEA Technical Efficiency for Malaysian Banks from 2000-2004 (Variable Returns to Scale) – By Year

No.	Banks	PTE (CRS)					
		2000	2001	2002	2003	2004	**MEAN**
1	MBB	1.000	1.000	1.000	1.000	1.000	**1.000**
2	AMBB	1.000	1.000	1.000	1.000	1.000	**1.000**
3	BMMB	1.000	1.000	1.000	1.000	1.000	**1.000**
4	BCBB	1.000	0.969	1.000	1.000	1.000	**0.994**
5	EON	0.982	0.885	1.000	0.988	1.000	**0.971**
6	SBB	1.000	1.000	0.646	1.000	1.000	**0.929**
7	RHB	1.000	1.000	0.633	1.000	1.000	**0.927**
8	HLBB	0.897	0.730	1.000	1.000	0.772	**0.880**
9	AFBB	0.857	0.918	0.445	0.844	0.991	**0.811**
10	PBB	0.882	0.800	0.507	0.837	1.000	**0.805**
11	BIMB	0.619	0.808	0.785	0.839	0.882	**0.787**
	MEAN	**0.931**	**0.919**	**0.820**	**0.955**	**0.968**	**0.919**

Furthermore, as evidenced in the results in Table 12, AMBB was operated in a condition free of any scale inefficiency. SBB, HLBB, and EON follow with an annual average level of scale inefficiency between 0.5% and 1.5%. BCBB, BIMB, and BMBB are the least efficient banks in terms of SE with an annual average level of scale inefficiency of 7.9%, 13.8%, and 48.3% respectively. Overall, all the banks possess the average SE level of 91.3% for the period of 2000 to 2004.

Table 12: DEA Scale Efficiency for Malaysian Banks from 2000-2004 (Variable Returns to Scale) – By Year

No.	Banks	SE (CRS)					
		2000	2001	2002	2003	2004	**MEAN**
1	AMBB	1.000	1.000	1.000	1.000	1.000	**1.000**
2	SBB	1.000	1.000	0.973	1.000	1.000	**0.995**
3	HLBB	0.963	0.968	1.000	1.000	0.994	**0.985**
4	EON	0.878	1.000	1.000	0.999	1.000	**0.975**
5	RHB	1.000	0.997	0.899	0.959	1.000	**0.971**
6	AFBB	0.993	0.996	0.935	0.936	0.870	**0.946**
7	PBB	0.866	0.963	0.973	0.983	0.905	**0.938**
8	MBB	0.816	0.955	1.000	1.000	0.873	**0.929**
9	BCBB	0.894	0.961	0.769	0.982	1.000	**0.921**
10	BIMB	0.805	0.859	0.850	0.943	0.851	**0.862**
11	BMMB	0.498	0.637	0.438	0.513	0.498	**0.517**
	MEAN	**0.883**	**0.940**	**0.894**	**0.938**	**0.908**	**0.913**

The Influence of Banks' Characteristics on the Efficiency of Islamic and Conventional Commercial Banks

Descriptive Analysis

Table 13 shows the descriptive statistics of the dependent variables and independent variables. An explanation of the dependent variable is presented in the subsection 5.2.1.1.

Table 13: Descriptive Statistics: Dependent Variables (DV) and Independent Variables (IV)

	Sample	Minimum	Maximum	Mean	Standard Deviation
TE	55	0.416	1.000	0.837	0.181
PTE	55	0.445	1.000	0.918	0.136
SE	55	0.438	1.000	0.913	0.141
Bank Size	55	3,508,818	143,551,149	36,420,677	33,457,684
Profitability	55	-0.0369	0.0442	0.0097	0.0121
Market Power	55	0.0053	0.1570	0.0434	0.0394
NPLs	55	0.0030	0.9572	0.0958	0.1296
Capitalization	55	0.0129	0.1503	0.0850	0.0288

Linear Regression

During this stage, this study uses standard regression. It is where all variables are entered at one time and it will help to estimate the direct impact of each independent variable on the dependent variable. (DeVaus, 2002).

Dependent Variable: Technical Efficiency

Table 14 shows the regression statistics for the regression of the independent variables on TE. The R-square shows that 23.7% of the variation in the TE is explained by this set of variables. It was found that bank size and market power are significantly associated to TE. Bank size is positively and significantly associated to TE, while market power is significant and negatively associated to TE.

Table 14: Dependent Variable: Technical Efficiency[a]

Variable	Expected Sign	Standardardized Coefficients Beta	Sig. (p-value)
(Constant)			0.031
Bank Size	+	0.888	0.003*
Profitability	+	0.038	0.806
Market Power	+	-0.519	0.068***
NPLs	-	0.116	0.440
Capitalization	+	-0.132	0.428
R-Square		*0.237*	

Adjusted R-Square	*0.159*
F	*3.038*
Sig of F	*0.018*[a]

[a] Predictors: (Constant), Capitalization, Market Power, NPLs, Profitability, Size
*Significance level below 0.01
**Significance level below 0.05
***Significance level below 0.10

Dependent Variable: Pure Technical Efficiency

Table 15 shows the regression statistics for the regression of the independent variables on PTE. The R-square shows that 15.6% of the variation in PTE is explained by this set of variables. The significant variable in this regression is capitalization, which is negatively associated to PTE.

Table 15: Dependent Variable: Pure Technical Efficiency[a]

Variable	Expected Sign	Standardardized Coefficients Beta	Sig. (p-value)
(Constant)			0.028
Bank Size	+	-0.244	0.420
Profitability	+	0.165	0.317
Market Power	+	0.306	0.300
NPLs	-	-0.169	0.285
Capitalization	+	-0.442	0.015**
R-Square		*0.156*	
Adjusted R-Square		*0.069*	
F		*1.806*	
Sig of F		*0.129*[a]	

[a] Predictors: (Constant), Capitalization, Market Power, NPLs, Profitability, Size
*Significance level below 0.01
**Significance level below 0.05
***Significance level below 0.10

Dependent Variable: Scale Efficiency

Table 16 shows the regression statistics for the regression of the independent variables on SE. The R-squared shows that 48.5% of the variation in SE is explained by this set of variables. The significant variables in this regression are bank size, market power, and NPLs where it was found that bank size and NPLs are positively associated to SE and market power is negatively associated to SE.

Table 16: Dependent Variable: Scale Efficiency[a]

Variable	Expected Sign	Standardized Coefficients Beta	Sig. (p-value)
(Constant)			0.000
Bank Size	+	1.391	0.000*
Profitability	+	-0.094	0.467
Market Power	+	-0.966	0.000*
NPLs	-	0.295	0.019**
Capitalization	+	0.218	0.116
R-Square		*0.485*	
Adjusted R-Square		*0.433*	
F		*9.238*	
Sig of F		*0.000*	

[a] Predictors: (Constant), Capitalization, Market Power, NPLs, Profitability, Size
*Significance level below 0.01
**Significance level below 0.05
***Significance level below 0.10

Hypotheses Test

Table 17 provides the expected sign and the summary results of the linear regression.

Table 17: Directional relationship sign, results from linear regression

HYPOTHESES	**EXPECTED SIGN**	**RESULTS OF THE STUDY** EFFICIENCY LEVELS TE	PTE	SE	**HYPOTHESES TEST**
H_{1a}: The larger the bank size, the higher the TE.	+	+*			ACCEPT
H_{1b}: The larger the bank size, the higher the PTE.	+		-		REJECT
H_{1c}: The larger the bank size, the higher the SE.	+			+*	ACCEPT
H_{2a}: The higher the profitability, the higher the TE.	+	+			ACCEPT
H_{2b}: The higher the profitability, the higher the PTE.	+		+		ACCEPT
H_{2c}: The higher the profitability, the higher the SE.	+			-	REJECT
H_{3a}: The larger the market power, the higher the TE.	+	-***			REJECT
H_{3b}: The larger the market power, the higher the PTE.	+		+		ACCEPT
H_{3c}: The larger the market power, the higher the SE.	+			-*	REJECT

H_{4a}: The higher the NPLs, the lower the TE.	-	+			REJECT
H_{4b}: The higher the NPLs, the lower the PTE.	-		-		ACCEPT
H_{4c}: The higher the NPLs, the lower the SE.	-			+**	REJECT
H_{5a}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the TE.	+	-			REJECT
H_{5b}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the PTE.	+		-**		REJECT
H_{5c}: The higher the bank's capitalization (i.e. well-capitalized bank), the higher the SE.	+			+	ACCEPT

*Significance level below 0.01
**Significance level below 0.05
***Significance level below 0.10

Hypothesis 1 stated that the higher the bank size the higher the efficiency measures. The hypothesis explains that the bank size is positively associated with efficiency measures. This hypothesis is soundly supported by the result of bank size with TE and bank size with SE. Significant positive association was found in bank size with TE and bank size with SE. However, this hypothesis was not supported by the association between bank size and PTE. The negative association that was found between bank size and PTE was not significant. This study found that the larger the bank size, the higher the TE and SE the bank experienced.

Furthermore, in terms of the finding on significant positive association between size and SE, Maghyereh (n.d.) explained that shakeout theory posits that smaller banks may not be able to obtain enough capital and management ability to successfully operate updates, thus suggesting a positive relation between bank size and performance. This finding is supported by Hassan M.K. (2005) who found that larger banks are associated with higher efficiency. In addition, positive and statistically significant association was also found between size and TE (Aly et al., 1990; Maghyereh, n.d.), between bank size and PTE (Aly et al., 1990; Maghyereh, n.d.; Miller & Noulas, 1996), and between bank size and SE (Maghyereh, n.d.). In contrast, Isik and Hassan (2002; 2003) found a negative association between size and SE.

Furthermore, in contrast to the findings of this study where statistically significant positive association was found between size and TE, Katib (1999) and Guan et al. (2005) found that bank size is negatively related to TE measures. Although Katib (1999) and Guan et al. (2005) did their studies in the Malaysian banking sector, the difference could be due to the different sample period, different selection of inputs and outputs or different economic conditions of the sample period.

Hypothesis 2 stated that the higher the profitability, the higher the efficiency measures. This hypothesis explains the positive relationship between profitability and efficiency measures. This hypothesis was not supported by significant results of the study. The positive association between profitability and PTE and between profitability and TE was not found to account for any significant association. Also, the negative association between profitability and SE was not found to account for a significant association. The results in this study indicate that the profitability of the banks did not significantly influence the efficiency measures.

These findings are not consistent with previous studies that have indicated that profitability is positively significantly associated to efficiency (Darrat et al., 2002; Maghyereh, n.d.; Hassan, M.K., 2005). Specifically, Miller and Noulas (1996) found significant positive association between profitability and PTE. On the other hand, Isik and Hassan (2002) found that small banks are more profit efficient.

Hypothesis 3 stated that the larger the market power, the higher the efficiency levels. This explains that there is a positive relationship between market power and efficiency levels. The hypothesis was not supported by any significant result of this study. As anticipated, a positive association between market power and PTE exists. However, the positive association was not found to account for any significant association. On the other hand, the association between market power and TE and between market power and SE was found to account for significant negative association. The finding of the study suggests that the larger the market power of the bank, the lower the SE and TE.

Such evidence is consistent with the hypothesis introduced by Edward and Heggestad (1973; as explained by Maghyereh, n.d.) where in highly concentrated markets, uncertainty avoidance or risk aversion rather than efficiency, becomes the objectives of some banks. Thus, it can be concluded that market power (lack of competition) can lead to decreased in efficiency (Maghyereh, n.d.). The negative significant association between market power and TE and between market power and SE is supported by Maghyereh (n.d.).

Hypothesis 4 stated that the higher the amount of NPLs, the lower the efficiency measures. This suggests that NPLs and efficiency measures have a negative relationship. This hypothesis was not supported by any significant result of this study. Although the association between NPLs and PTE was found to be negative, it was not found to account for any significant association. However, the associations between NPLs and TE and between NPLs and SE were found to be positive. The association between NPLs and TE did not account for a significant association. On the other hand, the positive association between NPLs and SE was found to be significant. This suggests that the amount of NPLs did influence the SE levels of the banks positively.

The positive relationship between NPLs and SE was explained by Berger and DeYoung (1997). Berger and DeYoung (1997) explained using skimping hypothesis. This is where the amount of resources allocated to underwriting and monitoring loans affects both loan quality and measured cost efficiency (Berger & DeYoung, 1997). This will involve a tradeoff between short term operating and future loan performance problems. Also, Berger and DeYoung (1997) found that increases in measured cost

efficiency generally were followed by increases in NPLs. In contrast, the study by Isik and Hassan (2003) found a strongly negative relationship between NPLs and efficiency scores.

Hypothesis 5 stated that the higher the bank's capitalization, the higher the efficiency measures. This explains that the well-capitalized bank is positively associated with efficiency measures. These hypotheses were not supported by this study. Capitalization was found to be negatively associated with TE and PTE. On the other hand, capitalization was found to be positively associated with SE. However, neither of the findings was found to account for any significant association. Furthermore, a significant association between capitalization and PTE was found but it was negatively associated. Thus, in this study, it was found that the higher the capitalization of a bank, the lower the PTE.

In contrast, a positive association was found to exist between capitalization and efficiency (Darrat et al., 2002; Isik & Hassan, 2003). The finding of this hypothesis could be due to the association between higher equity to assets (i.e capitalization) with lower productivity (Mukherjee K., 2001).

EFFICIENCY OF CCBs AND ICBs IN MALAYSIA

The scope of efficiency of the ICBs and CCBs measured in this study is related to the efficiency of the individual banks in intermediating or mobilizing labour cost, capital, and total deposits and loanable funds into loans and advances, and income. This study used the input oriented model to measure efficiency.

Table 18 summarizes the average efficiency of the ICB and CCB between 2000 and 2004 measured by DEA. The data indicates that on average the ICB and CCB in Malaysia can produce the same level of output by actually using only 83.7% of the input mix (inputs consist of labour cost, capital, and total deposits and loanable funds). On the other hand, the average PTE and SE is at 91.9% and 91.3% respectively. Furthermore, more banks are found to be technically efficient under the assumption of VRS (VRS can be divided into IRS and DRS; IRS portrays increased in the production of outputs requires smaller percentage increase in the input, while DRS portrays cost increase with scale of production) compared to the technically efficient banks under the assumption CRS (appropriate when all banks are operating at an optimal scale, a condition where average cost of production do not change with scale of production). Also, the study by Katib (1999) found that higher efficiency scores were reported under the VRS as compared to CRS.

Table 18: Summary of Average DEA Efficiency of Malaysian Banks from 2000-2004 By Bank

No.	Banks	MEAN		
		TE	PTE	SE
1	AMBB	1.000	1.000	1.000
2	EON	0.947	0.971	0.975
3	MBB	0.929	1.000	0.929
4	SBB	0.926	0.929	0.995
5	BCBB	0.915	0.994	0.921
6	RHB	0.905	0.927	0.971
7	HLBB	0.868	0.880	0.985
8	AFBB	0.767	0.811	0.946
9	PBB	0.751	0.805	0.938
10	BIMB	0.680	0.787	0.929
11	BMMB	0.517	1.000	0.517
	MEAN	**0.837**	**0.919**	**0.913**

Under the VRS assumption, MBB and BMMB move to the technically efficient status in addition to being CRS technically efficient banks. The MBB full PTE is caused by the largest amount of outputs (outputs consist of loan and advances, and income) possessed by MBB. Furthermore, the BMMB full PTE is caused by the smallest amount of inputs (inputs consist of labour cost, capital and, total deposits and loanable funds) possessed by BMMB, even though it possessed the lowest TE. The PTE measures do not discriminate between big and small banks.

Overall, the average technical inefficiency of the ICB and CCB in Malaysia is mainly due to scale inefficiency. This is observed by the lower level of SE as compared to TE. The result indicated that the average efficiency in Malaysia during the entire period of the study is due to the disadvantageous conditions displayed by the SE and not due to inefficient operations.

This finding is supported by Guan et al. (2004) who found that PTE dominates SE across three frontiers (i.e. pre-crisis, post-crisis and pooled) in their study on 10 anchor banks in Malaysia (i.e.1995-1996 and 2001-2002). This suggests that Guan et al. (2004) found that the major source of overall technical inefficiency for Malaysian banks is scale inefficiency (related to inefficiency caused by scale of production) and not pure technical inefficiency (related to inefficiency caused by inefficient operation). Furthermore, Katib (1999) found that scale inefficiency in Malaysia is relatively larger for the years 1989 to 1995. Also, Krishnasamy et al. (2003) found that scale inefficiency contributed to Malaysian banks in 2000 to 2001. On the other hand, Fadzlan and Suraya (2005) found that pure technical inefficiency contributed to Malaysian banks' post-merger TE in 2001 to 2003.

When the individual banks were analyzed, it was found in this study that MBB as the largest bank in Malaysia did not experience fully efficient conditions. MBB, and BMMB are banks that are locally efficient (efficient in a particular area, in this study it refers to the Malaysian banking industry) and not globally efficient (considering the international banking industry) due to the scale size of the DMU. In the case of MBB, this is mainly due to the average scale inefficiency of 7.1%. Krishnasamy (2003) explained that the scale inefficiency might be due to the industry-wide consolidation, where size alone is not a sufficient condition to guarantee efficiency in terms of economies of scale and success. This would be consistent with previous studies that found medium-sized banks being slightly more scale efficient than large banks (Mester, 1987; Humphrey, 1990; Berger, Hunter & Timme, 1993 as quoted by Krishnasamy et al., 2003). In addition, BCBB also experienced quite high scale inefficiency at an average of 7.9%.

Individually, on average other CCB banks excluding MBB and BCBB experienced pure technical inefficiency of between 2.9% and 19.5% and scale inefficiency of between 0.5% and 6.2%. These banks experienced such conditions probably because they may still be suffering from post-merger condition and may have fallen short of sound management planning resulting in the condition mentioned above (i.e. medium-sized banks being slightly more scale efficient than large banks) (Krishnasamy et al., 2003). The implication from the bank mergers is that it is a complex proposition and may result in disruptions rather than construct competence in the short term (Krishnasamy et al., 2003).

In addition, PBB, BIMB and BMMB were one of the least efficient banks. PBB is one of the most successful banks in Malaysia. Its equities structure is based on individual ownership where the equity holders are its directors (PBB, 2004: 163-165). Also, PBB had received considerable recognition for its achievement. In this respect, PBB is well-known for its success in the bond trust units in Malaysia that PBB offers. The excellent reputation and achievements of PBB could be due to the good investment portfolios and strategies possessed by PBB. However, its ranking in this study may be due to its lending portfolios where PBB was very selective in giving out loans and advances. It will only give out loans and advances to selected industries that involve low risk portfolios. For example, in 2004, 92% of the Group's gross loans, advances and financing outstanding were loans to the retail sector (i.e. to cater for the business needs of SMEs, the purchase of residential properties and passenger vehicle consumers) (PBB, 2004: 194-197). On the other hand, both of the ICBs are least efficient perhaps due to the management structure (Saaid et al., 2003), capital structure, inefficient use of resources (Saiful Azhar & Mohd Affandi, 2001, Saaid et al., 2003; Salleh et al., 2001; Shaari & Fadhilah, 2001; Amrizal & Nursofiza, 2004), government interference (Sarker, 1999), advancement in technology experienced by other CCB (El-Gamal & Inanoglu, 2002; Okuda & Hashimoto, 2004), and innovation in the products offered by CCB that attract more customers (Sarker, 1999).

COMPARATIVE EFFICIENCY OF ICBs AND CCBs IN MALAYSIA

The average pure technical inefficiency and scale inefficiency of BIMB stand at 21.3% and 7.1% respectively. This suggests that the source of inefficiency in BIMB is mainly pure technical inefficiency (i.e. inefficient operations or management). The efficient operations and management refer to the ability of a particular financial institution (i.e. bank) in managing its inputs (i.e. labour, capital and total deposits and loanable funds) and intermediating it into outputs (i.e. loans and advances). In other words, this would reflect on the managerial ability and expertise, and technological advancement of the banks.

As explained by previous studies, BIMB performed below its optimum level where the input element was not fully utilized (Amrizal & Wan Nursofiza, 2004). The operations of BIMB were highly influenced by internal and external factors (Amrizal & Wan Nursofiza, 2004), such as improper allocation of input, changes in the economy and changes in monetary policy (Amrizal & Wan Nursofiza, 2004).

The pure technical inefficiency of the CCB is between 2.9% to 19.5% as compared to the pure technical inefficiency of BIMB of 21.3%. The finding shows that managerial efficiency of the CCB is higher than the managerial efficiency of the ICB. Several factors that lead to the low managerial efficiency of ICBs in Malaysia as compared to the CCBs may be caused by the management structures of ICBs (Saaid et al., 2003), the capital structures of ICBs, the involvement of less expertise or unskilled labour in ICBs (Saaid et al., 2003) to improve the management in the process of mobilization of inputs into outputs (Saaid et al., 2003; Salleh et al., 2001; Shaari & Fadhilah, 2001; Amrizal & Nursofiza, 2004), less capability to develop attractive and innovative products and being able to market the products to the customers (Sarker, 1999), volume of operations of CCBs (Samad, 2004), the technological advancement of CCBs (El-Gamal & Inanoglu, 2002; Okuda & Hashimoto, 2004), networking created by CCBs, and changes in the economy condition and policy (Amrizal & Nursofiza, 2004)

On the other hand, BMMB was found to be locally efficient and not globally efficient due to the disadvantageous display by the SE of the DMUs. BMMB has full PTE scores and a relatively low average SE (0.517). The average scale inefficiency of BMMB is at 48.3%, which is quite high if compared to the scale inefficiency of other ICB and CCBs. This can be interpreted to mean that the TE of BMMB under the assumption of CRS is mainly attributed to the disadvantageous conditions displayed by SE. This shows that BMMB may have the potential to improve its efficiency by scaling up its activities. Scaling up its activities can be referred to injecting more capital or increasing deposits amount by encouraging more depositors to deposit their money in the bank to increase investment made by the bank in profitable financing activities.

It is very crucial for ICBs in Malaysia to operate at an efficient pace to ensure their competitiveness with the CCBs. If the factors that impede its efficient level are not considered and improved by the management of the ICBs, it is probable that the ICBs will not able to improve its business and make full use of any opportunity that will come its way. ICBs should keep abreast of current technological developments that

may affect their ability to move forward. Also, ICBs should always prepare themselves to face challenges and to be more receptive to the changes in the economy with the lower level efficiency that they possess. The most recent challenge that ICBs should be aware of is the issuance of new conditional licenses under the IBA and Takaful Act to allow qualified local and foreign lenders and even Takaful operators to conduct the full range of Islamic banking and Takaful business in foreign currencies by BNM. The lack of technological advancement, structure, capital and networking of the ICBs will definitely give the advantage of the announcement on the Islamic banking in foreign currencies to the CCBs. Action should be taken by the ICBs to enable them to operate at full efficiency levels to take up the challenges and opportunities, and to face the threat that will hinder the ICB to perform efficiently to ensure better performance in terms of efficiency.

CONCLUSION

TE was significantly influenced at significance level below 0.01, by bank size. In contrast, TE was insignificantly influenced by profitability. This explained that as TE[8] increased, the size of the bank increased significantly while the profitability of the banks increased insignificantly. Also, the NPLs are insignificantly positively associated to TE indicating that the more technically efficient the banks become, the higher the NPLs become. This is shown by the fact that, in Malaysia, no association was found between technological aspects of the production of outputs and NPLs.

Furthermore, it was found that as the banks are more technically efficient, the share of the deposits that the banks possess is lower. In addition, higher levels of TE (i.e. technological aspects of production of output) lead to lower bank capitalization. This signals that banks did not have the ability to control the level of banks' risk and the higher probability of banks going into default (Gambacorta and Mistrulli, 2003).

In measuring the effect of the bank's specific characteristics on PTE[9], it was found that capitalization has negatively associated at significance level below 0.05 to PTE. This indicates that although the banks possess high PTE, they may not have the ability to control the level of risk and this signifies the higher probability of a bank going into default (Gambacorta and Mistrulli, 2003).

Furthermore, in this study it was found that the bank size and NPLs are insignificantly negative associated to PTE. This explains that the lower the size of the banks, the higher the efficiency level of operations and management in Malaysian banks. In addition, the higher PTE of Malaysian banks lead to lower NPLs reported by the

[8] TE distinguishes the technological aspects of production from other aspects. When we discuss technology, this would relate to the knowledge, tools, equipment and work techniques of institutions (Bartol and Martin, 1998). The achievement (in terms of efficiency) in an institution may ensure that the customer value, satisfaction and quality are protected

[9] PTE identifies the source of inefficiency caused by the inefficient operations or management. Managerial and technological abilities are explained by Bartol and Martin (1998) as the main contributors to the transformation processes (i.e. in converting the inputs into outputs). The elements in the managerial and technological abilities include planning, organizing, leading, controlling and technology (Bartol & Martin, 1998). Thus, in the context of this study, the inefficient operations and management that lead to the pure technical inefficiency may involve inefficient planning, organizing, leading, controlling and technology

banks. However, the influences of bank size and NPLs on PTE are insignificant. Also, profitability and market power are insignificantly positively associated to PTE. The higher the profitability and market power that the banks' possessed lead to the higher efficiency level of operations and management though not at a significant level.

In measuring the effect of the bank's specific characteristics on SE, it was found that bank size and NPLs are positively associated at significance level below 0.01 and 0.05 respectively to SE. This explains that the higher the size of the bank, the higher the SE. In addition, the higher the NPLs the higher the SE. This may imply that larger banks possess high SE are due to their ability to obtain enough capital and management ability to successfully operate the banks. Furthermore, the positive association between NPLs and SE explains that the lower the sources of inefficiency caused by disadvantages displayed by the scale inefficiency (Cooper et al., 2000) lead to higher NPLs. This evidenced that in Malaysia, the advantageous condition displayed by the SE are not associated to NPLs.

Market power is negatively associated at significance level below 0.01 to SE. This implies that the market power decreases when the SE increases. Although the bank manages to avoid the disadvantageous display by SE, it did not have a large amount of deposits. Capitalization is insignificantly positive associated to SE. This implies that the capitalization increases when the SE increases. This evidenced that banks that manage to avoid the disadvantageous display by SE, they may have the ability to control for the level of risk and thus signifies the lower probability of a bank going into default (Gambacorta and Mistrulli, 2003).

Profitability is insignificantly negatively associated to SE. The negative association between profitability and SE could be due to the pattern of efficiency levels in Malaysia where some Malaysian banks that possess high efficiency levels are experiencing DRS where cost increases with the scale of production. Thus, higher cost will lower the profitability of the scale efficient banks. The cost includes the cost of NPLs.

BIBLIOGRAPHY

Abul Hasan Muhammad Sadeq. (1990). *Economic Development in Islam*. Kuala Lumpur: Pelanduk Publications.

Afifi, A.A., & Clark, V. (1996). *Computer-Aided Multivariate Analysis* (3rd Ed.). US: Chapman & Hall.

Akhtar, M.H. (2002, October). *X-Efficiency Analysis of Commercial Banks in Pakistan: A Preliminary Investigation*. Retrieved April 20, 2005. http://www.pide.org.pk/

Al-Faraj, T.N., Alidi, A.S., & Bu-Bshait, K.A. (1993). Evaluation of Bank Branches by Means of Data Envelopment Analysis. *International Journal of Operations & Production Management*, 13(9), 45-52

Al-Osaimy, M.H., Bamakhramah, A.S. (2004). An Early Warning System for Islamic Banks Performance. *Islamic Economics*, 17(1). 3-14.

Aly, H.Y., Grabowski, R., Pasurka, C. & Rangan, N. (1990). Technical, Scale and Allocative Efficiencies in US Banking an Empirical Investigation. *Review of Economics and Statistics*, 72, 211-218.

Amrizal Amir, & Wan Nursofiza Wan Azmi. (2004), X-efficiency of Bank Islam Malaysia Berhad (BIMB): A Prelimenary Study. Paper presented at The National Seminar in Islamic Banking & Finance (iBAF) 2004: The Global Challenges and Competitiveness of Malaysian Financial Institutions, Malaysia.

Anthanassopoulos, A.D. & Giokas, D. (2000). The use of Data Envelopment Analysis in banking institutions: Evidence from the Commercial Bank of Greece. *Interfaces*, 30(2), 81-95.

Avkiran, N.K. (1999). The Evidence on Efficiency Gains: The Role of Mergers and the Benefits to the Public. *Journal of Banking and Finance*, 23, 991-1013.

Ayadi, O.F., Adebayo, A.O. & Omolehinwa, F. (1998). Bank Performance Measurement in a Developing Economy: An Application of Data Envelopment Analysis. *Managerial Finance*, 24(7), 5-16.

Bank Negara Malaysia (BNM) Annual Report 2000. (2000). Retrieved September 10, 2005. http://www.bnm.gov.my

Banker, R.D., Charnes, A. & Cooper, W.W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, 30(9), 1078-1092.

Bartol, K.M. & Martin, D.C. (1998). *Management* (3rd edn.). USA: The McGraw-Hill Companies.

Bashir, A.-H. M. (1997). Islamic Political Economy in Capitalist Globalization – Agenda for Change. In Choudhury, M.A., Abdad, M.Z. & Muhammad Syukri, S. (eds.), *Measuring the Performance of Islamic Banks: The Case of Sudan* (pp. 319-332). Kuala Lumpur: Utusan Publication & Distributors Sdn. Bhd.

Bashir, A.-H. M. (2000). *Assessing the Performance of Islamic Banks: Some Evidence from the Middle East*. Retrieved June 13, 2005. http://www.sba.luc.edu/orgs/meea/volume3/revisedbashir.htm

Batchelor, V.B. (2006, February). Comparable Measurement of Bank Productivity within a Dual Islamic and Conventional Banking System. Paper presented at the 2nd International Research Conference on Islamic Banking and Risk Management, Regulation and Supervision, Kuala Lumpur, Malaysia.

Berger, A.N. & DeYoung, R. (1997). Problem Loans and Cost Efficiency in Commercial Banks. *Journal of Banking and Finance*, 21, 1-29.

Berger, A.N. & Humphrey, (1997). Performance of Financial Institutions: Efficicency, Innovation, Regulation. In Harker, P.T. & Zenios, S.A. (eds.), *Efficiency of Financial Institutions: International Survey and Directions for Future Research* (pp. 32-92).USA: Cambridge University Press.

Berger, A.N., & Mester, L.J. (1997). Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions. *Journal of Banking and Finance*, 21, 895-947.

Camanho, A.S., & Dyson, R.G. (1999). Efficiency, Size, Benchmarks and Targets for Bank Branches: An Application of Data Envelopment Analysis. *Journal of the Operational Research Society*, 50, 903-915.

Case, K.E. & Fair, R.C. (1996). *Principles of Economics* (4th edn.). New Jersey: Prentice-Hall International, Inc.

Central Bank of Malaysia Act (Revisited). (1958). Retrieved January 2, 2006. http://www.bnm.gov.my/index.php?ch=14&pg=17&ac=13&full=1

Chen, T. (2002). A Comparison of Chance-Constrained DEA and Stochastic Frontier Analysis: Bank Efficiency in Taiwan. *Journal of the Operational Research Society*, 53, 492-500.

Coelli, T. & Walding, S. (n.d.). *Performance Measurement in the Australian Water Supply Industry: A Preliminary Analysis*. Retrieved July 15, 2006. http://www.abs.aston.ac.uk/newweb/research/cepmma/CP/my_document/my_files/Tim%20Coelli.pdf

Coelli, T.J. (1996). A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program. Centre for Efficiency and Productivity Analysis (CEPA) Working Paper No. 8/96, University of New England.

Cooper, W.W., Seiford, L.M., & Tone, K. (2000). *Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software*. Massachusetts: Kluwer Academic Publisher.

Darrat, A.F. (2000). On the Efficiency of Interest-Free Monetary System: A Case Study. Preliminary draft submitted for possible presentation for the ERF 7th Annual Conference, October 26th – 29th, 2000, Amman, Jordan.

Darrat, A.F., Topuz, C., & Yousef, T. (2002, January). Assessing Cost and Technical Efficiency of Banks in Kuwait. Paper presented to the ERF's 8th Annual Conference in Cairo.

DeVaus, D. (2000). *Analyzing Social Science Data: 50 Key Problems in Data Analysis*. London: Sage Publication.

Dogan, E., & Fausten, D.K. (2003). Productivity and Technical Change in Malaysian Banking: 1989-1998. *Asia-Pacific Financial Markets*, 10, 205-237.

Drake, L., & Howcroft, B. (2002). An Insight into the Size Efficiency of a UK Bank Branch Network. *Managerial Finance*, 28(9), 24-36.

El-Gamal, M. A., & Inanoglu, H. (2002, August). Efficiency vs. Heterogeneous Technologies in the Turkish Banking: 1990-2000. Rice University, Economic Working Paper.

Elhiraika, A.B. (1999). The 1997-98 East-Asian Financial Crises: An Islamic Perspective. ERF Working Paper Number 199936.

Fadzlan Sufian., & Suraya Ibrahim. (2005). An Analysis of the Relevance of Off-Balance Sheet Items in Explaining Productivity Change in Post-Merger Bank Performance: Evidence of Malaysia. *Management Research News*, 28(4), 74-92.

Gambacorta, L. & Mistrulli, P.E. (2003, February). *Bank Capital and Lending Behavior: Empirical Evidence for Italy. Paper presented in European Economic Association & Econometric Society on 20th – 24th August 2003, Stockholm*. Retrieved August 27, 2006. http://www.bis.org/

Giokas, D. (1991). Bank Branch Operating Efficiency: A Comparative Application of DEA and the Loglinear Model. *Omega International Journal of Management Sciences*, 19, 549-557.

Grigorian, D.A., & Manole, V. (2002, June). Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis. World Bank Policy Research Working Paper 2850. Retrieved April 26, 2005. http://ssrn.com

Guan, H.L., & Randhawa, D.S. (2005). Competition, Liberalization and Efficiency: Evidence from a Two-Stage Banking Model on Banks in Hong Kong and Singapore. *Managerial Finance*, 31(1), 52-77.

Guan, H.L., Randhawa D.S., & Wee, C.H., Raymond. (2004, June & July). *The Role of Anchor Banks and Efficiency of Bank Consolidation: Evidence from Malaysia. Draft of paper submitted for considerations for the EFMA Annual Meetings, Basel, Switzerland*. Retrieved April 26, 2005. http://ssrn.com

Gujarati, D.N. (2003). *Basic Econometric (International Ed.).* New York: McGraw-Hill.

Haslem, J.A., Scheraga, C.A., & Bedingfield, J.P. (1999). DEA Efficiency Profiles of U.S. Banks Operating Internationally. *International Review of Economics and Finance*, 8, 165-182.

Hassan, M.K. (2005, December). The Cost, Profit and X-Efficiency of Islamic Banks. Paper presented at 12th ERF Conference Paper, Cairo.

Hassan, M.K., & Bashir A.M. (1999). Determinants of Islamic Banking Profitability. ERF Working Paper Series.

Isik, I., & Hassan, M.K. (2002). Cost and Profit Efficiency of the Turkish Banking Industry: An Empirical Investigation. *The Financial Review*, 37, 257-280.

Isik, I., & Hassan, M.K. (2003). Efficiency, Ownership and Market Structure, Corporate Control and Governance in Turkish Banking Industry. *Journal of Business Finance & Accounting*, 30(9 & 10), 1363-1421.

Jemric, I., & Vujcic, B. (2002). Efficiency of Bank in Croatia: A DEA Approach. *Comparative Economic Studies*, 44(2/3), 169-193.

Katib, M.N. (1999, June). Technical Efficiency of Commercial Banks in Malaysia. *Banker's Journal Malaysia*, 111, 40-53.

Krishnasamy, G., Alfieya Hanuum Ridzwa., & Perumal, V. (2003). Malaysian Post Merger Bank's Productivity: Application of Malmquist Productivity Index. *Managerial Finance*, 30(4), 63-74.

Leong, W.H., Dollery, B., & Coelli, T. (2003). Measuring Technical Efficiency of Banks in Singapore for the Period 1993-99: An Application and Extension of the Bauer et al. (1997) Technique. *ASEAN Economic Bulletin*, 20(3), 195-210.

Limam, I. (2001). A Comparative Study of GCC Banks' Technical Efficiency. Economic Research Forum (ERF) Working Paper Series Number 200119.

Luo, X. (2003). Evaluating the Profitability and Marketability Efficiency of Large Banks: An Application of Data Envelopment Analysis. *Journal of Business Research*, 56, 627-635.

Maghyereh, A. (n.d.). *The Effect of Financial Liberalization of the Efficiency of Financial Institutions: the case of Jordanian Commercial Banks.* Retrived February 10, 2006. http://207.36.165.114/Zurich/Papers/520018.pdf

Miller, S.M., & Noulas, A.G. (1996). The Technical Efficiency of Large Bank Production. *Journal of Banking & Finance*, 20, 495-509.

Mohd Zaini Abd. Karim. (2001, December). Comparative Bank Efficiency across Select ASEAN Countries. *ASEAN Economic Bulletin*, 18(3), 289-304.

Molyneux, P., & Iqbal, M. (2005). *Thirty Years of Islamic Banking: History, Performance and Prospects*. New York: Palgrave Macmillan.

Mukherjee, K., Ray, S.C., & Miller, S.M. (2001). Productivity Growth in Large US Commercial Banks: The Initial Post-deregulated Experience. *Journal of Banking & Finance*, 25, 913-939.

Naughton, S., & Shanmugam, B. (1990). Interest-Free Banking: A Case of Malaysia. *Journal of Islamic Banking and Finance*: 40-57

Neal, P., (2004). X-Efficiency and Productivity Change in Australian Banking. *Australian Economic Papers*, 13(2), 174-191.

Norashfah Yaakop Yahaya Al'Haj. (2005, May). X-efficiency and Technological Innovation in Malaysian Banks. Presented in the Malaysian Finance Association 7th Annual Conference Consolidation and Prudent Financial Management: Roads to Malaysian Economic Prosperity, Terengganu, Malaysia.

Noulas, A. (1997). Productivity Growth in the Hellenic Banking Industry: State vs. Private Bank. *Applied Financial Economy*, 7, 223-228.

Okuda, H. & Hashimoto, H. (2004). Estimating Cost Functions of Malaysian Commercial Banks: The Differential Effects of Size, Location, and Ownership. *Asian Economic Journal*, 18(3), 233-259.

Oral, M., & Yolalan, R. (1990). An Empirical Study on Measuring Operating Efficiency and Profitability of Bank Branches. *European Journal of Operational Research*, 46, 282,-294.

Paradi, J.C., & Schaffinit, C. (2004). Commercial Branch Performance Evaluation and Results Communication in a Canadian Bank – A DEA Application. *European Journal of Operational Research*, 156, 719-735.

Pellegrina, L.D. (2005, February). Capitalization Requirements, Efficiency and Governance: A Comparative Experiment on Islamic and Western Banks. Paper Presented at the International Conference on Islamic Banking Monash University, Prato, September 10, 2003.

Saaid, A.E., Saiful Azhar, Rosly., Mansor, H. Ibrahim. & Naziruddin, Abdullah. (2003). The X-Efficiency of the Sudanese Islamic Banks. *IIUM Journal of Economics and Management*, 11(2), 123-141.

Saiful Azhar Rosly, & Mohd Afandi Abu Bakar. (2003). Performance of Islamic and Mainstream Banks in Malaysia. *International Journal of Social Economics*, 30(11/12), 1249-1265.

SallehYahya., Hooy, C.W., & Goh, W.K. (2001). Rating of Malaysian Commercial Banks: A DEA Approach. *Banker's Journal Malaysia*, 118, 5-18.

Samad, A. (1999). Comparative Efficiency of the Islamic Bank Malaysia Vis-à-vis Conventional Banks. *IIUM Journal of Economics and Management*, 7(1), 1-25.

Samad, A., & Hassan, M.K. (1999). The Performance of Malaysia Islamic Bank during 1984-1997: An Exploratory Study. *International Journal of Islamic Financial Services*, 1(3), 3-11.

Samad, A. (2004). Performance of Interest-Free Islamic Banks Vis-à-vis Interest-Based Conventional Banks of Bahrain. *IIUM Journal of Economics and Management*, 12(2), 115-129.

Sathye, M. (2001). X-efficiency in Australian Banking: An Empirical Investigation. *Journal of Banking & Finance*, 25, 613-630.

Schaffnit, C., Rosen, D., & Paradi, J.C. (1997). Best Practice Analysis of Bank Branches: An Application of DEA in a large Canadian Bank. *European Journal of Operational Research*, 98, 269-289.

Shaari A. Hamid., & Fadhilah, Ahmad. (2001). Rating of Malaysian Commercial Banks: A DEA Approach. *Banker's Journal Malaysia*, 118, 5-18.

Sturm, J.E., & Williams, B. (2004). Foreign Bank Entry, Deregulation and Bank Efficiency: Lessons from Australian Experience. *Journal of Banking & Finance*, 28, 1775-1799.

Thanassoulis, E. (2001). *Introduction to the Theory and Application of Data Envelopment Analysis: A Foundation Test with Integrated Software*. Massachusetts: Kluwer Academic Publisher.

Wilson, R. (1995). Islamic Development Finance in Malaysia. In Al-Harran, S. (eds.), *Leading Issues in Islamic Banking & Finance* (pp.59-81). Kuala Lumpur: Pelanduk Publications.

Wong, S.S. (1995), Bank Islam Malaysia: Performance Evaluation, 1983-1993. In Al-Harran, S. (eds.), *Leading Issues in Islamic Banking & Finance* (pp. 83-101). Kuala Lumpur: Pelanduk Publications.

Yudistira, D. (2004, August). Efficiency in Islamic Banking: An Empirical Analysis of 18 Banks. *Islamic-Economic-Studies*, 12(1), 1-19.