# TRENDS IN THE EFFICIENCY OF PUBLICLY LISTED MALAYSIAN COMMERCIAL BANKS OVER-TIME: A NON-PARAMETRIC DEA WINDOW ANALYSIS APPROACH[1]

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## Abstract

This paper utilises the non-parametric Data Envelopment Analysis (DEA) window analysis method to investigate the long-term trend in efficiency change of listed Malaysian commercial banks during the period of 1992 to 2003. We find listed Malaysian commercial banks exhibited an average overall efficiency of 90.4% and that the inefficiencies were largely attributed to pure technical rather than scale. Our results showed that the small Malaysian commercial banks outperformed their large and very large counterparts though not significantly different. We found that the large and very large banks exhibited higher pure technical efficiency scores while the smaller banks outperformed their larger counterparts on scale efficiencies. We also found that while the smaller banking groups tend to operate at CRTS and IRTS, the large banking groups on the other hand tend to operate at DRTS and CRTS at best.

**Key words:** Banks' efficiency, DEA Window Analysis, Malaysia.
**JEL classification:** G21, G24

## 1. Introduction

Examining banking performance has been a common practice among banking and finance researchers for a number of years. The main reason for continued interest in this area of research is the ever-changing banking business environment throughout the world. To date, most studies on banks efficiency and productivity however have mostly confined to the developed countries[2]. The dearth of literature on the performance of the banking sector in developing countries could be due to the non-availability of data. The small sample size of developing countries banking system could be another reason for the dearth of analysis on the banking system efficiency in this part of the world.

The analysis of banks' efficiency levels continues to be important from both a microeconomic and macroeconomic point of views as is documented by its long tradition in the literature[3]. From the micro perspective, the issue of banking efficiency is crucial, especially for developing countries, given increasing competition and measures to further liberalise the banking system, which render the issue of reducing the underperformance of the banking sector one of the main priorities for the financial sector. From the macro perspective, the efficiency of the banking sector influences the costs of financial intermediation and the overall stability of the financial markets. For developing countries, improvements in the banking sector could have a significant impact on the allocation of financial resources since this sector remains, still the most important source of financing private investment of firms, given the underdevelopment of the financial markets.

The aim of this paper is therefore twofold: firstly, despite the importance of the Malaysian banking sector to the domestic and regional economy and the mounting evidence on banks x-efficiency in other developed and developing economies, there are only a few microeconomic studies performed

[1] Another version of this paper was presented at the AFA/FMA 2005 Conference in Kuala Lumpur, Malaysia, July 11-13, 2005. The author would thank the discussant and participants at the AFA/FMA 2005 Conference for helpful comments and suggestions.
[2] Berger and Humphrey (1997) surveyed 130 studies that apply frontier efficiency analysis to investigate the efficiency of financial institutions in 21 countries. They report that the majority of these studies are confined to the U.S. banking sector and call for the need to examine the efficiency of financial institutions outside the U.S.
[3] For an overview see Berger and Mester (1997).

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in this area of research particularly with respect to efficiency studies. Although there exist some studies that have examined the performance of commercial banks in Malaysia, there is currently no study that have analysed a long time period, enough to shed some light on the trends in the efficiency changes of Malaysian banks over time.

This paper thus attempts to investigate the efficiency of Malaysian commercial banks over time by employing the Data Envelopment Analysis (DEA) window analysis approach, during the period of 1992 to 2003, a twelve yearly period, which has witnessed tremendous transformations in the Malaysian banking sector. The twelve-year range covered in this study also encapsulates significant changes in economic climate, in which Malaysian commercial banks have experienced both difficult and profitable operating periods.

While there exist a few studies that investigate publicly listed commercial banks efficiency, the studies have so far been confined to developed markets and we could not find a study that investigates listed commercial banks efficiency studies in the literature with respect to developing markets[1]. Furthermore, to the best of our knowledge at the point of writing, this would be the first study that employs DEA window analysis technique to investigate listed commercial banks efficiency. This study would thus fill a demanding gap in that case and to contribute further to the literature within the context of a developing economy and emerging market by providing the most recent evidence on the performance of Malaysian commercial banks, in particular the publicly listed banks.

Secondly, the paper aims to provide evidence on the nature of returns to scale of Malaysian banks. Given the recent mega-merger program initiated by the Malaysian government to strengthen the banking sector to face future challenges, understanding the precise nature of scale efficiency in the industry is critically important both to comprehend the economic rationale behind the industry's movement to consolidation and to prescribe policy going forward. Study in this nature is also of utmost importance to shed some light on the impact of the merger particularly on the returns to scale of Malaysian commercial banks.

Although a good deal of empirical analyses have been conducted into the returns to scale of U.S. and European countries banking sector, to the best of our knowledge, this issue, which is of great importance, has not been examined in previous research with respect to the Malaysian commercial banks. This dearth of analysis is possibly due to the relatively small sample size of Malaysian banks relative to U.S. and European banks. Viewed in this context therefore, the study provides some extremely important insights on the rationale behind the recent structural changes that are shaping the Malaysian banking industry and into the nature of returns to scale in Malaysian banking arising from the recent consolidation in the domestic banking arena.

Notwithstanding, the study also has important public policy implications, particularly with respect to the principal aim of the Malaysia's Financial Sector Master Plan (FSMP), a long-term development plan charting the future direction of the financial services industry in Malaysia to achieve a more competitive, resilient and efficient financial system[2]. The study could thus help the regulatory authorities in determining the future course of action to be pursued to further strengthen the Malaysian banking sector in particular the domestic incorporated commercial banks to meet the challenges of foreign banks entry from 2007 onwards[3].

Whilst the study has important public policy implications, the importance of this study would not only be limited to regulators and policymakers but to investments analysts, industry consultants and shareholders alike. As banks with higher efficiency scores tend to post higher profits (see Beccali *et al.*, 2005), it could be argued that the listed banks performance/efficiency may in future reflect the banks ability to pay higher dividends as dividends are expected to be paid out of net

[1] See Beccali *et al*. (2005) on European banks, Chu and Lim (1998) on Singapore banks, Adenso-Diaz and Gascon (1997) and Eisenbeis *et al.* (1999) on U.S. banks.
[2] Bank Negara Malaysia Financial Sector Masterplan (2001).
[3] As part of Malaysia's World Trade Organisation (WTO) commitment to further liberalised the banking sector and to give the foreign banks completely open access to the Malaysian markets by the end of 2006.

profits (Chu and Lim, 1998). Furthermore, as DEA window analysis reflects banks' efficiency stability overtime, it could be argued that banks with stable efficiency scores overtime worth considering for the longer-term investors.

The paper is structured as follows: The next section provides an overview of the Malaysian banking system. Section 3 reviews related studies in the main literature with respect to the study on banks efficiency. Section 4 outlines the approaches to the measurement and estimation of efficiency change. Section 5 discusses the results and finally section 6 provides some concluding remarks and suggestions for future research.

## 2. Overview of the Malaysian Banking Industry

In Malaysia, as in other developing economies, the banking system plays an important role in the economy by channelling funds from those who have excess funds to those who have productive needs for those funds. Unlike in other developed nations, where financial markets, as well as the banking system, work in unison to channel those funds, in developing countries, however, financial markets are undersized and sometimes completely absent. It falls on the banks to bridge the gap between savers and borrowers and to perform all tasks associated with the profitable and secure channelling of funds.

Two episodes of economic turbulence, the economic downturn of 1985-1986 and the financial crisis of 1997-1998 during the past decade, have resulted in commercial banks in Malaysia to suffer from high rates of non-performing loans arising from over exposure to the property sector in the early 1980s and imprudent exposure to share-based financing (BNM, 1999). The commercial banks again suffered from surging levels of non-performing loans and significant erosion of capital due to large provisions made against bad debts and interest-in-suspense resulted from the financial crisis in 1997-1998, which amounted close to 40% compared to only about 17% in 1985-1986 (Ito and Hashimoto, 2002).

Despite having entered the financial crisis in 1997 from a position of strength, the severity of the crisis had weakened the health of the banking sector, as reflected by the deterioration in the capitalisation and asset quality. In recognising this problem and anticipation of further adverse implications of the crisis on the banking system, the Malaysian central bank, Bank Negara Malaysia (BNM) has taken a four-pronged pre-emptive measure, to strengthen the resilience of the banking sector. This involved a merger program, the setting up of an asset management company (Pengurusan Danaharta Nasional Berhad), a special purpose vehicle to recapitalise the banking institutions (Danamodal Nasional Berhad) and the Corporate Debt Restructuring Committee (CDRC).

In order to minimise the potential impact of systemic risks on the banking sector as a whole, following the deepening of the financial crisis, the Government took stronger measures to promote (force) merging of banking institutions. Subsequently, ten banking groups were formed intended to avoid the turmoil in the financial markets due to the drastic reduction of financial institutions. The ten banking groups or anchor banks are: Malayan Banking Berhad, RHB Bank Berhad, Public Bank Berhad, Bumiputra-Commerce Bank Berhad, Multi-Purpose Bank Berhad, Hong Leong Bank Berhad, Affin Bank Berhad, Arab-Malaysian Bank Berhad, Southern Bank Berhad and EON Bank Berhad. Each bank had minimum shareholders' funds of Ringgit Malaysia (RM) 2 billion and asset base of at least RM 25 billion. Together, the 10 commercial banks controlled about 80 percent of the market for deposits and loans. With the exception of Multi-Purpose Bank Berhad, all other banking groups are currently listed on the local bourse, the Kuala Lumpur Stock Exchange (KLSE).

The merger program for domestic banking institutions, initiated in 1999 was finally concluded in 2001. The ten anchor banks emerged having complied with all the requirements of anchor bank status, such as minimum capitalisation, total asset size, and other prudential requirements. The focus of the domestic banking groups entered the next stage to complete the business integration processes and rationalisation exercises, e.g., branch, workforce, etc.

Table 1

Malaysian Banks Mergers and Acquisitions

| Anchor Banks | Banks Acquired | Finance Companies Acquired | Merchant Banks Acquired | Anchor's 30 June '00 Total Assets RMb | Post-Merger Assets Rmb | % of Systems Assets |
|---|---|---|---|---|---|---|
| Maybank | The Pacific Bank<br>Phileo Allied Bank | Mayban Finance*<br>Kewangan Bersatu<br>Sime Finance* | Aseambankers Malaysia* | 127 | 150 | 24.0 |
| Bumiputra-Commerce Bank | N.A. | Bumiputra-Commerce Finance* | Commerce International Merchant Bankers* | 63 | 67 | 10.7 |
| RHB Bank | N.A. | Interfinance<br>Delta Finance | RHB Sakura Merchant Bankers* | 51 | 56 | 9.0 |
| Public Bank | Hock Hua Bank | Public Finance*<br>Advance Finance | Sime Merchant Bankers | 43 | 50 | 8.0 |
| Arab-Malaysian Bank[1] | N.A. | Arab-Malaysian Finance* | Arab-Malaysian Merchant Bank* | 11 | 39 | 6.2 |
| Hong Leong Bank | Wah Tat Bank | Hong Leong Finance*<br>Credit Corporation | | 29 | 35 | 5.6 |
| Multi-Purpose Bank | International Bank Malaysia<br>Sabah Bank | Sabah Finance<br>Bolton Finance | Bumiputra Merchant Bankers<br>Amanah Merchant Bank | 9 | 14 | 2.2 |
| Affin Bank[2] | BSN Commercial Bank | Affin Finance*<br>BSN Finance | Perwira Affin Merchant Bankers*<br>BSN Merchant Bank | 15 | 30 | 4.8 |
| Southern Bank | Ban Hin Lee Bank | Perdana Finance<br>Cempaka Finance<br>United Merchant Finance | Perdana Merchant Bankers | 24 | 25 | 4.0 |
| EON Bank | Oriental Bank | EON Finance*<br>City Finance<br>Perkasa Finance | Malaysia International Merchant Bankers | 14 | 25 | 4.0 |

* – Originally part of the anchor bank's wider group
Source: Bank Negara Malaysia.

[1] The merger between Utama Banking group, comprising Bank Utama and Utama Merchant Bank with Arab-Malaysian banking group did not proceed due to a disagreement over the ultimate control of the merged entity initially.
[2] Another merger that failed to materialize was that of Multi-Purpose Bank and MBf Finance due to Multi-Purpose Bank's minority shareholders balking at the price involved. The Arab-Malaysian Banking Group however acquired MBf Finance from Danaharta.

## 3. Banking Efficiency Studies Utilising DEA Window Analysis Approach

Although studies investigating banks efficiency by DEA are voluminous, there are only a few papers, which have utilised the DEA window analysis approach to banking (see Avkiran, 2004; Reisman *et al.*, 2003; Webb, 2003 and Hartman and Storbeck, 1996). Asmild *et al.* (2004) combined a DEA like Malmquist Productivity Index with DEA window analysis on a sample of five Canadian banks over a 20-year period.

Applying a three-year window to a sample of 10 Australian trading banks during the period of 1986-1995, Avkiran (2004) found that Australian trading banks have exhibit deteriorating efficiency levels during the earlier part of the studies, before progressively trending upwards in the latter part. During the period of study, he found that interest expenses to be the main source of inefficiency of Australian trading banks. He suggests that most Australian banks have exhibited CRTS during the early period, DRTS and IRTS in the early 1990s and turned to exhibit CRTS during the latter part of the studies.

Webb (2003) utilises DEA window analysis to investigate the relative efficiency levels of large UK retail banks during the period of 1982-1995. Following the intermediation approach, three inputs are considered namely deposits, interests expense and operational expenses while total income and total loans are outputs. He found that during the period the mean inefficiency levels of UK retail banks were low compared to past studies on UK banking industry. He suggested that the overall long run average efficiency level was falling and that all the six large UK banks showed declining levels of efficiency over thee entire period. He concludes that scale inefficiency dominates pure technical inefficiencies; less big banks are more likely to report technical inefficiency; and during the period of study banks with asset levels over £105 billion suffer declining returns to scale (DRTS).

Reisman *et al.* (2003) investigate the impact of deregulation on the efficiency of eleven Tunisian commercial banks during 1990 to 2001. Applying three inputs namely fixed assets, number of employees, and deposits and loans and securities portfolios as outputs, they followed the intermediation approach to DEA with an extended window analysis. They find that deregulation had a positive impact on Tunisian commercial banks overall efficiency. They suggest that public banks outperformed private banks in transforming deposits into loans. The decomposition of overall efficiency into its pure technical and scale efficiency components indicates that private banks experienced predominantly pure technical inefficiency during the period. The public banks on the other hand were pure technically inefficient during the early period, which was mostly, scale inefficient towards the end of the period of study. They also suggest that both public and private banks were inefficient in their investments.

### *3.1. Studies on Malaysian commercial banks efficiency and productivity*

Despite substantial studies performed in regard to the efficiency and productivity of financial institutions in the U.S., Europe and other Asia-Pacific banking industries, the Malaysian banking industry has not followed suite partly due to the lack of available data sources and the small sample of banks. As pointed by Kwan (2003), the reason for the lack of research on the efficiency of Asian banks is due to the lack of publicly available data for non-publicly traded Asian financial institutions.

Among the notable microeconomic research performed on Malaysian banks' efficiency was by Katib and Mathews (2000), which studied the characteristics of the management structure and technical efficiency of the banking industry in Malaysia by DEA from 1989 to 1995. Okuda and Hashimoto (2004) conducted a research on the production technology of Malaysian domestic commercial banks with Stochastic Cost Functions approach adjusted to non-performing loans from the year 1991 to 1997.

More recently, Krishnasamy *et al.* (2004) have investigated Malaysian banks post-merger productivity changes. Applying two inputs, namely labour and total assets and loans and advances and total deposits as outputs, they found that during the period of 2000-2001, post-merger Malaysian

banks had achieved a total factor productivity growth of 5.1%. They found that during the period, eight banks posted positive total productivity growth ranging from 1.3% to 19.7%, one bank exhibited total factor productivity regress of 13.3% and a bank was stagnant. The merger has not resulted in better scale efficiency of Malaysian banks as all banks exhibit scale efficiency regress with exception of two banks. The results also suggest rapid technological change of post-merger Malaysian banks ranging from 5.0% to 16.8%. Two banks however experienced technological regress during the period of study.

## 4. Data and Methodology

Following Avkiran (2004), Reisman *et al.* (2003) and Webb (2003) among others, a non-parametric method, DEA, will be used in measuring the efficiency of the Malaysian banks. The method allows for the decomposition of the efficiency and productivity differences into one representing the banks' efficiency and productivity levels relative to their peers best practice frontiers. The DEA is a linear (mathematical) programming technique which forms a non-parametric surface/frontier (more formally a piecewise-linear convex isoquant) over the data points to determine the efficiencies of each DMU relative to this frontier. DEA has the advantage of being able to handle multiple inputs and outputs stated in different measurement units. It focuses on a best-practice frontier, rather than population central tendencies and does not require a functional form to be imposed relating to inputs and outputs (Charnes *et al.*, 1995). The relative efficiency of each bank in ratio form, where for each bank we obtain a ratio of all outputs over all inputs, is specified as follows:

$$\max \lambda_0 \theta_0 \tag{1}$$

$$\text{subject to } \sum_{j=1}^{n} \lambda_{0j} y_{rj} \geq y_{r0} \qquad (r = 1,\ldots..,s)$$

$$\theta_0 x_{i0} \geq \sum_{j=1}^{n} \lambda_{0j} x_{ij} \qquad (i = 1,\ldots..,n)$$

$$\sum_{j=1}^{n} \lambda_{0j} \leq 1$$

$$\lambda_{0j} \geq 0 \qquad (j = 1, \ldots..,n)$$

The main reason for choosing the DEA approach is the expressed interest in the Malaysian banking industry of reducing costs in the recent years owing to the increased competition fostered by liberal policies. Furthermore, DEA permits a researcher to investigate the relative efficiency among DMUs and allows the study to focus on the input savings efficiency, which can further be detailed into its pure technical and scale efficiency components. Hence, through input oriented DEA, we can dwell on the sources of input waste among Malaysian banks and draw some policy conclusions.

### *4.1. DEA Window Analysis*

In order to capture the variations of efficiency over time, Charnes *et al.* (1985) proposed a technique called 'window analysis' in DEA. The window analysis assesses the performance of a DMU over time by treating it as a different entity in each time period. This method allows for tracking the performance of a unit or DMU over time and provides a better degree of freedom (Avkiran, 2004 and Reisman, 2003). If a DMU is found to be efficient in one year despite the window in which it is placed, it is likely to be considered strongly efficient compared to its peers (Avkiran, 2004).

As there is no theory or justification that underpins the definition of the window size (Tulkens and van den Eeckaut, 1995), this paper utilises a three-year window, which is consistent with the origi-

nal work by Charnes *et al.* (1985). Furthermore, Avkiran (2004), Webb (2003) and Reisman (2003) have also utilised a three-year window to investigate banks' efficiency in Australia, U.K. and Tunisia respectively.

As Table 2 below illustrates the first window incorporates years 1992, 1993 and 1994. When a new period is introduced into the window, the earliest period is dropped. In window two, year 1992 will be dropped and year 1995 will be added to the window. Subsequently in window 3, years 1994, 1995 and 1996 will be assessed. The analysis is performed until window 10 analyses years 2001, 2002 and 2003. As DEA window analysis treats a DMU as different entity in each year, a three-year window with eight DMUs is equivalent to 24 DMUs. Subsequently, by applying a 10, three-year window, would considerably increase the number of observations of the sample to 240, providing a greater degree of freedom.

Table 2

Window Breakdown

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Window 1 | 1992 | 1993 | 1994 | | | | | | | | | |
| Window 2 | | 1993 | 1994 | 1995 | | | | | | | | |
| Window 3 | | | 1994 | 1995 | 1996 | | | | | | | |
| Window 4 | | | | 1995 | 1996 | 1997 | | | | | | |
| Window 5 | | | | | 1996 | 1997 | 1998 | | | | | |
| Window 6 | | | | | | 1997 | 1998 | 1999 | | | | |
| Window 7 | | | | | | | 1998 | 1999 | 2000 | | | |
| Window 8 | | | | | | | | 1999 | 2000 | 2001 | | |
| Window 9 | | | | | | | | | 2000 | 2001 | 2002 | |
| Window 10 | | | | | | | | | | 2001 | 2002 | 2003 |

The definition and measurement of inputs and outputs in the banking function remain a contentious issue among researchers. To determine what constitutes inputs and outputs of banks, one should first decide on the nature of banking technology. In the banking theory literature, there are two main approaches competing with each other in this regard: the production and intermediation approaches (Sealey and Lindley, 1977).

For the purpose of this study, a variation of the intermediation approach or asset approach originally developed by Sealey and Lindley (1977) will be adopted in the definition of input and output definition[1]. According to Berger and Humphrey (1997), the production approach might be more suitable for branch efficiency studies as at most times bank branches basically process customer documents and bank funding, while investment decisions are mostly not under the control of branches. Furthermore, Sathye (2001) also noted that this approach is more relevant to financial institutions as it is inclusive of interest expenses, which often accounts for one-half to two-thirds of total costs depending on the phase of the interest rate cycles.

The aim in the choice of variables for this study is to provide a parsimonious model and to avoid the use of unnecessary variables that may reduce the degree of freedom[2]. Accordingly, we model commercial banks as multi-product firms, producing 3 outputs and employing 2 inputs. All variables are measured in millions of Ringgit. The input vector includes (*x1*) *Total Deposits*, which include deposits from customers and other banks and (*x2*) *Interest Expenses* while (*y1*) *Total Loans*, which include loans to customers and other banks and (*y2*) *Interest Income* are the output

[1] Humphrey (1985) presets an extended discussion of the alternative approaches over what a bank produces.
[2] See Avkiran (2002) for discussion on the optimal number of inputs and outputs in DEA.

vectors. The variables selected for this study could be argued to fall under the intermediation approach to modelling bank behaviour.

To recognise that banks in recent years have increasingly been generating income from 'off-balance sheet' business and fee income generally, following Drake and Hall (2003) and Isik and Hassan (2003) among others, (*y3*) *Non-Interest Income* would be incorporated as a proxy to non-traditional activities as output. Non-interest income is defined as fee income, investment income and other income, which among others consists of commission, service charges and fees, guarantee fees, net profit from sale of investment securities and foreign exchange profit.

For the empirical analysis, *all* Malaysian commercial banks that are publicly listed on the KLSE from 1992-2003 would be used (see Table 3)[1]. During the study period, banks that were acquired or failed are dropped from the sample so that the final sample contains only surviving banks as of 2003. So as to focus on commercial banks and to maintain homogeneity, only commercial banks that make commercial loans and accept deposits from the public are included in the analysis. Therefore, Malaysian Islamic Banks, Development Banks, Investment Banks, Export-Import Banks and Cooperative Banks are excluded from the sample. The annual balance sheet and income statement used to construct the variables for the empirical analysis were taken from published balance sheet information in annual reports of each individual bank.

Table 3

Sample Banks Summary Statistics

| Banks | Share Capital ('000) | Market Capital (RM'm) | Total Assets (RM'm) | Abbreviation Used |
|---|---|---|---|---|
| AMMB Holdings Bhd | 1,706.00 | 5,288.70 | 58,553.84 | AHB |
| Affin Holdings Bhd | 993.50 | 1,063.00 | 35,360.50 | AMB |
| Commerce Asset Holdings Bhd | 2,593.10 | 10,631.70 | 97,933.98 | CAH |
| Hong Leong Bank Bhd | 1,435.00 | 7,461.70 | 43,568.60 | HLB |
| Maybank Bhd | 3,589.50 | 34,638.30 | 160,955.41 | MBK |
| Public Bank Bhd | 3,175.50 | 17,973.40 | 64,640.32 | PBK |
| RHB Capital Bhd | 1,823.50 | 3,792.80 | 69,485.70 | RHB |
| Southern Bank Bhd | 1,122.90 | 2,874.50 | 29,787.18 | SBK |

## 5. Empirical Results

As has been stated earlier, the study will be the first in the literature that investigates the efficiency of listed commercial banks in a developing economy. Therefore, the results reported below provide valuable information on the efficiency of publicly listed commercial banks in a developing economy particularly the Malaysian listed commercial banks. The DEA model is applied in 10, three-year window and the results are reported for the general trend in overall efficiency for each window and then decomposed into pure technical and scale efficiency.

The average of all scores, for each bank, is given in the column denoted "Mean". The column labelled "SD" indicates the standard deviation for the score of each bank during the entire period. The column labelled "LDY" indicates the largest difference in a bank's scores in the same year but in different windows. The column labelled "LDP" indicates the largest difference in a bank's scores for the entire period. A bank can have different efficiency scores in different windows. A bank that is efficient in one year regardless of the window is said to be stable in its efficiency rating (Cooper *et al.*, 2000). Charnes *et al.* (1985) have also suggested that a low mean efficiency tended to be accompanied by high variance.

[1] Eon Capital Berhad was not included in the analysis as the bank was listed only since 2002.

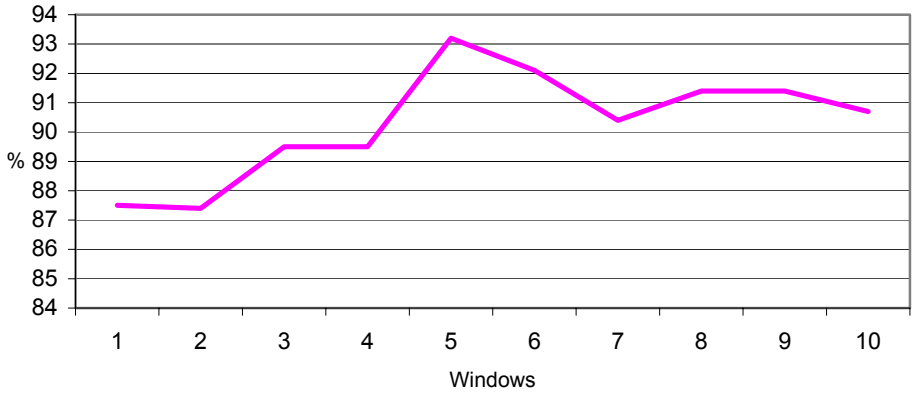


Fig. 1. Mean Overall Efficiency Levels of Publicly Listed Malaysian Commercial Banks

### *5.1. General Trends*

Looking at the average overall efficiency levels for each window in Figure 1, it is clear that Malaysian banks average efficiency levels were on the uptrend in windows 2 and 3, stabilising at the 90% levels in window 3 and 4, before staging upwards again in window 5. The overall efficiency level however declined slightly in window 6 and dropped further in window 7. One clear reason for the decline in efficiency levels of Malaysian banks during this period was due to the inclusion of year 1997 and year 1998 in the windows, which was marked as a period of economic instability brought about by the Asian Financial Crisis that struck the region during 1997 to 1998. The results thus indicate the importance of external shocks, such as downturn in the economy in negatively affecting banks operations and thus efficiency. In tandem with the economic recovery, Malaysian banks average overall efficiency levels recovered in window 8 and stabilise around the 91% level in window 9.

The average overall efficiency levels again declined in window 10, which could be argued to be caused by few factors. Firstly, it could be argued that during the period, Malaysian banks have just completed the mega-merger program initiated by the government and was concluded during the year 2001. Banks could be argued to have to absorb extra capacities, incurred higher costs arising from systems integration, branch closures and employees laid off resulting from the merger (Shanmugam and Nair, 2003). The consolidation program for the domestic banking institutions represents a major structural enhancement of the banking system, clear long-term benefits are expected to come from the reduction in duplication of resources to attain higher levels of economies of scale and efficiency. However, given the complications in integrating and rationalising the different operations, the benefits of the merger program are expected to become more visible over time (The Asian Banker, 2003).

Secondly, the 2001-2003 period was marked as a period of heightened geopolitical uncertainties, which has raised concerns over the sustainability of the economic growth in most part of the world. To mitigate the negative impacts and to stimulate economic activities, central banks from all over the world, particularly the U.S. Federal Reserve Bank, have taken steps to lower their interest rates. The Malaysian central bank was also not an exception. It has lowered its intervention rates, which in turn is used by Malaysian banks to determine the Base Lending Rates (BLR), the lending rates for loans to borrowers. During the period, the BLR declined from an average of 6.8% in 2001 to 6.0% in 2003 while interest rates on deposits were relatively stable at 3.0%. The lower BLR could be argued to have negative impacts on Malaysian banks, which carries huge amount of loans pegged to the BLR as these banks could have earned lower net interest margins during this period[1].

[1] The current Base Lending Rate (BLR) computation is as follows: [Intervention Rate/(1-SRR) x (0.8) + 2.25

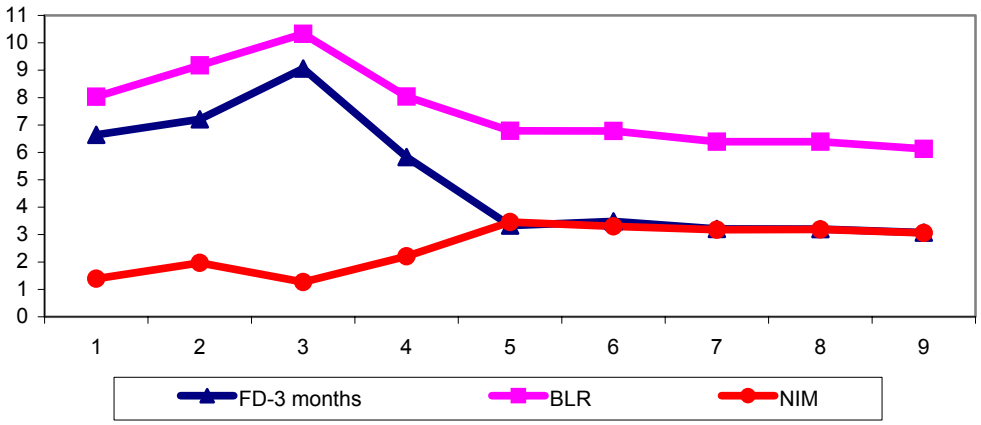


Fig. 2. Malaysian Banks Net Interest Margins

Thirdly, the period has also witnessed intensification of competition especially for hire purchase and housing loans. To stay competitive and to attract borrowers amidst the intensification of competition, Malaysian banks have taken the steps to further lower their rates which have resulted in further margin squeeze especially for the small banks which have mostly source their incomes from the hire purchase financing and housing loans[1].

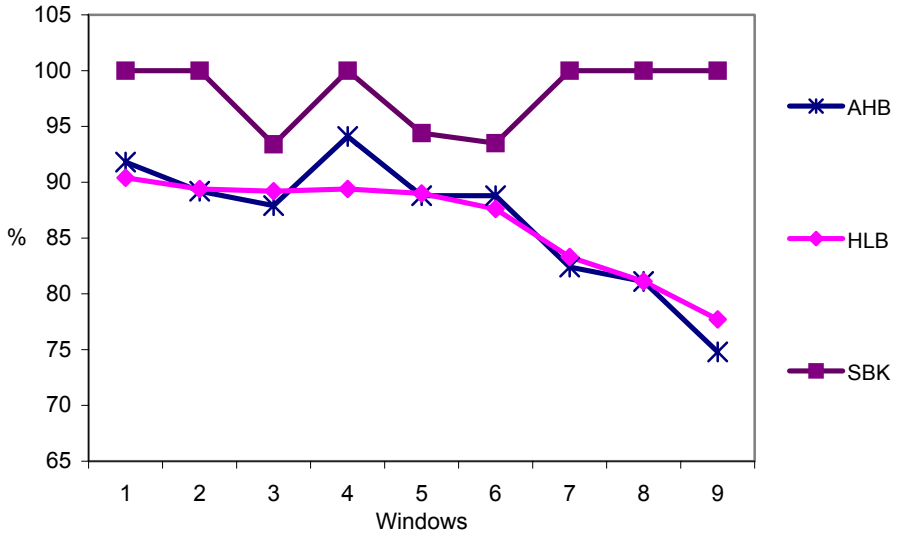


Fig. 3. Small Malaysian Banks Overall Efficiency, 2000-2003 (Windows 7-10)

where SRR=The Statutory Reserve Requirement 2.25 = The Administrative Spread

[1] For further discussions see Fitch (2004), KL City Securities (2004).

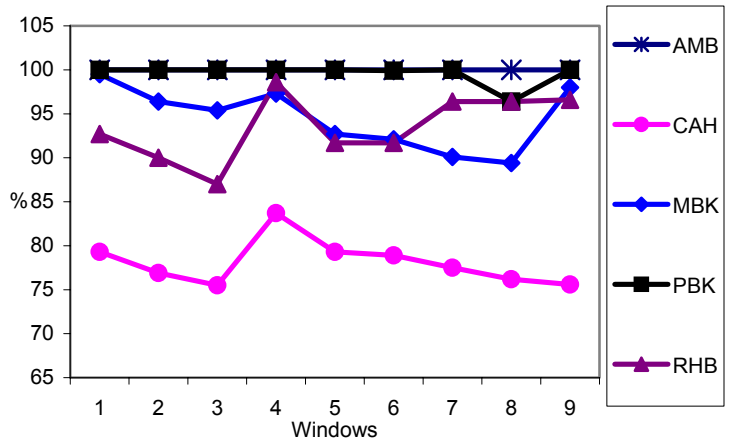


Fig. 4. Large Malaysian Banks Overall Efficiency, 2000-2003 (Windows 7-10)

From Figures 3 and 4 it is apparent the starking difference between the large and small banks efficiency during this period. In the small banking group, while SBK has been able to maintain its overall efficiency levels AHB and HLB have exhibit significant deterioration in efficiency levels. On the other hand, with the exception of CAH, which has been a consistently reporting low overall efficiency scores throughout the period of study, large Malaysian banks have fared better during this period.

Lastly, it could also be argued that the low interest rates environment has prompted Malaysian corporations to tap into the debt market as a source of funding instead of going to the banks for line of credit during this period[1]. As Malaysian corporations moved away from the traditional way of financing their business is motivated by the cheap financing costs in the bond markets, banks that have traditionally concentrated on corporate loans could have experienced sluggish loan growth during this period.

### *5.2. Overall Efficiency*

Table 4 decomposes overall average efficiency scores for each bank, with each bank represented as if it is a different DMU at each of the three successive dates noted at the top of each column. Ten separate windows are represented as separate rows in Table 4. Taking AMMB for example, in Table 4 the efficiency of AMMB in the first window is 80.1, 78.7 and 100.0. These figures correspond to the estimated relative efficiency of AMMB for years 1992, 1993 and 1994 respectively. In the second window, relative efficiency estimates of 72.5, 100.0 and 100.0 correspond respectively to years 1993, 1994 and 1995.

The approach used in formulating Table 4 lends itself to a study of 'trends' and the examination of the 'stability' of efficiency scores, as well as within windows by the adoption of 'row views' and 'column views' respectively. For instance, taking AMMB again for example, the bank's efficiency varies from 72.5 to 100.0 in year 1992 through to 2003 by adopting a 'row view' perspective. At the same time, the efficiency of a DMU within the different windows can also vary substantially by adopting a 'column view' perspective. This variation reflects simultaneously both the absolute performance of a bank over time and the relative performance of that bank in comparison to its peers in the sample.

[1] The bond market (including both public and private sector bonds) tripled in size, from 44.7% of GDP in 1996 to 80.6% of GDP as at end-June 2003. The private debt securities market accounted for 54% of bonds outstanding and 43.6% of GDP as at end-June 2003 compared to 13.5% of GDP in 1996. Funds raised by the private sector through the bond market increased to 16% of the total private sector debt financing as at end-June 2003 from 9.3% in 1996. See Bank Negara Malaysia Annual Reports 2000, 2001, 2002 and 2003.

Table 4

Window Analysis of Overall Efficiency Scores

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | Mean/Window | Mean | SD | LDY | LDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 100.0 | 76.3 | 87.3 | | | | | | | | | | 87.9 | | | | |
| | 2 | | 75.2 | 87.7 | 87.1 | | | | | | | | | 86.7 | | | | |
| | 3 | | | 87.7 | 97.1 | 84.1 | | | | | | | | 89.6 | | | | |
| | 4 | | | | 100 | 86.6 | 77.8 | | | | | | | 88.1 | | | | |
| AHB | 5 | | | | | 97.9 | 87.9 | 70.3 | | | | | | 85.4 | 85.9 | 0.081 | 13.8 | 29.7 |
| | 6 | | | | | | 91.2 | 73.1 | 86.9 | | | | | 83.7 | | | | |
| | 7 | | | | | | | 73.2 | 81.9 | 91.8 | | | | 82.3 | | | | |
| | 8 | | | | | | | | 78.3 | 89.2 | 94.1 | | | 87.2 | | | | |
| | 9 | | | | | | | | | 87.9 | 88.8 | 82.4 | | 86.4 | | | | |
| | 10 | | | | | | | | | | 88.8 | 81.1 | 74.8 | 81.6 | | | | |
| | 1 | 80.1 | 78.7 | 100.0 | | | | | | | | | | 86.3 | | | | |
| | 2 | | 72.5 | 100.0 | 100.0 | | | | | | | | | 90.8 | | | | |
| | 3 | | | 100.0 | 100.0 | 94.5 | | | | | | | | 98.2 | | | | |
| | 4 | | | | 100.0 | 94.2 | 100.0 | | | | | | | 98.1 | | | | |
| AMB | 5 | | | | | 100.0 | 100.0 | 100.0 | | | | | | 100.0 | 96.7 | 0.073 | 10.5 | 27.5 |
| | 6 | | | | | | 100.0 | 100.0 | 89.9 | | | | | 96.6 | | | | |
| | 7 | | | | | | | 100.0 | 89.5 | 100.0 | | | | 96.5 | | | | |
| | 8 | | | | | | | | 100.0 | 100.0 | 100.0 | | | 100.0 | | | | |
| | 9 | | | | | | | | | 100.0 | 100.0 | 100.0 | | 100.0 | | | | |
| | 10 | | | | | | | | | | 100.0 | 100.0 | 100.0 | 100.0 | | | | |
| | 1 | 90.7 | 81.6 | 92.1 | | | | | | | | | | 88.1 | | | | |
| | 2 | | 80.1 | 87.9 | 78.1 | | | | | | | | | 82.0 | | | | |
| | 3 | | | 87.9 | 78.1 | 80.6 | | | | | | | | 82.2 | | | | |
| | 4 | | | | 82.5 | 82.1 | 75.9 | | | | | | | 80.2 | | | | |
| CAH | 5 | | | | | 93.0 | 86.3 | 88.6 | | | | | | 89.3 | 82.6 | 0.059 | 15.5 | 17.5 |
| | 6 | | | | | | 91.4 | 91.0 | 79.4 | | | | | 87.3 | | | | |
| | 7 | | | | | | | 92.0 | 77.3 | 79.3 | | | | 82.9 | | | | |

Table 4 (continuous)

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | Mean/Window | Mean | SD | LDY | LDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 | | | | | | | | 77.3 | 76.9 | 83.7 | | | 79.3 | | | | |
| | 9 | | | | | | | | | 75.5 | 79.3 | 77.5 | | 77.4 | | | | |
| | 10 | | | | | | | | | | 78.9 | 76.2 | 75.6 | 76.9 | | | | |
| | 1 | | 82.3 | | | | | | | | | | | 82.3 | | | | |
| | 2 | | 82.3 | | 92.0 | | | | | | | | | 87.2 | | | | |
| | 3 | | | | 99.6 | 89.6 | | | | | | | | 94.6 | | | | |
| | 4 | | | | 100.0 | 93.2 | 86.1 | | | | | | | 93.1 | | | | |
| HLB | 5 | | | | | 100.0 | 95.1 | 86.7 | | | | | | 93.9 | | | | |
| | 6 | | | | | | 96.6 | 88.5 | 85.2 | | | | | 90.1 | 88.6 | 0.061 | 10.5 | 22.3 |
| | 7 | | | | | | | 88.0 | 81.1 | 90.4 | | | | 86.5 | | | | |
| | 8 | | | | | | | | 81.4 | 89.4 | 89.4 | | | 86.7 | | | | |
| | 9 | | | | | | | | | 89.2 | 89.0 | 83.3 | | 87.2 | | | | |
| | 10 | | | | | | | | | | 87.6 | 81.1 | 77.7 | 82.1 | | | | |
| | 1 | 89.1 | 88.4 | 82.3 | | | | | | | | | | 86.6 | | | | |
| | 2 | | 86.6 | 80.8 | 91.6 | | | | | | | | | 86.3 | | | | |
| | 3 | | | 82.8 | 91.6 | 81.5 | | | | | | | | 85.3 | | | | |
| | 4 | | | | 95.2 | 83.1 | 81.8 | | | | | | | 86.7 | | | | |
| MBK | 5 | | | | | 93.4 | 91.7 | 91.8 | | | | | | 92.3 | 90.5 | 0.053 | 13.5 | 18.7 |
| | 6 | | | | | | 95.3 | 94.6 | 91.5 | | | | | 93.8 | | | | |
| | 7 | | | | | | | 95.7 | 88.2 | 99.5 | | | | 94.5 | | | | |
| | 8 | | | | | | | | 88.4 | 96.4 | 97.3 | | | 94.0 | | | | |
| | 9 | | | | | | | | | 95.4 | 92.7 | 90.1 | | 92.7 | | | | |
| | 10 | | | | | | | | | | 92.1 | 89.4 | 98.0 | 93.2 | | | | |
| | 1 | 73.7 | 76.2 | 70.9 | | | | | | | | | | 73.6 | | | | |
| | 2 | | 75.6 | 70.9 | 78.2 | | | | | | | | | 74.9 | | | | |
| | 3 | | | 75.3 | 81.4 | 84.1 | | | | | | | | 80.3 | | | | |
| | 4 | | | | 84.1 | 85.2 | 84.2 | | | | | | | 84.5 | | | | |

Table 4 (continuous)

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | Mean/Window | Mean | SD | LDY | LDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PBK | 5 | | | | | 94.0 | 93.5 | 80.7 | | | | | | 89.4 | 87.8 | 0.102 | 13.5 | 29.1 |
| | 6 | | | | | | 97.7 | 81.8 | 96.7 | | | | | 92.1 | | | | |
| | 7 | | | | | | | 83.1 | 85.1 | 100.0 | | | | 89.4 | | | | |
| | 8 | | | | | | | | 85.3 | 100.0 | 100.0 | | | 95.1 | | | | |
| | 9 | | | | | | | | | 100.0 | 100.0 | 100.0 | | 100.0 | | | | |
| | 10 | | | | | | | | | | 99.9 | 96.4 | 100.0 | 98.8 | | | | |
| | 1 | 88.8 | 92.7 | 100.0 | | | | | | | | | | 93.8 | | | | |
| | 2 | | 84.5 | 100.0 | 93.5 | | | | | | | | | 92.7 | | | | |
| | 3 | | | 100.0 | 93.5 | 82.9 | | | | | | | | 92.1 | | | | |
| | 4 | | | | 98.0 | 88.1 | | | | | | | | 93.1 | | | | |
| RHB | 5 | | | | | 100.0 | | 98.2 | | | | | | 99.1 | 93.2 | 0.063 | 17.1 | 22.8 |
| | 6 | | | | | | | 99.8 | 88.3 | | | | | 94.1 | | | | |
| | 7 | | | | | | | 99.4 | 82.8 | 92.7 | | | | 91.6 | | | | |
| | 8 | | | | | | | | 77.8 | 90.0 | 98.6 | | | 88.8 | | | | |
| | 9 | | | | | | | | | 87.0 | 91.7 | 96.4 | | 91.7 | | | | |
| | 10 | | | | | | | | | | 91.7 | 96.4 | 96.6 | 94.9 | | | | |
| | 1 | 94.8 | 100.0 | 100.0 | | | | | | | | | | 98.3 | | | | |
| | 2 | | 100.0 | 100.0 | 96.7 | | | | | | | | | 98.9 | | | | |
| | 3 | | | 100.0 | 96.9 | 89.5 | | | | | | | | 95.5 | | | | |
| | 4 | | | | 100.0 | 94.2 | 87.0 | | | | | | | 93.7 | | | | |
| SBK | 5 | | | | | 100.0 | 98.9 | 95.9 | | | | | | 98.3 | 97.8 | 0.035 | 13.0 | 13.0 |
| | 6 | | | | | | 100.0 | 98.8 | 100.0 | | | | | 99.6 | | | | |
| | 7 | | | | | | | 99.4 | 100.0 | 100.0 | | | | 99.8 | | | | |
| | 8 | | | | | | | | 100.0 | 100.0 | 100.0 | | | 100.0 | | | | |
| | 9 | | | | | | | | | 93.4 | 94.4 | 100.0 | | 95.9 | | | | |
| | 10 | | | | | | | | | | 93.5 | 100.0 | 100.0 | 97.8 | | | | |

**Mean** = Average score for the ten year period; **SD** = Standard Deviation for the period; **LDY** = Largest difference between scores in the same year; **LDP** = Largest difference between scores across the entire period.

From Table 4, it is apparent that, Malaysian banks have exhibited an average overall efficiency score of 90.4% for the 1992-2003 period, suggesting that the Malaysian banking system has performed relatively well in its basic function – transforming deposits to loans. It is apparent from Table 4 that SBK is the best performer for the period, maintained its position with average overall efficiencies of 97.8% and accompanied by a relatively low standard deviations of 0.035, which is consistent with Charnes *et al.* (1985). To recap, Charnes *et al.* (1985) suggested that DMUs with high efficiency levels tend to demonstrate lower standard deviations compared to its peers with lower efficiency levels. Interestingly, despite exhibiting low overall efficiency scores, we find that CAH standard deviation is relatively low compared to its peers. However, it is not surprising as the banks have been consistently exhibiting low levels of overall efficiency throughout the period of study.

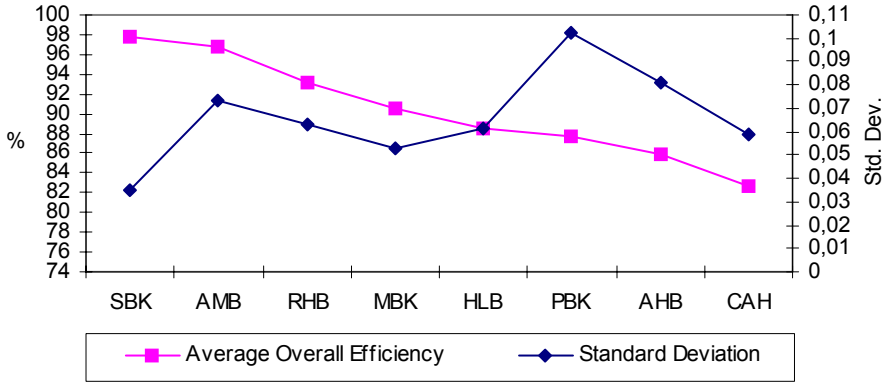


Fig. 5. Malaysian Banks Mean Overall Efficiency versus Standard Deviation

While SBK is the best bank in terms of maximizing outputs, on the other hand our findings suggest that CAH and AHB were the worst performers with 82.6% and 85.9% overall efficiency levels and standard deviations of 0.059 and 0.081 respectively during the period. We also find that MBK and PBK exhibit improvements and upward trend in the later parts of the period, while HLB overall efficiency scores seem to deteriorate during the latter part of the studies.

Our results suggest that the smaller banking groups with total assets of less than RM50 billion, exhibited higher efficiencies but not significantly higher at 90.7% compared to the large and very large peers overall efficiencies of 90.0% and 90.5% respectively, while the very large bank reports slightly higher overall efficiency level compared to its large counterparts. Similar to the findings of Webb (2003) on UK banks, we find that SBK – the smallest bank in the sample in terms of total assets – to be the best performer throughout the period with an average overall efficiency level of 97.8%[1].Small banks usually conduct relationship banking and stay close to their customers. This approach could have compensated whatever technological disadvantages they may have compared to its large counterparts[2]. This gives small banks competitive advantage over large banks and this could be a reason why despite the generous incentives given by BNM for banks to merge or consolidate to attain a much larger size, still many commercial banks in Malaysia have opted to stay out of any merger or consolidation exercises[3].

As overall efficiency score is a composite of both pure technical and scale efficiency scores, the relative sizes of these indexes provide evidence as to the source of overall inefficiency. An insight into the decomposition of overall efficiency into its pure technical and scale efficiency components sug-

[1] The finding above is not unusual. For instance, Berger (2000) found that profit efficiency consistently declines as asset size increases with the smallest asset size group having the highest efficiency estimate. Additionally, Ferrier and Lovell (1990) found that small banks are more cost efficient than large banks.

[2] It is to be noted that some technologies, such as accounting system and other IT-based system are now available for small banks even for microfinance institutions that enable them to efficiently service numerous small accounts.

[3] Prior to the mega-merger program initiated by BNM.

gests that during the period of study, pure technical inefficiency (input related) dominates scale inefficiency (output related) in Malaysian banking[1]. Because the choice of optimum production level is to a great extent under the management discretion, the underperformance of Malaysian banks with respect to the frontier banks, which are operating under similar conditions, can be mainly attributed to internal problems and "poor" management practices i.e. management's failure to control costs.

### *5.3. Pure Technical Efficiency*

Table 5 presents the pure technical efficiency of Malaysian banks. In general, it has been concluded by among others Berger *et al.* (1993) that larger banks report higher levels of technical or x-efficiency, than do their smaller counterparts. Accordingly, we also find that large Malaysian banks average pure technical efficiency is higher compared to its smaller counterparts but lower in comparison to the very large bank.

Table 5

Window Analysis of Average Pure Technical Efficiency Scores, 1992-2003

| | AFB | AMB | CAH | HLB | MBK | PBK | RHB | SBK | Sample Mean |
|---|---|---|---|---|---|---|---|---|---|
| 92-93-94 | 90.93 | 88.97 | 98.80 | 89.30 | 100.00 | 91.80 | 96.67 | 100.00 | **94.6** |
| 93-94-95 | 88.20 | 91.67 | 92.03 | 93.30 | 98.20 | 87.97 | 95.00 | 99.63 | **93.3** |
| 94-95-96 | 90.83 | 100.00 | 88.93 | 96.90 | 99.27 | 90.17 | 99.33 | 96.70 | **95.3** |
| 95-96-97 | 89.33 | 100.00 | 83.37 | 94.43 | 99.67 | 93.77 | 100.00 | 98.23 | **94.9** |
| 96-97-98 | 86.17 | 100.00 | 91.60 | 95.67 | 100.00 | 95.30 | 100.00 | 99.43 | **96.0** |
| 97-98-99 | 86.03 | 97.00 | 95.47 | 93.37 | 100.00 | 95.83 | 100.00 | 100.00 | **96.0** |
| 98-99-00 | 82.87 | 96.80 | 90.57 | 86.57 | 100.00 | 89.77 | 95.07 | 100.00 | **92.7** |
| 99-00-01 | 90.13 | 100.00 | 85.10 | 87.47 | 100.00 | 95.53 | 91.97 | 100.00 | **93.8** |
| 00-01-02 | 90.67 | 100.00 | 82.43 | 87.20 | 100.00 | 100.00 | 95.87 | 98.57 | **94.3** |
| 01-02-03 | 82.37 | 100.00 | 81.57 | 82.87 | 100.00 | 98.80 | 97.67 | 100.00 | **92.9** |
| **Mean** | **87.8** | **97.4** | **89.0** | **90.7** | **99.7** | **93.9** | **97.2** | **99.3** | **94.4** |

Our results suggest that the smaller banking groups, AHB, HLB and SBK have reported average pure technical efficiency of 92.5% compared to their larger counterparts with total assets of RM50 billion to RM100 billion, AMB, CAH, PBK and RHB, which exhibit an average pure technical efficiency levels of 94.3%. MBK, which is the largest bank in our sample in terms of total assets, exhibits the highest average pure technical efficiency score of 99.7% during the period.

A possible explanation for the higher pure technical efficiency of the large banks could be due to the fact that large banks may have the advantage over their smaller counterparts as large banks attract more deposits and loans transactions and that the large banks may command larger interest rate spreads. Furthermore, large banks offer wider range of services and in the process derive substantial non-interest income from commissions, fees and other treasury activities.

It could be argued that large banks extensive branch networks and larger depositors base attract cheap source of funds while on the other hand the smaller banks with smaller depositors base might resort to purchasing funds in the inter-bank market, which is more costly and may explain the lower technical efficiency scores of the small Malaysian banks. Our results are consistent with the findings by Chu and Lim (1998) and Lim and Randhawa (2005) on Singapore banks, which operate in a similar oligopolistic banking environment. They have generally concluded that the large Singapore banks have better advantage through their extensive branch networks in attracting cheap deposits and help the larger banks to exhibit higher pure technical efficiency compared to their smaller counterparts.

[1] Our findings are consistent with earlier findings by Zaim (1995) on Turkish bank, Fukuyama (1993) on Japanese banks and Aly *et al.* (1990) on U.S. banks.

### *5.4. Scale Efficiency*

Earlier studies on banks efficiency have generally concluded that large banks tend to report lower levels of scale efficiencies (see Webb, 2003, Drake, 2001, and Miller and Noulas, 1996). Table 6 presents the scale efficiency of Malaysian banks. In contrast to the pure technical efficiency, our findings suggest that small Malaysian commercial banks exhibit the highest average scale efficiency scores compared to their large and very large counterparts and that the very large bank in our sample reported the lowest average scale efficiency score during the period.

Table 6

Window Analysis of Average Scale Efficiency Scores, 1992-2003

| | AFB | AMB | CAH | HLB | MBK | PBK | RHB | SBK | Sample Mean |
|---|---|---|---|---|---|---|---|---|---|
| 92-93-94 | 96.37 | 96.73 | 89.27 | 92.10 | 86.50 | 80.27 | 97.03 | 98.27 | **92.1** |
| 93-94-95 | 98.13 | 98.87 | 89.43 | 93.55 | 87.83 | 85.13 | 97.53 | 99.23 | **93.7** |
| 94-95-96 | 98.70 | 98.17 | 92.73 | 97.55 | 85.93 | 89.07 | 92.77 | 98.70 | **94.2** |
| 95-96-97 | 98.53 | 98.07 | 96.13 | 98.53 | 86.97 | 90.17 | 93.05 | 95.47 | **94.6** |
| 96-97-98 | 99.10 | 100.00 | 97.60 | 98.17 | 92.30 | 93.80 | 99.10 | 98.83 | **97.4** |
| 97-98-99 | 97.33 | 99.60 | 91.70 | 96.50 | 93.80 | 96.00 | 94.05 | 99.60 | **96.1** |
| 98-99-00 | 99.37 | 99.67 | 92.07 | 99.93 | 94.47 | 99.53 | 96.27 | 99.80 | **97.6** |
| 99-00-01 | 96.83 | 100.00 | 93.33 | 99.13 | 94.03 | 99.50 | 96.40 | 100.00 | **97.4** |
| 00-01-02 | 95.67 | 100.00 | 94.03 | 99.97 | 92.73 | 100.00 | 95.60 | 97.33 | **96.9** |
| 01-02-03 | 99.00 | 100.00 | 94.30 | 99.13 | 93.17 | 99.93 | 97.17 | 97.83 | **97.6** |
| **Mean** | **97.9** | **99.1** | **93.1** | **97.5** | **90.1** | **93.3** | **95.9** | **98.5** | **95.8** |

Our results suggest that the smaller banking groups, AHB, HLB and SBK have reported average scale efficiency of 98.1% compared to their larger counterparts, AMB, CAH, PBK and RHB, which exhibit an average scale efficiency levels of 95.4%. MBK, which is the largest bank in our sample with total assets of over RM150 billion, exhibits the lowest average scale efficiency score of 90.8% during the period.

A possible explanation for the lower scale efficiency of large Malaysian banks could be due to the large depositors base resulting from government protection, high capital reserve requirement by BNM and overly conservative loan growth strategies, particularly during the post crisis period as Malaysian banks have been reluctant to lend large amounts to corporations after being burnt during the crisis. It could also be argued that Malaysian banks could have taken an overly conservative and cautious loan growth strategies as banks attempt to rehabilitate their balance sheets from the rising non-performing loans. On the other hand, the small Malaysian banks, which have smaller depositors base and thus lesser deposits to transform into loans, have attained higher scale efficiency levels compared to their larger counterparts.

### *5.5. Returns to Scale*

The nature of returns to scale of Malaysian banks is considered next. As have been mentioned earlier, a bank can operate at CRTS or VRTS where CRTS signifies than an increase in inputs results in a proportionate increase in outputs and VRTS means a rise in inputs results in a disproportionate rise in outputs. Moreover, a bank operating at VRTS can be at increasing returns to scale (IRTS) or decreasing returns to scale (DRTS). Hence, IRTS means that and increase in input results in a higher increase in outputs, while DRTS indicates that an increase in inputs results in lesser output increases.

To identify the nature of returns to scale, first the CRTS scores (obtained with the CCR model) were compared with VRTS (using BCC model) scores. For a given bank, if the VRTS score equals to its CRTS score, the bank is said to be operating at constant returns to scale (CRTS). On the other hand, if these scores are not equal, a further step is needed to establish whether the bank is

operating at IRTS or DRTS. To do this, the DEA model is used under non-increasing returns to scale assumptions (NIRS). If the score under VRTS equals the NIRS score then the bank is said to be operating at DRTS. Alternatively, if the score under VRTS is different from the NIRS score, than the bank is said to be operating at IRTS (Coelli *et al.*, 1998).

Table 7 reports the nature of returns to scale for each bank in the sample. In general, this table indicates that large banks tend to operate at CRTS or DRTS, whereas smaller banks tend to operate at CRTS or IRTS, which is similar to earlier studies by Noulas *et al.* (1996), McAllister and McManus (1993) and Reisman *et al.* (2003). McAllister and McManus (1993) suggest that while small banks have generally exhibited IRTS, the large banks on the other hand tend to exhibit DRTS and at best CRTS.

As it appears, the small Malaysian banks experience increasing returns to scale (IRTS) in their operations. One implication is that, for the small Malaysian banks, increases in inputs would result in more than proportional increases in outputs. Hence, the banks that operate with IRTS could achieve significant cost savings and efficiency gains by increasing the scale of their operations. In other words, substantial gains could be obtained from altering scale via internal growth or further consolidation in the sector. In fact, in a perfectly competitive and contestable market, scale inefficient banks should be absorbed by the efficient banks to exploit cost advantages. Thus, the banks that experience IRTS should either eliminate their scale inefficiency or be ready to become a prime target for acquiring banks, which can create value from underperforming banks by streamlining their operations and eliminating their redundancies and inefficiencies (Evanoff and Israelvich, 1991).

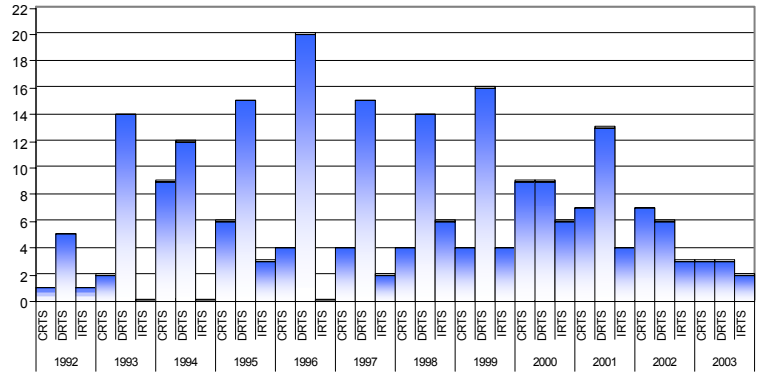


Fig. 6. Malaysian Banks Returns to Scale Developments

From Figure 6, it is apparent from the trends that, Malaysian banks have mainly been operating at DRTS during the early part of the studies, only to improved during the latter part of the studies. It is particularly interesting to note that Malaysian banks have been efficient in absorbing extra capacities only about three years after the mega-merger program initiated by the Malaysian government was concluded. Thus, our result implies that the merger program has been successful in eliminating scale efficiency in Malaysian banking. Hence, as far as improving banks' efficiency is concerned, (to eliminate scale inefficiency), merger and acquisitions seems to be an appropriate policy.

Table 7

Nature of Returns to Scale of Individual Banks

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | CRTS | DRTS | DRTS | | | | | | | | | |
| | 2 | | DRTS | DRTS | IRTS | | | | | | | | |
| | 3 | | | DRTS | IRTS | DRTS | | | | | | | |
| | 4 | | | | CRTS | DRTS | DRTS | | | | | | |
| AHB | 5 | | | | | DRTS | DRTS | DRTS | | | | | |
| | 6 | | | | | | DRTS | DRTS | DRTS | | | | |
| | 7 | | | | | | | IRTS | IRTS | IRTS | | | |
| | 8 | | | | | | | | IRTS | IRTS | DRTS | | |
| | 9 | | | | | | | | | IRTS | DRTS | CRTS | |
| | 10 | | | | | | | | | | DRTS | IRTS | IRTS |
| | 1 | DRTS | DRTS | CRTS | | | | | | | | | |
| | 2 | | DRTS | CRTS | CRTS | | | | | | | | |
| | 3 | | | CRTS | CRTS | DRTS | | | | | | | |
| | 4 | | | | CRTS | DRTS | CRTS | | | | | | |
| AMB | 5 | | | | | CRTS | CRTS | CRTS | | | | | |
| | 6 | | | | | | CRTS | CRTS | DRTS | | | | |
| | 7 | | | | | | | CRTS | DRTS | CRTS | | | |
| | 8 | | | | | | | | CRTS | CRTS | CRTS | | |
| | 9 | | | | | | | | | CRTS | CRTS | CRTS | |
| | 10 | | | | | | | | | | CRTS | CRTS | CRTS |
| | 1 | DRTS | DRTS | DRTS | | | | | | | | | |
| | 2 | | DRTS | DRTS | DRTS | | | | | | | | |
| | 3 | | | DRTS | DRTS | DRTS | | | | | | | |
| | 4 | | | | DRTS | DRTS | DRTS | | | | | | |
| CAH | 5 | | | | | DRTS | DRTS | CRTS | | | | | |
| | 6 | | | | | | DRTS | DRTS | DRTS | | | | |

Table 7 (continuous)

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | | | | | | | IRTS | DRTS | DRTS | | | |
| | 8 | | | | | | | | DRTS | DRTS | DRTS | | |
| | 9 | | | | | | | | | DRTS | DRTS | DRTS | |
| | 10 | | | | | | | | | | DRTS | DRTS | DRTS |
| | 1 | | DRTS | | | | | | | | | | |
| | 2 | | DRTS | | DRTS | | | | | | | | |
| | 3 | | | | DRTS | DRTS | | | | | | | |
| | 4 | | | | CRTS | DRTS | DRTS | | | | | | |
| HLB | 5 | | | | | CRTS | DRTS | DRTS | | | | | |
| | 6 | | | | | | DRTS | DRTS | DRTS | | | | |
| | 7 | | | | | | | IRTS | IRTS | CRTS | | | |
| | 8 | | | | | | | | IRTS | IRTS | IRTS | | |
| | 9 | | | | | | | | | IRTS | CRTS | CRTS | |
| | 10 | | | | | | | | | | IRTS | IRTS | IRTS |
| | 1 | DRTS | DRTS | DRTS | | | | | | | | | |
| | 2 | | DRTS | DRTS | DRTS | | | | | | | | |
| | 3 | | | DRTS | DRTS | DRTS | | | | | | | |
| | 4 | | | | DRTS | DRTS | DRTS | | | | | | |
| MBK | 5 | | | | | DRTS | DRTS | DRTS | | | | | |
| | 6 | | | | | | DRTS | DRTS | DRTS | | | | |
| | 7 | | | | | | | DRTS | DRTS | DRTS | | | |
| | 8 | | | | | | | | DRTS | DRTS | DRTS | | |
| | 9 | | | | | | | | | DRTS | DRTS | DRTS | |
| | 10 | | | | | | | | | | DRTS | DRTS | DRTS |
| | 1 | DRTS | DRTS | DRTS | | | | | | | | | |
| | 2 | | DRTS | DRTS | DRTS | | | | | | | | |
| | 3 | | | DRTS | DRTS | DRTS | | | | | | | |
| | 4 | | | | DRTS | DRTS | DRTS | | | | | | |

Table 7 (continuous)

| Bank | Window | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PBK | 5 | | | | | DRTS | DRTS | DRTS | | | | | |
| | 6 | | | | | | DRTS | DRTS | DRTS | | | | |
| | 7 | | | | | | | DRTS | DRTS | CRTS | | | |
| | 8 | | | | | | | | DRTS | CRTS | CRTS | | |
| | 9 | | | | | | | | | CRTS | CRTS | CRTS | |
| | 10 | | | | | | | | | | DRTS | IRTS | CRTS |
| | 1 | DRTS | DRTS | CRTS | | | | | | | | | |
| | 2 | | DRTS | CRTS | IRTS | | | | | | | | |
| | 3 | | | CRTS | DRTS | DRTS | | | | | | | |
| | 4 | | | | DRTS | DRTS | | | | | | | |
| RHB | 5 | | | | | CRTS | | DRTS | | | | | |
| | 6 | | | | | | | DRTS | DRTS | | | | |
| | 7 | | | | | | | DRTS | DRTS | DRTS | | | |
| | 8 | | | | | | | | DRTS | DRTS | DRTS | | |
| | 9 | | | | | | | | | DRTS | DRTS | DRTS | |
| | 10 | | | | | | | | | | DRTS | DRTS | DRTS |
| | 1 | IRTS | CRTS | CRTS | | | | | | | | | |
| | 2 | | CRTS | CRTS | DRTS | | | | | | | | |
| | 3 | | | CRTS | DRTS | DRTS | | | | | | | |
| | 4 | | | | CRTS | DRTS | IRTS | | | | | | |
| SBK | 5 | | | | | CRTS | IRTS | IRTS | | | | | |
| | 6 | | | | | | CRTS | IRTS | CRTS | | | | |
| | 7 | | | | | | | IRTS | CRTS | CRTS | | | |
| | 8 | | | | | | | | CRTS | CRTS | CRTS | | |
| | 9 | | | | | | | | | IRTS | IRTS | CRTS | |
| | 10 | | | | | | | | | | IRTS | CRTS | CRTS |

Note: CRTS = Constant Returns to Scale; DRTS = Decreasing Returns to Scale; IRTS = Increasing Returns to Scale.

## 6. Conclusions and Suggestions for Further Research

Utilising the non-parametric Data Envelopment Analysis (DEA) window analysis method, we attempt to investigate the long-term trend in efficiency change of listed Malaysian commercial banks during the period of 1992-2003. Our results suggest that during the period of study, listed Malaysian commercial banks have exhibited an average overall efficiency of 90.4% and that the inefficiencies were largely attributed to pure technical (input related) rather than scale (output related). During the period of study, small Malaysian commercial banks were found to have outperformed their large and very large counterparts though not significantly different.

We find that large Malaysian banks have exhibited higher pure technical efficiency scores compared to their smaller counterparts, which could be attributed to the fact that large banks with more branch networks attract more deposits and loans transactions, which in turn command larger interest rate spreads. Large Malaysian banks also offer a wider range of services and thus derive substantial non-interest income from commissions, fees and other treasury activities.

On the other hand, our results suggest that the smaller Malaysian commercial banks outperform their larger counterparts on scale efficiencies, suggesting that the large Malaysian banks inefficiencies were largely due to scale rather than pure technical or x-inefficiency. The lower scale efficiency of the large banks could be possibly due to an overly conservative and cautious loan growth strategies particularly during the post crisis period. Another possible explanation for the higher scale efficiency of the small Malaysian commercial banks could be due to their smaller depositors base and hence lesser deposits to transform into loans compared to their large counterparts.

Consistent with earlier studies, we also find that while the smaller banking groups tend to operate at CRTS and IRTS, the large banking groups on the other hand tend to operate at DRTS and CRTS at best. An important implication for the small Malaysian banks, which operates at the wrong scale of operations (IRTS), a proportional increase in inputs would result in more than proportional increases in outputs. Our findings thus suggest the need for further consolidation in the Malaysian banking sector especially among the small Malaysian banks, which could result in significant cost savings and efficiency gains by increasing their scale of operations.

Due to its limitations, this paper can be extended in a variety of ways. It is suggested that further analysis into the investigation of x-efficiency of Malaysian banks to consider risk exposure factors. As to establish overall bank performance, risk exposure factors should be taken into account along with productive efficiency measures. As the best bank may not necessarily be the most efficient producer of loans, but also one, which balances high efficiency with low risk assumptions. Moreover, this paper examined the intermediation functions of banks could be extended by considering the production function at the same time. Investigation of changes in productivity over time as a result of technical change or progress by using the Malmquist Total Factor Productivity Index could be yet another extension.

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