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Sufian, Fadzlan and Abdul Majid, Muhamed Zulkhibri

Bumiputra-Commerce Bank Berhad, University of Malaya, Central Bank of Malaysia

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CONSOLIDATION AND EFFICIENCY: EVIDENCE FROM NON-BANK FINANCIAL INSTITUTIONS IN MALAYSIA

FADZLAN SUFIAN**
Bumiputra-Commerce Bank Berhad (BCB)
University of Malaya (UM)

MUHD-ZULKHIBRI ABDUL MAJID*
Central Bank of Malaysia

* Corresponding author: Department of Monetary and Financial Policy, Central Bank of Malaysia, Jalan Dato' Onn, 50480 Kuala Lumpur, Malaysia. E-mail: khibri1974@yahoo.com or muhamedz@bnm.gov.my. Tel: 603-2698-8044; Fax: 603-2698-7927.

** Planning and Research Department (BCB) and Department of Banking and Finance, University of Malaya (UM). E-mail: fadzlan.sufian@cimb.com.

All findings, interpretations, and conclusions are solely of the author's opinion and do not necessarily represents the views of the institutions.

CONSOLIDATION AND EFFICIENCY: EVIDENCE FROM NON-BANK FINANCIAL INSTITUTIONS IN MALAYSIA

ABSTRACT

This paper investigates the efficiency changes of finance and merchant banking institutions in Malaysia, during and post-consolidation periods by applying the non-parametric Data Envelopment Analysis (DEA). The evidence suggests that pure technical efficiency is more related to overall efficiency than scale efficiency. On average, 28.7% of finance and merchant banking institutions are operating at CRS, while the majority are scale inefficient. Our results from the Tobit regression analysis further confirmed that the level of equity capital is positively related with the level of efficiency gain. Financial institutions with higher ratio of loans to assets are related to higher level of efficiency. This might reflect the degree of market power exists in the loan markets compared to the other product markets with institutions developed their strategic niche within the market.

JEL Classification: G21; G28
Keywords: Non-Bank Financial Institutions, Data Envelopment Analysis (DEA), Malaysia, Tobit

INTRODUCTION

The existence of universal banking in many parts of the world, (that is, banks also engaged in securities market activities), implies that bank-based financial system will tend to have a smaller range of equity-type assets than those with a more broadly based structure including a wide range of non-bank financial institutions. More generally, non-bank financial institutions play a range of roles that are not suitable for banks and through their provision of liquidity, divisibility, informational efficiencies and risk pooling services they broaden the spectrum of risks available to investors. In this way, they encourage and improve the efficiency of investment and savings. The provision of a broader range of financial instruments reflects the ability of the institutions to foster a risk management culture by attracting customers who are least able to bear risks and fill the gaps in bank-based financial services.

Secondly, from the view of financial stability, in a financial sector in which non-bank financial institutions are comparatively underdeveloped, banks will inevitably be required to assume risks that otherwise might be borne by the stock market, collective investment schemes or insurance companies. However, there is basic incompatibility between the kinds of financial contracts offered by the banks and those offered by the financial institutions. Thus, banks are more likely to fail as a result. One way of minimising financial fragility in the developing economies may be to encourage a diversity of financial markets and institutions, where investors are able to assume a variety of risks outside the banking system itself. Without this diversity, there is a tendency for all risks to be bundled within the balance sheet of the banking system, which may likely lead to severe financial crises. This point was widely noted by policymakers in their analysis of the lessons of the Asian currency crisis. As Greenspan [1999] pointed out, the impact of the currency crisis in Thailand might

have been significantly less severe if some of the risks borne by the Thai banks had instead been borne by the capital markets. Thus, there are very good reasons to perform studies on the non-bank financial sector in parallel with the banking system with regards to their efficiency and productivity.

The importance of investigating the efficiency of Malaysian finance and merchant banking institutions could be best justified by the fact that in Malaysia, the finance and merchant banking institutions play an important role in complementing the facilities offered by the commercial banks. The existence of finance and merchant banking institutions supported by efficient money and capital markets, keep the financial sector complete and enhance the overall growth of the economy. Although Malaysia is moving towards a full market based economy, its capital markets are still at its infancy. As a sophisticated and well-developed capital market is considered as the hallmark for a market-based economy worldwide, thus study of this nature is particularly important as the health and development of the capital market rely largely on the health of the finance and merchant banking institutions. Efficient and productive finance and merchant banking institutions are expected to enhance the Malaysian capital market in its pursuit to move towards a full market based economy.

By applying the non-parametric Data Envelopment Analysis (DEA) methodology, we attempt to investigate the efficiency of Malaysian finance and merchant banking institutions during the period of 2000-2004. The preferred non-parametric Data Envelopment Analysis (DEA) methodology has allowed us to distinguish between three different types of efficiency, such as technical, pure technical and scale efficiencies. Additionally we have performed a series of parametric and non-parametric tests to examine whether the merchant banks and finance companies were drawn from the same population. Finally, we have employed

Tobit regression model to investigate the association between the efficiency scores derived from the DEA results with set of specific determinants of finance and merchant banking institutions behaviour.

Our study is confined to the 20 finance and merchant banking institutions which were issued licences by the central bank of Malaysia, Bank Negara Malaysia (BNM) up to 2004 under the Banking and Financial Institutions Act, 1989 (BAFIA). The finance and merchant banking institutions in Malaysia consist primarily the finance companies and merchant banks. This paper also aimed to fill a demanding gap in the literature on efficiency and productivity of Malaysian financial institutions, by providing the most recent evidence on the productivity changes of Malaysian finance and merchant banking institutions in post-consolidation period.

We have found that the mean overall or technical efficiency has been 78.1% and 91.3% for merchant banks and the finance companies respectively. In other words, during the period of study, the merchant banks could have produced the same amount of outputs by only using 78.1% of the inputs that it currently employed. Similarly, the finance companies could have reduced 8.7% of the amount of inputs it employed currently without affecting the amount of outputs that it currently produces. Overall, our results suggest that pure technical efficiency dominates the scale efficiency effects in determining Malaysian finance and merchant banking institutions overall or technical efficiency. Further, most of our results from the parametric and non-parametric tests reject the null hypotheses that the merchant banks and the finance companies were drawn from the same population suggesting that it is appropriate to construct a separate frontier for both the merchant banks and finance companies.

To further complement the results of the efficiency measures, we have carried out regression analysis to correlate various finance and merchant banking institutions determinants with the efficiency scores derived from the DEA. Our results from Tobit regression model suggest that overall efficiency is positively and significantly associated with bank capitalization and market share. This finding is consistent with the results of the previous research that usually report higher efficiency levels for well-capitalized financial institutions and the existence of market power in loan market. On the other hand, we found that that both size and economic environment have negative relationship to bank efficiency though not statistically significant. This suggest that the large bank might be perceived as "too big too fail", which could lead to moral hazard behaviour especially in good economic condition. Interestingly, we find insignificant relationship between overall efficiency and overhead expenses.

This paper makes significant contributions on at least three fronts. Firstly, this will be the first study to investigate the efficiency of finance and merchant banking institutions in a developing economy. Despite the significance of the NBFI sector towards developing economies economic developments, studies that attempt to investigate this issue is relatively scarce. To the best of our knowledge, despite having undergone tremendous development over the past two decades, there has been no microeconomic study performed in the area of research on the Malaysian finance and merchant banking institutions. Hence, this study would be the first to provide important insights into the efficiency change among Malaysian finance and merchant banking institutions. Secondly, the period chosen has witnessed the intensification of competition in the Malaysian banking sector, resulted from the Malaysian government's move to further liberalise the banking system ahead of the opening of the financial sector to foreign competitions. Thirdly, the period chosen has also

witnessed the growing preference of Malaysian corporate sector in issuing more corporate debt securities in the capital markets instead of opting for the more traditional bank loan financing. This renders the importance of the finance and merchant banking institutions efficiency issues from both the policymakers and public point of views.

This paper is set out as follows: The second section will provide a brief overview of the Malaysian financial system. Section 3 reviews the main literature. Section 4 outlines the approaches to the measurement and estimation of productivity change. Section 5 discusses the results and finally Section 6 concludes.

OVERVIEW OF THE MALAYSIAN FINANCIAL SYSTEM

The Malaysian financial system can broadly be divided into the banking system and the non-bank financial intermediaries. These two banking institutions are different with respect to their activities. For a well functioning financial market along with the banking system and the non-bank financial intermediaries, finance and merchant banking institutions have an important role to uplift the economic activity. These two financial sectors can simultaneously build up and strengthen the financial system of the country. The banking system is the largest component, accounting for approximately 70% of the total assets of the financial system. The banking system can be further divided into three main groups namely the commercial banks, finance companies and the merchant banks.

The commercial banks are the main players in the banking system. They are the largest and most significant providers of funds in the banking system. As at end-2003, there are 10 domestically incorporated and 13 locally incorporated foreign commercial banks in Malaysia. Legally, Malaysian commercial banks enjoy the widest scope of permissible activities and are able to engage in a full range of banking

services. Traditionally, Malaysian commercial banks main functions include retail-banking services, trade financing facilities, treasury services, cross border payment services and custody services. Apart from the more traditional activities, Malaysian commercial banks are also allowed to engage in foreign exchange activities i.e. to buy, sell and lend foreign currencies and to provide current account facilities.

Finance companies formed the second largest group of deposit taking institutions in Malaysia. There were 10 domestically incorporated finance companies in Malaysia as at end-2003. Traditionally, finance companies specialise in consumption credit, comprising mainly of hire purchase financing, leasing, housing loans, block discounting and secured personal loans. The finance companies are allowed to accept savings and fixed deposits from the public, but are prohibited from providing current account facilities. They are also not allowed to engage in foreign exchange transactions compared to the commercial banks. During the later part of the last decade, the finance companies began to expand its traditional role in retail financing to include wholesale banking as well.

Merchant banks emerged in the Malaysian banking scene in the late 1970s, marking an important milestone in the development of the financial system alongside of the corporate development of the country. As the country's small businesses prospered and grew into large corporations, the banking needs of the nation became larger and more sophisticated, requiring more bulk financing and complex banking services.

Merchant banks filled the need for such services by complementing the facilities offered by commercial banks which were at times more focused on providing short-term credit for working capital and trade financing. They play a role in the short-term money market and capital raising activities such as financing,

syndicating, corporate financing, providing management advisory services, arranging for the issue and listing of shares as well as managing investment portfolio. As at end-2003, there were 10 merchant banks in Malaysia and all were domestically controlled institutions.

LITERATURE REVIEW

In the past few years, DEA has frequently been applied to banking industry studies. The first application analysed efficiencies of different branches of a single bank. Sherman and Gold [1985] studied the overall efficiency of 14 branches of a U.S. savings bank. DEA results showed that six branches were operating inefficiently compared to the others. Similar study by Parkan [1987] suggested that eleven branches out of thirty-five were relatively inefficient.

Rangan *et al.* [1988] shifted the unit of assessment from branches to consolidated banking institutions. They applied DEA to a larger sample of 215 U.S. banks and attempted to break down inefficiency to that stemming from pure technical inefficiency and scale inefficiency. They employed the intermediation approach by using three inputs (labour, capital and purchased funds) and five outputs (three types of loans and two types of deposits). Their results indicated that banks could have produced the same level of output with only 70% of the inputs actually used, while scale inefficiencies of the banks were relatively small, suggesting that the sources of inefficiency to be pure technical rather than scale.

In addition to the heavy concentration on the US, DEA has fast become a popular method in assessing financial institutions efficiency among banking researchers in other nations. Fukuyama [1993 and 1995] was among the early researchers particularly among countries in Asia to employ DEA to investigate banking efficiency. Employing labour, capital, and funds from customers as inputs

and revenue from loans and revenue from other business activities as outputs, Fukuyama [1993] considers the efficiency of 143 Japanese banks in 1990. He found that the pure technical efficiency to average around 0.86 and scale efficiency around 0.98 implying that the major source of overall technical inefficiency is pure technical inefficiency. The scale inefficiency is found to be mainly due to increasing returns to scale. He also found that banks of different organisational status perform differently with respect to all efficiency measures (overall, scale, pure technical). Scale efficiency is found to be positively but weakly associated with bank size.

Despite substantial studies performed on the developed economies banking industry with regard to the efficiency and productivity of financial institutions, there are only a handful of studies performed on the Malaysian banking industry partly due to the lack of available data sources and the small sample of banks. As pointed out by Kwan [2003], the lack of research on the efficiency of Asian banks was due to the lack of publicly available data for non-publicly traded Asian financial institutions. The most notable research conducted on Malaysian banks' productivity and efficiency are by Krishnasamy *et al.* [2004] and Sufian and Ibrahim [2005].

Krishnasamy *et al.* [2004] investigated Malaysian banks post-merger productivity changes. Applying labour and total assets as inputs, while 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 have posted positive total productivity growth ranging from 1.3% to 19.7%, one bank has exhibited total factor productivity regress of 13.3%, while another was stagnant. The merger has not resulted in better scale efficiency of Malaysian banks as all banks exhibited scale efficiency regress with the 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.

More recently, Sufian and Ibrahim [2005] applied the Malmquist Productivity Index method to investigate the extent of off-balance sheet (OBS) items in explaining Malaysian banks total factor productivity changes. They found that the inclusion of OBS items resulted in an increase in the estimated productivity levels of all banks in the sample during the period of study. They also suggested that the impacts were more pronounced on Malaysian banks technological change rather than efficiency change.

METHODOLOGY

In this section, we propose data envelopment analysis to evaluate relative efficiency for 20 finance companies and merchant banks. The DEA method was first described by Charnes *et al.* [1978] who employed a mathematical planning model (CCR model) to measure the efficiency frontier based on the concept of Pareto optimum. Then Banker *et al.* (1984) developed a revised model (BCC model) to measure technical efficiency and scale efficiency. We denote Y_{kj} as the *j*th output of the *k*th DMU and X_{ki} as the *i*th input of the *k*th DMU. If a DMU employs *p* input to produce *q* output, the score of *k*th DMU, E_k , is a solution from the fractional linear programming problem (CCR model):

$$\underset{U_j V_t}{Max} \; E_k = \frac{\sum_{j=1}^{q} U_j Y_{kj}}{\sum_{i=1}^{p} V_i X_{ki}} \tag{1}$$

$i = 1, 2, \ldots, p \quad j = 1, 2, \ldots, q \quad r = 1, 2, \ldots, K \ldots R$

$$\text{s.t.} \quad \frac{\sum_{j=1}^{q} U_j Y_{rj}}{\sum_{i=1}^{p} V_i X_{ri}} \leq 1 \qquad U_j,\ V_i > 0$$

where U_j and V_i give the slack in the *j*th output and the *i*th input, respectively. The BCC model is the revised version of the CCR model. The former model can be reformulated by adding $\sum_{j=1}^{n} \lambda_j = 1$ to the problem, which provides valuable information about the cost-benefit (BCC model):

$$Min \ \ TE = \theta - \varepsilon \left(\sum_{j=1}^{p} S_{ki}^{-} + \sum_{j=1}^{q} S_{kj}^{+} \right)$$

$$\text{s.t.} \quad \sum_{r=1}^{r} \lambda_{ri} X_{ri} - \theta X_{ki} + S_{ki}^{-} = 0$$

$$\sum_{r=1}^{r} \lambda_r Y_{rj} - S_{kj}^{+} = Y_{kj}$$

$$\sum_{r=1}^{r} \lambda_r = 1 \qquad \lambda_r \geq 0 \tag{2}$$

where θ is the efficiency score and ε is a non-archimedean quantity the value of which is very minute. Note that we can calculate the (pure) technical efficiency score from the BCC model, then the scale efficiency score can be derived by overall efficiency and technical efficiency scores because the overall efficiency score is equal to the power of (pure) technical efficiency and scale efficiency score.

It is also a considerable interest to explain the determinants of technical efficiency scores derived from the DEA models. As defined in equations (1) to (2) the DEA score falls between the interval 0 and 1 ($0 < h^* \leq 1$) making the dependent variable a limited dependent variable. A commonly held view in previous studies is

that the use of the Tobit model can handle the characteristics of the distribution of efficiency measures and thus provide results that can guide policies to improve performance. DEA efficiency measures obtained in the first stage are the dependent variables in the second stage of the Tobit model. The Tobit model was first introduced in the econometrics literature by Tobin [1958]. These models are also known as truncated or censored regression models where expected errors are not equal zero. Therefore, estimation with an Ordinary Least Squares (OLS) regression of h^* would lead to a biased parameter estimate since OLS assumes a normal and homoscedastic distribution of the disturbance and the dependent variable [Maddala, 1983].

In recent years, many DEA applications employ a two-stage procedure involving both DEA and Tobit. Among others, Luoma *et al.* [1996] and Chilingerian [1995] conduct both DEA and Tobit analyses in health sector applications to estimate both inefficiency and the determinants of inefficiencies. Jackson and Fethi [2000] apply DEA with Tobit to evaluate technical efficiency in Turkish banks.

The standard Tobit model can be defined as follows for observation (bank) i:

$$\begin{aligned} y_i^* &= \beta' x_i + \varepsilon_i \\ y_i &= y_i^* \quad \text{if} \quad y_i^* \geq 0 \quad \text{and} \\ y_i &= 0, \text{ otherwise} \end{aligned} \tag{3}$$

where $\varepsilon_i \sim N(0, \sigma^2)$, x_i and β are vectors of explanatory variables and unknown parameters, respectively. The y_i^* is a latent variable and y_i is the DEA score.

The likelihood function (L) is maximized to solve β. and σ based on 63 observations (banks) of y_i and x_i is

$$L = \prod_{y_i=0}(1-F)\prod_{y_i>0}\frac{1}{(2\Pi\sigma^2)^{1/2}} \times e^{-[1/(2\sigma^2)](y^i-\beta x_i)^2} \tag{4}$$

where

$$F_i = \int_{-\infty}^{\beta x_i / \sigma} \frac{1}{(2\Pi)^{1/2}} e^{-t^2/2} dt \qquad (5)$$

The first product is over the observations for which the banks are 100 percent efficient (y = 0) and the second product is over the observations for which banks are inefficient (y >0). F_i is the distribution function of the standard normal evaluated at $\beta' x_i / \sigma$.

Data Sample, Inputs-Outputs Definition and the Choice of Variables

For the empirical analysis, *all* Malaysian non-bank financial institutions will be incorporated in the study. The annual balance sheets and income statements used to construct the variables for the empirical analysis were taken from published balance sheet information in annual reports of each individual NBFI. Four NBFIs have to be excluded from the study due to unavailability of data due to mergers and acquisitions.

The definition and measurement of inputs and outputs in the banking function remains 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].

Under the production approach, a financial institution is defined as a producer of services for account holders, that is, they perform transactions on deposit accounts and process documents such as loans. Hence, according to this approach, the number of accounts or its related transactions is the best measures for output, while the number of employees and physical capital is considered as inputs. Previous studies

that adopted this approach are among others by Sherman and Gold [1985], Ferrier and Lovell [1990] and Fried *et al.* [1993].

The intermediation approach on the other hand assumes that financial firms act as an intermediary between savers and borrowers and posits total loans and securities as outputs, whereas deposits along with labour and physical capital are defined as inputs. Previous banking efficiency studies research that adopted this approach are among others Charnes *et al.* [1990], Bhattacharyya *et al.* [1997] and Sathye [2001].

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 inputs and outputs used[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.

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. All variables are measured in millions of Ringgit (RM). We model Malaysian finance and merchant banking institutions as a multi-product firms producing two outputs by employing three inputs. Accordingly, we assume Malaysian finance and merchant banking institutions produce Total Loans (*y1*) and Non-Interest Income (*y2*) by employing Total Deposits (*x1*) and Fixed Assets (*x2*).

[**Insert Table 1**]

Several bank- and industry-specific factors may influence the level of productivity and efficiency of a particular bank. Some of these factors may be neither

[1] Humphrey (1985) presets an extended discussion of the alternative approaches over what a bank produces.

inputs nor outputs in the production process, but rather circumstances faced by a particular bank. The variables consist of two groups - the first representing firm-specific attributes, and the second encompassing the market condition in effect over the period examined. The bank-specific variables included in the regressions are: size (LNTA= log of total assets measured in million of Malaysian Ringgit); capitalization (EQTY = book value of stockholders' equity as a fraction of total assets); market share (LOANS/TA = total loans over total assets); and overhead cost (OE = total overhead expenses over total assets). The LNTA and EQTY variables are included in the model to examine the effect of bank size and capitalization on efficiency. Strong capital structure is essential for the banks in emerging economies since it provides additional strength to withstand financial crises and increased safety for depositors during unstable macroeconomic conditions. Furthermore, lower capital ratios in banking imply higher leverage and risk, and therefore greater borrowing costs. Thus, the efficiency level should be higher in better-capitalized banks. However, we do not have any *a priori* expectation on the signs of the coefficients of other bank-specific variables.

The GDP variable represents the growth rate in country domestic product and is used as a proxy for economic conditions. Favorable economic conditions will affect positively the demand and supply of banking services, but will either impact positively or negatively on bank efficiency. To distinguish between merchant banks and finance companies, we included SPEC variable and to accounts for the effect of bank specialization.

RESULTS

The efficiency of Malaysian finance and merchant banking institutions s was first examined by applying the DEA method for each year under investigation using a

common frontier. We extend the analysis by examining the efficiency of merchant banks only, finance companies only and a pooled common frontier for all finance and merchant banking institutions for all years. Table 2 reports the sample statistics of the various efficiency scores of Malaysian finance and merchant banking institutions for the years 2000 (Panel A), 2001 (Panel B), 2002 (Panel C), 2003 (Panel D), 2004 (Panel E), Merchant Banks (Panel F), Finance Companies (Panel G) and All finance and merchant banking institutions All Years (Panel H). The results suggest that Malaysian finance and merchant banking institutions have exhibited mean overall efficiency score of 89.2% in year 2000 (Panel A), before recording the highest mean overall efficiency score of 89.9% in year 2001 (Panel B). The Malaysian finance and merchant banking institutions mean overall efficiency declined to 82.9% and 79.2% in years 2002 and 2003 (Panel C and Panel D) respectively, before improving to record overall efficiency of 81.3% in year 2004 (Panel E). The decomposition of overall efficiency into its pure technical and scale efficiency components suggest that pure technical inefficiency dominates scale inefficiency of Malaysian finance and merchant banking institutions during all years under investigation. This implies that during the period of study, Malaysian finance and merchant banking institutions have been inefficient in controlling their costs rather than having been operating at the wrong scale of operations.

[**Insert Table 2**]

During the period of study, we have found that the Malaysian merchant banks (Panel E) have exhibited mean overall efficiency of 78.1%, suggesting mean input waste of 22.9%. In other words, the domestic banks could have produced the same amount of outputs by only using 78.1% of the amount of inputs it used. From Table 2

(Panel E) it is clear that pure technical inefficiency dominates scale inefficiency in determining the efficiency of Malaysian merchant banks during the period of study.

Our results from Table 2 (Panel F) suggest that Malaysian finance companies have exhibited higher mean overall efficiency of 91.3% compared to its merchant banks counterparts. In contrast to the merchant banks, our results suggest that the finance companies inefficiency were mainly attributed to scale rather than pure technical. Our findings suggest that the finance companies have exhibited higher pure technical and scale efficiency of 95.9% and 95.0% (merchant banks – 83.1% and 93.7%) respectively, suggesting that Malaysian finance were more managerially efficient in controlling their costs and has been operating at the right scale of operations compared to their merchant banks counterparts during the period of study.

The results for all finance and merchant banking institutions for all years (Table 3, Panel G) suggest that pure technical inefficiency was the dominant factor influencing Malaysian finance and merchant banking institutions efficiency. During the period 2000-2004, our results from Panel F suggest that, Malaysian finance and merchant banking institutions have exhibited mean overall (technical) efficiency of 84.7%. The decomposition of the overall efficiency into its pure technical and scale components suggest that the inefficiency could be attributed mainly to pure technical (10.5%) rather than scale (5.6%).

We now turn our discussion on the developments of the Malaysian finance and merchant banking institutions returns to scale. As Panel 1 of Table 3 shows, over the five-year period, the share of inefficient Malaysian finance and merchant banking institutions has witnessed an increasing trend, from 62.5% in year 2000 to 81.25% in year 2004. It is apparent from Panel 1of Table 3 that, the number of Malaysian finance and merchant banking institutions experiencing economies of scale (IRS) has

increased substantially from 2 (12.5%) in year 2000 to 5 (37.5%) in year 2004. The share of scale efficient banks (operating at CRS) has declined from 6 (35.7%) in year 2000, to only 3 (18.75%) in year 2004. On the other hand, the share of Malaysian finance and merchant banking institutions experiencing diseconomies of scale (DRS) has remained stable at 8 (50.0%) in years 200 and 2001, declined to 5 (31.75%) in year 2002 before increasing again to 8 (50.0%) in years 2003 and 2004.

[**Insert Table 3**]

Panel 2 of Table 3 displays the returns to scale by size measured in billions of RM. Panel 2 of Table 3 presents the overall summary results from the sample of the 80 observations over the five-year period. Examination of Panel 2 of Table 3 reveals that while, on average, 23 or 28.75% of all Malaysian finance and merchant banking institutions were operating at CRS, the majority, 71.25%, is scale inefficient (operating at DRS or IRS). Of the scale inefficient banks, 28 or 35.0% is small finance and merchant banking institutions, 7 or 8.75% is medium finance and merchant banking institutions and 22 or 27.5% is large finance and merchant banking institutions. Of the banks experiencing DRS, 9 or 11.25% is small finance and merchant banking institutions and the majority, 28 or 35.0% is medium and large finance and merchant banking institutions (8.75% due to medium finance and merchant banking institutions and 26.25% due to large finance and merchant banking institutions). Whereas, of the banks experiencing IRS, the majority 19 (23.75%) is small finance and merchant banking institutions and only 1 (1.25%) is large finance and merchant banking institutions. As observed, the convexity of the frontier assures that banks experiencing IRS are more frequently smaller banks. Our results congregate with earlier findings by among other Miller and Noulas [1996] and McAllister and McManus [1993]. McAllister and McManus [1993] suggest that while

small banks have generally exhibit IRS, the large banks on the other hand tend to exhibit DRS and at best CRS.

After examining the efficiency results, the issue of interest now is whether the two samples are drawn from the same population and whether the merchant banks and finance companies possessed the same technology. The null hypothesis tested is that the merchant banks and finance companies were drawn from the same population or environment. We tested the null hypothesis that merchant banks and finance companies were drawn from the same population and have identical technologies by using a series of parametric (ANOVA and *t*-test) and non-parametric (Kolmogorov-Smirnov and Mann-Whitney [Wilcoxon Rank-Sum]) tests. Based on most of the results presented in Table 4, we could reject the null hypothesis at the 0.05 levels of significance that the merchant banks and finance companies came from the same population and have identical technologies. This implies that, there is significant difference between the merchant banks and finance companies technologies (frontiers) and that it is appropriate to construct a combined frontier. Furthermore, the results from the Levene's test for equality of variances rejected the null hypothesis that the variances among merchant banks and finance companies were equal, implying that we could not assume the variances among merchant banks and finance companies to be equal.

[Insert Table 4]

The second stage regressions were estimated to further investigate the determinants of efficiency performance over time by using the Tobit regression model. Unlike a conventional Ordinary Least Square estimation, in case with limited dependent variables, Tobit models are known to generate consistent estimates of regression coefficients. The results of estimation are presented in Table 5. A positive

coefficient implies an efficiency increase whereas a negative coefficient reflects the deterioration in efficiency.

[Insert Table 5]

The coefficient on the size variable is negative for the efficiency index but it is statistically insignificant at the 1 % level, indicating that, on average, larger financial institutions attain a lower level of efficiency in their operations. This might imply that as banks grow larger and venture into different banking businesses, they are not able to control cost and become harder to efficiently create revenues. This is consistent with conventional wisdom and historical fact that small banks typically have higher profitability ratios. The level of equity capital is positively related with the level of efficiency gain. This finding is consistent with the results of the previous research that usually report higher efficiency levels for well-capitalized financial institutions. Financial institutions with higher ratio of loans to assets are related to higher level of efficiency. This might reflect higher market power that exist in the loan markets compared to the other product markets in which banks operate as well as the control for the strategic niche of the bank. Finally, the dummy variable representing bank specialization is significant indicating that finance companies are more efficient relative to merchant banks. On the other hand, the level of overhead expenditure is found to be insignificant with respect to bank efficiency. The GDP variable is negatively linked to efficiency growth but insignificant at conventional level.

CONCLUSIONS

The paper attempts to investigate the efficiency of Malaysian finance and merchant banking institutions during the period of 2000-2004. The preferred non-parametric Data Envelopment Analysis (DEA) methodology has allowed us to distinguish between three different types of efficiency, such as technical, pure

technical and scale efficiencies. Additionally we have performed a series of parametric and non-parametric tests to examine whether the merchant banks and finance companies were drawn from the same population. Finally, we have employed Spearman Rho Rank-Order and the Parametric Pearson correlation coefficients to investigate the association between the efficiency scores derived from the DEA results with the traditional accounting ratios.

We have found that the mean overall or technical efficiency has been 78.1% and 91.3% for merchant banks and the finance companies respectively. In other words, during the period of study, the merchant banks could have produced the same amount of outputs by only using 78.1% of the inputs that it currently employed. Similarly, the finance companies could have reduced 8.7% of the amount of inputs it employed currently without affecting the amount of outputs that it currently produces. We found that PTE is more related to OE than SE, confirming the dominant effect of pure technical efficiency in determining the overall efficiency of Malaysian finance and merchant banking institutions. Further, most of our results from the parametric and non-parametric tests reject the null hypotheses that the merchant banks and the finance companies were drawn from the same population suggesting that it is appropriate to construct a separate frontier for both the merchant banks and finance companies.

Our results suggest that the number of Malaysian finance and merchant banking institutions experiencing economies of scale (IRS) has increased dramatically from 12.5% in year 2000 to 31.25% in year 2004. The share of scale efficient banks (operating at CRS), declined from 37.5% in year 2000 to 18.5% in year 2004, while Malaysian finance and merchant banking institutions experiencing diseconomies of scale (DRS) remained stable at 50.0% during the five-year study period. Examination

of the sample of 80 observations over the five-year period reveals that while, on average, 28.75% of all Malaysian finance and merchant banking institutions were operating at CRS, the majority, 71.25%, is scale inefficient (operating at DRS or IRS). Of the scale inefficient finance and merchant banking institutions, 35.0% is small finance and merchant banking institutions, 8.75% is medium finance and merchant banking institutions and 27.5% is large finance and merchant banking institutions. Our results thus suggests that the convexity of the frontier has assures that banks experiencing IRS are more frequently the smaller banks.

To further complement the results of the efficiency measures, we have correlated various bank specific determinants with the efficiency scores derived from the DEA. Our results from Tobit regression model suggest that efficiency is positively and significantly associated with bank-capitalization and market share. On the other hand, we found that that size and economic environment have negative relationship to efficiency though not statistically significant whereas overhead expenditure has a positive association with efficiency but insignificant. Interestingly, we have also found positively and significant relationship between the degree of specialisation and bank efficiency.

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Table 1: **Descriptive Statistics for Inputs and Outputs**

	2000 (RMb)	**2001** (RMb)	**2002** (RMb)	**2003** (RMb)	**2004** (RMb)
Outputs					
Total Loans (y1)					
Min	172,048	179,370	136,731	89,774	136,552
Mean	4,089,029.44	4,195,137	4,952,955.06	5,122,363.75	5,259,250.63
Max	14,045,862	17,097,078	22,909,030	25,160,438	26,048,864
S.D	4,013,245.39	4,949,607.76	6,609,351.42	7,027,574.37	7,191,474.18
Other Income (y2)					
Min	1,080	799	939	534	3,730
Mean	60,217.69	63,605.25	57,418.13	69,020	71,603.63
Max	242,411	350,575	207,255	313,840	392,518
S.D	66,727.10	93,480.63	6,376,814	97,747.24	113,478.62
Inputs					
Total Deposits (x1)					
Min	58,302	88,858	113,195	63,782	108,898
Mean	4,123,328.44	4,291,041.44	5,039,194	5,032,300.94	5,237,107.88
Max	14,546,269	17,012,443	19,591,827	19,609,194	20,411,793
S.D	4,126,896.05	4,948,226.30	6,180,309.37	5,957,495.91	5,749,856.56
Fixed Assets (x2)					
Min	279,167	506,331	553,523	662,855	594,538
Mean	6,840,386.88	6,948,016.94	7,070,498.94	8,898,910.69	9,176,940.81
Max	21,371,114	20,186,180	23,625,038	32,529,566	33,618,318
S.D	6,224,024.14	6,354,506.67	6,717,443.03	9,076,978.74	8,936,914.42

Table 2: **Summary Statistics of Efficiency Measures**

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2000				
Overall Efficiency	0.892	0.661	1.000	0.117
Pure Technical Efficiency	0.927	0.702	1.000	0.116
Scale Efficiency	0.963	0.882	1.000	0.041
Panel B: 2001				
Overall Efficiency	0.899	0.59	1.000	0.132
Pure Technical Efficiency	0.934	0.616	1.000	0.115
Scale Efficiency	0.955	0.82	1.000	0.050
Panel C: 2002				
Overall Efficiency	0.839	0.574	1.000	0.159
Pure Technical Efficiency	0.896	0.607	1.000	0.144
Scale Efficiency	0.935	0.825	1.000	0.061
Panel D: 2003				
Overall Efficiency	0.792	0.488	1.000	0.182
Pure Technical Efficiency	0.867	0.562	1.000	0.173
Scale Efficiency	0.911	0.769	1.000	0.077
Panel E: 2003				
Overall Efficiency	0.813	0.503	1.000	0.175
Pure Technical Efficiency	0.851	0.542	1.000	0.175
Scale Efficiency	0.955	0.819	1.000	0.054
Panel F: Merchant Banks Only				
Overall Efficiency	0.781	0.488	1.000	0.175
Pure Technical Efficiency	0.831	0.542	1.000	0.168
Scale Efficiency	0.937	0.769	1.000	0.063
Panel G: Finance Companies Only				
Overall Efficiency	0.913	0.590	1.000	0.101
Pure Technical Efficiency	0.959	0.616	1.000	0.086
Scale Efficiency	0.950	0.828	1.000	0.056
Panel H: All NBFIs All Years				
Overall Efficiency	0.847	0.488	1.000	0.157
Pure Technical Efficiency	0.895	0.542	1.000	0.147
Scale Efficiency	0.944	0.769	1.000	0.060

Table 3: **Returns to Scale (RTS) in Malaysian Non-Bank Financial Institutions**

Panel 1: **Developments in RTS**[a]

RTS	Years									
	2000		2001		2002		2003		2004	
	No. of NBFIs	% Share	No. of NBFIs	% Share	No. of NBFIs	% Share	No. of NBFIs	% Share	No. of NBFIs	% Share
CRS	6	37.5	5	31.25	5	31.25	4	25.0	3	18.75
DRS	8	50.0	8	50.0	5	31.25	8	50.0	8	50.0
IRS	2	12.5	3	18.75	6	37.5	4	25.0	5	31.25
Total	**16**	**100.0**	**16**	**100.0**	**16**	**100.0**	**16**	**100.0**	**16**	**100.0**

Panel 2: **RTS by Size**[b]

Size	CRS		DRS		IRS		Total	
	No. Of NBFIs	% Share	No. Of NBFIs	% Share	No. Of NBFIs	% Share	No. Of NBFIs	% Share
SML_NBFIs	13	16.25	9	11.25	19	23.75	41	51.25
MED_ NBFIs	6	7.5	7	8.75	0	0	13	16.25
LAR_ NBFIs	4	5.0	21	26.25	1	1.25	26	32.50
Total	**23**	**28.75**	**37**	**46.25**	**20**	**25.0**	**80**	**100.0**

[a] Panel 1 presents the trend in the RTS of Malaysian Non-Bank Financial Institutions by year. RTS are the increase in output that result from increasing all inputs by the same percentage. There are three possible cases. (1) Constant Returns to Scale (CRS), which arise when percentage change in outputs = percentage change in inputs; (2) Decreasing Returns to Scale (DRS), which occur when percentage change in outputs < percentage change in inputs; (3) Increasing Returns to Scale (IRS), which occurs when percentage change in outputs > percentage change in inputs. Over the years, 23 observations (28.75% of total 80 observations) belonged to the NBFIs that experienced CRS, 37 observations (46.25% of total 80 observations) belonged to the NBFIs that experienced DRS and 20 observations (25.0% of total 80 observations) belonged to the NBFIs that experienced IRS.

[b] Panel 2 provides the summary of overall RTS according to various size groups over the years 2000-2004. SML_NBFIs is defined as NBFIs with total assets < industry's Mean, MED_NBFIs is defined as NBFIs with total assets in the mean range, while LRG_NBFIs is defined as NBFIs with total assets > industry's mean. Over the years studied, 41 observations (51.25% of total 80 observations) belonged to SML_NBFIs of which 13 or 31.70% of 41 SML_NBFIs observations experienced CRS, 9 (21.95%) experienced DRS and 19 (46.35%) experienced IRS. 13 observations (16.25% of total 80 observations) belonged to MED_NBFIs, of which, 6 or 46.15% of 13 MED_NBFIs observations experienced CRS, 7 (53.85) experienced DRS and no MED_NBFI experienced IRS. 26 observations or 32.50% of total 80 observations belonged to LAR_NBFIs, of which 4 or 15.38% of 26 LAR_NBFIs observations experienced CRS, 21 (80.77%) experienced DRS and 1 (3.85%) experienced IRS.

Table 4: **Summary of Parametric and Non-Parametric Tests for the Null Hypothesis that Merchant Bank (*mb*) and Finance Companies (*fc*) Possessed Identical Technologies (Frontiers)**

	Test Groups			
	Parametric Test		**Non-Parametric Test**	
Individual Tests	Analysis of Variance (ANOVA) test	*t*-test	Kolmogorov-Smirnov [K-S] test	Mann-Whitney [Wilcoxon Rank-Sum] test
Hypotheses	$Mean_{mb} = Mean_{fc}$		$Distribution_{mb} = Distribution_{fc}$	$Median_{mb} = Median_{fc}$
Test Statistics	*F* (Prob > *F*)	*t* (Prob > *t*)	K-S (Prob > K-S)	*z* (Prob > *z*)
Overall Efficiency	8.809 (0.005)***	-2.968 (0.005)***	1.588 (0.013)**	-1.999 (0.046)**
Pure Technical Efficiency	8.715 (0.005)***	-2.952 (0.005)***	1.299 (0.068)*	-2.451 (0.014)**
Scale Efficiency	0.570 (0.454)	-0.755 (0.454)	0.577 (0.893)	-0.417 (0.677)

Note: Test methodology follows among others, Aly *et al.* (1990), Elyasiani and Mehdian (1992) and Isik and Hassan (2002). Parametric (ANOVA and t-test) and Non-Parametric (Kolmogorov-Smirnov and Mann-Whitney) tests test the null hypothesis that domestic and foreign banks are drawn from the same efficiency population (environment).
The numbers in parentheses are the *p*-values associated with the relative test.
*** indicate significant at the 0.01 level
** indicates significant at the 0.05 level
* indicates significant at the 0.10 level

Table 5: **Results of Tobit Regression Analysis**

	EFFICIENCY SCORE					
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CONSTANT	1.068** (0.288)	0.766** (0.336)	0.609** (0.264)	0.598** (0.259)	0.592** (0.262)	0.651** (0.292)
LNTA	-0.014 (0.014)	-0.051 (0.018)	-0.001 (0.014)	-0.002 (0.014)	-0.0029 (0.014)	-0.002 (0.015)
EQTY	-	0.127* (0.052)	0.308** (0.059)	0.313** (0.059)	0.312** (0.055)	0.353** (0.051)
LOANS/TA	-	-	0.322** (0.079)	0.315** (0.077)	0.312** (0.075)	0.126** (0.061)
GDP	-	-	-	-0.009 (0.006)	-0.009 (0.006)	-0.008 (0.006)
OE/TA	-	-	-	-	0.374 (2.665)	1.342 (2.506)
SPEC	-	-	-	-	-	0.167** (0.045)
No. of Observations	63	63	63	63	63	63
Log-likelihood	28.29	29.59	45.06	46.24	46.25	52.04

Note: * and ** represent significance at the 5% and 1% levels respectively, standard error in parentheses.