THE EFFICIENCY OF NON-BANK FINANCIAL INTERMEDIARIES: EMPIRICAL EVIDENCE FROM MALAYSIA

Fadzlan Sufian
The University of Malaysia and CIMB Bank Berhad

Abstract

This paper investigates the performance of Malaysian non-bank financial institutions during the period of 2000-2004. Several efficiency estimates of individual NBFIs are evaluated using the non-parametric Data Envelopment Analysis (DEA) method. The findings suggest that during the period of study, scale inefficiency outweighs pure technical inefficiency in the Malaysian NBFI sector. We find that the merchant banks have exhibited a higher, technical efficiency compared to their peers. The empirical findings suggest that scale efficiency tends to be more sensitive to the exclusion of risk factors, implying that potential economies of scale may be overestimated when risk factors are excluded.

Keywords: Non-Bank financial intermediaries, Data Envelopment Analysis (DEA), Risk
JEL Classification: G21, G28

1. Introduction

Non-Bank Financial Institutions (NBFIs) play important dual roles in a financial system. They complement the role of commercial banks by filling in financial intermediation gaps by offering a range of products and services. They also compete with commercial banks, forcing the latter to be more efficient and responsive to their customers needs. NBFIs' state of development is usually a good indicator to the state of development of a country's financial system as a whole.

The importance of investigating the efficiency and productivity of Malaysian NBFIs could be best justified by the fact they play important roles in complementing the facilities offered by the commercial banks, as well as being key players in the development of the capital markets. As sophisticated and well-developed as capital markets are considered to be as the hallmark for a market-based economy worldwide, such a study of this nature is particularly important as the health and development of the capital market relies largely upon the performance of NBFIs. Hence, efficient and productive NBFIs are expected to enhance the Malaysian capital markets in its pursuit to move towards a full market based economy.

Despite the significant, economic developments of the NBFI sector, studies that attempt to investigate this issue are relatively scarce. Over the years, while there have been extensive literature examining the productivity and efficiency of banking industries in various countries, empirical works on NBFIs' productivity & efficiency are still in its infancy. To the best of our knowledge, there has been no microeconomic study performed with respect to NBFIs. The study therefore aims to fill a demanding gap in that case. Nevertheless, the study will also be the first to investigate the sources of NBFIs' productivity changes in developing economies.

Section 2 will provide a brief overview of the Malaysian financial system with reviews of related studies. Section 3 will outline the approaches to the measurement and estimation of efficiency change, while Section 4 will discuss the results. Naturally, Section 5 will conclude the paper.

2. Background and Related Literature

The Malaysian financial system can be broadly divided into the banking system and non-bank financial intermediaries. The banking system is the largest component, accounting for approximately 70 percent of the financial system's total assets. The banking system can be further divided into three main groups, namely the commercial banks, financial companies, and 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, enjoying the widest scope of permissible activities, those of which are able to engage in a full range of banking services.

Financial companies formed the second largest group of deposit taking institutions in Malaysia. Traditionally, financial companies specialize in consumption credit, comprising mainly of hire purchase financing, leasing, housing loans, block discounting, and secured personal loans. Merchant banks emerged in the Malaysian banking scene in 1970, marking an important milestone in the development of the financial system, alongside Malaysian corporate development. They play a role in the short-term money market and capital raising activities such as financing, syndicating, corporate financing, and management advisory services that arrange for the issue and listing of shares, as well as managing portfolios.

The Malaysian financial system's assets and liabilities continued to be highly concentrated at the commercial banking sector with total assets and liabilities amounting to RM 761,254.8 billion (or 3.05 times the national GDP at the end of 2004). Prior to the Asian Financial Crisis in 1997/98, financial companies' assets and liabilities were seen increasing from only RM531 million (or 0.05 times the national GDP in 1970) to a high of RM 152.4 billion (or 0.77 times in 1997). The ratio however, has gradually declined to RM 123.6 billion (or 0.60 times in 1998) to RM 109,409.8 billion (or 0.52 times the GDP in 2000), before increasing again in year 2001, to reach a post crisis high of RM 141,911.0 billion (or 0.61 times the GDP in 2003).

Due to further consolidation in the Malaysian financial sector, financial companies' assets as a ratio of the national GDP declined again to reach a low of

0.27 times in 2004. As for the merchant banks, a similar trend is observed where their assets and liabilities (as a ratio of the national GDP) have been increasing since 1971, reaching a peak of RM 44.3 billion or 0.23 times GDP in 1997 (before the Asian financial crisis). During the post crisis period, the merchant banks' assets and liabilities continued to remain stable at 0.17 to 0.22 times the national GDP. A combination of both financial companies and merchant banks' total assets reveal that the non-bank financial sector commanded approximately 22.8 percent of the banking system's total assets and liabilities.[1]

Table 1: Assets of the Financial System, 1960 – 2004

Year	Commercial Banks		Finance Companies		Merchant Banks	
	RM million	As a Ratio of GDP	RM million	As a Ratio of GDP	RM million	As a Ratio of GDP
1960	1,231.9	0.21	n.a.	n.a.	n.a.	n.a.
1970	4,460.2	0.38	531.0	0.05	19.6*	0.002
1980	32,186.1	0.63	5,635.4	0.13	2,228.7	0.05
1990	129,284.9	1.23	39,448.0	0.50	11,063.2	0.14
1995	295,460.0	1.77	91,892.0	0.55	27,062.0	0.16
1996	360,126.8	1.98	119,768.8	0.65	34,072.8	0.19
1997	480,248.1	2.46	152,386.8	0.77	44,300.0	0.23
1998	453,492.0	2.52	123,596.9	0.68	39,227.8	0.22
1999	482,738.3	2.50	116,438.0	0.60	39,184.0	0.20
2000	512,714.7	2.44	109,409.8	0.52	36,876.0	0.18
2001	529,735.5	2.51	121,811.1	0.58	41,025.2	0.19
2002	563,254.1	2.56	130,520.0	0.59	41,415.5	0.19
2003	629,975.3	2.71	141,911.0	0.61	44,103.6	0.19
2004	761,254.8	3.05	68,421.1	0.27	42,691.0	0.17

Source: Bank Negara Malaysia.

*As at end 1971.

The Malaysian financial sector is currently facing a number of challenges such as frequent changes in technology required for modern banking, increasing competition, rising customer expectations, etc. Hence, the efficiency and productivity issues have become a major area of concern for the banks' management. In fact, productivity is an important criterion to measure the performance of banks in addition to profitability, financial, and operational efficiency. An efficient management of banking operations aimed at increasing the efficiency and productivity of the financial sector requires up to date knowledge.

[1] The figure is at end-2003, prior to the consolidation of financial companies into their respective commercial banking parents.

A lot of research work has so far taken place concerning the views about the role of financial & banking developments in economic growth [McKinnon (1973); Shaw (1973); Rajan & Zingales (1998); Levine (2004); Singh (2005)], as well as banking efficiency and productivity [(Das & Ghosh (2006); Sufian (2007); and Weill (2007)].[2] Similarly, some studies have been undertaken for measuring the productivity and efficiency of banks in Malaysia [most notably, Katib & Matthews (2000) and Okuda & Hashimoto (2004)]. Concerning our information, despite NFBIs' significance towards economic development, studies that attempt to investigate this issue are relatively scarce. Over the years, while there have been extensive literature examining the productivity & efficiency of banking industries in various countries, empirical works on NBFIs' productivity & efficiency are still in its infancy.

3. Methodology and Data

A non-parametric Data Envelopment Analysis (DEA) is employed with a variable return to scale assumption, measuring Malaysian NBFIs' input-oriented technical efficiencies. DEA involves constructing a non-parametric production frontier based on the actual input-output observations in the sample, relative to the measured efficiency of each firm in the sample (Coelli, 1996). Let us give a short description of the Data Envelopment Analysis[3]. Assume that there is data on K inputs and M outputs for each N NBFI. For the ith NBFI, these are represented by the vectors x_i and y_i, respectively. Let us introduce the K x N input matrix, X, and the M x N output matrix, Y. To measure the efficiency for each NBFI, we calculate a ratio of all inputs, such as $(u'y_i/v'x_i)$, where u is an M x 1 vector of output weights, and v is a K x 1 vector of input weights. To select optimal weights, we specify the following mathematical programming problem:

$$\begin{aligned} &\min_{u,v} (u'y_i/v'x_i), \\ &u'y_i/v'x_i \leq 1, \qquad j = 1, 2, \ldots, N, \\ &u, v \geq 0 \end{aligned} \tag{1}$$

The above formulation has a problem of infinite solutions; therefore we impose the constraint $v'x_i = 1$, which leads to:

$$\begin{aligned} &\min_{\mu,\varphi} (\mu'y_i), \\ &\varphi'x_i = 1 \\ &\mu'y_i - \varphi'x_j \leq 0 \qquad j = 1, 2, \ldots, N, \\ &\mu, \varphi \geq 0 \end{aligned} \tag{2}$$

---

[2] See Berger & Humphrey (1997) for an excellent review.

[3] Good reference books on efficiency measures are Coelli *et al*. (1998), Cooper *et al*. (2000), and Thanassoulis (2001).

where we change notation from u & v to μ & φ, respectively, in order to reflect transformations. Using the duality in linear programming, an equivalent envelopment form of this problem can be derived:

$$\begin{aligned} &\min_{\theta,\lambda} \theta, \\ &y_i + Y\lambda \geq 0 \\ &\theta x_i - X\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \tag{3}$$

where θ is a scalar representing the value of the efficiency score for the ith decision-making unit, which will range between 0 and 1. λ is a vector of N x 1 constants. The linear programming has to be solved N times, once for each NBFI in the sample. In order to calculate efficiency under the assumption of variable returns to scale, the convexity constraint ($N1'\lambda=1$) will be added to ensure that an inefficient NBFI is only compared against NBFIs of similar size; thus providing the basis for measuring economies of scale within the DEA concept.

For the empirical analysis, *all* Malaysian NBFIs would be incorporated. The annual balance sheets and income statements used to construct the variables for the empirical analysis are sourced from published balance sheet information in the annual reports. Due to scarce data from M & A activity, the final sample was an unbalanced panel sample of 92 NBFI observations.

There are two main approaches that exist in banking theory literature to define the banking function: the production and intermediation approaches [Sealey & Lindley (1977)]. Under the production approach, which was pioneered by Benston (1965), 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. The intermediation approach on the other hand, assumes that financial firms act as an intermediary between savers and borrowers, hypothesizing total loans and securities as outputs; whereas deposits with labor and physical capital are defined as inputs. 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.

Given the sensitivity of efficiency estimates to the specification of outputs and inputs, we have estimated two alternative models. In DEA Model A, we model Malaysian NBFIs as multi-product firms, producing two outputs by employing two inputs. Accordingly, *Total Deposits* (*x1*) include deposits from customers and other banks. *Fixed Assets* (*x2*) are used as input vectors to produce *Total Loans* (*y1*), which include loans to customers and other banks. *Investments* (*y2*) include investment securities held for trading, investment securities available for sale (AFS), and investment securities held to maturity. To assess the importance of risk and lending quality problems in explaining the efficiency of Malaysian NBFIs, following the approach by the likes of Drake and Hall (2003) and Charnes *et al*. (1990), *Loan Loss Provisions* (*x3*) is incorporated as an input variable in DEA Model B.

Table 2: Descriptive Statistics for Inputs and Outputs

The table presents summary statistics of the variables used to construct the efficiency frontier for both DEA Model A and DEA Model B over the period 2000-2004. The sample is divided into peer groups (i.e., merchant banks and financial companies). MB denotes merchant banks and FC denotes finance companies.

		2000 (RMb)		**2001** (RMb)		**2002** (RMb)		**2003** (RMb)		**2004** (RMb)	
Outputs		**MB**	**FC**	**MB**	**FC**	**MB**	**FC**	**MB**	**FC**	**MB**	**FC**
Total Loans	Min	172.05	1,927.44	135.04	887.41	136.73	1,116.10	89.77	1,363.46	136.55	1408.4
	Mean	1,784.70	6,832.02	1,549.44	6,904.33	1,336.28	7,383.17	1,173.53	9,773.36	1,045.39	9,454.49
	Max	7,677.01	15,743.03	7,571.63	15,765.02	6,906.83	16,732.43	5,582.32	25,160.44	5,274.91	26,048.86
	S.D	2,426.46	4,537.73	2,192.84	4,929.12	2,014.58	5,095.30	1,706.99	7,690.041	1,628.510	8,241.46
Investments	Min	61.79	180.97	74.8	40.55	57.82	41.69	99.51	75.77	98.67	69.91
	Mean	1,710.31	1,473.56	1,530.41	1,116.91	1,655.44	818.38	2,085.44	966.80	2,058.65	797.97
	Max	5,525.08	3,416.52	4,985.66	2,800.68	5,999.55	1,730.22	8,023.00	2,454.12	6,558.26	2,317.31
	S.D	1,945.90	1,220.12	1,858.97	1,063.46	2,035.57	599.90	2,503.18	991.46	1,974.16	910.38
Inputs											
Fixed Assets	Min	0.84	21.68	0.25	5.31	0.32	6.71	0.10	6.54	0.06	2.02
	Mean	4.46	55.66	7.90	49.63	11.51	88.86	16.21	87.12	14.56	95.84
	Max	11.71	186.94	39.69	205.86	45.00	425.22	53.69	439.35	54.17	424.60
	S.D	4.07	54.42	12.45	58.76	16.62	130.90	19.61	134.07	19.93	141.93
Total Deposits	Min	58.30	1,480.76	88.86	913.12	20.23	1,164.16	63.78	1,226.55	74.62	1,084.00
	Mean	2,331.99	7,145.82	1,906.52	6,514.09	1,555.06	7,445.49	1,660.76	8,306.54	2,003.80	7,903.50
	Max	8,110.02	14,546.27	8,853.50	13,928.60	5,356.46	16,025.89	5,302.27	19,609.19	5,929.86	20,411.79
	S.D	2,543.59	4,183.57	2,596.72	4,757.44	1,676.94	5,590.04	1,676.48	6,506.15	1,796.95	7,057.08
Loan Loss Provisions	Min	1.18	0.60	10.00	35.18	0.08	17.78	7.47	33.79	17.70	59.72
	Mean	55.7925	136.40	71.09	119.96	32.78	107.03	47.45	108.10	58.43	155.74
	Max	160.28	519.78	229.44	384.38	154.35	311.64	253.24	378.73	159.31	347.76
	S.D	58.02	168.09	68.35	106.56	47.14	84.65	79.14	101.04	40.40	96.39

Table 2 presents the summary statistics of the input and output variables used to construct the efficiency frontier. During the period of study, it is apparent that the financial companies were almost three times larger (in terms of asset size) and commanded higher market share in terms of loans & deposits, compared with their merchant bank peers. On the other hand, although the merchant banks were smaller, they seem to have produced a higher amount of investments with lower amounts of defaulted loans. The differences are further confirmed by a series of parametric (*t*-test) and non-parametric (Kruskal-Wallis and Mann-Whitney [Wilcoxon Rank-Sum] tests), which suggest that the differences in the mean are significant for all variables at the 1 per cent level of significance[4].

4. Results

In this section, we will discuss the technical efficiency change (TE) of the Malaysian NBFI sector, measured by the Data Envelopment Analysis (DEA) method, along with its decomposition into pure technical efficiency (PTE) and scale efficiency (SE) components. With the existence of scale inefficiency, we will attempt to provide evidence on the nature of returns to scale of Malaysian NBFI. The efficiency of Malaysian NBFIs was first examined by applying the DEA method for each year under investigation by employing the traditional input-output variables. We extend the analysis to examine the merchant banks and financial companies' efficiency results derived from an alternative model, which incorporates a non-discretionary, input variable.

4.1 Efficieny of the Malaysian NBFI Sector

Table 3 presents the mean efficiency scores of the merchant banks for the years 2000 (Panel A), 2001 (Panel B), 2002 (Panel C), 2003 (Panel D), 2004 (Panel E), and All Years (Panel F). The results from DEA Model A seems to suggest that the merchant banks' mean technical efficiency has been on a declining trend during the earlier part of the studies, before increasing again during the latter years. The decomposition of overall efficiency into its pure technical and scale efficiency components suggest that the merchant banks have exhibited higher scale efficiency during 2000 and 2002.

Overall, the results imply that during the period of study, the merchant banks have been operating at the wrong scale of operations. During the period of study, the results from Panel F of Table 3 seem to suggest that the merchant banks have exhibited a mean technical efficiency of 69.6 percent, suggesting a mean input waste of 30.4 percent. In other words, the merchant banks could have produced the same amount of outputs by only using 69.6 percent of the amount of inputs it uses. From Table 3 (Panel F), it is also clear that scale inefficiency outweighs pure, technical inefficiency in determining the total technical inefficiency of the merchant banks.

---

[4] Investment is not significant in the case of the Mann-Whitney [Wilcoxon Rank-Sum] and Kruskal-Wallis tests at any conventional levels. To conserve space, we do not report the results here. They are available from the authors upon request.

Table 3: Summary Statistics of Efficiency Measures – Merchant Banks (DEA Model A)

The table presents mean, minimum, maximum, and standard deviation of Malaysian NBFIs' technical efficiency (TE), its mutually exhaustive, pure technical efficiency (PTE), and scale efficiency (SE) components derived from DEA Model A (excluding the risk factor). Panel A, B, C, D, and E shows the mean, minimum, maximum, and standard deviation of TE, PTE, and SE of the merchant banks for the years 2000, 2001, 2002, 2003, and 2004, respectively. Panel F presents the merchant banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores, respectively. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2000				
Technical Efficiency	0.908	0.443	1.000	0.193
Pure Technical Efficiency	0.925	0.527	1.000	0.167
Scale Efficiency	0.974	0.841	1.000	0.056
Panel B: 2001				
Technical Efficiency	0.745	0.342	1.000	0.271
Pure Technical Efficiency	0.897	0.547	1.000	0.180
Scale Efficiency	0.822	0.372	1.000	0.218
Panel C: 2002				
Technical Efficiency	0.750	0.216	1.000	0.327
Pure Technical Efficiency	0.851	0.266	1.000	0.266
Scale Efficiency	0.861	0.438	1.000	0.222
Panel D: 2003				
Technical Efficiency	0.506	0.188	1.000	0.320
Pure Technical Efficiency	0.894	0.429	1.000	0.201
Scale Efficiency	0.562	0.188	1.000	0.298
Panel E: 2004				
Technical Efficiency	0.582	0.331	1.000	0.209
Pure Technical Efficiency	0.924	0.685	1.000	0.133
Scale Efficiency	0.636	0.386	1.000	0.226
Panel F: Merchant Banks All Years				
Technical Efficiency	0.696	0.188	1.000	0.295
Pure Technical Efficiency	0.897	0.266	1.000	0.190
Scale Efficiency	0.770	0.188	1.000	0.258

Table 4 presents mean efficiency scores of the finance companies for the years 2000 (Panel A), 2001 (Panel B), 2002 (Panel C), 2003 (Panel D), 2004 (Panel E), and All Years (Panel F). Similar to their merchant bank counterparts, the results from DEA Model A seem to suggest that the financial companies' mean technical efficiency has been on a declining trend during the earlier part of the studies, before increasing during the latter years. The decomposition of technical efficiency into its pure technical and scale efficiency components suggest that scale inefficiency outweighs the pure technical inefficiency of the financial companies during all years. The results seem to suggest that the finance companies have exhibited a mean technical efficiency of 44.7 percent, which is lower compared to their merchant bank counterparts.

Likewise, the results suggest that the financial companies' inefficiency was mainly due to scale, rather than pure technical albeit at a higher degree of 44.8 percent (merchant banks – 23.0 percent). The financial companies also seem to have exhibited a lower pure technical efficiency of 82.0 percent (merchant banks – 89.7 percent). Overall, the results suggest that compared to their merchant bank counterparts, the financial companies were relatively managerially inefficient in controlling their operating costs and have been operating at a relatively less optimal scale of operations.

Table 4: Summary Statistics of Efficiency Measures – Finance Companies (DEA Model A)

The table presents mean, minimum, maximum, and standard deviation of Malaysian NBFIs' technical efficiency (TE), its mutually exhaustive, pure technical efficiency (PTE), and scale efficiency (SE) components derived from DEA Model A (excluding the risk factor). Panel A, B, C, D, and E shows the mean, minimum, maximum, and standard deviation of TE, PTE, and SE of the finance companies for the years 2000, 2001, 2002, 2003, and 2004, respectively. Panel F presents the finance companies' mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores, respectively. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2000				
Technical Efficiency	0.538	0.350	1.000	0.216
Pure Technical Efficiency	0.811	0.466	1.000	0.197
Scale Efficiency	0.679	0.399	1.000	0.228
Panel B: 2001				
Technical Efficiency	0.389	0.266	0.693	0.142
Pure Technical Efficiency	0.807	0.491	1.000	0.219
Scale Efficiency	0.489	0.342	0.693	0.124
Panel C: 2002				
Technical Efficiency	0.248	0.058	0.589	0.149
Pure Technical Efficiency	0.828	0.530	1.000	0.186
Scale Efficiency	0.300	0.092	0.589	0.155
Panel D: 2003				
Technical Efficiency	0.490	0.243	0.769	0.140
Pure Technical Efficiency	0.822	0.440	1.000	0.199
Scale Efficiency	0.599	0.446	0.769	0.104
Panel E: 2004				
Technical Efficiency	0.625	0.296	0.974	0.188
Pure Technical Efficiency	0.835	0.428	1.000	0.209
Scale Efficiency	0.758	0.540	0.974	0.169
Panel F: Finance Companies All Years				
Technical Efficiency	0.447	0.058	1.000	0.205
Pure Technical Efficiency	0.820	0.428	1.000	0.193
Scale Efficiency	0.552	0.092	1.000	0.220

The findings are interesting in that although the merchant banks were small relative to their financial counterparts with having relatively limited operations, they seem to have exhibited higher efficiency levels. The findings support the divisibility theory, which holds that there will be no such operational advantage accruing to large NBFIs if the technology is divisible. That is, small scale NBFIs can produce financial services at costs per unit output comparable to those of large NBFIs, suggesting no or possibly negative association between size and performance.

This was made possible as advances in technology reduced the size and cost of automated equipment; thus, significantly enhancing small NBFIs ability to purchase expensive technology, implying more divisibility in the banking industry's technology (Kolari & Zardkoohi, 1987). Since the dominant source of the total technical X- (in) efficiency in the Malaysian NBFI sector seems to be scale related, it is worth investigating the composition of the efficiency frontier. Table 5 shows NBFIs that lie on the efficiency frontier under DEA Model A.

Table 5: Composition of Production Frontiers (DEA Model A)

Bank	Type	2000	2001	2002	2003	2004	Count
Affin Merchant Bank	MB	IRS	DRS	DRS	DRS	DRS	**0**
Affin-ACF Finance	FC	DRS	DRS	DRS	DRS	DRS	**0**
Alliance Finance	FC		DRS	DRS	DRS	DRS	**0**
Alliance Merchant Bank	MB		DRS	DRS	DRS	DRS	**0**
Arab-Malaysian Finance	FC	CRS	DRS	DRS	DRS	DRS	**1**
Arab-Malaysian Merchant Bank	MB	CRS	DRS	DRS	DRS	DRS	**1**
Aseambankers	MB	CRS	DRS	CRS	DRS	DRS	**1**
Bumiputra-Commerce Finance	FC	DRS	DRS	DRS	DRS	DRS	**0**
Commerce International Merchant Bankers	MB	CRS	CRS	DRS	DRS	DRS	**2**
EON Finance	FC	DRS	DRS	DRS	DRS		**0**
Hong Leong Finance	FC	DRS	DRS	DRS	DRS	DRS	**0**
Malaysian International Merchant Bankers	MB	IRS	CRS	CRS			**2**
Mayban Finance	FC	DRS	DRS	DRS	DRS	DRS	**0**
Public Finance	FC	DRS	DRS	DRS	DRS		**0**
Public Merchant Bank	MB		CRS	CRS	DRS	DRS	**2**
RHB Delta Finance	FC		DRS	DRS	DRS	DRS	**0**
RHB Sakura Merchant Bankers	MB	CRS	CRS	CRS	DRS	DRS	**3**
Southern Finance	FC	DRS	DRS	DRS	DRS	DRS	**0**
Southern Investment Bank	MB	CRS	IRS	DRS	CRS	IRS	**2**
Utama Merchant Bank	MB	IRS	DRS	CRS	CRS	CRS	**3**
Number of NBFI	**n**	**6**	**4**	**5**	**2**	**1**	

Note: CRS – (Constant Returns to Scale); DRS – (Decreasing Returns to Scale); IRS – (Increasing Returns to Scale); The NBFIs corresponds to the shaded regions which have not been efficient in any year in the sample period (2001-2005) compared to the other NBFIs in the sample; MB – Merchant Bank; FC – Finance Company

The composition of the efficiency frontier for DEA Model A suggests that the number of 100 percent efficient NBFIs [operating at constant returns to scale (CRS)], varies between one to six NBFIs. During the period of study, the merchant banks seem to have dominated the efficiency frontier for DEA Model A. It is also clear from the results that two merchant banks, namely RHB Sakura Merchant Bankers and Utama Merchant Bank, have appeared the most times on the efficiency frontier. A total of eight merchant banks have appeared at least once on the efficiency frontier, while only two merchant banks have failed to make it to the frontier. On the other hand, the results seem to suggest that only one financial company has managed to make it to the frontier, while nine others have never made it to the efficiency frontier throughout the period of study.

2.2 Non-performing Loans and the Gap Between the Two DEA Models

Having established the basic DEA model, we now analyze the potential impact of risk and problem loans concerning the efficiency of Malaysian NBFIs. As indicated previously, these results are obtained by modifying the initial DEA model to incorporate an additional, non-discretionary input variable, in the form of provisions of loans losses. In general, the findings seem to suggest that controlling for problem loans resulted in a higher mean technical efficiency of Malaysian NBFIs during all years[5]. In line with the findings by Drake & Hall (2003) and Altunbas *et al.* (2000), the results seem to suggest that potential economies of scale may well be overestimated when risk factors are excluded. Likewise, it is clear that the inclusion of loan loss provisions has resulted in a higher mean pure technical efficiency of Malaysian NBFIs[6]. The results support earlier findings by Altunbas *et al.* (2000), who had suggested that the mean scale efficiency estimate is much more sensitive than the mean pure technical efficiency estimate to the exclusion of risk factors.

We now turn to discuss the impact of the inclusion of loan loss provisions on the evolution of the merchant banks' technical efficiency. The results from Table 6 suggest that the inclusion of risk factors has resulted in a higher technical efficiency for merchant banks. It is also apparent that the inclusion of loan loss provisions has had a greater positive impact on the merchant banks' scale efficiency. Table 7 highlights the results for the financial companies. Similar to their merchant bank counterparts, the results from Table 7 suggest that the inclusion of risk factors has resulted in a higher technical efficiency for financial companies. Likewise, it is also apparent that the inclusion of loan loss provisions has had a greater positive impact on the financial companies' scale efficiency. With a closer look at the results, it seems that the magnitude of the increase in the financial companies' pure technical and scale efficiency is higher compared to their merchant bank peers. A plausible reason is that during the period of study, the financial companies had a higher amount of defaulted loans compared to their peers.

---

[5] Except for the merchant banks during the year 2000.

[6] Except for the merchant banks during the year 2000.

Table 6: Summary Statistics of Efficiency Measures – Merchant Banks (DEA Model B)

The table presents mean, minimum, maximum, and standard deviation of Malaysian NBFIs' technical efficiency (TE), its mutually exhaustive, pure technical efficiency (PTE), and scale efficiency (SE) components derived from DEA Model B (inclusive of the risk factor). Panel A, B, C, D, and E shows the mean, minimum, maximum, and standard deviation of TE, PTE, and SE of the merchant banks for the years 2000, 2001, 2002, 2003, and 2004, respectively. Panel F presents the merchant banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores, respectively. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2000				
Technical Efficiency	0.908	0.443	1.000	0.193
Pure Technical Efficiency	0.926	0.532	1.000	0.165
Scale Efficiency	0.973	0.834	1.000	0.058
Panel B: 2001				
Technical Efficiency	0.818	0.437	1.000	0.219
Pure Technical Efficiency	0.897	0.551	1.000	0.179
Scale Efficiency	0.903	0.683	1.000	0.119
Panel C: 2002				
Technical Efficiency	0.837	0.275	1.000	0.251
Pure Technical Efficiency	0.914	0.492	1.000	0.159
Scale Efficiency	0.905	0.559	1.000	0.189
Panel D: 2003				
Technical Efficiency	0.885	0.504	1.000	0.204
Pure Technical Efficiency	0.912	0.513	1.000	0.181
Scale Efficiency	0.963	0.793	1.000	0.085
Panel E: 2004				
Technical Efficiency	0.896	0.700	1.000	0.127
Pure Technical Efficiency	0.950	0.857	1.000	0.048
Scale Efficiency	0.946	0.700	1.000	0.110
Panel F: Merchant Banks All Years				
Technical Efficiency	0.869	0.275	1.000	0.199
Pure Technical Efficiency	0.929	0.492	1.000	0.151
Scale Efficiency	0.927	0.559	1.000	0.123

The empirical findings clearly demonstrate the importance of risk in explaining financial institutions' efficiency, in particular scale efficiency. If anything could be deduced from the results, the omission of risk factors may significantly overestimate financial institutions' potential economies of scale, which could lead to bias conclusions and consequently, policy recommendations. The findings are particularly important for the Malaysian policy makers in its quest to consolidate the banking system further to achieve greater economies of scale and efficiency. The Malaysian government has always believed that such a move would result in larger institutions, which could withstand greater competition from foreign players, as well as any shocks to the financial system. As the actual potential economies of scale may significantly be lower than initially expected, policy makers should be

more cautious in promoting mergers as a means in achieving greater efficiency by attaining better economies of scale.

Furthermore, most of the research conducted surrounding the explanation of bank or thrift industry failures had found that failing institutions carried a large proportion of non-performing loans in their books prior to failure [Dermiguc-Kunt (1989); Whalen (1991); Barr & Siems (1994); Berger & Humphrey (1992); Barr & Siems (1994); and Wheelock & Wilson (1995)]. Banks approaching failure tend to have low cost efficiency while experiencing high ratios of problem loans, as failing banks tend to be located far from the best practice frontiers.

Table 7: Summary Statistics of Efficiency Measures – Finance Companies (DEA Model B)

The table presents mean, minimum, maximum, and standard deviation of Malaysian NBFIs' technical efficiency (TE), its mutually exhaustive, pure technical efficiency (PTE), and scale efficiency (SE) components derived from DEA Model B (inclusive of the risk factor). Panel A, B, C, D, and E shows the mean, minimum, maximum, and standard deviation of TE, PTE, and SE of the merchant banks for the years 2000, 2001, 2002, 2003, and 2004, respectively. Panel F presents the merchant banks mean, minimum, maximum, and standard deviation of TE, PTE, and SE scores, respectively. The TE, PTE, and SE scores are bounded between a minimum of 0 and a maximum of 1.

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
Panel A: 2000				
Technical Efficiency	0.823	0.560	1.000	0.174
Pure Technical Efficiency	0.902	0.561	1.000	0.162
Scale Efficiency	0.918	0.644	1.000	0.122
Panel B: 2001				
Technical Efficiency	0.799	0.511	1.000	0.173
Pure Technical Efficiency	0.878	0.517	1.000	0.196
Scale Efficiency	0.918	0.747	1.000	0.094
Panel C: 2002				
Technical Efficiency	0.643	0.324	1.000	0.212
Pure Technical Efficiency	0.860	0.533	1.000	0.181
Scale Efficiency	0.726	0.512	1.000	0.139
Panel D: 2003				
Technical Efficiency	0.801	0.554	1.000	0.157
Pure Technical Efficiency	0.859	0.562	1.000	0.153
Scale Efficiency	0.940	0.752	1.000	0.085
Panel E: 2004				
Technical Efficiency	0.963	0.764	1.000	0.097
Pure Technical Efficiency	0.982	0.769	1.000	0.098
Scale Efficiency	0.979	0.949	1.000	0.018
Panel F: Finance Companies All Years				
Technical Efficiency	0.795	0.324	1.000	0.189
Pure Technical Efficiency	0.882	0.517	1.000	0.161
Scale Efficiency	0.900	0.512	1.000	0.130

Table 8: Composition of Production Frontiers (DEA Model B)

Bank	Type	2000	2001	2002	2003	2004	Count
Affin Merchant Bank	MB	IRS	DRS	DRS	CRS	CRS	**2**
Affin-ACF Finance	FC	DRS	DRS	DRS	DRS	IRS	**0**
Alliance Finance	FC		DRS	DRS	DRS	CRS	**1**
Alliance Merchant Bank	MB		DRS	DRS	IRS	IRS	**0**
Arab-Malaysian Finance	FC	CRS	DRS	DRS	DRS	DRS	**1**
Arab-Malaysian Merchant Bank	MB	CRS	DRS	DRS	DRS	CRS	**2**
Aseambankers	MB	CRS	DRS	CRS	CRS	CRS	**4**
Bumiputra-Commerce Finance	FC	CRS	CRS	DRS	DRS	CRS	**3**
Commerce International Merchant Bankers	MB	CRS	CRS	CRS	CRS	DRS	**4**
EON Finance Berhad	FC	CRS	DRS	DRS	DRS		**1**
Hong Leong Finance	FC	DRS	DRS	DRS	IRS	DRS	**0**
Malaysian International Merchant Bankers	MB	IRS	CRS	CRS			**2**
Mayban Finance	FC	DRS	DRS	DRS	CRS	CRS	**2**
Public Finance	FC	DRS	CRS	CRS	CRS		**3**
Public Merchant Bank	MB		CRS	CRS	CRS	CRS	**4**
RHB Delta Finance	FC		IRS	DRS	CRS	CRS	**2**
RHB Sakura Merchant Bankers	MB	CRS	CRS	CRS	DRS	CRS	**4**
Southern Finance	FC	DRS	DRS	DRS	DRS	IRS	**0**
Southern Investment Bank	MB	CRS	IRS	IRS	CRS	IRS	**2**
Utama Merchant Bank	MB	IRS	DRS	CRS	CRS	CRS	**3**
Number of NBFI	**n**	**8**	**6**	**7**	**9**	**10**	

Note: CRS – (Constant Returns to Scale); DRS – (Decreasing Returns to Scale); IRS – (Increasing Returns to Scale); The NBFIs corresponds to the shaded regions which have not been efficient in any year in the sample period (2001-2005) compared to the other NBFIs in the sample; MB – Merchant Bank; FC – Finance Company

Next, the composition of the efficiency frontier and the nature of the returns to scale for DEA Model B are discussed. Table 8 presents the results of the nature of returns to scale in the Malaysian NBFI sector, derived from DEA Model B. Unlike the results from DEA Model A, the composition of the efficiency frontier for DEA Model B suggests that the number of 100 percent efficient NBFIs had increased substantially to between six and ten NBFIs. The results from DEA Model B are very much similar to those from DEA Model A, where the merchant banks seem to have dominated the efficiency frontier. It is apparent from Table 8 that the global leaders under DEA Model B have increased to four merchant banks, while there was only one merchant bank that failed to appear on the efficiency frontier throughout the period of study. Unlike DEA Model A, the results from DEA Model B suggest that seven finance companies have managed to appear on the efficiency frontier, while there were only three finance companies that have never made it to the efficiency frontier throughout the period of study.

Table 9: Summary of the Null Hypothesis Tests of Identical Technologies between Merchant Banks and Finance Companies

The table present results from the parametric (ANOVA and *t*-test) and nonparametric (Kolmogorov-Smirnov, Mann-Whitney and Kruskall-Wallis) tests. The tests are performed to test the null hypothesis that domestic and foreign banks are drawn from the same population (environment). Test methodology follows among others, Aly et al. (1990), Elyasiani and Mehdian (1992), and Isik and Hassan (2002).
*** indicate significant at the 5% level.

	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**	**Kruskall-Wallis Equality of Populations test**
Hypotheses	$Mean_{mb} = Mean_{fc}$		$Distribution_{mb} = Distribution_{fc}$	$Median_{mb} = Median_{fc}$	
Test Statistics	*F* (Prb > *F*)	*t* (Prb > *t*)	*K-S* (Prb > *K-S*)	*z* (Prb > *z*)	χ^2 (Prb > χ^2)
Panel A: 2000					
TE Model A	15.606***	-3.950***	1.572***	8.500***	7.316***
TE Model B	0.851	-0.922	1.000	21.500	1.387
PTE Model A	1.107	-1.052	0.857	22.000	2.128
PTE Model B	0.083	-0.289	0.500	26.000	0.524
SE Model A	14.699***	-3.834***	1.601***	7.500***	7.868***
SE Model B	1.318	-1.148	0.750	22.500	1.136
Panel B: 2001					
TE Model A	0.634***	-3.678***	1.342	11.500***	8.541***
TE Model B	0.045	-0.213	0.671	44.000	0.211
PTE Model A	0.040	-0.996	0.671	35.000	1.541
PTE Model B	0.051	-0.225	0.447	44.000	0.283
SE Model A	17.639***	-4.200***	1.565***	12.000***	8.314***
SE Model B	0.095	-0.308	0.447	47.000	0.053

(continued)

Panel C: 2002					
TE Model A	19.470***	-4.412***	1.565***	11.000***	8.824***
TE Model B	3.911	-1.978	1.342	24.000	4.033***
PTE Model A	0.053	-0.230	0.671	40.000	0.685
PTE Model B	1.530	-1.237	0.894	34.000	1.753
SE Model A	42.959***	-6.554***	2.012***	2.000***	13.367***
SE Model B	3.494	-1.869	1.342	28.000	2.887
Panel D: 2003					
TE Model A	0.021	-0.147	0.991	37.000	0.427
TE Model B	0.866	-0.753	0.798	33.000	1.073
PTE Model A	0.614	-0.783	0.822	31.000	1.460
PTE Model B	0.489	-0.699	0.822	33.000	1.190
SE Model A	0.140	0.374	1.016	32.000	1.128
SE Model B	0.034	-0.185	0.547	33.000	1.074
Panel E: 2004					
TE Model A	0.198	0.445	0.657	32.500	0.114
TE Model B	0.168	0.409	0.457	35.000	0.012
PTE Model A	1.149	-1.072	0.572	28.000	0.743
PTE Model B	0.816	-0.903	0.514	33.000	0.150
SE Model A	1.564	1.250	0.915	24.000	1.333
SE Model B	2.158	1.469	0.686	36.000	0.000

4.3 Univariate Results

After examining the DEA results, the issue of interest now is whether the two samples are drawn from the same population (i.e., whether the merchant banks and financial companies possess the same technology). The null hypothesis tested is that the merchant banks and financial companies are drawn from the same population or environment, having identical technologies. We have tested the null hypothesis by using a series of parametric (ANOVA and *t*-test) and non-parametric [Kolmogorov-Smirnov, Mann-Whitney, (Wilcoxon Rank-Sum), and Kruskall-Wallis] univariate tests. The results are presented in Table 9.

Based on most of the results for DEA Model A, we failed to reject the null hypothesis at the 5 percent levels of significance that the merchant banks and the financial companies are drawn from the same population having identical technologies, while the results for DEA Model B failed to reject the null hypothesis during all years. This implies that there is no significant difference between the merchant banks and the financial companies' technologies (frontiers); thus, it is appropriate to construct a combined frontier. Furthermore, the results from the Levene's test for equality of variances do not reject the null hypothesis that the variances among the merchant banks and the financial companies are equal, implying that we can assume the variances between both groups to be equal.

5. Conclusion

The preferred, non-parametric Data Envelopment Analysis (DEA) methodology allowed us to distinguish between three different types of efficiency: technical, pure technical, and scale efficiencies. During the period of study, the results suggested that the Malaysian merchant banks exhibited a mean technical efficiency of 69.6 percent, while the financial companies have exhibited a lower mean technical efficiency of 44.7 percent. Overall, the results suggest that scale inefficiency dominates pure technical inefficiency effects in determining Malaysian NBFIs' total technical inefficiency. The findings also seem to suggest that scale efficiency tends to be much more sensitive to the exclusion of risk factors, implying that potential economies of scale may be overestimated when risk factors are excluded.

The empirical findings clearly demonstrate the importance of risk in explaining financial institutions' efficiency, particularly scale efficiency. If anything could be deduced from the results, the exclusion of risk factors may significantly overestimate the financial institutions potential economies of scale, which could result in bias conclusions and policy recommendations. The findings are important for policy makers in its quest to consolidate the banking system further to achieve greater economies of scale and efficiency. As the actual potential economies of scale may significantly be lower than initially expected, policy makers should be more cautious in promoting mergers as a mean to achieve greater efficiency by attaining better economies of scale.

Author statement: Fadzlan Sufian is affiliated with the research department of a local bank, the CIMB Bank Berhad and is a staff member of the The University of Malaysia. E--mail: fadzlan14@gmail.com.

References

Altunbas, Y., Liu, M-H., Molyneux, P., and Seth, R. (2000). Efficiency and Risk in Japanese Banking, *Journal of Banking and Finance* 24 (10): 1605-1628.

Aly, H.Y., Grabowski, R., Pasurka, C. and Rangan, N., (1990). Technical, Scale and Allocative Efficiencies in U.S. Banking: An Empirical Investigation, *Review of Economics and Statistics* 72 (2): 211-218.

Avkiran, N.K., (2002). *Productivity Analysis in the Service Sector with Data Envelopment Analysis*. Camira: N.K. Avkiran.

Barr, R. and Siems, T., (1994). Predicting Bank Failure Using DEA to Quantify Management Quality, Working Paper, Federal Reserve Bank of Dallas.

Benston, G.J., (1965). Branch Banking and Economies of Scale, *The Journal of Finance* 20 (2): 312-331.

Berger, A.N and Humphrey, D.B., (1992). Measurement and Efficiency Issues in Commercial Banking, in Z.Griliches, (eds.), *Measurement Issues in the Service Sectors*. National Bureau of Economic Research: University of Chicago Press, 245-279.

Berger, A.N. and Humphrey, D.B., (1997). Efficiency of Financial Institutions: International Survey and Directions for Future Research, *European Journal of Operational Research* 98 (2): 175-212.

Berger, A.N. and Mester, L.J., (1997). Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions, *Journal of Banking and Finance* 21 (7): 895-947.

Charnes, A., Cooper, W.W., Huang, Z.M., and Sun, D.B., (1990). Polyhedral Cone – Ratio DEA Models with an Illustrative Application to Large Commercial Banks, *Journal of Econometrics* 46 (1-2): 73-91.

Coelli, T., (1996). A Guide to DEAP Version 2.1, *CEPA Working Paper* 8/96, University of New England, Armidale, Australia.

Coelli, T., Rao, D.S.P. and Batesse, G.E., (1998). *An Introduction to Efficiency and Productivity Analysis*. Boston, MA: Kluwer Academic Publishers.

Cooper, W.W., Seiford, L.M., and Tone, K., (2000). *Data Envelopment Analysis*. Boston: Kluwer Academic Publishers.

Das, A., and Ghosh, S., (2006). Financial Deregulation and Efficiency: An Empirical Analysis of Indian Banks During the Post Reform Period, *Review of Financial Economics* 15 (3): 193-221.

Dermiguc-Kunt, A., (1989). Deposit Institutions Failure: A Review of the Empirical Literature, *Federal Reserve Bank of Cleveland Economic Review* 25 (4): 2-18.

Drake, L., and Hall, M.J.B., (2003). Efficiency in Japanese Banking: An Empirical Analysis, *Journal of Banking and Finance* 27 (3): 891-917.

Elyasiani, E., and Mehdian, S., (1992), Productive Efficiency Performance of Minority and Non-Minority Owned Banks: A Non-Parametric Approach, *Journal of Banking and Finance* 16 (5): 933-948.

Isik, I., and Hassan, M.K., (2002). Technical, Scale and Allocative Efficiencies of Turkish Banking Industry, *Journal of Banking and Finance* 26 (4): 719-766.

Katib, M. N., and Mathews, K., (2000). A Non-Parametric Approach to Efficiency Measurement in the Malaysian Banking Sector, *The Singapore Economic Review* 44 (2): 89-114.

Kolari, J., and Zardkoohi, A., (1987). *Bank Costs, Structure and Performance*. Lexington Books: USA.

Levine, R., (2004). Finance and Growth: Theory, Evidence & Mechanism,in Aghion, P. and Durlauf, S., (eds), *Handbook of Economic Growth*, Amsterdam: North-Holland, pp. 81, in Reforming Corporate Governance in Southeast Asia, by Khai Leong Ho (2005), published by Institute of Southeast Asian Studies.

McKinnon, P.I., (1973). *Money and Capital in Economic Development,* Washington D.C., The Banking Institution.

Okuda, H., and Hashimoto, H., (2004). Estimating Cost Functions of Malaysian Commercial

Banks: The Differential Effects of Size, Location and Ownership, *Asian Economic Journal* 18 (3): 233-259.

Rajan R.G., and Zingales, L., (1998). Financial Dependence and Growth, *American Economic Review* 88 (2): 559-586.

Sealey, C., and Lindley, J.T., (1977). Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions, *Journal of Finance* 32 (4): 1251-1266.

Shaw, E.S., (1973). *Financial Deepening in Economic Development*, New York, Oxford University Press.

Singh, C., (2005). Financial Sector Reforms and State of Indian Economy, *Indian Journal of Economics & Business* 4 (1): 88-133.

Sufian F., (2007). Trends in the Efficiency of Singapore's Commercial Banking Groups: A Non-

Stochastic Frontier DEA Window Analysis Approach, *International Journal of Productivity and Performance Management* 56 (2): 99 – 136.

Thanassoulis, E., (2001). *Introduction to the Theory and Application of Data Envelopment Analysis*. Kluwer Academic Publishers: Boston.

Weill, L., (2007) Is there a Gap in Bank Efficiency between CEE and Western European Countries? *Comparative Economic Studies* 49 (1): 101–127.

Whalen, G., (1991). A Proportional Hazards Model of Bank Failure: An Examination of its Usefulness as an Early Warning Tool, *Federal Reserve Bank of Cleveland Economic Review* 27 (1): 21–31.

Wheelock, D.C., and Wilson, P.W., (1995). Explaining Bank Failures: Deposit Insurance, Regulation and Efficiency, *Review of Economics and Statistics* 77 (4): 689-700.