IJER, Vol. 10, No. 2, July-December, 2013, pp. 297-313

ASSESSING THE EFFECT OF MERGERS AND ACQUISITIONS ON REVENUE EFFICIENCY: EMPIRICAL EVIDENCE FROM THE MALAYSIAN BANKING SECTOR

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ABSTRACT

The paper attempts to examine the effect of mergers and acquisitions (M&As) on Malaysian banks' revenue efficiency. The data gathered in this study are divided into two event windows; the pre-merger (1995-1996) and post-merger (2002-2009) periods. The sample comprised of 34 commercial banks, including the control group of banks, was selected for this study. We employ the Data Envelopment Analysis (DEA) method to measure the Malaysian banking sector's revenue efficiency during both the pre and post-merger periods. The results indicate that the Malaysian banking sector's revenue efficiency has not improved during the post-merger period compared to the pre-merger period.

JEL CLASSIFICATIONS: G21; D24.

KEYWORDS: Bank; Mergers and acquisitions; Data Envelopment Analysis, Revenue efficiency.

1. INTRODUCTION

The globalisation era has altered the structure of the Malaysian commercial banking sector through greater deregulation and liberalisation.The Malaysian central bank, Bank Negara Malaysia (BNM), has encouraged financial institutions to join a 'forced merger' scheme so that they can become more efficient and competitive. The forced mega-mergers were enforced by BNM due to three main factors; competition from foreign banks, a large number of domestic commercial banks and financial crisis in Asia.

Since Malaysia opened up its financial sector, foreign banks have become a threat to its domestic counterparts. Upon realising this BNM has promoted merger and

acquisitions among domestic banks in order to encourage them to increase their capability. The act was seen as a move for local banks to cope with competition from foreign banks (Chong *et al.*, 2006).

Other than the competition from foreign banks, the implementation of forced mega-merger of domestic commercial banks in Malaysia was also influenced by two other factors; over-banked numbers and financial crisis (Chong *et al.*, 2006 and Ahmad *et al.*, 2007). With 58 domestic financial institutions, Chong *et al.* (2006) asserted that the Malaysia's banking system was considered by the government as being "over-banked" and fragmented. The forced merger scheme was seen as a mean to create a larger and stronger domestic banking sector with the hope that they would be able to withstand competition with foreign banks.

In 1997, Malaysia and other Asian countries were hit with financial crisis which had resulted in an economic downturn. The economic downfall had inevitably played a major role in contributing the forced mega-mergers in the Malaysian banking sector. It can be seen that the merger of the financial institutions had made them more efficient in facing challenges in deregulation and liberalisation. By 14th February 2000, 10 anchor banks were established as a result of the M&A programme.

The main motive of these M&As is to maximise the shareholders' value or wealth by maximising profit (Chong *et al.*, 2006). The main problem that contributes to the lower profit efficiency comes from revenue inefficiency. A bank may experience revenue inefficiency when it produces too few outputs for the given set of inputs. It can also be if it responds poorly to relative prices and produces too little of a high-priced output and too much of a low-priced output. Findings on previous studies on developed and developing countries which practiced voluntary and forced M&As show that the level of the profit is lower than the level of cost efficiency due to revenue inefficiency. The result is supported by Ariff & Can (2008) and Houston et al. (2001). Thus, instead of focusing on the effect of bank M&As on profit efficiency alone, it would be more useful to compare it with cost efficiency in order to identify the existence of revenue efficiency.

This study will add to the current knowledge on the effects of M&A on revenue efficiency in the Malaysian banking sector. Since numerous studies have mostly examined the effects of M&As on cost and profit efficiency to banking sector under the voluntary scheme, this study attempts to fill the gap on revenue efficiency in the Malaysian banking sector under the forced merger scheme. It examines the banks' revenue efficiency both before and after the merger periods. The results will clarify which period is more revenue efficient.

2. THEORETICAL FRAMEWORK AND REVIEW OF RELATED LITERATURE

2.1. Theories on Mergers and Acquisitions

The theory of the 'synergy or efficiency' in M&As encourage the maximising of shareholders' wealth for both the target and acquirer firms to produce positive total

gains (Berkovich and Narayan, 1993). Efficiency theories focus on fully utilising the scarce resources in order to produce quality production or services without any wastage from the view of economics perspective. The existence of the efficiency could improve the performance of the firm due to the improvement in the reduction cost, profitability and overall operation (Copeland and Weston, 1988).

In this regards, the operation of the firm should be efficient in order to ensure a maximum profit with a minimum costs of the firm's productions. This operational efficiency would keep firms to always make the right decision in production to gain a high profit. For example, the firm will not make any transaction if the cost of the transaction is higher than the projected benefit. Inefficiency could deteriorate the performance of the firm due to imprudent management by managers when setting their goals. Therefore, managers play important roles to ensure all operations are well managed for the benefits of the firms.

2.2. Bank Mergers and Acquisitions and Revenue Efficiency

Revenue is defined as how effectively a bank sells its outputs. Maximum revenue is obtained as a result of producing the output bundle efficiently (Rogers, 1998 and Andogo et al., 2005). In fact, revenue efficiency is composed of technical and allocative efficiency which are related to managerial factors and is regularly associated with regulatory factors (Isik and Hassan, 2002).

Hence, in order to ascertain the revenue efficiency, banks should focus on both technical efficiency (managerial operating on the production possibilities) and allocative efficiency (bank producing the revenue maximizing mix of outputs based on the certain regulation) (English *et al.*, 1993).

However, banks face a dilemma in determining the revenue efficiency because in order to increase the revenue, banks should produce quality outputs or services that require a higher or expensive cost (De Young and Nolle, 1996). An increase in the cost would contribute to being inefficient. However, cost inefficiency may possibly be compensated by higher or extra revenue obtained due to the quality services produced (Berger and Mester, 1997).

Another way to improve the revenue efficiency proposed by several studies is for banks to produce higher quality services and charge higher prices and struggle to avoid any improper choice of inputs and outputs quantities and mispricing of outputs (Andogo *et al.*, 2005, Maudos *et al*., 2003 and Rogers, 1998). The revenue inefficiency could be well identified via the profit function because this function combines both the cost and revenue efficiency to evaluate the profit efficiency (Lozano, 1997 and Akhevein *et al.*, 1997). The revenue efficiency would totally affect the efficiency of profit even though the cost efficiency is high. In essence, the revenue efficiency would be the major factor that influences the efficiency of the profit efficiency.

According to Berger & Humphrey (1997), Akhavein *et al.* (1997), and Bader *et al.* (2008), there have been limited studies done on revenue efficiency of banks. If the

studies were narrowed down into the revenue efficiency of the bank M&As, there are more likely to be paucity studies that looked into the event of M&As. Previous studies mostly measured the revenue efficiency of banks without this event. Only a few studies on the revenue efficiency of banks M&As generate a conclusive result but are less definitive on the impact of the revenue efficiency to the M&As. To evaluate the effects of M&As in banking sector in terms of revenue efficiency, the researcher could also base the findings on the profit efficiency since there is a positive correlation between profit and revenue efficiency (Roger, 1998).

It can be inferred that the revenue efficiency is more significant in those mergers that also experienced reduced cost (Cornett *et al.* 2006). The revenue efficiency opportunities appear to be most profitable in those mergers that offer the greatest opportunity for cost cutting activities such as activity focusing and geographically focusing mergers. Moreover, revenue efficiency does not only depend on managers' decision but also on the customers' behaviour.

Thus, revenue efficiency may be enhanced by raising prices as market power is expanded, or it might be enhanced when the merged institution restructures its assets mix (Ayadi and Pujals, 2005). Bank mergers also allow a higher abnormal return besides enhancing the revenue efficiency (Pilloff, 1996).

As seen from previous studies, M&As lead to the improvement on bank's profit efficiency via improving the revenue efficiency during the post-merger period. However, all the banks that are studied are under the voluntary M&As scheme where most of the studies were conducted in developed countries. There have been limited studies that focussed on forced bank M&As. Therefore, the gap is filled in areas where previous studies had not identified if the revenue efficiency could also be improved under the forced M&As in order to increase the level of the profit efficiency. Previous findings on voluntary M&As in revenue efficiency will serve as a guide in the understanding and classification of forced M&As in the Malaysian banking sectors on revenue efficiency improvement.

3. DATA AND METHODOLOGY

This study gathers data from all Malaysian commercial banks from 1995 to 2009. The primary source for financial data is obtained from the BankScope database produced by the Bureau van Dijk which provides the banks' balance sheets and income statements. Bankscope database contains specific data on 25,800 banks world-wide, including commercial banks in Malaysia. Furthermore, BankScope database presents the original currencies' data of the specific countries and provides the option to convert the data to any other currencies. The data are updated monthly. Ringgit Malaysia (the Malaysian currency) is used in this study since the study involves commercial banks in Malaysia. The information on the merger programme for the commercial banks in Malaysia was provided by Bank Negara Annual Report.

Data are analysed from those banks which are registered under the M&As in the Malaysian banking sector during the year of mega-merger 2000 (Sufian, 2009 and

Sufian and Habibullah, 2009). This analysis look at data two years preceding the year of the merger and eight years after the merger (-2,8). This event window was inspired by Rhoades (1998) who suggested that the three-year time period is optimal because about half of any efficiency gains should be realised within three years (-3,3). This fact is almost unanimously agreed among the experts interviewed. In fact, the overall period is covered by Sufian (2009) where he investigates the impact of M&As on bank profit efficiency in Malaysian commercial banks. The entire period starts from 1995 to 2009, but only 10 years is covered in this study (1995 to 1996 and 2002 to 2009) because the years of financial crisis (1997 to 1999) during merger period (2000) and cooling period (2001) are excluded to avoid any possible biases. The periods are divided into two event windows: 1995 to 1996, referred to as pre-merger period, and 2002 to 2009, considered as post-merger period.

The actual domestic commercial banks that were affected with the mega-merger in year 2000 were only 14 banks (7 acquirers and 7 targets) and were indicated as seven cases of mega M&As. To be included in the sample, both the acquiring and the target banks must not have been involved in any other merger prior to the year of merger period of the year 2000. To show a wide representation of the Malaysian banking sector, data were collected from 34 commercial banks in total, including several banks that served as the control groups. This is listed on Table 1 (14 domestic commercial banks were involved with M&As and 20 domestic and foreign commercial banks were not involved with M&As in Malaysia). In order to maintain the homogeneity, only commercial banks (banks that make commercial loans and accept deposits from the public) are included in the analysis (Sufian, 2007). Finance companies, Investment Banks and Islamic banks are excluded from the sample.

3.1. Methods of Measurement

The intermediation approach is also known as an asset approach whereby the financial firms are assumed to act as an intermediary between the savers and borrowers. Banks are seen as purchasing labour, materials and deposits funds that produce outputs of loans and investments. The inputs include interest expense, non-interest expense, deposits, other purchased capital, number of staff (full time equivalent), physical capital (fixed assets and equipment), demographics and competition. The potential outputs are measured as the dollar value of the bank's earning assets where the costs include both the interest and operating expenses (Berger *et al.*, 1987). Under this approach, the bank's outputs are found on the asset side of the balance sheet and deposits are seen as inputs. Avkiran (1999) suggested that potential outputs include net interest income, non-interest income, consumer loans, housing loans, commercial loans and investments. Previous banking efficiency studies that had adopted this approach are, among others, Charnes *et al.* (1990), Bhattacharya *et al.* (1997), Sathye (2001), and Sufian (2009). They also applied different accounting standards. Thus, the results of the efficiency scores will be affected and may vary depending on the selection of variables for each of the banks efficiency. The

DEA method requires bank inputs and outputs selection to be an arbitrary issue (Ariff and Can, 2008 and Berger and Humphrey, 1997).

Data Envelopment Analysis (DEA) frontier analysis method, also known is a linear mathematical programming approach. It constructs the frontier of the observed input-output ratios by linear programming techniques. The linear substitution is possible between observed input combinations on an isoquant (the same quantity of output is produced while changing the quantities of two or more inputs) that was assumed by DEA. Charnes *et al.* (1978) were the first to introduce the term DEA to measure the efficiency of each decision making units (DMUs), obtained as a maximum of a ratio of weighted outputs to weighted inputs. The more the output

Table 1
List of Malaysian Domestic Commercial Banks during the Year 2000

Banks Involved with M&As			
Acquirer		*Target*	
No	*Bank*	*No*	*Bank*
1	Affin Bank Bhd	2	BSN Commercial Bank Bhd
3	Alliance Bank Bhd	4	Sabah Bank Bhd
5	EON Bank Bhd	6	Oriental Bank Bhd
7	Hong Leong Bank Bhd	8	Wah Tat Bank Bhd
9	Maybank Bhd	10	Pacific Bank Bhd
11	Public Bank Bhd	12	Hock Hua Bank Bhd
13	Southern Bank Bhd	14	Ban Hin Lee Bank Bhd

Banks Not Involved with M&As	
No	*Bank*
15	ABN AMRO Bank Bhd
16	Arab-Malaysian Bank Bhd
17	Bangkok Bank Bhd
18	Bank of America Malaysia Bhd
19	Bank of China Bhd
20	Bank of Nova Scotia Bhd
21	Bank of Tokyo Mitsubishi Bhd
22	Bank Utama Bhd
23	Bumiputra Commerce Bank Bhd
24	Chase Manhattan Bank Bhd
25	Citibank Bhd
26	Deutsche Bank Bhd
27	HSBC Bank Malaysia Bhd
28	International Bank Malaysia Bhd
29	OCBC Bank Bhd
30	Overseas Union Bank Bhd
31	Phileo Allied Bank Bhd
32	RHB Bank Bhd
33	Standard Chartered Bank Bhd
34	United Overseas Bank Bhd

Sources: (1) Bank Negara Malaysia
(2) Sufian (2009); Sufian and Habibullah (2009), and Sufian (2007).

produced from given inputs, the more efficient is the production. Sherman and Gold (1985) were the first to apply DEA method to banking sectors. According to Bader *et al.* (2008), the DEA technique is extensively used in many recent banking efficiency studies (Drake *et al.*, 2006 and Sufian and Habibullah, 2009). Nevertheless, it was Farrell (1957) who originally developed this non-parametric efficiency approach.

This study employs estimates efficiency under the assumption of variable returns to scale (VRS). The VRS model was proposed by Banker, Charnes and Cooper (1984). The BCC model (VRS) extended the CCR model that was proposed by Charnes, Cooper and Rhodes (1978).

The CCR model presupposes that there is no significant relationship between the scale of operations and efficiency by assuming constant return to scale (CRS) and it delivers the overall technical efficiency (OTE). The CRS assumption is only justifiable when all decision making units (DMUs) are operating at an optimal scale. However, firms or DMUs in practice might face either economies or diseconomies of scale. Thus, if one makes the CRS assumption when not all DMUs are operating at the optimal scale, the computed measures of OE will be contaminated with scale inefficiency (SIE).

Banker, Charnes, and Cooper (1984) extended the CCR model by relaxing the CRS assumption. The resulting BCC model was used to assess the efficiency of DMUs characterised by VRS. The VRS assumption provides the measurement of pure technical efficiency (PTE), measuring the efficiency of the DMU's managerial. The PTE measures the efficiency of the DMU's pure managerial without being contaminated by scale. Therefore, VRS results may provide more reliable information on the DMU's efficiency rather than the CRS (Coelli, 1996 and Sufian, 2004).

The revenue, cost and profit efficiency models are given in Equations (1) – (3) below. As can be seen, the revenue, cost and profit efficiency scores are bounded within the 0 and 1 range.

Frontier Type	*Revenue Efficiency (Eq. 1)*	*Cost Efficiency(Eq. 2)*	*Profit Efficiency(Eq. 3)*
VRS	$max \sum_{r=1}^{S} q_r^o y_{ro}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le x_{io} \; i=1,2,...,m;$ $\sum_{i=1}^{n} \lambda_j y_{rj} \ge \tilde{y}_{ro} \; r=1,2,...,s;$ $\lambda_j, \tilde{y}_{ro} \ge 0$ $\sum_{j=1}^{n} \lambda_j = 1$	$min \sum_{i=1}^{m} p_i^o \tilde{x}_{i\,o}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{io} \quad i=1,2,...,m;$ $\sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{ro} \quad r=1,2,...,s;$ $\lambda_j, \tilde{x}_{io} \ge 0$ $\sum_{j=1}^{n} \lambda_j = 1$	$max \sum_{r=1}^{s} q_r^o \tilde{y}_{ro} - \sum_{i=1}^{m} p_i^o \tilde{x}_{io}$ *subject to* $\sum_{j=1}^{n} \lambda_j x_{ij} \le \tilde{x}_{i\,o} \quad i=1,2,...,m$ $\sum_{j=1}^{n} \lambda_j \quad y_{rj} \ge \tilde{y}_{ro} \quad r=1,2,...,s$ $\tilde{x}_{io} \le x_{io}, \tilde{y}_{ro} \ge y_{ro}$ $\lambda_j \ge 0$ $\sum_{j=1}^{n} \lambda_{j=1}$

Source: Zhu (2009)

where

s is output observation

m is input observation

r is s^{th} output

i is m^{th} input

q^o_r is unit price of the output r of DMU0 (DMU0 represents one of the n DMUs)

p^o_r is unit price of the input i of DMU0

$\tilde{y}^r_o$ is r^{th} output that maximise revenue for DMU0

$\tilde{x}_{io}$ is i^{th} input that minimise cost for DMU0

y_{ro} is r^{th} output for DMU0

x_{io} is i^{th} input for DMU0

n is DMU observation

j is n^{th} DMU

λ_j is non-negative scalars

y_{rj} is s^{th} output for n^{th} DMU

x_{ij} is m_{th} input for DMU

By calculating these three efficiencies concepts (revenue, cost and profit), we could observe the effects of the bank M&As on these efficiency levels and more robust results could be obtained. Nevertheless, the revenue efficiency concept will be given more focus in this study rather than the other efficiencies concepts (cost and profit) as its focus is on the effect of the bank M&As on the revenue efficiency.

3.2. Variables Used

According to Cooper *et al.* (2002), there is a rule required to be complied with in order to select the number of inputs and outputs. A rough rule of thumb which could provide guidance is as follows:

$$n \geq \max \{m \times s, 3(m+s)\}$$

where

n is a number of DMUs

m is a number of inputs

s is a number of outputs

Because this study uses the intermediation approach, three inputs and outputs variables were chosen. The overall selection of the variable of banks' input and output was based on Ariff and Can (2008) and other major studies on the efficiency of the

banks involved with the event of the M&As (Sufian and Habibulah, 2009; Altunbas, 2001; Bader *et al.,* 2008; Isik and Hassan, 2002; and Hassan, 2005). The three input vector variables consist of x1: Deposits, x2: labour and x3: physical capital. The input prices consist of w1: price of loanable funds, w2: price of labour and w3: price of physical capital.

The three output vector variables are y1: loans, y2: investment; and y3: off-balance sheet items. Meanwhile, three output prices consist of r1: Price of loans, r2: price of investment and r3: price of off-balance sheet items. The summary of data used to construct the efficiency frontiers are presented in Table 2.

Table 2
Descriptive Statistics for Inputs, Inputs Prices, Outputs, and Outputs Prices

Variables	*Minimum (RM mil.)*	*Maximum (RM mil.)*	*Mean (RM mil.)*	*Std. Deviation (RM mil.)*
x1	190.100	243,132.000	27,953.100	41,139.726
x2	3.600	61,176.000	471.753	3,739.649
x3	0.700	1,420.000	226.940	331.046
w1	0.005	0.130	0.034	0.016
w2	0.002	6.336	0.031	0.387
w3	-0.286	15.971	2.148	2.507
y1	38.300	185,783.200	19,848.644	29,665.862
y2	39.700	61,677.500	5,758.159	8,673.051
y3	4.600	129,453.300	13,283.386	18,945.448
r1	0.034	2.512	0.143	0.213
r2	0.001	1.194	0.360	0.472
r3	0.001	3.630	0.030	0.221

Notes: x1: Deposits (total deposits, money market and short term funding), x2: Labour (personnel expenses), x3: Physical capital (interest income on loans and other interest income/ loans), w1: Price of deposits (total interest expenses/deposits), w2: Price of labour (personnel expenses/ total assets), w3: Price of physical capital (other operating expenses/ fixed assets), y1: Loans (net loans and interbank lending), y2: Investment (short-term, long term and entrusted investment or securities), y3: Off-balance sheet items (value of the off-balance sheet activities), r1: Price of loans (interest income on loans and others interest income/loans), r2: Price of investment (other operating income/investment) and r3: Price of off-balance sheet items (net fees and commissions/off-balance sheet items).

4. EMPIRICAL RESULTS

Before proceeding with the discussion of DEA results, this study first tested the rule of thumb on the selection of inputs and outputs variables suggested by Cooper et al. (2002). Since the total number of DMUs (34 banks) in this study is more than the numbers of inputs and outputs variables (3 x 3 @ 3 [3+3]), the selection of variables are valid since it complies with the rule of thumb and allows the efficiencies of DMUs to be measured.

Next, by calculating all three efficiencies concepts (revenue, cost and profit), we could observe the effect of the bank M&As to these efficiencies levels and further obtain more robust results. As stated, this study focuses on the effect of the bank M&As on the revenue efficiency, it will explain more on the revenue efficiency concept than the other efficiencies concepts (such as cost and profit efficiencies). Table 3 illustrates the revenue efficiency estimates together with other efficiency concepts which are cost and profit efficiency during per-merger and post-merger period.

4.1. The Malaysian Banking Sector During the Pre-Merger Period

Table 3 shows the mean for cost efficiency, revenue efficiency and profit efficiency of 83%, 79.7% and 69.5% during pre-merger period (1995-1996) in the Malaysian banking sector. Another way of interpreting this result is to suggest that these banks have slacked (inefficient) by not fully producing the outputs efficiently using the same input (revenue inefficiency) and by not fully using the inputs efficiently to produce the same outputs (cost inefficiency). Banks are said to have slacked if they fail to fully minimise the cost and maximise the revenue (profit inefficiency). The levels of cost inefficiency, revenue inefficiency and profit inefficiency are shown as 17%, 20.3% and 30.5%.

For the cost efficiency, the result means that the average bank utilised only 83% of the resources or inputs to produce the same level of output during the pre-merger period. In other words, on the average, Malaysian banking sector has wasted 17% of its inputs, or it could have saved 17% of its inputs to produce the same level of outputs. If the Malaysian banking sector had fully utilised its inputs, it could have saved on costs during the pre-merger period.

Nevertheless, it was noted that on the average, Malaysian banking sector was more efficient during the pre-merger period in utilising its inputs compared to its ability to generate revenues and profits. For revenue efficiency, the average bank could only generate 79.7% of the revenues, less than what it was initially expected to generate. Hence, revenue is lost by 20.3%, meaning that the average bank loses an opportunity to receive 20.3% more revenue given the same amount of resources, or it could have produced 20.3% of its outputs given the same level of inputs.

Obviously, the inefficiency is on the revenue side, followed by the profits. Similarly, the average bank could earn 69.5% of what was available, and lost the opportunity to make 30.5% more profits from the same level of inputs.

Even though the cost efficiency is reportedly highest during the pre-merger period, the revenue efficiency is found to be lower, and this led to higher revenue inefficiency. When both efficiencies concepts (revenue and cost efficiency) are compared, the higher revenue inefficiency had contributed to the higher profit inefficiency.

4.2. Malaysian Banking Sector during the Post-Merger Period

During the post-merger period (2002-2009) the Malaysian banking sector had exhibited mean cost efficiency, revenue efficiency and profit efficiency of 91.4%,

80.7% and 88.8% respectively. The levels of cost inefficiency, revenue inefficiency and profit inefficiency were 8.6%, 19.3% and 11.2% respectively (please refer to Table 3).

Table 3
Cost, Revenue, and Profit Efficiencies during Pre and Post Merger Periods

	Pre-merger (1995-1996)			*Post-merger (2002-2009)*		
Bank	*CE*	*RE*	*PE*	*CE*	*RE*	*PE*
ABN AMBRO Bank	0.767	0.801	0.492	0.801	0.583	0.739
Affin Bank	1.000	1.000	1.000	0.859	0.734	0.776
Alliance Bank Malaysia	0.847	0.774	0.540	0.863	0.729	0.705
AmBank (M) Bhd	1.000	1.000	1.000	0.857	0.726	1.000
Ban Hin Lee Bank	0.674	0.755	0.489	-	-	-
Bangkok Bank	1.000	0.820	1.000	0.878	0.739	0.905
Bank of America Malaysia	0.739	0.575	0.616	0.919	0.939	0.923
Bank of China	0.970	0.892	0.899	-	-	-
Bank of Nova Scotia	1.000	1.000	1.000	1.000	0.842	1.000
Bank of Tokyo-Mitsubishi	1.000	0.911	1.000	0.979	0.805	1.000
Bank Utama	0.751	0.741	0.714	1.000	1.000	1.000
BSN Commercial Bank	0.853	0.634	0.371	0.890	0.925	0.760
Bumiputra Commerce Bank	0.996	0.991	1.000	1.000	1.000	1.000
Chase Manhattan Bank	1.000	1.000	1.000	0.727	0.377	0.543
Citibank	0.885	0.856	0.872	0.970	0.899	0.981
Deutsche Bank	0.749	0.757	0.501	1.000	0.592	1.000
EON Bank	0.790	0.861	0.600	0.920	0.720	0.749
Hock Hua Bank	0.742	0.746	0.537	-	-	-
Hong Leong Bank	0.793	0.763	0.502	0.858	0.913	0.894
HSBC Bank Malaysia	0.880	0.962	0.877	0.812	0.779	0.737
International Bank Malaysia	0.569	0.516	0.296	-	-	-
Maybank	1.000	1.000	1.000	1.000	1.000	1.000
OCBC Bank	0.938	0.912	0.860	0.969	0.865	1.000
Oriental Bank	0.755	0.807	0.548	-	-	-
Overseas Union Bank	0.965	0.922	0.898	-	-	-
Pacific Bank	0.764	0.819	0.582	-	-	-
Phileo Allied Bank	0.647	0.367	1.000	-	-	-
Public Bank	0.636	0.709	0.424	0.853	0.838	0.811
RHB Bank	1.000	1.000	1.000	0.949	0.898	0.951
Sabah Bank	0.672	0.683	0.418	-	-	-
Southern Bank	0.703	0.773	0.519	0.866	0.834	0.821
Standard Chartered Bank	0.837	0.795	0.730	0.999	0.988	1.000
United Overseas Bank	0.855	0.551	0.382	0.940	0.848	0.959
Wah Tat Bank	0.650	0.582	0.318	-	-	-
ALL BANKS	0.830	0.797	0.695	0.914	0.807	0.888

Notes: CE: Cost efficiency, RE: Revenue efficiency, PE: Profit efficiency

As for the cost efficiency, the result means that the average bank had utilised only 91.4% of the resources or inputs in order to produce the same level of output during the post-merger period. In other words, on the average, the Malaysian banking sector had wasted 8.6% of its inputs, or it could have saved 8.6% of its inputs to produce the same level of outputs. Therefore, there was substantial room for significant cost savings for these banks if had they employed their inputs efficiently.

However, similar findings are noted in which on the average, the Malaysian banking sector is also found to be more efficient during the post-merger. It managed to utilise its inputs to generate revenues and profits. For revenue efficiency, the average bank could only generate 80.7% of the revenues than it was expected to generate. Hence, there is a slack of 19.3%, meaning that the average bank lost an opportunity to receive 19.3% more revenue, giving the same amount of resources or it had to produce 19.3% of its outputs with the same level of inputs.

Noticeably, the highest level of inefficiency is on the revenue side, followed by the profits. Similarly, the average bank could earn 88.8% of what was available, and lost the opportunity to make 11.2% more profits when utilising the same level of inputs.

As a conclusion, all the efficiencies concepts in Malaysian banking sector improved after the M&As. Cost efficiency improved from 83% during pre-merger to 91.4% during post-merger period, revenue efficiency improved from 79.7% to 80.7% and profit efficiency rose from 69.5% to 88.8%. Other than that, result shows that the level of cost efficiency is higher than that of profit efficiency due to the lower revenue efficiency level or higher inefficiency from the revenue side.

Therefore, the improvement of the revenue efficiency on Malaysian banking sector should be given more concentration since it could contribute to the lower profit efficiency of the bank. The improvement of revenue efficiency during pre-merger and post-merger periods was performed by a series of parametric (t-test) and non-parametric (Mann-Whitney [Wilcoxon]) and Kruskal-Wallis tests. Coakes and Steed (2003) suggested that the Mann-Whitney (Wilcoxon) is a relevant test for two independent samples coming from populations having the same distribution. The most relevant reason is that the data violate the stringent assumptions of the independent group's t-test, so it was decided that Mann-Whitney tests should be used. This study used parametric and non-parametric tests in order to obtain robust results.

4.3. Robustness Tests

Table 4 shows the robust result from the parametric and non-parametric tests of the data. The results of cost and profit efficiency from the parametric t-test show that the Malaysian banking sector exhibits a higher efficiency mean during post-merger period (0.914>0.830 and 0.888>0.695) and is significantly different. The results from the parametric t-test were further confirmed by non-parametric Mann-Whitney (Wilcoxon) and Kruskall-Wallis tests. Therefore, this indicates that the cost and profit

efficiency on Malaysian banking sector improved during post-merger period. Coakes and Steed (2003) suggest that the Mann-Whitney (Wilcoxon) is a relevant test for two independent samples coming from populations having the same distribution. The most relevant reason is that the data violate the stringent assumptions of the independent groups' t-test, so it was decided that Mann-Whitney tests should be used.

Table 4
Summary of Parametric and Non-Parametric Tests on Pre and Post-Merger Periods

Test groups						
	Parametric test		*Non-parametric test*			
Individual tests	*t-test*		*Mann-Whitney [Wilcoxon Rank-Sum] test*		*Kruskall-Wallis Equality of Populations test*	
Hypothesis	*Median Pre-merger = Median Post-merger*					
Test statistics	*t(Prb>t)*		*z(Prb>z)*		*X^2 (Prb > X^2)*	
	Mean	*t*	*Mean Rank*	*z*	*Mean Rank*	*X^2*
Cost Efficiency						
Pre-merger	0.830	4.033***	91.35	– 4.423***	91.35	19.56***
Post-merger	0.914		134.43		134.43	
Revenue Efficiency						
Pre-merger	0.797	0.271	109.68	– 1.809*	109.68	3.273*
Post-merger	0.807		127.81		127.81	
Profit Efficiency						
Pre-merger	0.695	5.736***	87.25	– 5.491***	87.25	30.153***
Post-merger	0.888		135.91		135.91	

***, **, * indicates significance levels at 0.01, 0.05, and 0.10 respectively.

However, an interesting result is obtained regarding the revenue efficiency during pre-merger and post-merger period in Malaysian banking sector. Result from parametric t-test exhibited revenue efficiency as higher during post-merger period compared to pre-merger periods (0.807>0.797), but statistically, it was not significantly different. This indicated that the revenue efficiency on Malaysian banking sector did not improve during post-merger period.

Nevertheless, both the non-parametric Mann-Whitney (Wilcoxon) and Kruskall-Wallis tests suggest that the result is statistically significant but only at 10% level. Even though this indicates the Malaysian banking sector exhibited higher revenue efficiency during post-merger period but it is statistically significant at only the 10% level. Since the significant level is low, this study concludes that the revenue efficiency on Malaysian banking sector did not improve during post-merger period.

To verify the difference between the merged and unmerged banks or control banks, this study again performed a series of parametric (t-test) and non-parametric (Mann-Whitney [Wilcoxon]) and Kruskall Wallis test. The results are presented in Table 5.

The results of cost and profit efficiency from the parametric t-test show that the Malaysian banking sector exhibited a lower mean merged bank (0.851<0.912 and 0.731<0.888) and significantly different. The results from the parametric t-test were further confirmed by non-parametric Mann-Whitney (Wilcoxon) and Kruskall-Wallis tests.

Table 5
Summary of Parametric and Non-Parametric Tests on Unmerged and Merged Banks

Test groups						
Parametric test			*Non-parametric test*			
Individual tests	*t-test*		*Mann-Whitney [Wilcoxon Rank-Sum] test*		*Kruskall-Wallis Equality of Populations test*	
Hypothesis	*Median Pre-merger = Median Post-merger*					
Test statistics	*t(Prb>t)*		*z(Prb>z)*		*X^2 (Prb > X^2)*	
	Mean	*t*	*Mean Rank*	*z*	*Mean Rank*	*X^2*
Cost Efficiency						
Unmerged bank	0.912	– 3.065***	138.120	– 5.048***	138.120	25.487***
Merged bank	0.851		91.830		91.830	
Revenue Efficiency						
Unmerged bank	0.802	0.165	128.630	– 1.828*	128.630	3.342*
Merged bank	0.808		111.380		111.380	
Profit Efficiency						
Unmerged bank	0.888	– 4.902***	138.740	5.777***	138.740	33.375***
Merged bank	0.731		90.540		90.540	

***, **, * indicates significance levels at 0.01, 0.05, and 0.10 respectively.

It is interesting to note that the results obtained from the revenue efficiency between the merged and unmerged banks seemed to suggest that the merged banks were relatively more revenue efficient (0.808>0.802), but the difference was not statistically significant under parametric t-test. However, the result was similar through non-parametric Mann-Whitney (Wilcoxon) and Kruskall-Wallis tests since the significant only at 10% level. Since the results from parametric and non-parametric tests showed the same findings, this study concluded that the revenue efficiency on Malaysian banking sector did not improve in merged bank

5. CONCLUSIONS

The study was carried out with the main purpose of identifying the effects that M&As have on revenue efficiency in the Malaysian banking sector during the pre- and post-merger period. To recap, the majority of the researchers have focused more on the effects of M&As on cost and profit efficiency in banking sectors and only a few have looked at the effects of M&As on revenue efficiency. In addition, much of the prior work highlight the voluntary bank merger (market-driven) where the acquirers and

targets were not urged to merge by the government, but they did it based on their own initiative (Berger *et al.*, 1996 and Cornett *et al.*, 2006). In the Malaysian context, bank M&As scheme took place out of order by the regulators; that is, based on a forced merger (Sufian and Habibullah, 2009 and Sufian, 2009).

Most studies focused more on the improvement in M&As but they have ignored the revenue efficiency side when in fact, it should be looked into in depth. It is because information on revenue efficiency found in previous mergers could be used to assist regulators in making decisions about future mergers that will maximise the profitability and efficiency of the overall banking sector (Cornett *et al.*, 2006).

The result of this study shows that they are no statistically significant difference on revenue efficiency between pre and post-merger period. To further verify the result, tests on the revenue efficiency to the merged banks and unmerged bank were performed and they showed consistent result with regard to the pre and post-merger period. This indicates the revenue efficiency on Malaysian banking sector did not improve during the post-merger period. The findings are consistent with the several studies such as Ariff and Can (2008), AL-Sharkas *et al.* (2007) Huizinga *et al.* (2001) and Akhavein *et al.* (1997). They discover that M&As do not improve bank's revenue efficiency since the level of cost efficiency is higher than profit efficiency. Although cost and profit efficiency has improved, banks may still face revenue inefficiency resulting from producing a small number of outputs, producing too much or little of a cheaper or expensive output, and selling it inefficiently.

The research concludes that findings from studies on M&As on revenue efficiency in the Malaysian banking sector provide guidance, better information and fill in the gap in current literature which can benefit the regulators, the banking sector itself, investors and academics when they make decisions on future M&As.

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