



## Impact of Merger on Efficiency and Productivity in Malaysian Commercial Banks

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### Abstract

This study seeks to determine the impact of mergers on efficiency and productivity of commercial banks in Malaysia for the period from 1995 until 2005. The study uses a non-parametric approach, namely DEA, to estimate the efficiency scores and to construct the Malmquist productivity index. To enable this estimation, three bank inputs and outputs were used. Amongst the findings are that banks exhibit higher efficiency scores after the merger and that the foreign banks are more efficient than the local banks. For productivity, the banks had improved in both periods, before and after the merger. However, it is the local banks that improved the most after the merger. The main source of productivity was technical change or innovation. The findings support the existing policy of having larger domestic banks in terms of size.

**Keywords:** Efficiency, Productivity, Data envelopment analysis, Commercial banks.

### 1. Introduction

By the end of the 1970s, Bank Negara Malaysia believed that there were too many banks in the country compared to its real size. The creation of new banks was not allowed and the existing banks were encouraged to consolidate. However, the call for bank consolidation throughout the 80s was not received well by the bankers. Only a few consolidations took place after the economic decline in 1985-86. After the Asian financial crisis, the government announced a major consolidation in 1999 that would reduce the number of domestic banking institutions to ten banking groups by 2000. Through this merger program, each domestic bank must have a minimum shareholder equity of RM2 billion and an asset base of RM25 billion (Bank Negara Malaysia, 1999). This consolidation exercise was finally completed in 2001.

This study wants to measure and compare the technical efficiency of the commercial banks before and after the merger and to identify the sources of productivity growth of the commercial banks. This is done by using a non-parametric approach, namely, data envelopment analysis. Original ideas of efficiency were discussed by Farrel (1957) and were later developed by the works of Aigner et al. (1977) and Meeusen and van den Broeck (1977) using a parametric approach and by the work of Charnes et al. (1978) using a non-parametric approach. On the other hand, the measurement of productivity using data envelopment analysis was introduced by Färe et al. (1994).

The findings of the study suggest that on average the commercial banks have improved in term of their technical efficiency. The scores of technical efficiency are higher after the merger. The study also indicates that the foreign banks are more efficient than the local banks. In term of productivity, the banks have improved by 9% in both period. This has been contributed by improvement in technology.

The current literature shows that there are three debatable issues related to the efficiency and productivity of financial institutions. The three issues are bank inputs and outputs, the concept of efficiency and productivity and the measurement of efficiency and productivity. A thorough discussion was provided by Berger and Humphrey (1997) and Ahmad Mokhtar et al (2006). Meanwhile, Siems and Barr (1998) and Chu and Lim (1998) showed differences in employing bank inputs and outputs. In the case of Malaysia, several studies looked into this topic, such as Katib and Matthews (1999), Ismail (2005), Sufian (2004, 2006), Sufian and Abdul Majid (2005), and Munisiamy and Pritam Singh (2008). Most studies focused on the developed countries.

The concept of productivity was introduced by Malmquist (1953). His work was later developed by Caves et al. (1982) and Grosskopf (2003). However, it was Färe et al. (1994) who initially developed the Malmquist Productivity Index using a DEA approach based on constant returns to scale. They analysed productivity growth in 17 OECD countries for the period 1979-1988. The decomposition of productivity growth was done under the assumption of constant returns to scale. They further stated that this decomposition provides an alternative way of testing for convergence of productivity growth, as well as allowing identification of innovations. Other studies on the productivity of financial institutions include Canhoto and Dermine (2003) and Casu et al. (2003). In the case of commercial banks in Malaysia, there were studies like Krishnasamy et al (2003), Sufian (2007) and Sufian and Haron (2008).

This study is organized as follows. Section 2 presents the methods and relevant models used in this study. This is followed with empirical results. Section 4 concludes.

## 2. Method

### 2.1 Efficiency model

This study uses the non-parametric approach, or DEA, due to its simplicity and for comparative purposes. This study follows the approach taken by Ismail (2005). He measured the efficiency scores and the productivity index of the commercial banks before the merger. However, this study extends his work by exploring the performance of the banks after the merger. He used the basic models of the DEA, the ones developed by Charnes, Cooper and Rhodes (1978), known as the CCR model and Banker, Cooper and Rhodes (1984), known as the BCR model. These models differ in terms of the basic assumptions made with regard to the returns to scale. This study uses the BCR model. Its primary formulation is written as

$$\text{Maximise } E_o = \sum_{i=1}^s u_i y_{io} - c_o \quad \text{Equation 1}$$

subject to

$$\sum_{j=1}^r v_j x_{jo} = 1$$

$$\sum_{i=1}^s u_i y_{im} - \sum_{j=1}^r v_j x_{jm} - c_o < 0, m=1, \dots, N.$$

where

$E_o$  = relative efficiency of the bank  $o$

$s$  = number of outputs produced by the bank  $o$

$r$  = number of inputs employed by the bank  $o$

$y_i$  = the  $i$ th output produced by the bank  $o$

$x_j$  = the  $j$ th input employed by the bank  $o$

$u_i$  =  $s \times 1$  vector of output weights and

$v_j$  =  $r \times 1$  vector of input weights.

$i$  runs from 1 to  $s$  and  $j$  runs from 1 to  $r$ .

$u_i, v_j > 0$ ; (small but positive). The parameter  $c_o$  is unconstrained in sign. It indicates the various possibilities of returns to scale.  $C_o > 0$  indicates increasing returns to scale and  $c_o = 0$  implies constant returns to scale. Finally,  $c_o < 0$  implies decreasing returns to scale. This model forms a convex hull of intersecting planes that envelop the data points more tightly than the CRS model. Therefore, it enables technical efficiency scores to be greater than or equal to those obtained under the CRS model.

### 2.2 Productivity model

To measure the productivity of commercial banks before and after the merger, this study follows the works of Caves et al. (1982) and Zhu (2003). These studies employed the technology within the period  $t+1$  as the reference technology (see Equation 2 below). Alternatively, the technology within the period  $t$  (base period) can also be used as the reference technology. This approach is taken by Casu et al. (2003), Canhoto and Dermine (2003), and Färe et al. (1994). The difference in the reference technology used affects the magnitude in interpreting the index. When the reference technology is based on period  $t+1$ , then  $M_o > 1$  implies deterioration in productivity over the period under study. On the other hand, when the reference technology is based on period  $t$ , then  $M_o > 1$  implies an improvement in productivity.

Our empirical Malmquist Productivity Index ( $M_o$ ) is written as:

$$M_o = \frac{D_o^t(x_o^t, y_o^o)}{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})} \left[ \frac{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{D_o^t(x_o^t, y_o^o)} * \frac{D_o^t(x_o^t, y_o^t)}{D_o^t(x_o^t, y_o^o)} \right]^{1/2} \quad \text{Equation 2}$$

or

$$M = E * T$$

where

$$E = \frac{D_o^t(x_o^t, y_o^o)}{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})}$$

$$T = \left[ \frac{D_o^{t+1}(x_o^{t+1}, y_o^{t+1})}{D_o^t(x_o^t, y_o^o)} * \frac{D_o^t(x_o^t, y_o^t)}{D_o^t(x_o^t, y_o^o)} \right]^{1/2}$$

where

$M$  = the Malmquist productivity index

$E$  = a change in efficiency over the period  $t$  and  $t+1$  (the term outside the square bracket)

$T$  = a measure of technical progress measured by shifts in the frontier over the period  $t$  and  $t=1$  (the two ratios in the square bracket).

### 3. Results

To estimate the efficiency score, we used three inputs and three outputs. The process of estimating the individual efficiency of the commercial bank was carried out by using Excel Solver Software developed by Zhu (2003). For the construction of the Malmquist Productivity Index, the estimation was done under the assumption of constant returns to scale. The bank inputs and outputs are the same.

#### 3.1 Descriptive statistics of the data

This study focuses on the conventional commercial banks only. Islamic commercial banks were excluded because of the different nature of the output produced. In principle, the outputs of Islamic banks are interest free. In 1995 and 1996, there were 37 commercial banks in Malaysia but only 32 banks were included in the sample. This is due to data limitations. Out of 32 banks, 21 were local banks and 11 foreign banks. Until 2000, the number of foreign banks in the sample remained at 11. The number of local banks started to fall in 1997 due to merger activity. The number was 31 in 1997, 30 in 1998, 28 in 1999 and only 9 in 2000. In 2000, data for some domestic banks were not available since the banks were about to merge. After 2000, the total number of commercial banks excluding Islamic banks stood at 23, 10 local banks and 13 foreign banks. The number of local banks was further reduced to 9 when another two banks merged in 2006. The inputs used were labour, total deposit and fixed assets. The outputs were total loans, other earning assets and other operating incomes. The descriptive statistics of the data is shown in Table 1.

#### 3.2 Pure technical efficiency

Table 2 shows the efficiency score of commercial banks for each year for the period 1995 until 2005. On average, the efficiency scores before the merger were lower than the efficiency scores after the merger. For the period 1995 to 2000, the average score was 67.57% compared with 95.20% for the period 2001-2005. We applied a t-test to show that the mean difference between these two periods is significant. Our post-merger result is similar to the one found by Sufian and Abdul Majid (2005) and Sufian (2004).

#### 3.3 Efficiency and bank ownership

We proceeded further by comparing the performance of both domestic and foreign banks. This comparison is shown in Table 3. The results clearly show that the foreign banks were more efficient than the local banks. The efficiency scores for foreign banks were 0.9003 compared with 0.6914 for the domestic banks.

#### 3.4 Productivity and its sources

Using the same inputs and outputs, the Malmquist Productivity Index was constructed. Table 4 shows the Malmquist Productivity Index and the sources of productivity growth: efficiency change and technical change or the 'catching-up effect' and the 'shifting-up effect'. The table reports the changes in productivity during two consecutive years (taking

the second year to construct the benchmark technology or reference technology) as well as changes between 1995 and 2000 and between 2001 and 2005. Recall that the Malmquist Productivity Index ( $M_o$ ) measures the change in productivity between two periods. Since technology in the second period is used as the reference technology, then if  $M_o$  is less than 1, there is productivity growth. If  $M_o$  is greater than 1, productivity deteriorates and if equal to one, productivity remains unchanged.

On average, productivity had increased over the 1995-2000 and 2001-2005 periods for the banks in our sample. In both periods, productivity increased by 9%. The productivity indexes stand at 0.91. This finding is slightly higher than those found by Krishnasamy et al (2003). They found that the productivity of the Malaysian commercial banks grew at 5% for the period 2001-2002. The main source of productivity growth came from technical change or innovation. The index for technical change was 0.98 before the merger and 0.78 after the merger. This implies that the frontier had shifted outward by only 2% before the merger and 22% after the merger.

### 3.5 Productivity and bank ownership

We now turn to the comparison of productivity growth over two groups of banks. Table 5 shows the Malmquist Productivity Index and the sources of productivity growth for these two groups. For the period 1995-2000, both domestic and foreign banks experienced an increase in productivity (8% and 10%, respectively). The sources of the productivity growth originate from both efficiency and technical change. For domestic banks, efficiency change improved by 10% but technical change deteriorated by 13%. On the other hand, the foreign banks experienced 15% improvement in technical change whilst efficiency change became lower by 12%. It should be noted that the estimation of this productivity index is done under the assumption of constant returns to scale.

After the merger, the productivity of domestic banks had increased by 34% while the productivity of foreign banks deteriorated by 23%. The improved productivity of domestic banks was contributed to by technical change (35%) rather than efficiency change. For foreign banks, the deterioration in productivity was caused by the decline in efficiency (31%) although their technical change had improved by 9%.

## 4. Conclusion

This study shows that on average that the commercial banks had improved in terms of their technical efficiency. The scores were 67.57% before the merger and 95.20% after the merger. The difference in the scores has been proven to be statistically significant. Secondly, the foreign banks have higher efficiency scores than the local banks (90.03% compared with 69.14%). Thirdly, the productivity of all banks increases by 9% in both periods (before and after the merger). This is contributed by improvement in technology (technical change) rather than efficiency change. An interesting finding is that the local banks have improved their productivity greater than the foreign banks'. However, it should be noted that the Productivity Index was constructed under the assumption of constant returns to scale.

The study found some justifications for the merger policy introduced by the Government in the late 1990s and also some support for the implementation of the Financial Master Plan (2001-2010). It can be stated that the merger had created more spaces for the banks to better utilize the resources and enhance their capacity, in particular the local banks. It had been claimed that before the merger Malaysia had many small banks relative to her economy. As a result of the merger, the local banks have been restructured. Bank branches were relocated so that any potential markets were well-captured.

The superior performance of the foreign banks should raise the eyes of the policy makers. The findings in this study are consistent with other studies that foreign banks are better in terms of utilizing their resources and producing outputs. The local banks should review their current practices and do benchmarking. It is already known that the local banks need to meet certain requirements set by the authorities. This is due to the needs to perform social obligations within the private sector. For example, priority areas have been identified for loan disbursement. The foreign banks, unlike this, are not required to meet this requirement. However, such requirements should not be taken as an excuse for their relative poor performance compared to their foreign counterparts. Service quality must be improved and the red tape in meeting customers must be removed. Professional attitudes must be upheld when entertaining customer needs.

The policy of enhancing the capacity of the banks should continue. By increasing the capacity, the banks can operate on a larger scale. Economic theory states that large scale operation enables lower costs and this can boost a bank's competitive edge. Easy access to banking services via the latest techniques, like online transactions, should be pursued further. By reducing face-to-face communication, transactions can be further improved. This can eventually place the banks on a higher frontier and higher efficiency levels.

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Table 1. Descriptive Statistics of Bank Inputs and Outputs (1995 – 2005)

	LAB	TD	FA	LOANS	OEA	OOY
1995-2000						
Mean	1922.17	7746.24	114.33	6946.64	4285.08	100.03
Std Deviation	2444.40	9998.41	157.61	9280.18	5945.13	135.94
Minimum	70.00	131.40	1.70	146.30	100.30	-4.60
Maximum	12200.00	60260.40	792.20	61003.90	32091.00	800.70
2001-2005						
Mean	3513.93	22992.04	300.95	18250.84	11102.83	460.97
Std Deviation	4001.61	25815.15	591.34	20442.63	12085.89	1424.83
Minimum	45.00	515.90	1.50	84.10	139.40	0.00
Maximum	19773.00	138149.90	4769.00	115481.60	59216.10	13917.00

Notes: a. LAB is the number of bank employees. TD is total deposits. FA is total fixed assets. LOANS are total loans issued by the banks (overdraft, term loans and others). OEA is other earning asset and OOY is other operating income. n is the number of commercial banks.

b. LAB figures for 1995, 1997 and 1999 are replacement value. The method used is mean substitution for each of the bank involved as suggested by Hair et al. (1998).

c. Figures are in thousands of ringgit Malaysia (RM) except for the number of bank employees.

Sources: Associations of Bankers in Malaysia (1996, 1998 and 2000).

Table 2. Summary of efficiency scores (1995 – 2005)

Pure technical efficiency	1995-2000 (%)	2001-2005 (%)
Mean	67.57*	95.20*
Standard Deviation	23.38	8.96
Minimum	23.14	68.18
Maximum	100	100

Note: \* significant at 1% level.

Table 3. Efficiency scores and bank ownership (1995 – 2005)

Efficiency	Domestic banks <sup>a</sup>	Foreign banks	t-statistics	Significance level
Mean pure technical efficiency	0.6914	0.9003	-8.1690	0.0000
Standard deviation	0.2497	0.1415		
No. of observations	160	118		

Note: <sup>a</sup> Local banks consist of both private banks and state-owned banks.

\* significant at 1% level.

\*\* significant at 5% level.

Table 4. Malmquist Productivity Index and sources of productivity growth

Periods	Average Productivity Index ( $M_0$ ) <sup>a, b</sup>	Efficiency Change	Technical Change
Before merger: 1995/2000	0.91	1.02	0.98
After merger: 2001/2005	0.91	1.16	0.78

Note: a. The calculation of productivity index is done based on the assumption of constant returns to scale and under input orientation.

b.  $M > 1$  means deterioration in productivity,  $M=1$  means no change in productivity and  $M < 1$  means improvement in productivity.

Table 5. Malmquist Productivity Index and sources of productivity growth by type of bank

Banks	1995-2000	2001-05
Productivity index <sup>a, b</sup>		
Domestic banks	0.92	0.66
Foreign banks	0.90	1.23
Efficiency Change		
Domestic banks	0.90	1.01
Foreign banks	1.12	1.31
Technical change		
Domestic banks	1.13	0.65
Foreign banks	0.85	0.91

Note: a. The calculation of productivity index is done based on the assumption of constant returns to scale and under input orientation.

b.  $M > 1$  means deterioration in productivity,  $M=1$  means no change in productivity and  $M < 1$  means improvement in productivity.