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Effects of Mergers and Acquisitions on Revenue Efficiency and the Potential Determinants: Evidence from Malaysian Banks

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ABSTRACT

This paper discusses on identifying the effects of regulators-guided mergers on production efficiency gains of Malaysian banks as measured by revenue efficiency ratio. The paper also examines the potential bank-specific and macroeconomics determinants correlated with revenue efficiency. The study sample consisted of banks that were engaged in mergers during 2002-2009 matched with those not engaged in mergers as the control sample. Results showed that revenue efficiency did not improve after the merger. Meanwhile, size, market power and management quality were shown to be correlated with revenue efficiency.

Keywords: Regulator-guided merger; Revenue efficiency; Malaysian banking sector; bank-specific; macroeconomics determinants.
JEL Classification: G21; D24

INTRODUCTION

On 14th February 2000, the banking regulator, Bank Negara Malaysia (BNM) promoted the merger event on the financial institutions and formed 10 anchor banks so that the regulatory capital could be improved so as to prevent recurrent bank failures in post-independence Malaysia. Some have termed this exercise as 'forced merger' to improve their efficiency and productivity. This activity was guided by BNM to face three industry challenges: foreign banks competition; big sized domestic commercial banks serving a small economy; and the effects of the 1997-9 financial crisis. As a result, ten (10) anchor banks were established due to the forced or guided merger exercise on 14th February 2000. The expected outcome of the mega-mergers is for the anchor banks to be more

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efficient compared to the efficiency in the prior period (Cornett *et al*., 2006; Akhavein *et al*., 1997).

Berger *et al*. (1993) recommended that bank could expect enhanced gainfulness, better costs and better administration quality for purchasers with more prominent measures of trusts intermediated if banks considered that they were efficient. The main motive of merging is to enhancing the wealth or value of shareholders by maximising profits (Chong *et al*., 2006), that is, the banking sector would show a greater degree of profit efficiency. Several studies (Kamarudin *et al*., 2014a; Kamarudin *et al*., 2014b; Kamarudin *et al*., 2013; Sufian *et al*., 2013) have suggested that revenue inefficiency is the one that could affect lower level of efficiency in banks' profitability.

Thus, instead of focusing on the level of profit efficiency in the event of merger, it would be more useful to compare it with cost efficiency to discover the continuation of revenue efficiency and the main impact on the banks' profitability. By employing the method of Data Envelopment Analysis (DEA), the present research contributes significantly to the limited knowledge to the importance of revenue efficiency in the banking sector. This study also sought to report findings on potential determinants that are correlated with producing revenue efficiency. For this purpose, Multivariate Regression Analysis (MRA) was applied in the current work.

The paper is organized in the following order: the subsequent section discusses relevant information obtained from the literature review. Discussions on data and methodology are given in section 3. The study elaborates on the results and relevant discussion in section 4. Finally, section 5 presents discussions on conclusion and policy implications.

LITERATURE REVIEW

Studies which combined both cost efficiency and profit efficiency have shown that inefficiency of revenue efficiency leads to different levels of cost efficiency and profit efficiency (Ariff & Can, 2008; Bader *et al*., 2008). Revenue efficiency is characterised as how successfully a bank offers its yields. Most extreme revenue is accomplished as a consequence of creating yield package proficiently (Rogers, 1998). Essentially, revenue efficiency is deteriorated into technical and allocative effectiveness which are identified through managerial variables and routinely connected with administrative components (Isik & Hassan, 2002). English *et al*. (1993) stated that with a specific end goal to determine revenue productivity, banks ought to concentrate on both efficiencies; technical efficiency (that is managerial effectiveness from working on the achievable generation probability bend) and allocative productivity (that is, bank delivering the revenue boosting blend of yields focusing around certain regulation).

An alternative approach to enhance revenue efficiency proposed by a few studies is for banks to create higher quality administrations and charge higher costs

by circumvent any unseemly decision of inputs and yields amounts or mispricing of yields (Rogers, 1998). Revenue inefficiency could be decently recognised by means of the benefit capacity on the grounds that this capacity joins both cost efficiency and revenue efficiency to assess benefit productivity (Akhavein *et al*., 1997), suggesting a guide to this research that profit efficiency is the way to assess bank efficiency in this case.

Revenue efficiency will completely influence efficiency of the profit despite the fact that there is higher level of cost efficiency. Generally, the level of revenue efficiency is the main consideration that impacts efficiency on the level of banks' profit efficiency. Akhavein *et al*. (1997) and Bader *et al*. (2008) expressed that there have been restricted studies done on banks' revenue efficiency. If the studies were narrowed down to revenue efficiency on the bank mergers, there is indeed a paucity of studies. It can be inferred that revenue efficiency is important in activity of mergers as it may also minimise cost (Cornett *et al*., 2006). Opportunities for revenue efficiency give an impression of being the most profitable in those mergers that offer the best open door for cost cutting exercises.

This review reveals the following gaps in research. First, there are numerous studies that have examined the effects of mergers on cost efficiency and profit efficiency in the banking sector under voluntary scheme. Next, there are limited findings on the banking sector in developing countries. Finally, none of the previous studies focused on the revenue efficiency concept in bank mergers. Therefore, this study presents novel contribution findings on the effects of mergers on revenue efficiency and also the determinants using data from the banking sector in Malaysia.

METHODOLOGY AND DATA EMPLOYED

The present study accessed data on all commercial banks in Malaysia over 1995 to 2009. The BankScope database is the main source of banks' financial data. The data were analysed from those banks registered as merged in the Malaysian banking sector during the year 2000. Two event windows were created for the test periods: 1995 to 1996 as pre-merger period that excluded the Asian Financial Crisis years of 1997-8 and the pre-merger period of 1999-2001 and 2002 to 2009 (the latter is considered as the period of post-merger). A total of 34 commercial banks were involved in this sample (14 domestic commercial banks were involved in the mergers, whereas 20 foreign and domestic commercial banks were not involved (refer to Table 1).

Method of Measurement in the First Stage

The study used the DEA frontier analysis method known as the programming approach of Mathematic (Malmquist, 1953). The technique of liner programming creates the frontier of the observed ratios of input-outputs in DEA.

DEA was first introduced to compute each Decision Making Units' (DMUs)

efficiency (Charnes *et al*., 1978). The efficiency of firms' production is due to the maximum output generated by utilising the minimum mix of inputs. Furthermore, the DEA method was first employed by Sherman and Gold (1985) to compute banks' efficiency. According to Bader *et al*. (2008), many studies have used DEA to examine banking efficiency. Nevertheless, this non-parametric approach was originally urbanised by Farrell (1957).

However, to measure cost, revenue and profit efficiency, this study employed the DEA efficiency system known as Excel Solver under the model of VRS developed by Zhu (2009). The efficiencies models are given in Equations (1) – (3) below. Note that the range of cost, revenue and profit efficiency scores is truncated between 0 and 1.

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

(Source: Zhu, 2009)

Where,

s = observation of output
m = observation of input
r = s^{th} output
i = m^{th} input
q_r^o = output r's price of DMU0
p_i^o = input i's price of DMU0
$\tilde{y}_{ro}$ = r^{th} output that maximise revenue for DMU0
$\tilde{x}_{io}$ = i^{th} input that minimise cost for DMU0
y_{r0} = r^{th} output for DMU0
x_{i0} = i^{th} input for DMU0
n = DMU observation
j = n^{th} DMU
λ_j = non-negative scalars
y_{rj} = s^{th} output for n^{th} DMU
x_{ij} = m^{th} input for n^{th} DMU

Measuring on the three efficiency concepts could provide the efficiency levels of the banking sector on the events of before and after the merges and also explain the importance of revenue efficiency to the banking profitability.

Variables and Approaches

Since the issue of selecting what constitutes inputs and outputs is still arbitrary, this study used the intermediation approach because it was assumed that bank is more suitably classified as an intermediary entity (Sufian *et al*., 2013; Sufian & Kamarudin, 2014; Sufian *et al*., 2014). The input variables are stated as follows: Xa (total deposits), Xb (expenses on labour) and Xc (capital of physical). Meanwhile, the input variables are listed as follows: Wa (Deposit's price), Wb (labour's price) and Wc (physical capital's price).

Next, the output variables are stated as follows: Ya (total loans), Yb (investment), and Yc (off-balance sheet items). There are three output prices used in this study (namely, Ra = loans' price; Rb = investments' price; and Rc = off-balance sheet items' price). The data employed to construct the efficiency frontiers are summarised below:

Summary of the Variables Used

Variables	Mean (RM mil.)	Std. Deviation (RM mil.)	Maximum (RM mil.)	Minimum (RM mil.)
Xa	27953.1000	41139.7260	243132.0000	190.1000
Xb	471.7530	3739.6490	61176.0000	3.6000
Xc	226.9400	331.0460	1420.0000	0.7000
Wa	0.0340	0.0160	0.1300	0.0050
Wb	0.0310	0.3870	6.3360	0.0020
w3	2.1480	2.5070	15.9710	-0.2860
Ya	19848.6440	29665.8620	185783.2000	38.3000
Yb	5758.1590	8673.0510	61677.5000	39.7000
Yc	13283.3860	18945.4480	129453.3000	4.6000
Ra	0.1430	0.2130	2.5120	0.0340
Rb	0.3600	0.4720	1.1940	0.0010
Rc	0.0300	0.2210	3.6300	0.0010

Note: Xa: Deposits (total deposits), Xb: Labour (expenses of personnel), Xc: Physical capital (Book value of fixed asstes), Wa: deposit's price (total interest expenses over total deposits), Wb: labour's price (personnel expenses over total assets), Wc: physical capital's price (other operating expenses over total fixed assets), Ya: Loans (loans and interbank lending), Yb: Investment (total investment or securities), Yc: Off-balance sheet items (value of the off-balance sheet activities), Ra: loans' price (total interest income on loans over total loans), Rb: investments' price (other operating income over investment), and Rc: off-balance sheet items' price (net fees and commissions over off-balance sheet items).

Method of Measurement in the Second Stage

The next function of the present research was to classify the possibility of bank-specific and macroeconomics determinants that were likely to be correlated with revenue efficiency during the post-merger period. The majority of past studies have utilized a model of multivariate regression to concentrate on the relationships between bank efficiency and potential logical variables to identify them as the determinants of efficiency.

By using the revenue efficiency scores as the dependent variable, this study appraised the accompanying model:

$$Z_{jt} = \alpha_t + \beta_{jt}\,(LNTA_{jt} + LLRGL_{jt} + ETA_{jt} + BDTD_{jt} + LOANSTA_{jt} + NIETA_{jt} + LNGDP_{jt} + INFL_{jt} + DP_{jt} + LNTA_{jt}*DP_{jt} + LLRGL_{jt}*DP_{jt} + ETA_{jt}*DP_{jt} + BDTD_{jt}*DP_{jt} + LOANSTA_{jt}*DP_{jt} + NIETA_{jt}*DP_{jt} + LNGDP_{jt}*DP_{jt} + INFL_{jt}*DP_{jt}) + \varepsilon_{jt}$$

Z_{jt}	Revenue efficiency of the j-th bank in the period t
LNTA	Log of total assets (size of bank)
LLRGL	Loan loss reserve to gross loan (asset quality)
ETA	Equity to total assets (capitalisation)
BDTD	Banks' deposit over total deposit (market power)
LOANSTA	Total loan over total assets (liquidity)
NIETA	Non-interest expense over total assets (management quality)
LNGDP	Log of gross domestic product (gross domestic product)
INFL	Customer prices index (inflation)
DP	Dummy post-merger period
LNTA*DP	Interaction bank size and dummy post-merger
LLRGL*DP	Interaction asset quality and dummy post-merger
ETA*DP	Interaction capitalisation and dummy post-merger period
BDTD*DP	Interaction market power and dummy post-merger period
LOANSTA*DP	Interaction liquidity and dummy post-merger period
NIETA*DP	Interaction management quality and dummy post-merger period
LNGDP*DP	Interaction gross domestic product and dummy post-merger period
INFL*DP	Interaction inflation and dummy post-merger period
j	Number of bank
t	Number of year
α	Constant term
β	Vector of coefficients
ε_{jt}	Normally distributed disturbance term

This study applied the step-wise regression method or separated models rather than the simultaneous models in order to avoid multicollinearity problems. Therefore, the proposed model contained 11 models.

Variables Description Used in the MRA Models

The natural logarithm of the variable total assets (LNTA) is a proxy of size of bank. This regression result exhibits that the large bank size is capable of becoming more efficient due to the benefits obtained such as increasing in revenue, quality of services and higher leverage from financial capital (Sufian *et al*., 2012). Meanwhile, loan loss reserve over gross loan (LLRGL) is a proxy of asset quality. Coefficient is assumed to be negative due to the bad loans (non-performing loans) that can reduce the level of efficiency on the banking sector (Ismail *et al*., 2009).

Capitalisation measured by earning over total assets (ETA) could exhibit that the well-capitalised banks would increase revenue of banks and profitability because of the lower expected bankruptcy costs, lower expected costs of financial distress and lower portfolio's risk (Demirguc-Kunt & Huizinga, 1999).

Banks' deposit over total deposit (BDTD) is a proxy of market power. The regression outcome suggests that the large market power contributes to the high bank concentration and therefore, changes both loan rates and market shares in imperfectly competitive loan markets and will contribute to the tendency of banks to charge high loan mark-ups (Carletti *et al*., 2007; Graeve *et al*., 2007). Total loan over total assets (LOANSTA) is a proxy of liquidity. Amid a frail economy, banks may be depressingly influenced since borrowers are prone to default on their advances. Ideally, banks ought to exploit great financial situations and watchman themselves amid unfavourable conditions (Sufian & Habibullah, 2009). Meanwhile, management quality is measured by non-interest expense over total assets (NIETA). The efficient banks are expected to operate at lower costs. On the other hands, higher profits earned by banks that are more efficient may be appropriated in the form of higher payroll expenditures paid to more productive human capital (Molyneux & Thornton, 1992; Athanasoglou *et al*., 2008).

Gross domestic product is entered as natural logarithm of gross domestic product (LNGDP). The coefficient of LNGDP is expected to be positive with the bank efficiency which shows that higher LNGDP leads to higher revenue efficiency. Furthermore, the variable of inflation (INFL) is measured by consumer price index. It may have immediate impacts such as increment in the cost of work and aberrant impacts like changes in premium rates and resource costs on bank execution. Finally, dummy for post-mergers periods (DP) is a proxy of revenue efficiency in the Malaysian banking sector during the post-merger period. DP is a binary variable that takes a value of 1 for post-merger years, and it is 0 otherwise. As expected, this coefficient was found to be positive, indicating that the banking sector has been relatively more revenue efficient during the-post merger periods.

Expected sign on variables

Variable	Description	Expected Sign
Bank-specific characteristics		
LNTA (Bank size)	Natural logarithm of total assets	+
LLRGL (Credit risk)	Loan loss reserve over gross loan	-
ETA (Capitalisation)	Total book value of shareholders equity over total assets	+
BDTD (Market power)	Banks' deposit over total deposit	+
LOANSTA (Liquidity)	Total loans over total assets	+/-
NIETA (Overhead expenses)	Non-interest expenses over total assets	-
Macroeconomics		
LNGDP (Economy growth)	Natural logarithm of gross domestic product	+
INFL (Inflation)	Consumer price index	+/-

EMPIRICAL RESULTS

Banking Sector in the Pre-Merger Period

Table 2 presents a summary of the means for cost efficiency, revenue efficiency and profit efficiency, which were 83%, 79.7% and 69.5% in the period of pre-merger (1995 to 1996). One all the more method for translating this result is to recommend that these banks had slacked (were wasteful) by not completely utilising the inputs proficiently to create the same yields (cost inefficiency) and by not completely delivering the yields effectively utilising the same data (revenue inefficiency). An alternate clarification is that no DMU can be 100% cost or revenue efficient since all organisations utilise slack assets to face changing needs from clients. Banks have slack in the event that they are unsuccessful in completely minimising cost and expanding the revenue (profit inefficiency). The levels of cost, revenue and profit inefficiencies are indicated as 17%, 20.3% and 30.5%, respectively.

Meanwhile, the result means of cost efficiency summarised that bank used only 83% of the assets or inputs to deliver the same level of yield amid the period of pre-merger. As such, on the normal, banks saving money segment has not completely utilised 17% of its inputs, or it could have spared 17% of its inputs to create the same level of yields if no slack was required by DMUs.

On average, however, the banking sector was more efficient in using its inputs in the period of pre-merger, contrasted with its capacity to produce profits and revenues. For revenue efficiency, the normal bank could just produce 79.7% of the revenues, short of what it was at the first anticipated that would create. Thus, banks could generally have created 20.3% of yields given the same level of inputs if no slack was needed for managing an account business. Detectably, the inefficiency of the revenue is trailed by the profit sides. Similarly, the normal bank could get 69.5% of what was reachable.

Although lower level of revenue efficiency was discovered, indicating that the higher level of revenue inefficiency, the cost efficiency was apparently the most elevated amid the period of pre-merger period. Looking at revenue efficiency and cost efficiency, the higher level of profit inefficiency led to the higher level of inefficiency in the revenue.

Banking Sector in the Post-Merger Period

During the period of post-merger (2002 to 2009), the banking sector scored 91.4%, 80.7% and 88.8% for mean of cost, revenue and profit efficiencies, respectively. Meanwhile, the scores of 8.6%, 19.3% and 11.2% were respectively indicated for the cost, revenue and profit inefficiencies (refer to Table 2).

In relation to cost efficiency, the results implied that bank had generally used only 91.4% of the assets or inputs so as to deliver the same level of yield. In this manner, it could have spared 8.6% of its inputs to deliver the same level of yields, if no slack was needed for managing an account business.

However, a similar finding is also noted, in which on average more efficient banking was identified during the period of post-merger. The result demonstrated that a bank could generally produce 80.7% of the revenues than it was relied upon to create. This seemed, by all accounts, to be a change in efficiency. Subsequently, there was a slack of 19.3%, implying that the normal bank had that much slack in creation. The largest amount of inefficiency is generally on the revenue side, emulated by the profits. Similarly, the normal bank could acquire 88.8% of what was accessible, and had a slack of 11.2% when using the same level of inputs.

In summary, all the banks' efficiency proportions were enhanced after the period of merger. In particular, revenue efficiency enhanced from 79.7% to 80.7% (pre to post-merger period). Profit efficiency increased from 69.5% to 88.8% and cost efficiency enhanced from 83% to 91.4%. Besides, the results also indicated that the lower level of revenue efficiency might contribute to the different levels between cost and profit efficiency since the level of profit efficiency was found to be lower than cost efficiency.

Thus, more awareness should provide to the improvement of banks' revenue efficiency since the revenue efficiency might influence the lower or higher level of profit efficiency in the banking sector. The efficiency results were further tested in order to attain more robust results by performing the t-test parametric and the Mann-Whitney (Wilcoxon) and Kruskal-Wallis non-parametric tests.

Tests of Robustness

Table 3 is a summary of the results obtained from the parametric and non-parametric tests. The Malaysian banking sector exhibited higher cost efficiency and profit efficiency mean in the period of post-merger (0.9140>0.8300 and 0.8880>0.6950) through the t-test on the parametric test. Furthermore, the Kruskall-Wallis and Mann-Whitney (Wilcoxon) tests on the non-parametric test also verified the findings. Thus, the banks' cost and profit efficiency were demonstrated to have been enhanced during the period of post-merger.

Notwithstanding, an intriguing result was also acquired in regards to the revenue efficiency during the period of pre-merger and post-merger. The t-test results exhibited the higher level of banks' revenue efficiency during the period of post-merger period as compared to the pre-merger period (0.8070>0.7970), although the distinction is not critical. This indicated that the level of banks' revenue efficiency did not progress. The findings obtained from the Kruskall-Wallis and Mann-Whitney (Wilcoxon) tests from the non-parametric tests also support the results.

Determinants of Revenue Efficiency

Table 4 is a summary of the MRA model results on the relationships between the banks' revenue efficiency and their bank-specific and macroeconomics determinant variables using the fixed effects model (FEM) and random effects model (REM).

The table first shows the potential determinants on the banks' revenue efficiency in the periods of pre-merger and post-merger (1995 to 2009). Next, the determinants on banks' revenue efficiency in the period of post-merger were produced from Models 4 to 11, with the interaction variables of dummy for the post-mergers periods (DP). The equations are based on 245 bank year observation covering the period of 1995 to 2009.

The results show that the relationship between revenue efficiency and three determinants [asset quality (LLRGL), capitalization (ETA) and market power (BDTD)] is significantly negative (see Table 4). It is positive in Model 1 and the sign is also consistent in all models. However, the impact of size (LNTA) on the revenue efficiency is only significant in models 4 and 7, while liquidity (LOANSTA) is only significant in models 3, 9 and 10. Management quality (NIETA) is totally insignificant in all models in the estimation regression. Therefore, the three determinants (LNTA, LOANSTA and NIETA) are considered as relatively insignificant in influencing the revenue efficiency.

The first significant determinant is LLRGL proxy of asset quality. The coefficient LLRGL is statistically significant and negative (except in Model 4, where it is significant at 5% level). Similar results have been reported from all models, indicating that the lower ratio of LLRGL increases the asset quality and leads to higher revenue efficiency. The results indicated the banking sector was able to manage and reduce the number of the non-performing loans (NPLs). It was aided by the establishment of *Pengurusan Danaharta Nasional Berhad* (Danaharta) and *Danamodal Nasional Berhad* (Danamodal) in 1998. These entities were set up with the purpose of dealing with the situation of rising NPLs and recapitalisation of the banking sector, as well as acting as a catalyst to rationalise the sector. Danaharta had managed RM39.9 billion of NPLs, meanwhile Danamodal injected RM7.1 billion in the financial institution to reduce the burden of NPLs on the financial institutions. As a result, asset quality was enhanced due to the reduced NPLs which had increased the revenue of the banking sector. The result is consistent with that of previous studies by Sufian and Habibullah (2009), Kosmidou (2008) and Cornett *et al*. (2006), which further supports the argument that lower LLRGL banks face higher asset quality and this contributes to higher efficiency.

The second significant determinant is capitalisation (ETA). The results showed (except in models 3, 4, 6 and 10) significant positive signs on the coefficient, suggesting that the larger capitalisation of bank contributed to higher revenue efficiency. This was because larger or higher capitalisation could reduce all the risks of bankruptcy and increase the revenue of the bank (Berger, 1995; Demirguc-Kunt & Huizinga, 1999). In addition, the positive effect of capital in revenue efficiency showed that by having

more capital, bank could easily extend loans and reap higher revenue and profits (Ramlall, 2009).

Finally, the findings suggest that the level of market power (BDTD) is statistically significant and positive, suggesting that the higher market power will contribute to higher revenue efficiency. The finding is consistent with that of Pasiouras *et al*. (2008), i.e., banks' market share has positive effects on efficiency. Higher market power had contributed to higher bank concentration and therefore changed both loan rates and market shares in a perhaps imperfectly competitive loan market.

Model 2 includes the macroeconomic variables as additional control variables. The results showed gross domestic product (LNGDP) as being relatively insignificant. When the overall models were compared, only models 7 and 11 suggested that gross domestic product (LNGDP) was a significant factor, although it was negative in bank revenue efficiency during the period of 1995 through 2009. Therefore, gross domestic product insignificantly influences the revenue efficiency based on the overall models.

Finally, inflation (INFL) coefficient shows a significant negative relationship with bank revenue efficiency in all models (except for models 4, 6, 8 and 9). The negative sign states that the lower inflation will lead to the higher revenue efficiency of the bank. This result is also consistent with that of a previous study (Kosmidou, 2008). The negative relationship with bank revenue efficiency implies that the levels of inflation were unanticipated. The unanticipated or anticipated inflation could significantly affect performance of the banking sector (Perry, 1992).

As a conclusion, asset quality, capitalisation, market power and inflation are significant determinants that have influenced the higher level of banks' revenue efficiency in the periods of pre- and post-merger.

Robust Test during the Post-Merger Period

The second purpose of this research was to identify the bank-specific determinants of revenue efficiency, particularly during the post-merger period. It proceeded with the robustness test by allowing all the bank-specific determinants to interact and adding control variables (macroeconomic) against the dummy post-merger variable (DP). New six interaction variables (LNTA*DP, LLRGL*DP, ETA*DP, BDTD*DP, LOANSTA*DP* and NIETA*DP) were included in Model 4 to Model 9. In addition, the two macroeconomic variables (LNGDP*DP and INFL*DP in models 10 and 11) had also interacted against DP. Therefore, for these models, the discussion focuses on the findings of the new variables that were added to the baseline specification (Model 1).

Size of Bank

The effect of size is insignificant for revenue efficiency. The result changed when the interaction variable of LNTA*DP

was included in Model 4. The result showed that the coefficient of LNTA*DP is significantly positive at 1% level, indicating that the higher the size of a bank, the higher the revenue efficiency would be during post-merger period. The result is also consistent with that of Cornett *et al*. (2006) and Akhavein *et al*. (1997), providing support to the argument that big banks produced higher revenue efficiency after mergers.

Asset Quality

The effect of asset quality (LLRGL) on the revenue efficiency is significant at 5% level in all models (except for Model 4). Nevertheless, it should be mentioned that asset quality is insignificant for revenue efficiency when the interaction term DP (LLRGL*DP) was included in Model 5. The findings indicated asset quality did not influence the revenue efficiency during the post-merger period.

Capitalisation

The results show (except for models 3, 4, 6 and 10) significant positive signs on the coefficient of ETA, suggesting that larger capitalisation of bank would contribute to higher revenue efficiency. Furthermore, with the interaction term, the result remained the same but significant at 10% level with a positive sign. This indicated that larger capital did not contribute to the higher level of banks' revenue efficiency in the period of post-merger. Most of the previous studies have shown contradictory results, where well-capitalised banks were found to lead to the higher profitability (Athanasoglou *et al*., 2008).

Market Power

The impact of market power (BDTD) on revenue efficiency was found to be significantly positive in all models. This indicated that market power could influence revenue efficiency where a higher market power would lead to higher revenue efficiency. Furthermore, with the interaction term (BDTD*DP), the results were also shown to be significant at 5% and it is positive with revenue efficiency as shown in Model 7. This result is also similar with the findings from the previous studies where the event of M&As increased the market power of large banks and led to higher revenue efficiency. The large market power was a result of the large market share through M&As (Carletti *et al*., 2007).

Liquidity

In all models, liquidity (LOANSTA) was not a significant determinant for revenue efficiency. Nevertheless, when the interaction variable (LOANSTA*DP) was included, the result became significant and only at 10% level with a positive sign. This indicated that larger liquidity did not contribute to the higher level of banks' revenue efficiency in the period of post-merger. Nonetheless, several studies have found contradicting result on liquidity and its influence on efficiency in the period of post-merger (Pana *et al*., 2010; Diamond & Rajan, 2001).

Management Quality

Management quality (NIETA) did not significantly influence revenue efficiency in all the models. However, this determinant changed to significant and positive at 1 % level after the robustness test was carried out with the interaction of DP variable (NIETA*DP) in the regression Model 9. This indicated that management quality could influence revenue efficiency, where a higher management quality would lead to higher revenue efficiency. The positive coefficient indicates that higher costs led to higher quality management and contributed to the higher level of banks' revenue efficiency in the period post-merger. Athanasoglou *et al*. (2008) suggested that the market shares and profits could be enhanced via capabilities of the superior management.

CONCLUSION

This study has the main purpose of identifying the effects of regulator-guided mergers of banks on revenue efficiency in Malaysia during the periods of pre- and post-merger. Most studies focused more on the improvement from mergers but ignored revenue efficiency. The present study investigated the impacts of mergers on the banks' revenue efficiency. The findings obtained could be used for decision making by regulators to enhance banks' efficiency and directly improve the profitability of the banking sector (Cornett *et al*., 2006).

The findings have shown that the difference on the levels of banks' revenue efficiency between the periods of pre- and post-merger is statistically insignificant. This indicates that the level of bank's revenue efficiency did not significantly improve in the period of post-merger. Several studies (Akhavein *et al*., 1997; Ariff & Can, 2008) have also documented similar findings. The researchers suggested that even though the levels of banks' profit efficiency and cost efficiency increased with the impacts of mergers event, the profit efficiency level would still be lower compared to the cost efficiency level in the banking sector. The lower level of banks' profit efficiency rather than cost efficiency is due to banks' failure to improve their revenue efficiency level. Banks may even now confront revenue inefficiency because of delivering a little number of yields, creating an excess of or little of a less expensive or costly yield, and offering it wastefully.

This study also focused on examining the determinants of revenue efficiency, particularly in the period of post-merger. Since the DEA results showed that the revenue efficiency did not improve during post-merger period, this study moved on to the second stage, which was to identify the determinants that could improve revenue efficiency in the period of post-merger. Thus, factors such as size of bank, quality of asset, market share, liquidity, capitalisation and management quality represented the six potential determinants known as the explanatory

variables investigated in this study. Gross domestic product and inflation were two external determinants that were included to serve as additional control variables. The study discovered that only three bank-specific determinants influenced the level of banks' revenue efficiency in the period of post-merger. These were the size of bank, market power and management quality. The improvement of revenue efficiency was also influenced by the inflation, a macroeconomic variable which was used as the additional control variable.

Finally, the research concluded that the findings from the impact of mergers on the level of Malaysian banks' revenue efficiency could provide guidance, better information and also fill in the gap in the literature. The findings may benefit the regulators, the banking sector itself, as well as investors and academics.

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APPENDICES

TABLE 1
Domestic Commercial Banks in Malaysia (Year 2000)

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

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

(Source: Bank Negara Malaysia)

TABLE 2
Bank Efficiencies Score (1995 to 2009)

BANK	1995-1996 (Pre-Merger)			2002-2009 (Post-Merger)		
	RE	CE	PE	RE	CE	PE
ABN AMBRO Bank	0.8010	0.7670	0.4920	0.5830	0.8010	0.7390
Affin Bank	1.0000	1.0000	1.0000	0.7340	0.8590	0.7760
Alliance Bank Malaysia	0.7740	0.8470	0.5400	0.7290	0.8630	0.7050
Arab-Malaysian Bank	1.0000	1.0000	1.0000	0.7260	0.8570	1.0000
Ban Hin Lee Bank	0.7550	0.6740	0.4890	-	-	-
Bangkok Bank	0.8200	1.0000	1.0000	0.7390	0.8780	0.9050
Bank of America Malaysia	0.5750	0.7390	0.6160	0.9390	0.9190	0.9230
Bank of China	0.8920	0.9700	0.8990	-	-	-
Bank of Nova Scotia	1.0000	1.0000	1.0000	0.8420	1.0000	1.0000
Bank of Tokyo-Mitsubishi	0.9110	1.0000	1.0000	0.8050	0.9790	1.0000
Bank Utama	0.7410	0.7510	0.7140	1.0000	1.0000	1.0000
BSN Commercial Bank	0.6340	0.8530	0.3710	0.9250	0.8900	0.7600
Bumiputra Commerce Bank	0.9910	0.9960	1.0000	1.0000	1.0000	1.0000
Chase Manhattan Bank	1.0000	1.0000	1.0000	0.3770	0.7270	0.5430
Citibank	0.8560	0.8850	0.8720	0.8990	0.9700	0.9810
Deutsche Bank	0.7570	0.7490	0.5010	0.5920	1.0000	1.0000
EON Bank	0.8610	0.7900	0.6000	0.7200	0.9200	0.7490
Hock Hua Bank	0.7460	0.7420	0.5370	-	-	-
Hong Leong Bank	0.7630	0.7930	0.5020	0.9130	0.8580	0.8940
HSBC Bank Malaysia	0.9620	0.8800	0.8770	0.7790	0.8120	0.7370
International Bank Malaysia	0.5160	0.5690	0.2960	-	-	-
Maybank	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
OCBC Bank	0.9120	0.9380	0.8600	0.8650	0.9690	1.0000
Oriental Bank	0.8070	0.7550	0.5480	-	-	-
Overseas Union Bank	0.9220	0.9650	0.8980	-	-	-
Pacific Bank	0.8190	0.7640	0.5820	-	-	-
Phileo Allied Bank	0.3670	0.6470	1.0000	-	-	-
Public Bank	0.7090	0.6360	0.4240	0.8380	0.8530	0.8110
RHB Bank	1.0000	1.0000	1.0000	0.8980	0.9490	0.9510
Sabah Bank	0.6830	0.6720	0.4180	-	-	-
Southern Bank	0.7730	0.7030	0.5190	0.8340	0.8660	0.8210
Standard Chartered Bank	0.7950	0.8370	0.7300	0.9880	0.9990	1.0000
United Overseas Bank	0.5510	0.8550	0.3820	0.8480	0.9400	0.9590
Wah Tat Bank	0.5820	0.6500	0.3180	-	-	-
ALL BANKS	0.7970	0.8300	0.6950	0.8070	0.9140	0.8880

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

TABLE 3
Robustness Test on Banks Efficiencies in the Pre-Merger and Post Merger Periods

	Test groups					
	Parametric test		Non-parametric test			
Tests	t-test		Mann-Whitney [Wilcoxon Rank-Sum] test		Kruskall-Wallis Equality of Populations test	
Hypothesis			MedianPre-merger = MedianPost-merger			
Statistics Test		*t(Prb>t)*	*z(Prb>z)*		*X^2 (Prb> X^2)*	
	Mean	*t*	Mean Rank	*Z*	Mean Rank	*X^2*
Revenue Efficiency						
Pre-merger	0.7970	0.2710	109.6800	– 1.809*	109.6800	3.273*
Post-merger	0.8070		127.8100		127.8100	
Cost Efficiency						
Pre-merger	0.8300	4.033***	91.3500	– 4.423***	91.3500	19.56***
Post-merger	0.9140		134.4300		134.4300	
Profit Efficiency						
Pre-merger	0.6950	5.736***	87.2500	– 5.491***	87.2500	30.153***
Post-merger	0.8880		135.9100		135.9100	

***, **, * indicate significant levels at 0.01, 0.05, and 0.10 respectively.

TABLE 4
Multivariate Regression Analysis Models under Fixed Effect Model and Random Effect Model

Variable	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11
CONSTANT	0.7240*	0.8030	0.5660**	1.5620**	0.9600	2.1880**	1.3220**	2.0990**	1.000*	0.5540*	2.9490***
Std. Error	*0.4060*	*0.5820*	*0.2840*	*0.6990*	*0.6220*	*1.0710*	*0.6110*	*1.0410*	*0.5840*	*0.2860*	*1.1130*
Determinants Variables											
LNTA	-0.1080	0.0540	-0.0070	–0.3090**	0.0550	0.0520	0.0850*	0.0400	0.0530	-0.0040	0.0390
Std. Error	*0.0820*	*0.0610*	*0.0570*	*0.1230*	*0.0610*	*0.0550*	*0.0490*	*0.0560*	*0.0600*	*0.0580*	*0.0610*
LLRGL	–0.0130***	–0.0170***	–0.0160***	–0.0180**	–0.0200***	–0.0180***	–0.0170***	–0.0190***	–0.0190***	–0.0160***	–0.0200***
Std. Error	*0.0050*	*0.0040*	*0.0040*	*0.0080*	*0.0060*	*0.0040*	*0.0050*	*0.0040*	*0.0040*	*0.0040*	*0.0040*
ETA	0.3370**	0.2530**	0.1720	0.2240	0.2540**	0.1210	0.2860**	0.2270**	0.2050*	0.1780	0.2120*
Std. Error	*0.1380*	*0.1100*	*0.1100*	*0.1400*	*0.1100*	*0.1210*	*0.1200*	*0.1020*	*0.1110*	*0.1100*	*0.1110*
BDTD	3.8160***	1.0400**	1.3880***	4.6000***	1.0270*	0.9880**		1.0880**	0.9810*	1.3680***	1.0890**
Std. Error	*1.2580*	*0.5260*	*0.5090*	*1.2510*	*0.5250*	*0.4920*		*0.5060*	*0.5220*	*0.5110*	*0.5280*
LOANSTA	0.0020	0.0020	0.0020**	0.0020	0.0020	0.0020	0.0010	0.0000	0.0020*	0.0020**	0.0020
Std. Error	*0.0020*	*0.0010*	*0.0010*	*0.0020*	*0.0010*	*0.0010*	*0.0010*	*0.0020*	*0.0010*	*0.0010*	*0.0010*
NIETA	0.0700	0.2800	0.4230	0.0820	0.2840	0.3080	0.3140	0.3730	0.2930	0.4120	0.3590
Std. Error	*0.4210*	*0.3040*	*0.3030*	*0.2860*	*0.3040*	*0.2370*	*0.2950*	*0.2410*	*0.3020*	*0.3040*	*0.3050*
Macroeconomic Variables											
LNGDP		-0.0840			-0.1160	-0.3240	–0.2000*	-0.2980	-0.1260		–0.4410**
Std. Error		*0.1250*			*0.1330*	*0.2010*	*0.1120*	*0.1900*	*0.1250*		*0.2020*
INFL		–0.0210**	–0.0190**	-0.0120	–0.0190*	-0.0130	–0.0180*	-0.0130	-0.0090	–0.0190**	–0.0620***
Std. Error		*0.0100*	*0.0110*	*0.0180*	*0.0110*	*0.0140*	*0.0100*	*0.0140*	*0.0110*	*0.0110*	*0.0210*
DP			0.0450								
Std. Error			*0.0510*								

***, **, * indicate significant levels at 0.01, 0.05, and 0.10, respectively.

TABLE 4 (Continue)

Variable	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M 10	M 11
Interaction Variables											
LNTA*DP				0.0340***							
Std. Error				*0.0110*							
LLRGL*DP					0.0050						
Std. Error					*0.0070*						
ETA*DP						0.1250*					
Std. Error						*0.0730*					
BDTD*DP							0.9530**				
Std. Error							*0.3680*				
LOANSTA*DP								0.0010*			
Std. Error								*0.0010*			
NIETA*DP									6.9000***		
Std. Error									*2.5320*		
LNGDP*DP										0.0070	
Std. Error										*0.0090*	
INFL*DP											0.0530**
Std. Error											*0.0240*
	M 1	**M 2**	**M 3**	**M 4**	**M 5**	**M 6**	**M 7**	**M 8**	**M 9**	**M 10**	**M 11**
R^2	0.3620	0.1930	0.1940	0.3820	0.1960	0.2050	0.1890	0.1990	0.2190	0.1930	0.2100
Adj R^2	0.2410	0.1660	0.1660	0.2570	0.1650	0.1750	0.1620	0.1680	0.1890	0.1660	0.1790
Durbin Watson	2.1400	1.8280	1.8320	2.1800	1.8270	1.8480	1.8450	1.8710	1.9060	1.8300	1.9010
F-statistic	2.9830***	7.0580***	7.0840***	3.0600***	6.3470***	6.7500***	6.8970***	6.4680***	7.3130***	7.0560***	6.9200***
Est. tech	FEM	REM	REM	FEM	REM	REM	REM	REM	REM	REM	REM

***, **, * indicate significant levels at 0.01, 0.05, and 0.10, respectively.