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The Cost Efficiency Effects Of Involuntary Bank Mergers: Evidence From The Malaysian Banking Industry

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Much of the merger and banking efficiency studies is centered on the market driven or voluntary merger. Thus, the uniqueness of Malaysian merger policy offers an interesting platform for this study to embark on. The merger in Malaysia is unique as all the domestic banks were enforced to merge by the government in year 1999 after years of persuasion with little success. This study attempts to quantify the impact of the involuntary merger on the cost efficiency gains over the 1990-2005 periods. Firstly, several tests have been performed to investigate whether it is best to envelope data with a common frontier of data envelopment analysis (DEA) or by separate frontiers. Secondly, this paper assesses the cost, allocative, technical, pure technical and scale efficiencies of Malaysian banking industry as the results of the merger. Thirdly, a set of environmental variables (size, economic growth, market concentration, risk and the government ownership) are regressed on each type of the cost efficiencies using the Tobit regression model approach. To overcome the problem of the inherent dependency of DEA efficiency scores in the regression analysis, a bootstrapping technique is applied. In general, the results suggest that the enforcement of the bank merger policy has resulted in an improvement of bank efficiency levels.

Keywords: involuntary mergers, efficiency, Malaysia

1.0 INTRODUCTION

Bank mergers are claimed to be the sources of efficiency gains from the realization of economies of scale and economies of scope, the removal of overlapping services and the increasing awareness of innovative banking tools; however, one needs to read over the assertions with caution. It is due to the fact that much of the prior research has focused on the market driven merger or the voluntary merger. The voluntary bank merger refers to the process by which two or more banks merged and become one new entity.

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The merger takes place without any objection from the shareholders and the board of both banks. The purchase is considered done once the acquirer purchased the shares of the target bank. On the other hand, involuntary merger refers to the merger of a firm that is insolvent or in danger of insolvency and it is initiated by the government or the authority. In the Malaysian banking context, the involuntary merger term refers to a unique banking sector reform that was announced in 1999 as a result of the economic crisis. Initially, central bank of Malaysia introduced a rescue scheme; the scheme had been costly, yet the banks reluctance to merge.[1] Specifically, the government announced the unprecedented measure by forcing 58 financial institutions to merge into six anchor banks on 29 July 1999.[2] Theoretically, the policy was intended to create more robust banks to compete innovatively and to enhance their operational efficiency effectively (Oh, 2000). Due to the strong protests, the central banks of Malaysia revised the scheme by allowing banks to choose their own partners and leaders (Bank Negara Malaysia, October 1999).[3] As at 14 February 2000, the central bank revealed the ten anchor banks (by maintaining the initial six anchor banks selected) as part of the merger exercise and 13 foreign banks were left untouched. It has been a decade; thus, it seems timely to retrospect this issue.

As far as efficiency is concerned, efficiencies as the results of the bank mergers had been studied extensively. This study would like to make a point that the relationship between the bank mergers and the efficiencies is applicable in the free market, in the dominant manner of the voluntary bank merger circumstances. This study begs to differ in the involuntary bank merger context as it is hard to resist the fact that the market with and without government interventions will result in the market performance at the varying degrees. The fact that the significant changes in the market structure will results in the intense of competition and the increased of catastrophic risk is hardly can be denied. Eventually being efficient or inefficient will determine the competitiveness of the firms and in the long run, it will influence the contestability of the market. The efficiency measurement would give an indication whether current banks are ready to face the challenge of globalize and liberalized of the financial institutions. With respect to the Malaysian merger policy, it is believed that the merger is a necessary pre-condition to create strong, efficient and competitive domestic banking institutions. However, the central bank is expected to continue to support the policy by introducing appropriate policies, such as enhancing the expertise and professionalism of

[1] The reluctance of the domestic banks to merge could be explained by the unique characteristics of the Asian corporations as highlighted in Claessens et al. (2000a; 2002b). The corporations' ownership is concentrated among families and due to that, self-recapitalization makes banks less willing to absorb losses thus, hinders corporate restructuring.

[2] Lang (2002) expresses the difficulty to ascertain whether the merger is voluntary or forced; government may force the merger without determining the partners or government may establish strong incentives to merge. Finally, government may stimulate the merger by giving hints that a merger would be approved on certain conditions or by signalling that a problematic institution will not be rescued by government intervention.

[3] Many market players view the initial merger scheme as politically motivated since the government had handpicked six anchor banks to lead the merger process and the government had placed a deadline for the banks consolidation to take place (Chin and Jomo, 2001).

the banking personnel, and bringing about more effective corporate governance to further increase the resilience and competitiveness of the domestic banking institutions.[4]

Theory suggests that merger have the potential to increase efficiency (Berger and Humphrey, 1992; Shaffer, 1993 and Rhoades, 1998); efficiency will motivate banks to consider operational improvements, substitute for inefficient management and implement new organizational structure. On the other hand, Berger (2003) adds that merger and acquisition can decrease bank efficiency due to increased costs (e.g. consultant fees, severance pay, legal expenses etc.) along with downsizing disruptions, the merging of organizational cultures and managerial turf battles. The existing studies continue the debate on the efficiency gains as the results of bank merger.[5] The existing literature fails to provide convincing empirical evidence on the merger gain thus the questions on the merger and acquisition gains remain. Succinctly, there is no strong support for the hypothesis that mergers have a beneficial effect on merged banks and the banking industry as a whole.[6] Cavallo and Rossi (2001) state that "...so far, the empirical literature based on the US experience does not support this common belief" (p. 516).

It is interesting to highlight that all the aforementioned studies are based on voluntary merger. Thus, the aim of this paper is to contribute to the above debate from a specific outlook. More precisely, this paper would like to examine the influence of merger on banking efficiency in a setting of involuntary merger within Malaysian banking sector. Despite the substantial structural changes and the pivotal role of the sector to the economy, research on the implication of merger policy on Malaysian banking efficiency appears to be limited. Most of the domestic banking literature concentrates on the efficiency and productivity of the banking sector (Okuda and Hashimoto, 2004; Batchelor et al., 2005; Fadzlan, 2005; Fadzlan and Suraya, 2005; Fadzlan, 2006; Fadzlan and Muhamed Zulkhibri, 2006; Matthews and Mahadzir, 2006) whilst Guru et al. (2003) and Shanmugan (2003) focus on causes of the consolidation process. Last but not least, few studies focus on the effects of mergers and acquisitions as in Krishnasamy et al. (2003), Tan and Hooy (2003), Batchelor et al. (2005), Fadzlan (2004), Fadzlan and Suraya (2005), Chong et al. (2006), Fauzias Mat Nor et al. (2006) and Muhamed Zulkhibri and Fadzlan (2006).

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[4] As one of the strategy to increase the competitiveness of the domestic banking institutions, Malaysian government announced a significant measure to liberalize the sector by allowing as many as seven new foreign banks to enter the banking industry by 2010 (Bernama, 28 April 2009).

[5] Numbers of research show merely no evidence of efficiency gains from bank mergers (Peristiani, 1997; DeYoung, 1997; Amel et al., 2004; and Havrylchyk, 2004). On the other hand, some researchers expressed cynicism (Akhavein et al., 1997; Resti, 1998; Cuesta and Orea, 2002; Focarelli and Panetta, 2002; Huizinga et al., 2001; Worthington, 2004) while few studies suggest that the benefits of mergers and acquisitions seem to accrue only after certain years of time (Berger, 2000; Focarelli et al., 2002; Cuesta and Orea, 2002; and Campa and Hernando, 2006).

[6] There is no consensus reached on the efficiency gains of bank mergers as concluded in a series of review undertaken by Berger and Humphrey (1997; Pilloff and Santomero, 1997; Rhoades, 1998; Berger et al., 1999; Amel et al., 2004; Nail and Parisi, 2005).

In line with this study spirit, Fadzlan (2004) and Fauzias et al. (2006) investigate the impact of merger on the pure technical efficiency and scale efficiency while Chong et al. (2006) investigate the effects on the shareholder's wealth. The latter reveals that the involuntary merger scheme destroys economic value in aggregate and the acquiring banks tend to gain at the expense of the target banks study, a contrary results with the voluntary merger findings. While the referred paper employs the event study methodology in measuring the shareholders' wealth effect of the merging barks during the merger announcement, this study attempts to explore the issue of involuntary merger and the impact on the production efficiency of Malaysia's banking sector using frontier approach.[7]

By employing the data envelopment analysis (DEA), Fadzlan (2004) and Fauzias et al. (2006) measure the implication of mergers on Malaysia banking efficiency. Fadzlan (2004) estimates the efficiency levels based on three sub-periods: 1998-1999 to refer to the pre merger period, 2000 is considered as the merger year and 2001-2003 to represent the post merger period. The results illustrate that Malaysian banks efficiency levels deteriorate significantly in the merger year but are higher during post merger as compared to the pre merger period. On the other hand, Fauzias et al. (2006) report that on average; the merger does not enhance the productive efficiency of the banks. The efficiency scores are estimated based on three years each to represent pre merger and post merger periods, from 1998 to 2003. It is worth mentioning that both studies measure efficiency by constructing a separate frontier pertains to respective periods and compare the scores for the respective periods in quantifying the effects of mergers on the efficiency. By enumerating the efficiency effects based on separate frontiers for sub periods, the aforementioned studies raise the methodological concern.

Methodologically speaking, DEA efficient frontier is generated by the input-output combination of the best practice decision making units (DMUs) with a unity efficiency score. In other words, DEA establishes a benchmark efficiency score of unity that no other firm can exceed; this benchmark constitutes the reference technological for the sample. Hence, if banks are observed in two different periods and the efficiency scores are calculated with different samples of banks; the comparison of efficiency scores would only show changes in the relative efficiency of the bank with other banks in two different periods. Using DEA, this study will tackle the problem by constructing a common frontier enveloping the data sets for all banks in the sample throughout the study period. The common frontier approach is very popular amongst the cross-country studies as in Allen and Rai (1996), Dietsch and Lozano-Vivas (2000), Casu and Molyneux (2003), Lozano-Vivas et al. (2002).

In a nutshell, this study can be seen as an importance step in gaining a better understanding of a phenomenon that is commonly observed but rarely investigated; namely, the implications of the involuntary merger policy. The involuntary merger offers an unparalleled opportunity to test out the merger theories and to determine whether efficiency

[7] Event study enables the researchers to estimate overall improvement of banks as the change of shareholder value wealth effects reflects the level of efficiency and performance; however frontier analysis is able to capture the ex-ante and ex-post performance of the merged entities.

gains can be created from this type of merger. Thus, the relationship between bank mergers and cost efficiencies (cost, pure technical, technical, scale and allocative efficiency) change is examined. Apart from that, the study embraces the environmental variables to see their impacts on the efficiency of the banks before, during and after the mergers. This paper contributes to government policy with an empirical evaluation of the impact of government initiated merger on the efficiency of a banking system given a market which is more national in scope and highly concentrated. This paper is structured as follows. Following the introduction, Section 2 and 3 provide the sample of banks with data on inputs and outputs as well as the DEA methodology are presented. Last but not least, the empirical results are presented in Section 4 whilst Section 5 concludes the paper.

2.0 METHODOLOGY

This study employs input-oriented DEA as it is believed that domestic commercial banks should dwell well on the sources of input waste (Isik and Hassan, 2003). Input-oriented DEA is defined as the maximum possible proportional reduction in input with output held constant whilst output-oriented DEA seeks the maximum proportional increase in output with fixed levels of input. The input-oriented model of DEA put more weighted on the expansion of output quantity out of a given amount of inputs. Input and output quantities of a group of firms are sets of data used to construct a piece-wise frontier over the data points. Data is analyzed using the DEA Excel Solver, Zhu (2003). There is no consensus on the best procedure for measuring efficiency. To study technical and allocative efficiency, two main approaches have been widely adopted namely a parametric and non-parametric approach. Both require the specification of a cost or production function or frontier but the former involves the specification and econometric estimation of a statistical technique. The parametric approach comprises the SFA, the thick frontier approach (TFA) and the DFA. Conversely, the non-parametric approach provides a piecewise linear frontier by enveloping the observed data points which is well known as DEA.[8]

A review by Berger and Humphrey (1997) asserts efficiency measures derived from parametric and non-parametric methods have advantages and disadvantages over another. The main advantage of DEA is that it does not require a priori assumption about the analytical form of the production function and it places less structure on the frontier; therefore, the misspecification of the production technology is void (Serano-Chicah et al., 2005). Apart from that, DEA can deal with multiple inputs and outputs as well as factors that are beyond the management control. To boot, DEA provides technical and scale efficiency measures and the sources for each individual bank without having data on input prices. DEA also yield slightly lower mean efficiency and greater dispersion than the parametric approach. On top of everything, DEA works well with small sample and assorted size of banks (Havrylchyk, 2006); thus, DEA is the chosen methodology because the method is less data demanding. The data in DEA speaks by itself because the analysis is focused on maximizing

[8] The name Data Envelopment Analysis comes from the property of mathematical parlance because a frontier is said to "envelop" all the points on or below the frontier (Cooper et al., 2004).

each individual observation in contrast to fit into a single regression plane that is assumed to describe the behaviour of each observation on average (Charnes et al., 2001). Thus, this study employs DEA to measure efficiency in Malaysian banking industry.

DEA is based on the relative efficiency concept. DEA aims to identify the firms that determine an envelopment surface against other firms that are not located on the frontier.[9] An efficiency index of one or any firm that lie on the surface is considered efficient and identified as the best practice unit relatively to other units. Any other units that lie elsewhere are deemed inefficient relatively to the best practice unit with the efficiency indexes are less than one. It should be highlighted that the firm's efficiency score depends heavily on the performance of other firms in the sample. Thus, efficiency measures in DEA are relative, not absolute measures.

DEA efficiency score is obtained by taking the maximum ratio of weighted outputs to weighted inputs. This measurement allows multiple outputs and inputs to be reduced to single "virtual" input (x_i) and single "virtual" output (y_i) by optimal weighs.

$$\begin{aligned} &\max_{u,v} && (u'y_i / v'x_i), \\ &\text{subject to (s.t.)} && u'y_j / v'x_j \le 1, && j = 1,2,\ldots,n \\ & && u, v \ge 0, \end{aligned} \tag{1}$$

The vectors x_i and y_i indicate the $K \times N$ inputs matrix and $K \times M$ outputs matrix for *i*th DMUs respectively. In addition, the vector $(u'y_i / v'x_i)$ represents the ratio of all outputs over all inputs where u is an $M \times 1$ vector of output weighs and v is a $K \times 1$ vector of input weighs. The efficiency for the *i*th DMU is maximized by finding values for u and v, subject to the constraints that all efficiency measures must be less than or equal to one; thus, leads to infinite number of solutions. A constant constraint $(\rho' x_i = 1)$ needs to be imposed on (1).

$$\begin{aligned} &\max_{\mu,v} && (\mu' y_i), \\ &\text{s.t.} && \rho' x_i = 1, \\ & && \mu' y_j - \rho' x_j \le 0, && j = 1,2,\ldots,n \\ & && \mu, \rho \ge 0, \end{aligned} \tag{2}$$

The efficiency measure is then a function of multipliers of the "virtual" input-output combination, as in equation (2). The notations μ and ρ indicate the transformation of u and v. The envelopment form is as below:

$$\min_{\theta,\lambda} \quad \theta,$$

[9] Originally, Charnes et al. (1978) describe DEA as a mathematical programming model applied to observational data to obtain empirical estimates of production functions and/or efficient production possibility surfaces that are a cornerstone of modern economics.

$$\begin{aligned} \text{s.t.} \quad & -y_i + Y\lambda \geq 0, \\ & \theta x_i - X\lambda \geq 0 \\ & \lambda \geq 0, \end{aligned} \tag{3}$$

where θ is a scalar and λ is an $N \times 1$ vector of constants. The value of θ is the efficiency score for the *i*th DMU and it should be solved n times.

Banker et al. (1984) extend the CCR model by relaxing the CRS assumption; the efficiency is assessed on the assumption of variable returns to scale (VTS). Factors such as imperfect competition and constraints in finance may cause a DMU not to be operating at optimal scale (Casu and Molyneux, 2003). To calculate cost efficiency under the assumption of VRS, the convexity constraint $N1'\lambda = 1$ is applied to equation (3).

$$\begin{aligned} \min_{\theta,\lambda} \quad & \theta, \\ \text{s.t.} \quad & -y_i + Y\lambda \geq 0, \\ & \theta x_i - X\lambda \geq 0, \\ & N1'\lambda = 1 \\ & \lambda \geq 0, \end{aligned} \tag{4}$$

where $N1$ is an $N \times 1$ vector of ones.

To account for allocative efficiency, the vector of input prices w_i is inserted in equation (4), shown as below:

$$\begin{aligned} \min_{\lambda, xi^*} \quad & w_i' x_i^*, \\ \text{s.t.} \quad & -y_i + Y\lambda \geq 0, \\ & x_i^* - X\lambda \geq 0, \\ & N1'\lambda = 1 \\ & \lambda \geq 0, \end{aligned} \tag{6}$$

where x_i^* is the cost minimizing vector of input quantities for the *i*th DMU, given the input prices w_i and the output levels y_i. The total cost efficiency or overall efficiency of the *i*th DMU is calculated as:

$$OE = w_i' x_i^* / w_i' x_i$$

thus, the allocative efficiency is calculated as AE = OE/TE. In a nutshell, using DEA this research attempts to investigate the overall efficiency, technical efficiency, pure technical efficiency, scale efficiency and allocative efficiency.

There has been a growing concern whether the efficiency scores estimated utilizing both non parametric and parametric approaches are biased. With respect to that, advances have been made not only on the techniques of efficiency measurement but the practices also involve the changing perspective on the important of environmental factors on bank efficiencies. For instance, DEA treats all deviations from the frontier and the random noise factors as inefficiency; thus, DEA may overstate the true levels of relative inefficiency. For this purpose, this research employs a two stage DEA approach following Coelli et al. (1998) to tackle the implications of environmental variables on bank efficiencies. In this context, the term environment is used to describe factors that could influence the efficiency of a firm,

where such factors are not traditional inputs and are not under the control of management (Fried et al., 1999).

The first stage involves the computation of the efficiency indices by solving the DEA problem using the chosen inputs and outputs. In the second stage, the efficiency scores are regressed upon environmental variables via Tobit regression as it can account for truncated data. An important conceptual issue relates to the data generating process and the associated issue of distribution of the error terms has been raised by Xue and Harker (1999). If the chosen variables used in the computation of the efficiency indices in the first stage are correlated with the explanatory variables in the second stage; the estimates will be inconsistent and biased. This study employs Xue and Harker (1999) procedures for the bootstrap method to solve the dependency problem in DEA efficiency scores using S-Plus 8.0 for Windows by Insightful Corporation (2007).

An unbalanced panel data tobit model is preferred as it allows the use of the truncated data as the dependent variable and the factors that influence efficiency as the independent variables. The model is regressed using Limdep 9.0 econometric software by Greene (2007).

$$y_{it} = \beta'_{it} + \mu_{it} + v_{it}$$
$$y_{it} = 1 \; if \; y^*_{it} \geq 1$$
$$y_{it} = y^*_{it} \; if \; y^*_{it} \geq 1$$

where y is an efficiency score for the *i*th DMU in the *t*th time-period, x is a set of explanatory variables posited to explain the presence of efficiency in the DMUS, β are parameters to be estimated, $Var[\mu_{it} + v_{it}] = \sigma^2{}_{\mu} + \sigma^2{}_{v} = Var[\varepsilon_{it}] \sim N[0,\sigma^2]$ and $i = 1,\ldots,N$ and $t = 1,\ldots,T$. In this approach, the efficiency of each DMU is expected to depend on a set of environmental variables that characterize its operations.

3.0 DATA AND VARIABLES

3.1 *Data*

The study includes all the domestic banks in Malaysia and covers the period from 1995 to 2005; however, data on the target banks ranges from 1995 to 1999 only as they were absorbed into the anchor banks as the results of the merger. The input and output data are obtained from the BankScope database package produced by Bureau van Dijk electronic publishing (BVDep), supplemented with the published balance sheet and income statement as reported in annual reports of the domestic banks. All data is in MYR$ Millions. The banks comprise ten anchor banks which are Affin Bank Ltd. (Affin), Alliance Bank Ltd. (Alliance), AMBank Ltd. (AM), Bumiputra-Commerce Bank Ltd. (BCB), EON Bank Ltd. (EON), Hong Leong Bank Ltd. (Hong Leong), Malayan Banking Ltd. (Maybank), Public Bank Ltd.

(Public), RHB Bank Ltd. (RHB) and Southern Bank Ltd. (Southern).[10] With respect to the total assets, Maybank dominates the market shares in 1995 and 2005; with 44.36 percent (%) and 27.74% respectively. The figures had placed Maybank to be the largest player in the market, followed by Public bank and RHB bank whilst the forth largest bank is the BCB bank. The three smallest banks are Southern bank, Affin bank and Alliance bank with the 2005 market shares are 4.73%, 3.61% and 3.41% respectively. Table 1 as per appendix 1 describes the banks included in the empirical study and the structure of the banking industry for year 1995, 2000 and 2005.

3.2 *Variable*

The definition and measurement of inputs and outputs in the banking function remain a contentious issue among researchers. There is longstanding dispute over what banks produce and what resources banks consume (Berger and Humphrey, 1992). With regard to this, there are two main approaches in the banking theory literature namely the production and intermediation approaches (Sealey and Lindley, 1977). Financial institution is defined as a producer of services for account holders under the production approach. Hence, the number of accounts (deposits) or its related transactions (loans) represents output, while the number of employees and physical capital is considered as inputs. The intermediation approach on the other hand assumes that financial firms act as an intermediary between savers and borrowers and posits total loans and securities as outputs, whereas deposits along with labor and physical capital are defined as inputs.[11] On top of that, Berger and Humphrey (1992) introduce the value added approach whereby outputs consist of loans and deposits and labor, physical capital and purchased funds are classified as inputs.

This study employs intermediation approach in choosing the variables. Based on the list of inputs and outputs in the preceding studies as well as data availability; the input variables used are personnel expenses[12], capital which is the book value of premises and fixed assets, deposits and short term funding (hereafter denoted as deposits) whereas the output variables are represented by total loans, securities and off-balance sheet items. The input prices are calculated as price of labor (total expenditures on employees such as salaries, employee benefits and reserves for retirement pay divided by the total assets); price of capital (the book value of premises and fixed assets is divided by the total assets) and price of deposits (total of interest expenses divided by deposits and short-term funding).

Using the efficiency measures derived from the DEA estimations as the dependent variable, the following Tobit regression model is estimated, the efficiency indices computed from the DEA act as the dependent variable:

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[10] The merger process has reduced the number of domestic commercial banks from twenty-four to ten anchor banks; however, Southern Bank merges voluntarily with Bumiputra-Commerce Bank in 2006. As a result, the merged entity changes its name to CIMB Bank Berhad.

[11] Berger and Humphrey (1997) claim that the intermediation approach is more relevant as it is inclusive of interest expenses which often account for one-half to two-thirds of total costs.

[12] Since information with respect to the number of employees is unavailable for most banks, data on personnel expenses is used.

$$\theta_i = \beta_1 SIZE + \beta_2 GDP + \beta_3 HHI + \beta_4 RISK + \beta_5 GOV + \varepsilon_i$$

where:

1. Size is measured as log of total assets (TA)
2. GDP is taken as log of gross domestic products (GDP) to indicate the economic growth
3. HHI: Hirschman-Herfindahl index to indicate the market concentration
4. RISK: measured as loan/TA to indicate the risks
5. GOV: dummy variable to indicate the government ownership in the banks

4.0 RESULTS AND DISCUSSIONS

This section reports the results of the DEA efficiency analysis relative to the common frontier. First, the common frontier is defined following the traditional approach, i.e. building the frontier by pooling the data set for the banks in the sample. This allows one to compare the banks for each year against the same benchmark. Overall, the results show that the separate frontiers approach reports higher efficiency scores for all types of efficiencies across the pre, merger and post merger periods. The types of efficiencies are the cost efficiency, allocative efficiency, technical efficiency, pure technical efficiency and scale efficiency. To rule out whether the frontiers come from the same population, several tests (t-test, Wilcoxon Rank-Sum, Kruskal–Wallis, Mann-Whitney and Kolmogorov–Smirnov) are performed. Results in Table 2 indicate that the null hypothesis is rejected at varies of significance level. With the arguments that if banks are observed in two different periods and the efficiency scores are calculated with different samples of banks; the comparison of efficiency scores would only show changes in the relative efficiency of the bank with other banks in two different periods. Thus, a common frontier is adopted in this model. Table 3 illustrates the average efficiency scores relative to the common frontier. Meanwhile, Figures 1 – 10 as per appendix 2 illustrate further on the trend of efficiency scores among the banks with respect to the common and separate frontiers.

Table 2: Summary of parametric and non-parametric tests of the hypothesis that common and separate frontiers come from the same population

Name of the tests	t-test	Wilcoxon Rank-Sum test	Kruskal-Wallis test	Mann-Whitney test	Kolmogorov-Smirnov test
Test statistics	t (prob > t)	z (prob > z)	χ^2 (prob > χ^2)	μ (prob > μ)	D (prob > D)
CE	2.978 (0.003)*	15.552 (0.000)*	9.409 (0.002)*	3.067 (0.002)*	1.662 (0.008)*
TE	2.763 (0.006)*	14.813 (0.000)*	8.577 (0.003)*	2.929 (0.003)*	1.501 (0.022)**
AE	1.198 (0.232)	15.528 (0.000)*	3.973 (0.046)**	1.993 (0.046)**	1.394 (0.041)**
PTE	2.973 (0.003)*	15.576 (0.000)*	9.534 (0.002)*	3.088 (0.002)*	1.555 (0.016)**
SE	0.882 (0.378)	15.552 (0.000)*	1.957 (0.162)	1.399 (0.162)	1.233 (0.096)

Note: * 1% significant level

** 5% significant level

Table 3 shows the average efficiency scores of the input-oriented DEA model based on the intermediation approach with respect to the cost efficiency (CE), allocative efficiency (AE), technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE). Though the efficiency scores are available throughout the study period (1995-2205), the findings reported are based on the sub-periods which are the pre-merger (Pre), the merger (Merger) and the post-merger (Post) periods (the rest of the findings are available upon request). The results show that in the context of all banks, all types of the efficiency scores recorded an increment with the

Table 3: The summary of the efficiency relative to common frontier

Bank/Period	CE	AE	TE	PTE	SE
All Banks:					
Pre	0.7626	0.9242	0.8270	0.7621	0.9253
Merger	0.8152	0.9224	0.8816	0.8440	0.9592
Post	0.8450	0.9335	0.9043	0.8396	0.9300
Affin:					
Pre	0.8075	0.9508	0.8496	0.8446	0.9940
Merger	0.6983	0.8007	0.8721	0.8660	0.9929
Post	0.7669	0.8572	0.8973	0.8869	0.9886
Alliance:					
Pre	0.7586	0.9278	0.8194	0.7673	0.9370
Merger	0.8031	0.9766	0.8227	0.8206	0.9974
Post	0.8631	0.9698	0.8902	0.8842	0.9933
AM:					
Pre	0.7129	0.9253	0.7715	0.7581	0.9819
Merger	0.9886	0.9886	1.0000	1.0000	1.0000
Post	0.8092	0.9144	0.8908	0.8518	0.9588
BCB:					
Pre	0.8156	0.8677	0.9383	0.9333	0.9942
Merger	0.8726	0.9572	0.9116	0.8840	0.9698
Post	0.9468	0.9600	0.9864	0.9155	0.9281
EON:					
Pre	0.8126	0.9581	0.8487	0.8246	0.9700
Merger	0.8478	0.9345	0.9073	0.8496	0.9364
Post	0.8582	0.9379	0.9157	0.8385	0.9165
Hong Leong:					
Pre	0.6868	0.9582	0.7174	0.7034	0.9811
Merger	0.7688	0.9284	0.8280	0.7787	0.9404
Post	0.8028	0.9142	0.8720	0.8129	0.9272
Maybank:					
Pre	0.8890	0.9727	0.9137	0.7832	0.8598
Merger	0.9469	0.9679	0.9783	0.7951	0.8127
Post	0.9909	0.9909	1.0000	0.8187	0.8187
Public:					
Pre	0.6962	0.9149	0.7558	0.7404	0.9801
Merger	0.6740	0.8539	0.7893	0.7694	0.9748
Post	0.7446	0.9035	0.8237	0.6748	0.8249

RHB:					
Pre	0.8735	0.9334	0.9379	0.9182	0.9782
Merger	0.8537	0.9249	0.9230	0.8960	0.9707
Post	0.9441	0.9506	0.9929	0.9427	0.9494
Southern:					
Pre	0.7300	0.8794	0.8298	0.8127	0.9785
Merger	0.6979	0.8911	0.7833	0.7808	0.9967
Post	0.7238	0.9359	0.7737	0.7698	0.9949

highest increment is reported in the case of CE scores (10.81%) and PTE scores (10.17%) whilst the lowest increment reported in the case of SE (0.51%). The results indicate that, on surface the merger yields the benefits in terms of cost saving and the usage of inputs; however, the policy had a very minimum effect on the influence of size on the efficiency. The results further supported by the Maybank case where, being the largest player in the market had shown tremendous improvement in their performance by recorded a positive growth in all types of efficiency scores but SE (-4.78%). In fact, the negative growth of SE is recorded with respect to almost all banks (except for the smaller banks such as the Alliance and Southern banks). Thus, the argument that the merger needs to be undertaken as to reap the benefits of the economies of scale effects is accepted with sceptical thought.

The results of the Tobit regression are summarized in Table 4 below with $\alpha = 0.05$ significance level. A set of environmental variables which are size, economic growth, market concentration, risk and government ownership are regressed upon five types of efficiencies namely cost efficiency, allocative efficiency, technical efficiency, pure technical efficiency and scale efficiency. The results yield something in common which is the market concentration variable is found to be insignificant across all types of efficiency. Basically, it indicates that the market shares of the firms in the industry produces null effect on the efficiency performance of the banks. With respect to technical efficiency scores, the results reveal that the external factors namely size and government factors influence the banking technical efficiency significantly at 1% significance level. However, government owned shares in the banks influence the efficiency scores greater than the size factor as the coefficient value indicates that with an increment of 1 unit of government shares in the banks will increase the technical efficiency scores by 0.2. On the other hand, the size indicates that with 1 unit of increment in total assets; the efficiency will increase by 0.09.

Comparing the results of the bootstrap regression to the results of the direct Tobit regression as in Table 5, the first conclusion that can be drawn is that the bootstrap method helps one to reduce the ambiguity of the responses of the hypothesis testing. In fact, with respect to the technical efficiency scores; the coefficients for the influence of government shares in bank on the banks efficiency lead to the same conclusions as reached earlier in the basic sample (Table 4). In addition, the explanatory variable i.e. size which is measured as log of total assets shows the consistent results with the observed sample found in seven out of 10 bootstrap samples. In addition, the market concentration variable which is measured by the Hirschman-Herfindahl index appears in only three out of 10 bootstrap samples. The bootstrap results strengthened the initial findings that the market concentration does not play

a significant role on the efficiency indexes. On the other hand, with respect to the scale efficiency scores; size is significant in all but three of bootstrap samples.

Table 4: Tobit Censored Regression Estimates

	$\hat{\beta}_j$	s.e.	*t* value	Pr (>|t|)
CE:				
SIZE	0.14046027	0.03757012	7.15590001	0.0002*
GDP	-0.43871350	0.15644461	2.53173733	0.0050*
HHI	0.000823505	0.00014098	1519.33884	0.5591
RISK	0.62571613	0.21975220	0.63028253	0.0044*
GOV	0.14614162	0.03799279	0.39285714	0.0001*
AE:				
SIZE	0.07185350	0.03277350	7.15590001	0.0283**
GDP	-0.17867342	0.13647117	2.53173733	0.1905
HHI	0.000251401	0.00012298	1519.33884	0.8380
RISK	0.92601571	0.19169622	0.63028253	0.0000*
GOV	0.00321599	0.03314221	0.39285714	0.9227
TE:				
SIZE	0.09962342	0.03500041	7.15590001	0.0044*
GDP	-0.08012563	0.14574417	2.53173733	0.5825
HHI	0.63792345	0.00013134	1519.33884	0.6272
RISK	-0.02305069	0.20472167	0.63028253	0.9104
GOV	0.20015357	0.03539417	0.39285714	0.0000*
PTE:				
SIZE	-0.03228445	0.03253036	7.15590001	0.3210
GDP	0.19645930	0.13545871	2.53173733	0.1470
HHI	-0.61716969	0.00012207	1519.33884	0.6131
RISK	0.42863837	0.19027405	0.63028253	0.0243**
GOV	0.15941092	0.03289634	0.39285714	0.0000*
SE:				
SIZE	-0.12764392	0.03390650	7.15590001	0.0002*
GDP	0.55490487	0.14118906	2.53173733	0.0001*
HHI	-0.62264304	0.00012723	1519.33884	0.6246
RISK	0.62185180	0.19832327	0.63028253	0.0017*
GOV	-0.02119964	0.03428796	0.39285714	0 .5364

Note: * 1% significant level
** 5% significant level

Table 5: Summary of p-value with respect to the Observed and Bootstrap Samples

Samples	Size	GDP	HHI	Risk	Gov
Basic:					
CE	0.0002*	0.0050*	0.5591	0.0044*	0.0001*
AE	0.0283**	0.1905	0.838	0.0000*	0.9227
TE	0.0044*	0.5825	0.6272	0.9104	0.0000*
PTE	0.3210	0.1470	0.6131	0.0243*	0.0000*
SE	0.0002*	0.0001*	0.6246	0.0017*	0 .5364

Bootstrap 1:					
CE	0.0604	0.2180	0.3170	0.0083*	0.0011*
AE	0.0081*	0.8680	0.0787	0.0000*	0.0577
TE	0.0303**	0.0000*	0.0117**	0.8277	0.0016*
PTE	0.5178	0.7184	0.8766	0.0017*	0.0000*
SE	0.3690	0.0448**	0.9047	0.0000*	0.0986
Bootstrap 2:					
CE	0.0000*	0.0035*	0.8647	0.0123**	0.0204**
AE	0.0000*	0.0038*	0.6426	0.0000*	0.1135
TE	0.0173**	0.8738	0.7792	0.1932	0.0000*
PTE	0.0633**	0.0032*	0.0893	0.1022	0.0001*
SE	0.0000*	0.0000*	0.0063*	0.0000*	0.3807
Bootstrap 3:					
CE	0.0000*	0.0079*	0.5106	0.2795	0.0002*
AE	0.0261**	0.3269	0.6780	0.0010*	0.5499
TE	0.0000*	0.2292	0.7966	0.5984	0.0000*
PTE	0.7413	0.3600	0.4396	0.0152**	0.0000*
SE	0.0000*	0.0001*	0.2231	0.0000*	0.7147
Bootstrap 4:					
CE	0.0486**	0.1595	0.3272	0.1822	0.0006*
AE	0.1509	0.2110	0.2562	0.0000*	0.9208
TE	0.0883	0.0101**	0.5969	0.7342	0.0000*
PTE	0.1489	0.3894	0.6479	0.1654	0.0000*
SE	0.0002*	0.0000*	0.2728	0.0063*	0.5351
Bootstrap 5:					
CE	0.0002*	0.0423*	0.9952	0.0978	0.0000*
AE	0.0030*	0.5202	0.8216	0.3250	0.0336**
TE	0.2710	0.6828	0.0832	0.0098*	0.0002*
PTE	0.0031*	0.7453	0.1870	0.0103**	0.0000*
SE	0.5805	0.0206**	0.6563	0.1730	0.8573
Bootstrap 6:					
CE	0.0000*	0.0000*	0.5508	0.0002*	0.0002*
AE	0.0008*	0.0165**	0.9383	0.0000*	0.6117
TE	0.2156	0.0246**	0.2192	0.1098	0.0000*
PTE	0.0001*	0.2124	0.7255	0.9768	0.0000*
SE	0.0000*	0.0000*	0.0822	0.0013*	0.1405
Bootstrap 7:					
CE	0.0005*	0.0249**	0.6042	0.0416**	0.0108**
AE	0.0053*	0.0095*	0.0941	0.0000*	0.0747
TE	0.0551**	0.0000*	0.0002*	0.9899	0.0000*
PTE	0.1048	0.0477**	0.2449	0.0052*	0.0000*
SE	0.0000*	0.0000*	0.0068*	0.0012*	0.5233
Bootstrap 8:					
CE	0.0286**	0.3060	0.6015	0.4088	0.0000*
AE	0.0010*	0.3549	0.5492	0.0065*	0.0576**
TE	0.4930	0.0825	0.1566	0.2640	0.0000*
PTE	0.9780	0.5466	0.8376	0.0579	0.0008*
SE	0.8263	0.1412	0.1870	0.0010*	0.2873
Bootstrap 9:					
CE	0.0000*	0.2697	0.0687	0.1672	0.0000*
AE	0.0000*	0.1574	0.2317	0.0080*	0.1733

TE	0.0605	0.1708	0.1146	0.5885	0.0000*
PTE	0.4825	0.0107**	0.1313	0.8189	0.0000*
SE	0.0472*	0.0020*	0.9244	0.4419	0.4845
Bootstrap 10:					
CE	0.0012*	0.0428**	0.8595	0.0254**	0.0037*
AE	0.3926	0.5520	0.1096	0.0000*	0.7800
TE	0.0040*	0.2980	0.1320	0.6451	0.0001*
PTE	0.6639	0.2805	0.6725	0.5149	0.0009*
SE	0.0003*	0.0000*	0.5397	0.1128	0.5869
Note: * 1% significant level ** 5% significant level					

5.0 CONCLUSIONS

Generally, the study reveals that there is an increasing trend in the efficiency scores over the post merger. This finding signals for a further investigation in this matter. The most important part of this study wishes to inquire more on the selection of environmental variables that will influence the computation of efficiency scores in the setting of involuntary merger. Apart from that, the appropriate method to incorporate the environmental variables into the model is definitely demanded.

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Appendix 1

Table 1: Structure of the Malaysian Banking Industry (Share in %)

Banks	Assets (%)			Loans (%)			Deposits (%)		
	1995	2000	2005	1995	2000	2005	1995	2000	2005
Affin Bank Owner: Armed Forces Provident Fund	5.01	3.92	3.61	5.74	3.84	3.81	2.09	2.98	0.51
Alliance Bank Owner: Quantum Aspects	2.59	3.48	3.41	2.97	4.18	3.40	1.70	0.54	2.03
AMBank Owner: Azman Hashim	0.85	2.90	6.90	1.06	2.91	8.27	0.15	0.18	1.41
Bumiputera-Commerce Bank Owner: Ministry of Finance	8.16	15.62	11.70	8.75	14.38	13.00	20.16	15.32	4.75
EON Bank Owner: Hicom and Diversified Resources	2.15	4.26	5.18	2.49	4.50	6.01	0.52	3.71	1.70
Hong Leong Bank Owner: Quek Leng Chan	5.63	8.74	8.33	5.78	8.19	5.94	10.27	14.37	12.98
Malayan Banking Owner: Permodalan Nasional Berhad	44.36	31.42	27.74	44.86	31.94	27.75	37.60	28.73	34.22
Public Bank Owner: Teh Hong Piow	17.98	11.18	16.14	13.46	9.84	15.50	21.24	24.49	31.97
RHB Bank Owner: Rashid Hussain	10.22	12.53	12.26	11.82	13.45	11.05	0.56	6.75	8.92
Southern Bank Owner: Tan Teong Hen	3.05	5.95	4.73	3.07	6.77	5.27	5.71	2.93	1.51
Total	100	100	100	100	100	100	100	100	100

Appendix 2

Figure 1: The types of cost efficiency for Affin bank (1995-2005)

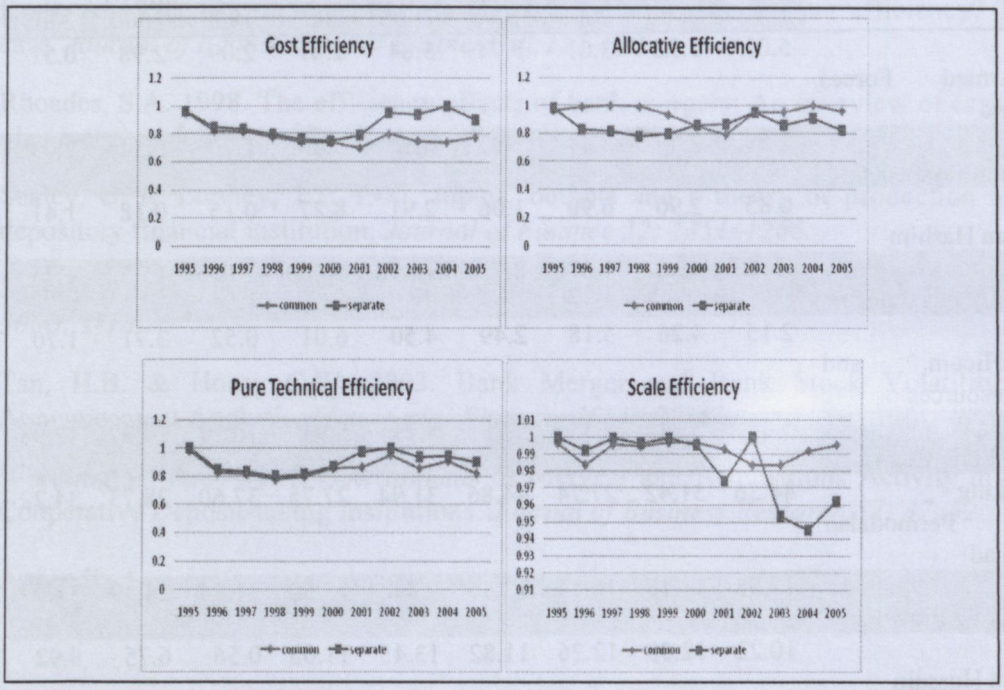

Figure 2: The types of cost efficiency for Alliance bank (1995-2005)

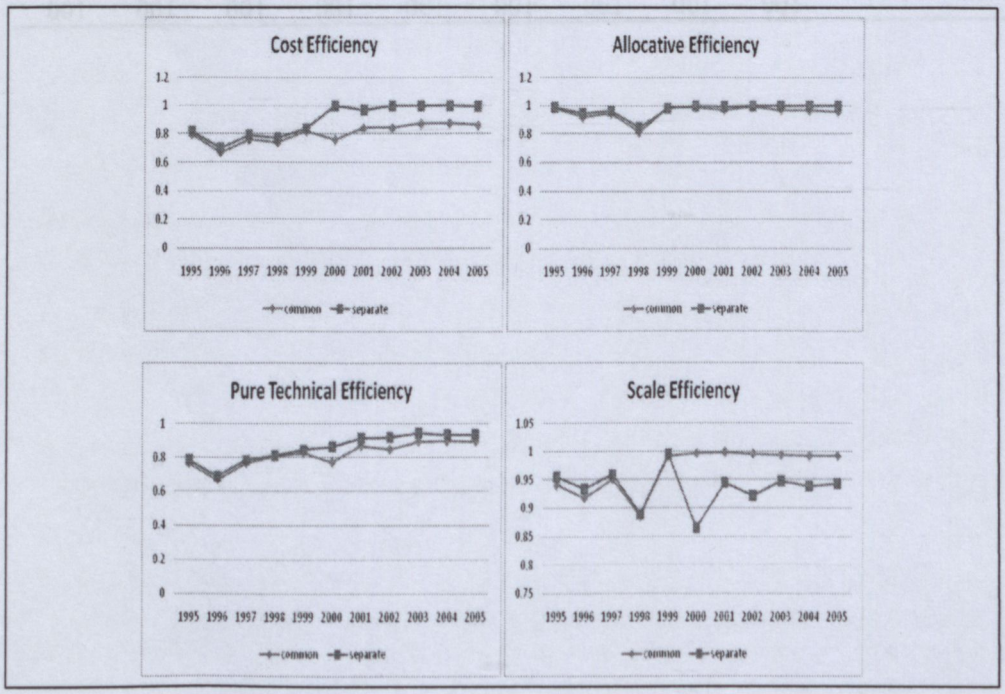

Figure 3: The types of cost efficiency for AM bank (1995-2005)

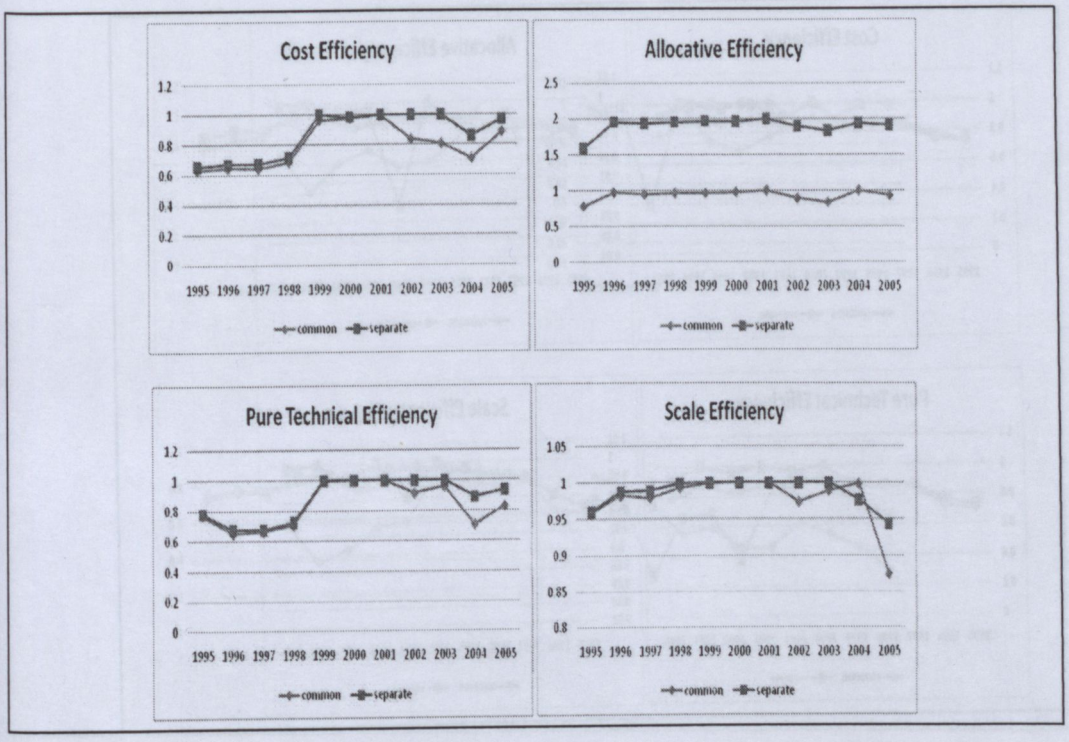

Figure 4: The types of cost efficiency for BCB bank (1995-2005)

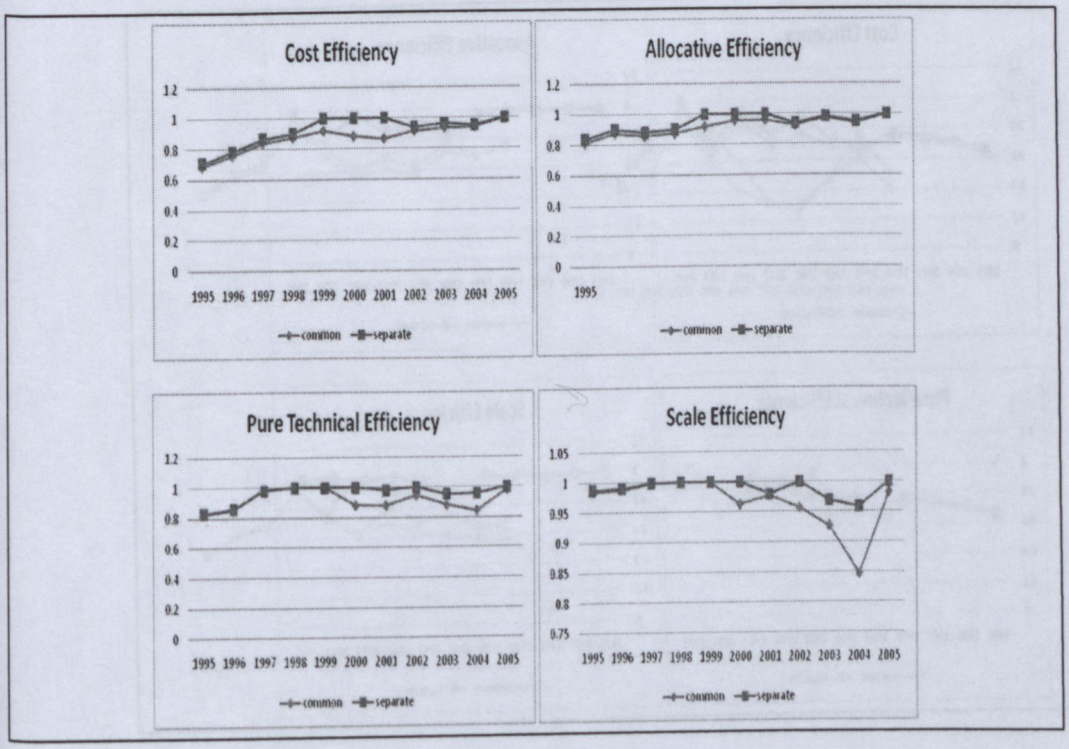

Figure 5: The types of cost efficiency for EON bank (1995-2005)

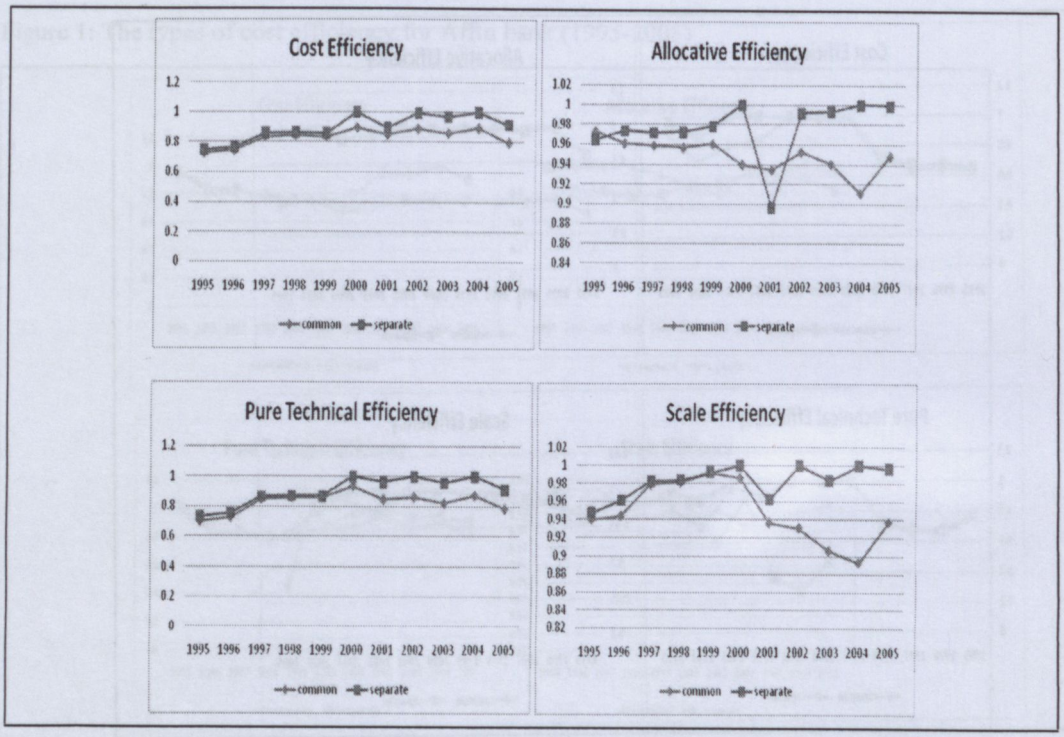

Figure 6: The types of cost efficiency for Hong Leong bank (1995-2005)

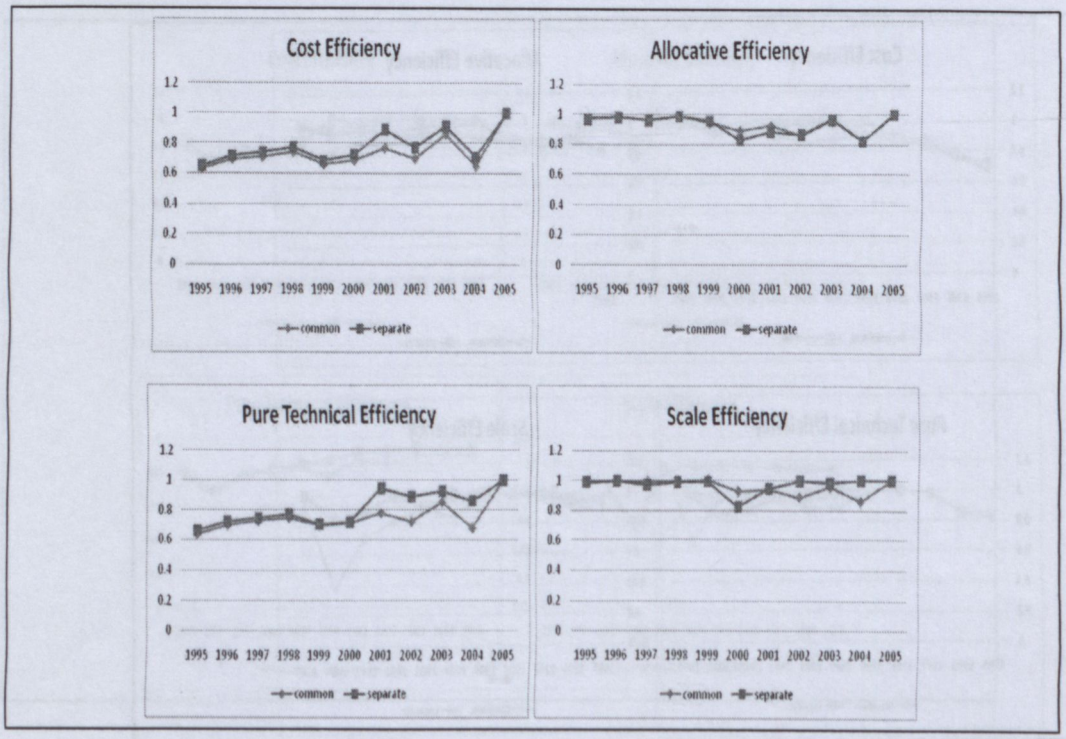

Figure 7: The types of cost efficiency for Maybank bank (1995-2005)

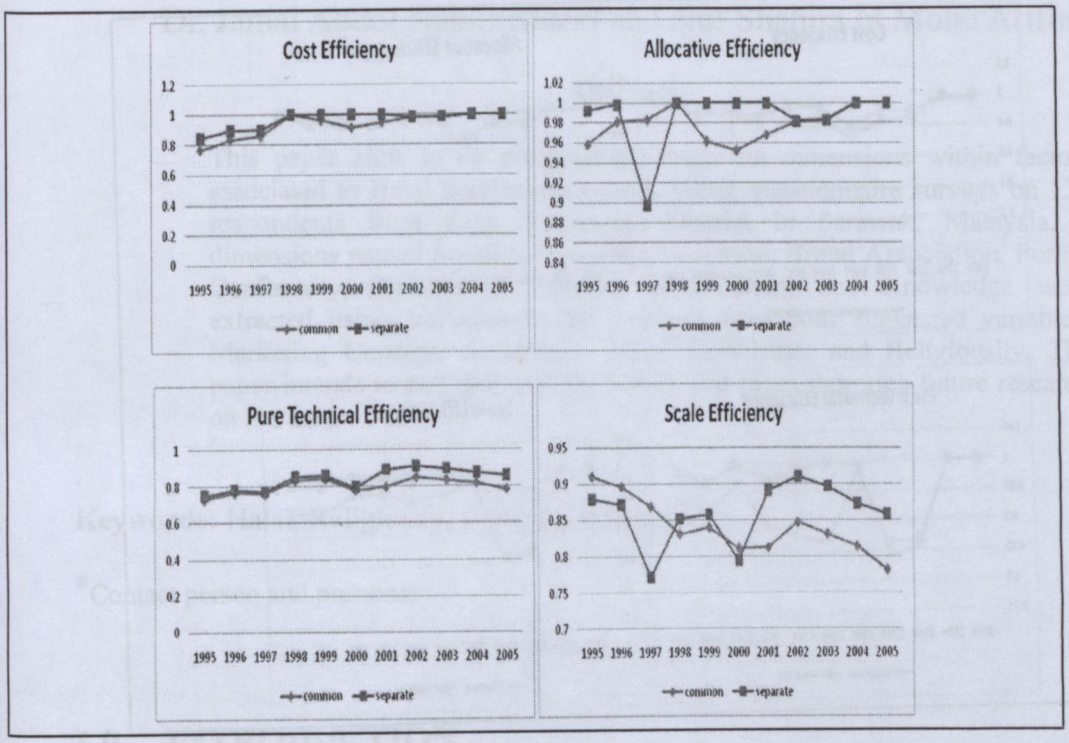

Figure 8: The types of cost efficiency for Public bank (1995-2005)

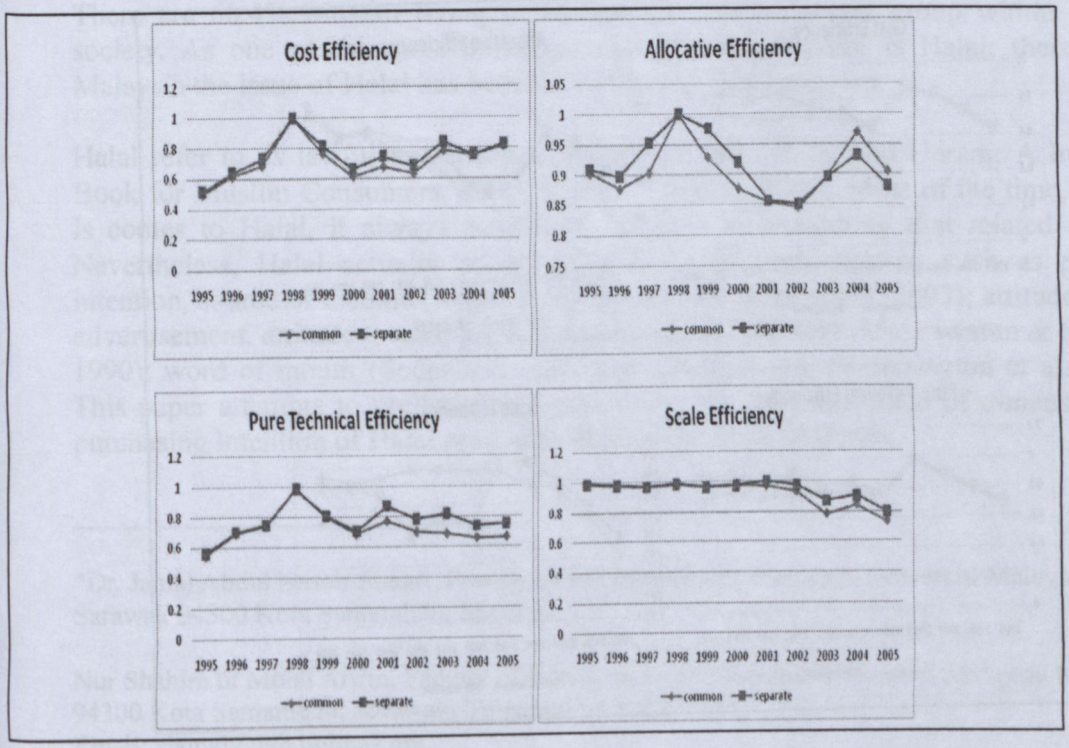

Figure 9: The types of cost efficiency for RHB bank (1995-2005)

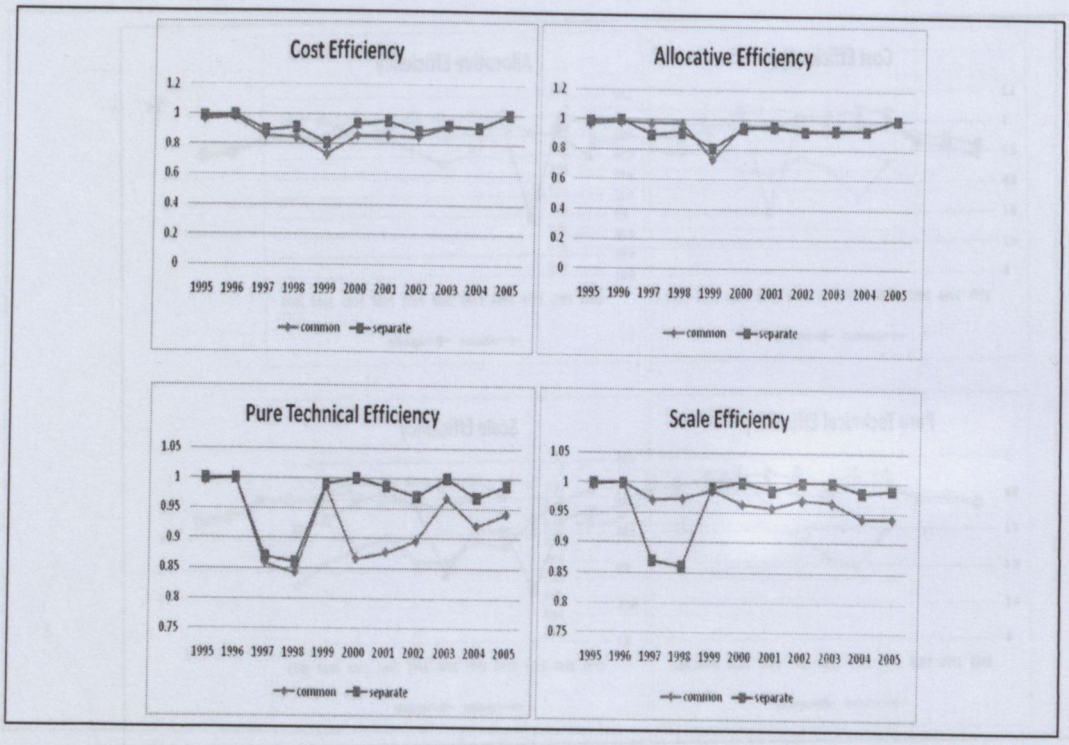

Figure 10: The types of cost efficiency for Southern bank (1995-2005)