Production Technology of Malaysian Commercial Banks:

The Estimation of Stochastic Cost Functions

Adjusted to The Non-Performing Loans[1]

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Abstract

Little microeconomic analysis of the banking business in Malaysia has been conducted. The only known serious academic research in this area is by Katib et al. (2000). This paper contributes to the expansion of the results of the empirical study by Katib et al.. (2000)., in two respects. Firstly, different form Katib et al.. (2000) using Data Envelop Analysis (DEA) based on a non-parametric approach. in this paper, we have estimated the cost function of Malaysian commercial banks with respect to almost the same analysis period, availing ourselves of SEA analysis based on a parametric approach.

The second contribution of this paper is that the estimation also factors in the existence of bad debts, which is ignored by Katib et al.. (2000). The difference in the quality of finance reflecting the difference in the management policies adopted is hard to discern when the economy is in good shape. However, as the economic situation deteriorates, bad debts come to the surface and the profitability of banks that have engaged in dubious financing deteriorates as debt arrears. In this paper, we have assumed a set of several different amounts of sound credit for individual banks, and made an estimation of the cost function for each case.

In our analysis, neither economies of scale nor economies of scope, which are said to be intrinsic to the banking industry, were observed for commercial banks in Malaysia. If the view that economies of scale and economies of scope are observed in efficient bank management is correct, then it is safe to assume that the management of domestic banks in Malaysia must be inefficient.

Moreover, no technological progress was observed in that cost declined over time despite the fact that the capital equipment ratio increased and labor productivity rose in the first half of the 1990s. In studies on developed countries, a decline in cost is observed over time in a competitive market, as is progress in labor saving technology due to investment in modernization. Our observation results suggest that Malaysian domestic banks were making unproductive capital investment.

No essential changes occurred in the analysis even when it was conducted assuming several different amounts of sound credit, i.e. factoring in the quality of credit. Moreover, on comparing our results with those of the earlier study by Katib et al.. (2000)., based on DEA, we have found no inconsistency between the two.

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1. Purpose and structure of this paper

In Malaysia, as in other ASEAN countries, full-scale and far-reaching financial liberalization has been promoted since the end of the 1980s. One of the fundamental objectives of financial liberalization was to create a competitive market environment, thereby improving the managerial efficiency of banks. It was expected that a competitive market environment would provide financial institutions with the incentive to minimize management costs on the basis of technically optimal choices.

On the other hand, the sound management of financial institutions is equally as important as efficient management if financial systems are to support economic development. Examples in industrialized countries have shown that while a financial liberalization policy improves managerial efficiency, without prudent regulations and supervision it will adversely affect the managerial robustness of financial institutions.

The changes in the behavior of banks in line with financial liberalization policies has attracted considerable attention from policymakers, as well as market players and scholars. Since the outbreak of the Asian crisis, moreover, it has been pointed out that the damage suffered by countries and the health of the banking sector are closely interrelated, and it has been widely argued that the behavior of banks in various countries was highly problematic. Strangely, however, even in recent years only limited formal analysis has been conducted using an economic framework to measure the ways in which financial liberalization policies in ASEAN countries have affected bank management. In comparison with the extensive empirical research conducted on banks' management behavior in relation to financial liberalization policies in industrialized countries, it may be said that there is a considerable lack of research in this area.

However, in order to clarify changes in Malaysia's bank management in the 1990s, it is essential to conduct a formal analysis on the way in which banks were actually managed, using analytic techniques of economics. In reality, there has been little microeconomic study conducted in this field to date. About the previous studies in this area using microeconomic data is by Katib and Mathews (2000).

The purpose of this paper is to make a microeconomic examination mapping the changes in the management structure and technical efficiency of local commercial banks in Malaysia, the core of the financial sector in that country. First and foremost, therefore, this paper will undertake fact-finding to ascertain the management structure of banks in Malaysia in the 1990s. Then, based on the specific characteristics of bank management identified, we will discuss the impact of the financial liberalization policy

on the Malaysian banking sector, as well as its policy implications for future financial policies.

This paper has the following merits. First, unlike Katib and Mathews, we have identified the characteristics of the management structure from a new perspective by employing a parametric approach, and have also extended our analysis to aspects not analyzed in the existing report. Katib and Mathews measured the technical efficiency of local commercial banks during the 1989-1995 period by means of a nonparametric approach using DEA (Data Envelopment Analysis). In this paper, we estimate the cost functions of local banks and examine their management structure and efficiency by setting our observation period for about the same period as theirs.

Secondly, we will conduct our analysis taking into consideration the question of the quality of bank finance, an issue that was ignored by Katib, et al. As has been made clear in the wake of the Asian crisis, it is superficially difficult to distinguish poor quality finance from good quality credit during good times. Analysis of bank management that disregards credit quality cannot be considered to represent a correct measurement of efficiency. In this paper, as a second characteristic, we endeavor to explicitly incorporate the question of the quality of Malaysian banks' credit into our analysis, where possible taking into account the actual conditions of bad debts as revealed during the Asian crisis. Specifically, we will make separate estimates for a case where the existence of bad debts is ignored and for a case where credit quality is taken into consideration, and examine the impacts thereof. We wish to use this method as a first step for proceeding with our analysis of bank management taking into consideration both managerial efficiency and strength.

The structure and outlines of this paper are as follows. In the second section, we will briefly summarize the expected impact of financial liberalization on the production structure of the banking business, as well as the method of analyzing it. In the third section, we will outline the characteristics of the profit/cost structure of local banks in Malaysia in the 1990s, using financial data of individual banks. In the fourth section we will estimate cost functions for local commercial banks utilizing panel data, based on the discussion in the preceding sections. Using the results of this estimation, we will clarify the management characteristics of the local banks with respect to economies of scale, economies of scope, technological progress, etc. We will also summarize the relationship between the results of our estimates and those of Katib, et al. In the fifth section, we will endeavor to analyze efficiency factoring in soundness in relation to the question of bad debts. We will assume several cases with respect to the level of bad debts, and check robustness against changes in the results of our estimation in the fourth

section. In the sixth section, we will summarize the relevance of the facts revealed by our analysis to Katib, et al., and suggest research tasks for the future.

2. Analytical Approach and Estimation Method

2.1 Production Technology of Banking Industry

As financial liberalization has progressed since 1980s, a lot of microeconomic analysis of banking industry has been done mainly based on the banks in developed countries, especially the U.S. While there is no clear agreement in identifying banks outputs and their factor inputs, generally there are two alternative approaches, the production approach and intermediation approach. The production approach recognizes banks as the institutions which produce financial services such as loans, deposits, and investment in securities business using factor inputs such as labor and capital. The intermediation approach takes bank as the institutions which absorb funds from the public to re-lend them. According to this approach, loans are taken for outputs and deposits are taken for factor.

Which approach should be adopted depends on the purpose of analysis. Actually, a wide variety of variables have been taken for banks outputs and factor inputs. In this paper, following basically the production approach, we recognize banks as the profit maximizing institutions make use of a set of inputs to produce a set of financial services. The inputs used in the production process of banks are raised funds, physical capital, and labor. The outputs of banks are financial services provided through various business operations of banks such as extending loans, issuing deposits, dealing with foreign exchanges. Here, we categorize these financial services into two: those accompanying traditional bank loan business, and all other services, including investment in security and the so-called “fee business.”

According to Clark (1984), the production activities of a bank can be summarized formally by the production function $\boldsymbol{F} : R_5, \rightarrow R$. Here, Y_1, Y_2, and Y_3 are banks outputs, which represent financial service accompanied by loan business and other fee based business, respectively. Q_1, Q_2, and Q_3 are banks inputs, which represent funds raised in the various forms, physical capital, and labor.

(1) $\boldsymbol{F}\ (Y_1, Y_2 ; Q_1, Q_2, Q_3) = 0$

The financial services produced by banks are measured by the "income" which is equalized to the market value of these services. Although the physical amounts of

financial services are not measurable, if the unit prices of these services are assumed to be constant, various "incomes" correspond to the physical indices based on divisia indexes. Therefore, we assume that Y_1 is measured by the interest income from loans and deposits and Y_2 is measured by total non-interest income, that is, current income minus interest income.

In the process of production, Q_1, Q_2, and Q_3 are measured respectively by the total amount of raised funds, the total market value of physical capital such as buildings and equipment, and number of workers.

2.2 Production Technology of Banking Industry and Cost Inefficiency

If $\boldsymbol{F}$ is a strictly convex structure, a unique multi-product joint cost function $\boldsymbol{C}$ given by equation (2) can be constructed. Here, P_1, P_2, and P_3 represent the price of each factor of production and where P_1Q_1, P_2Q_2, and P_3Q_3 are expenses for raising funds, physical capital, and workers, which roughly correspond to total interest expense, equipment expense, and payroll expense, respectively. Function $\boldsymbol{C}$ is homogenous of degree one, non-decreasing, and concave in P_1, P_2, and P_3. Since the duality between the production function $\boldsymbol{F}$ and the cost function $\boldsymbol{C}$ exists, either function contains the same information about the banks' production technology. Following the methodology of the majority of previous studies, instead of estimating the production function (1), we will estimate the cost function (2).

(2) $$\boldsymbol{C}=\boldsymbol{C}\,(Y_1, Y_2, P_1, P_2, P_3) = P_1Q_1 + P_2\,Q_2 + P_3Q_3$$

In our study, our investigation focus on three points. First, we focus on the economies of scale and economies of scope. As asserted by Leland and Pyle (1977), it is widely recognized that efficient banking operation is intrinsically characterized by economies of scale and economies of scope. According to studies by Gilligan and Smirlock (1984) and Gilligan et al. (1984), economies of scale and economies of scope can be observed in the banking industry of industrialized countries.

In the joint production process, it is said that there exists economies of scale if the proportional increase in all joint productions requires lesser proportional increase in the cost of production. Generally, for any industry characterized by large amount of fixed costs with its average costs decreasing, this implies that there is economies of scale. The banking industry requires a significant amount of fixed cost to maintain branch networks and computer on-line systems regardless of fluctuations in the business operation.

Economies of scope emerges in the joint process of production when some factors of production are shared or utilized jointly without congestion. Gilligan et al. (1984) states that this interdependence is expected to be prevalent in the banking industry. The various financial services provided by the banking industry require similar skills[2] and banks maintain similar information on customer profiles. Therefore, physical capital such as branch network, computer system, and personnel can be utilized jointly without congestion.

Secondly, our study focuses on the change in production structure over time, that is the technological progress. Over time, progress in technology will be seen as the major source of reducing banking operational cost. For example, new technologies such as computer on-line systems and ATM help reduce the operational cost. New technologies also allow the banks to increase their income and expand product services into new fields such as credit card business, telephone banking, and virtual banking.

Finally, we focus on the difference in production efficiency among individual banks. Although banks share the common production technology, all banks can utilize it efficiently for producing their services. Due to either internal or external causes, some banks may not make the best use of technology. We describe all technical and allocative efficiencies of individual banks as distinguished from scale and scope efficiencies and technological progress over time.

2.3 Production Technology and Method of Measuring Cost Inefficiency

The method of measuring production technology of banking industry is classified into tow, parametric approach and non-parametric approach. According to the former, assuming that production behaviors can be represented by a specific production function, the production technology is estimated by econometric technique. According to the latter, without assuming the specified shape of function, the optimal production behaviors are measured as the best practice.

The most widely used analysis of the non-parametric approach is the data envelopment analysis (DEA). Katib et al. (2000), the pioneering work on microeconomic analysis of Malaysia banking industry, uses DEA to measure the technical efficiency of twenty domestic commercial banks during the period from 1989 to 1995. According to their study, there was scale efficiency which was a major cause of technical inefficiency. The estimation analysis suggests that technical efficiency is negatively related to the number of bank branches and employment expenses, but

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[2] These skills include skills of screening, monitoring, and handling customers.

positively related to market power.

DEA has such advantages that one can measure production frontier without specifying the functional form of production function, and that one can calculate DEA sing a small number of samples. However DEA has the following limitations and problems. That is, measurement error and other noise may influence the shape and position of the frontier, the results of DEA may be influenced by outliers, and it cannot be used to conduct conventional tests of hypotheses[3].

In this paper, different from Katib et al. (2000), we adopt the parametric approach and estimate the bank cost function (2) under the assumption that the observed value of samples contain measurement errors. While parametric approach is restricted by the specification of cost frontier function, it has a merit that cost frontier can be handled stochastically by separating the term of inefficiency from statistical error term. In the following sections, choosing the study period similar to Katib et al. (2000), we will estimate cost function of Malaysia commercial banks and investigate their operational structure and efficiency. Applying stochastic parametric approach, it can be expected that production behaviors can be examined more wholly than Katib et al. (2000).

3. Changes in Business Activities of Malaysian Domestic Banks

Before estimating the cost function, we will clarify the characteristics of the Malaysian domestic banks' business activities using individual bank data. We summarized the implemented major financial liberalization measures during the period from 1991 to 1997 in table 1.

Table 1 Financial Reform in Malaysia: 1991-1997

We were able to collect data on 19 Malaysian commercial banks, and we will analyze the data for the period from 1991 to 1997. The concentration ratio of the Malaysian banking industry is very high; deposits for these 19 banks have a market share of 74%[4]. Thus, analyzing these banks we believe that we can capture the main characteristics of the behavior of the Malaysian banks[5].

We divide the examined 19 banks into two groups according to their average

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[3] See, for example, pp.245-246 in Coelli (1998).

[4] Average of the examined period (1991-1997).

[5] Katib (2000) analyzes 20 Malaysian domestic banks, whose data was available.

(1991-1997) asset size: large banks (the largest 9) and small banks (the smallest 10). Moreover, we exclude two large banks (Bumiputra Malaysia Bhd. and Multi-Purpose Bank Bhd.) from our sample, because they showed a different pattern of behavior. We list the names of the banks in each group in the appendix (see table A1).

3.1 Income Structure: Diversification of Outputs

First, we will examine the activities of domestic banks from the production side. Generally speaking, we expect that liberalization policy results in diversification of banking products. Changes in the share of non-interest income to total income $Y_2/(Y_1+Y_2)$ are shown in table 2.

Table 2 Share of Non-interest Income to Total Income

Taking a look at the structure of income, we can see that the share of non-interest income increased in the first half of the 90's, but started to decrease afterwards in both bank groups, thus the diversification of banking products did not occur in Malaysia. The amount of non-interest income increased in Malaysia in the 90's, at the same time however, interest income increased more rapidly, thus the banks' main source of income remained unchanged. Regarding the share of non-interest income, it is higher in the case of large banks than in the case of small banks. This indicates that small banks focus their business activities more on traditional lending business than large banks.

3.2 Cost Structure: The Characteristics of Factor Inputs

Next, we will examine the changes in Malaysian banks' production structure from the point of view of factor inputs. Changes in average productivity of funds $(Y_1+Y_2)/Q_1$, productivity of physical capital $(Y_1+Y_2)/Q_2$, and productivity of labor $(Y_1+Y_2)/Q_3$ are summarized in table 3.

Table 3 Changes in Average Factor Productivity

Taking a look at the productivity of funds, we cannot observe considerable differences between the two bank groups, moreover the level of productivity seems to be stable during the period examined.

Regarding the productivity of labor, it followed a rising trend, and it increased

significantly after 1995. Taking a closer look at the bank groups, we can say that the productivity of large banks exceeds that of small banks during the period examined, and the gap between the two groups widened in the second half of the 90's.

Finally, regarding the average productivity of physical capital, it decreased in the case of large banks, but we cannot see considerable changes in the case of small banks. The productivity of large banks exceeded that of small banks, however the gap between the two groups shrank in the second half of the 90's. The large banks invested heavily in fixed assets, and this had a negative effect on the productivity of physical capital.

Summarizing the main findings of the analysis above, we can say that the productivity of labor increased in the second half of the 90's, and regarding the productivity of physical capital, we saw a decrease in the case of large banks, and there were no considerable changes in the case of small banks. These changes in factor productivity correspond to the changes in factor input ratio. Table 4 shows the changes in labor capital (Q_2 / Q_3) ratio. Taking a look at the figures, we can say that this ratio shrank during the period examined. Taking a closer look, we can say that the small banks' production was capital intensive at the beginning of the 90's, however, due to heavy investments, the large banks' production became more capital intensive than that of the small banks'. Nevertheless, the gap between the two groups is not considerable.

Table 4 Changes in Labor Capital Ratio

3.3 Changes in Factor Prices

The changes in the production structure of Malaysian banks do not contradict the changes in factor prices. We summarize the changes in factor prices in table 5.

Table 5 Changes in Average Factor Prices

We calculated the average price of raised funds (P_1) in the following way: P_1 =interest expenses/raised funds. Generally speaking, the price of funds is decided by the market forces of supply and demand. Moreover, since the large banks have more branches they can raise funds at lower cost than small banks. However, in the case of the Malaysian banks we could not see considerable differences between the two groups regarding the average fund raising cost.

Taking a look at the changes in the price of labor (P_2 =personnel expenses/number of employees) we can say that during the first half of the 90's there were no

considerable changes, but the wages started to increase afterwards. Furthermore, the average wages in large banks were higher than those in small banks during the period examined.

Regarding the changes in the price of physical capital (P_3 =equipment expenses/fixed assets) we can see a decreasing trend in both bank groups. Taking a closer look at the two groups, we can see that during the first half of the 90's the large banks initially had a higher price, but they decreased their equipment expenses afterwards, thus had a lower price than the small banks in the second half of the 90's. The wages increased relatively to the price of physical capital, thus the production of Malaysian banks became more capital intensive in the 90's.

3.4 Cost Structure and Profitability

Table 6 summarizes the changes in ratios of operational costs ($P_1Q_1/(Y_1+Y_2)$ =ratio of fund raising expenses to total income, $P_2Q_2/(Y_1+Y_2)$ =ratio of personnel expenses to total income, $P_3Q_3/(Y_1+Y_2)$ =ratio of equipment expenses to total income). Taking a look at the figures we can say the following.

Table 6 Changes in Ratios of Operational Costs

Regarding the ratio of fund raising expenses we cannot see any considerable differences between the two bank groups. It comes from the fact that there were no considerable differences between the two groups in the case of the productivity of raised funds (see table 3) and the expenses of raised funds (see table 5).

Taking a look at the ratio of personnel expenses, we can say that during the first half of the 90's there were no significant changes, but the ratio started to decrease after 1995, since productivity grew more rapidly than wages. Furthermore, regarding productivity, the large banks were more productive than the small banks during the period examined, thus the ratio of personnel expenses in the case of large banks was lower than that of small banks.

Regarding the changes in the ratio of equipment expenses, we can see a decreasing trend in both bank groups. Taking a closer look at the two groups, we can see that by and large, the ratio of equipment expenses in the case of small banks was lower than in the case of large banks in the first half of the 90's, however in the second half of the 90's the large banks had a lower ratio than the small ones. It comes from the fact that in the second half of the 90's the average equipment expenses of large banks were lower

than those of small ones (see table 6).

Regarding the components of operational expenses of the Malaysian commercial banks, expenses for raising funds (P_1Q_1) were the largest ones, followed by personnel expenses (P_2Q_2), and equipment expenses (P_3Q_3). Consequently, as for the overall operating costs, the large banks operated at lower cost than the small ones, because they had a lower ratio of personnel expenses.

4. The Estimation of Cost Function of Malaysian Commercial Banks

Observation in the previous section suggests that domestic banks in Malaysia are pushing forward branch network expansion and also actively pursuing modernization investments in response to the financial reforms. Although domestic banks are expected to adjust their operations to the new changes, production technology of the banking industry cannot be examined in a comprehensive manner simply by analyzing the financial data. In this and next sections, the production structure of cost function of Malaysian banking industry will be investigated in a formal econometric analysis.

4.1 The Estimated Cost Function

In order to handle the small sample problem, we compile the cross-section data through the observed period so as to conduct the estimation of Malaysian commercial banks cost function using the panel data[6]. A time dummy variable is introduced in the cost function in order to measure explicitly a shift in production technology during the observation period. The estimation method, in principle, is a simple time trend approach as used in Okuda and Mieno (1999).[7] The *t*-th ($t = 1,2,\cdots, M$) period cost function for the *i*-th ($i = 1,2,\cdots, N$) bank is assumed to be represented by the trans-log cost function with three factors and two products (3).[8] Assume further that operating efficiency in equation (3) differs from bank to bank, and that efficiency factor for the i-th bank is a stochastic variable μ, where $\mu \geq 0$, $Var(\mu) = \sigma^2$. Time trend variable T ($T = t$) represent the effect of time passage over the production cost. By normalizing the values of all variables around the mean values, the trans-log cost

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[6] One other way to handle the limitation of data is to reduce the number of the explanatory variables matching to the level of number of data so as to satisfy the certain degree of freedom..

[7] For more details in time trend approach, see Caves et al.. (1981).

[8] All notations have the same representation as the ones used in the previous section.

function can be recognized to be a second order approximation of the cost function based on the mean values.

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\begin{aligned}
\ln C_{it} &= \alpha_0 + \alpha_j \sum_{j=1}^{2} \ln Y_{jit} + \frac{1}{2}\sum_{j=1}^{2}\sum_{k=1}^{2} \alpha_{jk} \ln Y_{jit} \ln Y_{kit} \\
&+ \sum_{j=1}^{3} \beta_j \ln P_{jit} + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln P_{jit} \ln P_{kit} + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \gamma_{jk} \ln Y_{jit} \ln P_{kit} \\
&+ \lambda_T T + \lambda_{TT} T^2 + \frac{1}{2}\sum_{j=1}^{3} \lambda_{TPj} T \ln P_{jit} + + \frac{1}{2}\sum_{j=1}^{2} \lambda_{TYj} T \ln Y_{jit} \\
&+ \mu_i + \nu_{it} \qquad (i = 1,2,,N)\ (t = 1,2,,M)
\end{aligned} \tag{3}
$$

In order for this cost function to be meaningful in the economics sense, the following four constraints should be met. They are: the symmetry between cross partial derivatives (4a), the monotonicity in products and factor prices (4b), homogeneity of degree one in factor prices (4c), and the week concavity in factor prices which is satisfied by (4d). Furthermore, to ensure sufficient degree of freedom in estimation as well as to simplify the estimation work as in Okuda and Mieno(1999), it is also assumed that the cost function (3) is separable between factor prices and products (4e).

(4a) $\alpha_{jk} = \alpha_{kj}, \quad \beta_{jk} = \beta_{kj} \quad (j, k = 1, 2)$

(4b) $\alpha_j > 0, \alpha_{jk} > 0 \ (j, k = 1, 2) \qquad \beta_j > 0, \beta_{jk} > 0 \ (j, k = 1, 2, 3)$

(4c) $\sum_{j=1}^{3} \beta_j = 1 \ (j = 1, 2, 3), \quad \sum_{j=1}^{3} \beta_{jk} = 0 \quad (j, k = 1, 2, 3)$

(4d) $Hp\left[\frac{\partial^2 C}{\partial P_j \partial P_k}\right] \le 0 \quad (j, k = 1,2,3)$

(4e) $\gamma_{jk} = 0 \quad (j, k = 1, 2, 3)$

4.2 Estimation Method

For statistical estimation, since the unbiased estimates of parameters can be obtained without specifying the distribution of μ, the method of within estimation will be used[9]. Equation (3) is transformed using the "within conversion" first, and the

[9] Using the "within-estimation," the unbiased estimates of parameters can be estimated without

obtained cost function is estimated with constraints by the Seemingly Unrelated Regression (SUR) simultaneously with cost share functions[10]. In the actual estimation process, the procedure is first to estimate equation (3) given constraints (4a), (4c), (4d), and (4e). Then the consistency of the estimated parameters with constraint (4b) is checked.

4.3 Economies of Scale and Scope, Technological Progress, and Cost Inefficiency

The trans-log cost function (3) has a general form in a sense that the restrictions of economies of scale, economies of scope, and Hicks neutrality with respect to technical change are not imposed[11]. These restrictions will be statistically tested in the process of estimation of the cost function. The following hypotheses concerned with production technology will be tested.

First, economies of scale will be tested. The total elasticity of scale on overall production at time T is represented by the formula (5) for the cost function $C = C(z\ln Y_1, z\ln Y_2, \ln P_1, \ln P_2, \ln P_3)$. Since a part of technical progress is realized in the form of economies of scale, the extent of economies of scale depends on time *T*. Economies of scale which does not depend on time passing exist, if $\alpha_1+\alpha_2<1$ and vice versa. Economies of scale will be tested by using the maximum likelihood test for the hypothesis that the cost function (3) is constant return to scale $\alpha_1+\alpha_2=1$.

$$(5)\quad \frac{\partial C_{it}}{\partial z}=\frac{\partial \ln C_{it}}{\partial \ln Y_{1it}}+\frac{\partial \ln C_{it}}{\partial \ln Y_{2it}}=\alpha_1+\alpha_2+\lambda_{TY1}T+\lambda_{TY2}T$$

Second, economies of scope will be tested. Economies of scope exist if the

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specifying the distribution of μ.

[10] Under the perfect competition, cost share functions are derived by Shepherd's Lemma. It is represented as follows in the case of trans-log cost functions.

$$\frac{P_{jt}X_{jt}}{C_{it}}=\beta_j+\beta_{kt}\ln P_{kt}+\gamma_{jk}\ln Y_{kt}+\lambda_{TPj}T$$

[11] It is claimed that "economies of scale" and "economies of scale" are presumed to exist inherently in the banking industry that is characterized by large fixed costs and common factors of production. See Leyland and Pyle (1977). Promotion of these economies and technical progress was generally recognized to be the important policy objectives in the Philippine financial reforms.

following complementarity of scope holds.[12] In other words, if the value of formula (6) is strictly less than zero, then economies of scope exist. As mention immediately later, actual estimation is conducted in the proximity of the mean values $\ln Y_{1it} = \ln Y_{2it} = 0$. Thereafter, the condition for economies of scope holds if $a_{12} + a_1 a_2 < 0$. Economies of scope will be tested by using the maximum likelihood test for the hypothesis that the cost function (3) satisfies $a_{12} + a_1 a_2 = 0$.

$$(6)\quad \frac{\partial^2 C}{\partial Y_{1it}\partial Y_{2it}} = \frac{C}{Y_{1it}Y_{2it}}\{a_{12} + (a_1 + a_{11}\ln Y_{1it} + a_{12}\ln Y_{1it}) \bullet (a_2 + a_{21}\ln Y_{2it} + a_{22}\ln Y_{2it})\}$$

Third, technical progress of the banking sector is defined as the increase in outputs over time with all factor inputs held fixed. For the cost function (3), it is represented by the formula (7). Here, (7) denotes technical progress at time t (with base year T = 0), and $\lambda_{TT} = \frac{\partial^2 \ln C}{\partial T^2}$ is the rate of change in technical progress. λ_{TPj} denotes the pure Hicksian bias in the technical progress where, if $\lambda_{TPj} = 0$, technical progress is purely "Hicks-neutral" with respect to the j-th factor.

$$(7)\quad \Psi \equiv -\frac{\partial \ln C}{\partial T} = -(\lambda_T + 2\lambda_{TT}T + \frac{1}{2}\sum_{j=1}^{3}\lambda_{TPj}\ln P_j + \frac{1}{2}\sum_{j=1}^{2}\lambda_{TYj}\ln Y_j)$$

From the estimated parameters, $\hat{a}_j, \hat{b}_k, \hat{c}_{lm}, \hat{d}_q, \hat{e}_n$, the estimate of the inefficiency of the i-th bank combined with the constant term, $a_0 + \mu$, is given by (8) where upper bar of variables represent average levels of i-th bank. The relative inefficiency of the i-th bank λ_i is represented by (9). We will examine the average level (the first order moment) of inefficiency which is given by $\bar{\lambda} \equiv \sum_{1}^{N-1}\exp(\lambda_i) / (N-1)$.

$$(8)\quad a_0 + \mu_i = \ln C_{it} - \left[\begin{array}{l} \hat{a}_1\overline{\ln Y_{it}} + \frac{1}{2}\hat{a}_2(\overline{\ln Y_{it}})^2 + \sum_{k}^{3}\hat{b}_k\overline{\ln P_{kit}}\,\frac{1}{2}\sum_{l}^{3}\sum_{m}^{3}\hat{c}_{lm}\overline{\ln P_{li}}\,\overline{\ln P_{mi}} \\ \quad + \hat{d}_1\bar{T} + \hat{d}_2\bar{T}^2 + \frac{1}{2}\sum_{1}^{3}\hat{e}_n\bar{T}\overline{\ln P_{nit}} \end{array}\right]$$

$$(9)\quad \lambda_i \equiv (a_0 + \mu_i) - (a_0 + \mu)^* \quad \text{for } (a_0 + \mu)^* = \min(a_0 + \mu_i)\ (i = 1, 2, , N)$$

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[12] See Kasuya (1996) for more detailed discussion.

4.4 Data Used

Data used in the estimation are based on banks' self-issued financial statements at the end of each fiscal year. The financial data of individual banks listed at the stock market are available from the Bank Negara Malaysia. The number of bank employees for each bank is taken from various issues of Bankers Directory, published every two years by Association of Banks in Malaysia. The values of individual variables used in the estimation are calculated as follows[13]. All variables are normalized by the GDP.

Y_1 = (Income from loans and deposits)

Y_2 = (Total non-interest income) - (Gain on exchange)

P_1 = (Total interest expense) / {(Deposits)+(Due to financial institutions)+(Other liabilities payable on demand) + (Borrowings)+(Banks liability under acceptances)+(Other liabilities)}

P_2 = {(Equipment expenses)+(Premise expenses)} / (Fixed assets)

P_3 = (Payroll expenses) / (Number of employees)

C = (Total interest expenses)+(Equipment expenses)+(Premise expense) +(Payroll expenses)

In order for our analysis to be credible, it is more appropriate to select a data set that covers only large and medium-sized banks and that is available continuously over the sample period. The operational pattern of these banks is more stable and established. In estimating the cost function by SUR method, every two years panel data from 1991 to 1997 for the 19 banks is used. The other banks were excluded from the estimation, since the data spanning the entire observation period is not.

4.5 Results of Estimation

The estimated results using the panel data during the 1991-1997 period are described in Table-7. The estimation of cost function was conducted for two different variations of equation (3). Table-7 is the estimated result of equation (3). Since some parameters do not satisfy either the theoretically expected signs or statistical significance, these variables are omitted from the estimated equation. In general, the fitness of the estimation in Table-7 is fairly good, and for major estimated parameters,

[13] Basic statistics of these variables are listed in the appendix (see Table A2).

$a_1, a_2, b_1, b_2, b_3, l_T, l_{TP1}, l_{TP2}, l_{TP3}$, no variable has the theoretically opposite sign with high statistical significance.

Table 7 Estimated Results of Cost Function

Since the calculated value of formula (5) was 1.015, which does not fulfill the condition for economies of scale $a_1 + a_2 < 1$, economies of scale was not observed. The statistical significance of this observation was tested by using the Wald test for the hypothesis that the cost function (3) is constant return to scale, $a_1 + a_2 = 1$. However, since the Wald statistics is 0.0599 and its P-value is 0.8066, statistical significance is not significant.

The calculated value of the conditioning formula (6) was 0.136, which does not satisfies $a_{12} + a_1 a_2 < 0$. This fact implies that dis-economies of scope was observed. For testing the observation, the likelihood chi-square test for the hypothesis that the cost function (3) satisfies $d_{12} + a_1 a_2 < 0$. Since the Wald statistics is 1920.7 and its P-value is 0.000, statistical significance is high enough

Technical progress was calculated by the formula (7). According (7), the change in the operational cost l_T during the observation period of seven years was positive. Among the coefficients in the formula (7), the parameters of all intersection terms of time and factor prices $l_{TP1}, l_{TP2}, l_{TP3}$ have the high statistical significance. This suggests two interesting things. First, interestingly, the observed technical progress of the Malaysia domestic banks is of fund saving type. This observation may suggest that the domestic banks cautiously suppressed the expansion of their assets regardless of the enlarged handling capability to extend loans. These business behaviors help improve the rate of return on banks' raised funds, which results in technological progress of the fund-saving type.

Secondly, the technical progress had the character of the labor as well as physical capital using bias. As shown in Section 3, expansion in physical capital in response to intensifying market competition and rising cost of labor resulted in the improvement in labor productivity. As production gets more capital intensive, however physical capital productivity declined in the 1990s, while labor productivity rose parallel to this development. Even though Malaysian banks have expanded modernization investments in the 1990s, their performance fell short of expectations. It seems that expansion in physical capital in response to competition was so rapid that the increase in the cost of physical investment overwhelmed the reduction of operational cost resulted from improvements in labor productivity. Consequently, production

technology became more capital using as well as labor using.

For the 1991-1997 period, the index for the relative operational inefficiency of Malaysian commercial banks $\overline{\Gamma}_i$ are given by Table 8. Interestingly, it is observed that the level of cost inefficiency is lower for small sized banks than for the large sized banks. Nevertheless, the first and second moment of the inefficiency seems to increase in 1990's, comparing with 1980's, which implies the efficiency of banks varies with the process of financial liberalization. The level of the operational inefficiency also varies between banks of different sizes. For the 1985-1994 period, the first and second order moment of inefficiency was the lowest for the large-sized banks and highest for the medium- sized banks.

Table 8 Cost Inefficiency of Individual Banks

4.6 Comparison with DEA

Comparing the estimated results of our study with DEA in Katib et al.. (2000)., some similarities are observed. First, in our study, the estimated total elasticity of scale is greater than unity and then economies of scale was not observed. Similar to our findings, the study of Katib et al.. (2000). also suggests that most commercial banks in Malaysia do not operate at constant returns to scale and that technical inefficiency is attributed to scale inefficiency. According their analysis, scale inefficiency is relatively large in the Malaysian commercial banks.

Secondly, according to our study, there was a tendency that the operational cost of Malaysian commercial banks increases over time. In our study, negative technological progress was observed. Corresponding to our results, the study of Katib et al.. (2000). suggests the deterioration of the operational efficiency of banks. In their study, the efficiency scores show that the overall technical efficiency of Banks has deteriorated between1989 and 1994.

Regarding to the efficiency of individual banks, our findings are different from those in Katib et al.. (2000).. According to Katib et al.. (2000)., best practice is provided by medium sized banks. The banks of smaller size have constant or increasing returns to scale, which implies that they are too small to realize scale merit. On the other hand, scale inefficiency exists in large banks, which implies that they are too large to operate business efficiently. Different from Katib et al.. (2000)., our results suggests that, in general, the small sized banks is more cost efficient than the large sized banks.

5. Estimation of Cost Function Adjusted to NPLs

If the activities of individual commercial banks in Malaysia are examined, there are apparently major fluctuations in the behavior in response to risk of individual banks. In this section, we will first make a study in this respect and then go on to examine how the estimation of cost function changes.

5.1 Differences in Bank Management Policies in Response to Risk

The estimation of the cost function in the preceding section was made without regard to the risks inherent in the business operations of banks. However, if there is a difference in the level of risk taken by banks, there will be a resulting difference in the bank's costs for the following reasons:

If a bank employs conservative management practices, then the quality of its finance will be high with the ratio of sound, low risk loans being high. Since borrowers in this case are sound managers, the lending rate is likely to be relatively low. In contrast, if a bank actively lends to high-risk borrowers, then the lending rate will be relatively high, with the quality of such finance deteriorating.

It is said that the management position of individual banks is reflected in its loan-deposit rate. A bank that employs conservative management practices, maintains loans at a low level relative to the deposits it has absorbed, taking into account the liquidity risk. On the other hand, a bank that makes light of risks sometimes uses the deposits it has absorbed to extend reckless loans. Thus, banks with a conservative stance tend to have a low loan-deposit ratio relative to reckless banks.

Suppose a bank executing conservative management and a bank that actively lends to risky borrowers have extended the same amount of loans, the bank that actively lends appears to have larger earnings as long as the difference in the quality of finance is not brought into the equation. Moreover, the bank executing conservative management has a low loan-deposit ratio relative to the bank executing reckless management, with the amount of lending of the former relative to the deposit amount being smaller than that of the latter. In this way, differences in the managerial policies of banks with respect to risk have a major impact on apparent earnings. As long as the difference in the quality of financing is not factored in, it appears to the outsider that the management cost in relation to the earnings of conservative banks is high and their cost efficiency low, relative to banks executing reckless managerial policies.

This difference in the quality of finance, which reflects management policies, is difficult to recognize when the economy is flourishing. When the economic situation deteriorates, however, dubious loans come to the fore, and the earnings of banks that have extended high-risk loans deteriorate as debts in arrears increase. It is not until such time that the differences in the quality of finance become visible.

5.2 Differences in Bank Behaviors in Response to Risk

Table 9 shows the average loan-deposit ratio from 1991 to 1997 of individual local commercial banks in Malaysia. According to this table, the average loan-deposit ratio of the large banks is generally lower than that of the small banks. However, major fluctuations can be seen in the loan-deposit ratio even within a group: within the large banks, the loan-deposit ratio of Public Bank is especially low, and within the small banks, that of BSN Commercial Bank is particularly high[14]. Judging from this trend, one gets the impression that larger banks tend to employ cautious management policies paying attention to the liquidity risk, while smaller banks adopt a bolder attitude to taking risks. Moreover, there appears to be a significant difference in the response to the liquidity risk according to banks

Table 9 Average Loan-Deposit Ratio of Domestic Commercial Banks

In reality, as a result of the recession in the wake of the Asian crisis, it has become clear that there were substantial differences in the quality of finance among individual banks. Table 10 shows the non performing loan ratio of domestic commercial banks in Malaysia as of March 1998. Generally speaking, non performing loan ratio of the small banks is higher than that of the large banks. However, it is necessary to take account of the fact that the non performing loan ratio greatly varies enormously among individual banks, even within a group: some larger banks have a comparatively high non performing loan ratio, while some smaller banks have a low non performing loan ratio.

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[14] In addition, For example, the average loan-deposit ratio of following banks (Hock Hua Bank Bhd., Ban Hin Lee Bank Bhd., Bank Utama (Malaysia) Bhd., and International Bank Malaysia Bhd) that classified as the small banks are lower than average of the average loan-deposit ratio of the large banks. Whereas, the average loan-deposit ratio of RHB Bank Bhd. that classified a large bank is higher than average of the average loan-deposit ratio of the small banks.

Moreover, it is also necessary to note that a higher loan-deposit ratio necessarily indicates a higher non performing loan ratio.

Table 10 NPL Ratio of Domestic Commercial Banks

5.3 Estimation of the Cost Function Taking into Account the Quality of Credit

The difference in the quality of credit of individual banks, as revealed after the Asian crisis, as well as the difference in each bank's response to risks, which is considered to provide the background for that difference, has a significant bearing on the cost structure of banks. In simple terms, banks that are cautious about risk extend loans to safe borrowers at low rates of interest, and their loan-deposit rates tend to be low because the profitability and cost efficiency of such banks appear to be lower than those of banks which manage recklessly disregarding risks in boom times.

In the estimation of the cost function in the preceding section, we disregarded the differences in the management policies of banks in response to risks, and of the resultant difference in the quality of debt. Here, we will take these factors into consideration and re-estimate the cost function by adjusting the quality of a bank's credit based on the following three assumptions:

Assumption 1: We assume here that the non performing loan ratio of each bank, as clarified in the wake of the Asian crisis, represents the quality of a bank’s credit throughout the observation period; that is, we assume that the income from interest from 1991 to 1997 includes the interest from the essentially bad debts at the same rate as that in March 1998. We then discount the income from interest of each bank from 1991 to 1995 by the non performing loan ratio as of March 1998, and use the amount arrived at as the proxy variable for the income from interest from the sound credit. We then employ the same cost function as that in the preceding section to make an estimation using this proxy variable.

Assumption 2: We assume that the non performing loan ratio of each bank, as clarified in the wake of the Asian crisis, represents the quality of a bank's credit in and after 1995; that is, we assume that the income from interest of each bank in and after 1995 includes the interest from the essentially bad debts at the same rate as that in March 1998. We then discount the income from interest of each bank in and after 1995 by the non performing loan ratio as of March 1998 and use the amount arrived at as the proxy variable for the income from interest from the sound credit. We then employ the same cost function as that in the preceding section to make an estimation using this

proxy variable.

Assumption 3: We assume that the non performing loan ratio of each bank, as clarified in the wake of the Asian crisis, represents the quality of each bank's credit in and after 1993; that is, we assume that the income from interest of each bank in and after 1995 includes the interest from the essentially bad debts at the same rate as that in March 1998. We then discount the income from interest of each bank in and after 1993 by the non performing loan ratio as of March 1998, and use the amount arrived at as the proxy variable for the income from interest from the sound credit. We then employ the same cost function as that in the preceding section to make an estimation using this proxy variable.

5.4 Estimated Results Adjusted to NPLs

Estimation is made based on the data available from 19 of the domestic commercial banks with respect to the period from 1991 to 1997 in the same way as in Section 4. The estimated results are summarized in Table 11.

The estimated results are essentially the same as the results in Section 4. The parameters of major explanatory variables, such as the income from interest , fund-raising cost , personnel expenses , goods expenses , parameters of the time trend dummy , and intersection terms of the time trend dummy and the factor cost, satisfy the theoretically expected sign conditions, and have a high level of statistical significance (*t*-value). However, the statistical significance (*t*-value) of the parameters of non-interest income are low.

Table 11 Estimated Results of the Cost Function

In terms of economies of scale, diseconomies were observed with a scale elasticity of 1.143, greater than unity. Moreover, since the statistical significance of this parameter is also high, economies of scale can be regarded as unrealized. Economies of scope are evaluated by the complementarity of scope (5); since Malaysia's scale complementarity is positive, it is considered that there was diseconomies of scope.

With respect to technological progress, no cost decline over time was confirmed since the value of expression (6) became positive. The bias of technological progress was of funds-saving type and of labor and physical capital using type. A bias, that is saving (using) with respect to a factor of production, refers to a decline (increase) in the share of the total cost of expenditure for that factor to secure an equivalent level of

income with the factor price being constant. With the factor price assumed to be constant, technological change (with the share of personnel expenses and goods expenses increasing and the share of fund-raising costs declining) was observed in the first half of the 1990s.

Table 12 summarizes the cost inefficiency of individual banks. The ranking is almost identical to the result in Section 4: that is, larger banks tend to be less cost inefficient than smaller banks. However, the ranking of banks with a high percentage of bad debts differs substantially from that mentioned in Section 4.

Table 12 Cost Inefficiency of Individual Banks

6. Concluding Remarks

Little microeconomic analysis of the banking business in Malaysia has been conducted. The only known serious academic research in this area is by Katib et al.. (2000). This paper contributes to the expansion of the results of the empirical study by Katib et al.. (2000)., in two respects.

Firstly, this paper has clarified the technical characteristics of Malaysian commercial banks from a different perspective using an analytical method that differs from that of Katib et al.. (2000). Katib et al.. (2000)., studied the characteristics of the management structure of the banking business in Malaysia by Data Envelop Analysis (DEA) based on a non-parametric approach. In this paper, we have estimated the cost function of Malaysian commercial banks with respect to almost the same analysis period, availing ourselves of SEA analysis based on a parametric approach.

The second contribution of this paper is that the estimation also factors in the existence of bad debts, in consideration of the fact that there is a difference in the response to risks of individual banks and in the quality of finance. In the analysis of Katib et al.. (2000)., the difference in the response to risks by individual banks is ignored. The difference in the quality of finance reflecting the difference in the management policies adopted is hard to discern when the economy is in good shape. However, as the economic situation deteriorates, bad debts come to the surface and the profitability of banks that have engaged in dubious financing deteriorates as debt arrears. It is not until such time that the difference in the quality of finance of individual banks becomes clear. In this paper, we have assumed a set of several different amounts of sound credit for individual banks, and made an estimation of the cost function for each case.

In our analysis, neither economies of scale nor economies of scope, which are said to be intrinsic to the banking industry, were observed for commercial banks in Malaysia. If the view that economies of scale and economies of scope are observed in efficient bank management is correct, then it is safe to assume that the management of domestic banks in Malaysia must be inefficient.

Moreover, no technological progress was observed in that cost declined over time despite the fact that the capital equipment ratio increased and labor productivity rose in the first half of the 1990s. In studies on developed countries, a decline in cost is observed over time in a competitive market, as is progress in labor saving technology due to investment in modernization. Our observation results suggest that Malaysian domestic banks were making unproductive capital investment.

No essential changes occurred in the analysis even when it was conducted assuming several different amounts of sound credit, i.e. factoring in the quality of credit. Moreover, on comparing our results with those of the earlier study by Katib et al.. (2000)., based on DEA, we have found no inconsistency between the two.

Several possibilities are conceivable as reasons underpinning the fact that the management of domestic banks in Malaysia was not efficient in spite of the progress in financial liberalization. First, some substantive restrictions remain, which may be hampering the streamlining of bank management. It is said that the Malaysian banking market was under various forms of strong government influence till the 1980s. For example, banks were required to provide loans for specific policy purposes, and the government was a major stockholder in many banks. If the impact of these restrictions has remained even after the progress in financial liberalization since the 1990s, this may have impeded independent management by financial institutions and constituted an obstacle to the pursuit of managerial efficiency.

However, one must not jump to such conclusions because there are constraints on our analysis in terms of data. In Malaysia, the business activities of commercial banks are severely restricted. For this reason, commercial banks, securities companies and investment banks, are integrated under holding companies, and securities market business is handled by related securities companies and investment banks. It may therefore, be institutionally difficult to realize economies of scope through diversification. However, it has not been possible to analyze these circumstances because the data used in this paper concern individual banks. This may be an important factor underpinning the apparent lack of economies of scope among Malaysian domestic banks.

Aside from this, it may be that there was little incentive for domestic banks to

implement serious management streamlining measures because the market environment for domestic banks was favorable during the 1990s. While a financial liberalization policy was pursued during the 1990s in Malaysia, the macroeconomic situation was good and the banking sector grew rapidly. At the same time, since severe restrictions were imposed on foreign banks, domestic banks were able to avoid market competition with foreign banks. In this market environment, it would not be surprising if Hicks's "quiet life hypothesis" held good.

In order to further develop our argument concerning the two possibilities mentioned above, it is necessary to conduct a formal analysis with respect to the interrelationship between the market structure and market outcome. Moreover, since research on the banking business in Malaysia has only been conducted for a very short period, it is too early to draw conclusions from the very few empirical studies that exist pertaining to production technology or efficiency. It is now necessary to accumulate a large number of empirical studies which employ either a parametric or a non-parametric approach.

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Table 1 Financial Reform in Malaysia: 1991-1997

(1)Financial Liberalization

Feb-91	Liberalization of set up of BLR(Base Lending Rate). Ceiling on margin of interest is BLR+4%.
Nov-95	Revision of calculation method of BLR as operating together to weighted average of previous month of three month inter-bank rate.

(2)Reduction of Operatonal Regulation

94	Approval to commercial bank to investment to qualifying corporate bond and CP.

(3)Maintenance of Regurations

Aug-94	Introduction of Two-Tier Regulatory System on commercial bank.
Jul-96	Introduction of the guideline of risk management on derivatives transactions.
Jan-97	Concerning BIS capital standards, revision of calculation method of off-balance-sheet exposure as calculated by current price base.

(4)Maintenance of Capital Market

Nov-92	Introduction of transfer settlement system.
Feb-93	Issue of Malaysia Saving Bond (5 year) by central bank.
Mar-93	Establishment of Securities Commission as supervisor organization.
	Effectuation of Futures Industry Act.
Dec-95	Establishment of KLOFFE (Kuala Lumpur Options and Financial Future Exchange).
May-96	Establishment of MME (Malaysia Monetary Exchange).
Aug-96	Introduction of Amanah Saham Wawasan 2020 on investment fund.
Sep-96	Establishment of Malaysian Rating Corporation Bearhad.
Sep-97	Effectuation of Khazanah National bond (three years).

(5)Liberalization of exchange, capital transaction.

Mar-94	Shift to a floating exchange rate system from a basket peg system.
Aug-97	Introduction of swap regulation.

(6)Maintenance of Settlement System

96	Publication of master plan on settlement system.
Apr-97	Establishment of ATM national network; MEPS(Malaysian Electoronic Payment System).

(Source) Bank Negara Malaysia, The Central Bank and the Financial System in Malaysia, Annual Reports, IMF, Exchange Arrangements and Exchange Restrictions.

Table 2 Share of Non-interest Income to Total Income: *Y2/(Y1+Y2)*

(%)

	1991	1992	1993	1994	1995	1996	1997
Large Banks	11.57	11.31	13.00	16.02	13.46	12.21	9.84
Small Banks	7.60	7.47	10.02	11.01	8.92	8.98	7.46

(Source) Bureau Van Dijk-Bank Scope.

Table 3 Changes in Average Factor Productivity

(1)Average Raised Funds Productivity: *(Y1+Y2)/Q1*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	0.09	0.10	0.09	0.08	0.08	0.08	0.10
Small Banks	0.09	0.10	0.09	0.08	0.08	0.08	0.09

(2)Average Labor Productivity: *(Y1+Y2)/Q2*

(1000MYR)

	1991	1992	1993	1994	1995	1996	1997
Large Banks	235.76		270.18		285.45		472.95
Small Banks	158.95		172.99		166.20		292.62

(3)Average Productivity of Physical Capital: *(Y1+Y2)/Q3*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	17.37	13.82	13.68	10.30	8.55	9.90	11.73
Small Banks	10.20	11.73	10.37	7.73	8.34	8.17	9.84

(Source) Bureau Van Dijk-Bank Scope. Various issues of Bankers Directory, published by Association of Banks in Malaysia.

Table 4 Changes in Labor Capital Ratio: *Q2/Q3*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	8.38		5.23		2.57		1.93
Small Banks	7.00		5.52		4.60		2.78

(Source) Bureau Van Dijk-Bank Scope. Various issues of Bankers Directory, published by Association of Banks in Malaysia.

Table 5 Changes in Average Factor Prices

(1)Price of Raised Funds: *P1=(Total interest expense)/{(Deposits)+(Borrowing from financial institutions)+(Other debts)}*

(%)

	1991	1992	1993	1994	1995	1996	1997
Large Banks	4.94	5.83	4.75	3.84	3.89	4.34	5.85
Small Banks	4.91	5.56	4.68	3.67	3.71	4.38	5.20

(2)Price of Labor: P2=*(Ratio of payroll expenses)/(Number of bank employees)*

(1000MYR)

	1991	1992	1993	1994	1995	1996	1997
Large Banks	25.047		25.291		28.671		34.830
Small Banks	22.106		22.523		24.919		28.341

(3)Price of Physical Capital: *P3={(Equipment expenses) + (Premise expenses)}/(Fixed assets)*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	0.460	0.320	0.308	0.250	0.179	0.133	0.152
Small Banks	0.268	0.278	0.229	0.170	0.193	0.142	0.159

(Source) Bureau Van Dijk-Bank Scope. Various issues of Bankers Directory, published by Association of Banks in Malaysia.

Table 6 Changes in Ratios of Operational Costs

(1)Ratio of Fund Raising Cost: *P1Q1/(Y1+Y2)*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	0.5820	0.6019	0.5595	0.4918	0.5175	0.5294	0.5763
Small Banks	0.5367	0.5725	0.5446	0.4802	0.4990	0.5340	0.5841

(2)Ratio of Payroll Expense: *P2Q2/(Y1+Y2)*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	0.1059		0.0998		0.1053		0.0768
Small Banks	0.1556		0.1432		0.1599		0.1072

(3)Ratio of Equipment Expense: *P3Q3/(Y1+Y2)*

	1991	1992	1993	1994	1995	1996	1997
Large Banks	0.0239	0.0247	0.0240	0.0264	0.0230	0.0136	0.0138
Small Banks	0.0267	0.0236	0.0212	0.0226	0.0212	0.0163	0.0151

(Source) Bureau Van Dijk-Bank Scope. Various issues of Bankers Directory, published by Association of Banks in Malaysia.

Table 7
Estimated Results of the Cost Function

Parameter	Estimated Value	t-statistic
a_1	0.624896	8.35024***
a_2	0.158686	2.86735***
b_1	0.794105	100.113***
b_2	0.176103	24.8683***
b_3	0.029792	15.2750***
l_T	0.230596	3.06206***
l_{TT}	-0.111255	-4.43185***
l_{TP1}	-0.040980	-2.97483***
l_{TP2}	0.032767	2.65569***
l_{TP3}	0.00821306	2.39077***
Economics of scale		1.01513
Wald statistics		0.05990
Economic of scope		0.13590
Wald statistics		192.07034

*, **, and *** represent significance of 10%, 5%, 1%

Table 8 Cost Inefficiency of Individual Banks

Ranking of Total Assets	Name of Bank	Cost Inefficiency	Ranking of Cost Efficiency
1	Malayan Banking Bhd.	1.940850993	11
2	Bank Bumiputra Malaysia Bhd.	2.338462599	17
3	Public Bank Bhd.	2.703394014	19
4	RHB Bank Bhd.	1.554046997	6
5	Bank of Commerce (M) Bhd.	1.90707592	10
6	Perwira Affin Bank Bhd.	2.185387291	16
7	Hong Leong Bank Bhd.	1.818470548	9
8	Pacific Bank Bhd.	2.062048525	14
9	Oriental Bank Bhd.	1.996851779	12
10	Multi-Purpose Bank Bhd.	1	1
11	Southern Bank Bhd.	1.395822763	3
12	Ban Hin Lee Bank Bhd.	2.08134504	15
13	Bank Utama (Malaysia) Bhd.	1.721901685	8
14	BSN Commercial Bank (Malaysia)Bhd.	1.524393748	5
15	Hock Hua Bank Bhd.	1.475645346	4
16	Eon Bank Bhd.	2.033602974	13
17	Sabah Bank Bhd.	1.556210712	7
18	International Bank MalaysiaBhd.	2.477250791	18
19	Wah Tat Bank Bhd.	1.143546224	2

Table 9 Average Loan-Deposit Ratio

(%)

Large Banks	
Malayan Banking Bhd.	92.85
Public Bank Bhd.	48.20
RHB Bank Bhd.	112.03
Bank of Commerce (M) Bhd.	89.10
Perwira Affin Bank Bhd.	91.12
Hong Leong Bank Bhd.	79.28
Southern Bank Bhd.	83.63
Average	85.17
Small Banks	
Pacific Bank Bhd.	87.90
Oriental Bank Bhd.	105.52
Ban Hin Lee Bank Bhd.	75.02
Bank Utama (Malaysia) Bhd.	78.88
Hock Hua Bank Bhd.	75.15
BSN Commercial Bank (Malaysia)Bhd.	168.68
Eon Bank Bhd.	89.48
Sabah Bank Bhd.	84.42
International Bank MalaysiaBhd.	79.72
Wah Tat Bank Bhd.	93.58
Average	93.83

(Source) Bureau Van Dijk-Bank Scope.

Table 10 NPL Ratio

(%)

Large Banks	
Malayan Banking Bhd.	2.41
Public Bank Bhd.	1.10
RHB Bank Bhd.	3.20
Bank of Commerce (M) Bhd.	4.49
Perwira Affin Bank Bhd.	5.10
Hong Leong Bank Bhd.	4.20
Southern Bank Bhd.	5.00
Average	3.64
Small Banks	
Pacific Bank Bhd.	4.91
Oriental Bank Bhd.	12.20
Ban Hin Lee Bank Bhd.	4.27
Bank Utama (Malaysia) Bhd.	7.06
Hock Hua Bank Bhd.	5.50
BSN Commercial Bank (Malaysia)Bhd.	9.89
Eon Bank Bhd.	6.12
Sabah Bank Bhd.	12.70
International Bank MalaysiaBhd.	8.36
Wah Tat Bank Bhd.	4.20
Average	7.81

(Source) Bureau Van Dijk-Bank Scope.

Table 11 Estimated Results of the Cost Function

Parameter	Assumption1		Assumption2		Assumption3	
	Estimated Value	t-statistic	Estimated Value	t-statistic	Estimated Value	t-statistic
a_1	0.626680	8.20698***	0.618661	8.14314***	0.573013	7.17048***
a_2	0.152212	2.69992***	0.154402	2.74241***	0.164050	2.72729***
b_1	0.793890	100.011***	0.794063	100.097***	0.794006	99.9695***
b_2	0.176292	24.8837***	0.176141	24.8769***	0.176161	24.8563***
b_3	0.029818	15.2733***	0.029796	15.2726***	0.029833	15.2813***
l_T	0.276895	3.62576***	0.359138	4.68954***	0.288060	3.60879***
l_{TT}	-0.136503	-5.22119***	-0.161093	-6.02610***	-0.125847	-4.54045***
l_{TP1}	-0.042020	-3.04321***	-0.041029	-2.97460***	-0.041889	-3.02095***
l_{TP2}	0.033677	2.72328***	0.032807	2.65579***	0.033453	2.69505***
l_{TP3}	0.00834218	2.42637***	0.00822186	2.39169***	0.00843527	2.44725***
Economics of scale		1.01735		1.01733		1.01759
Wald statistics		0.07593		0.07480		0.06431
Economic of scope		0.13168		0.13324		0.14002
Wald statistics		188.75947		185.50992		151.35940

*, **, and *** represent significance of 10%, 5%, 1%

Table 12 Cost Inefficiency of Individual Banks

		Assumption1		Assumption2		Assumption3	
(1)	Name of Bank	(2)	(3)	(2)	(3)	(2)	(3)
1	Malayan Banking Bhd.	2.446086673	18	2.517436604	18	2.996495607	18
2	Bank Bumiputra Malaysia Bhd.	2.541881465	19	2.607520142	19	3.030993283	19
3	Public Bank Bhd.	2.181228388	17	2.226956364	17	2.532276147	17
4	RHB Bank Bhd.	1.935273239	15	1.976776479	15	2.244924663	16
5	Bank of Commerce (M) Bhd.	1.956244821	16	1.992879591	16	2.228004577	15
6	Perwira Affin Bank Bhd.	1.643412205	12	1.669578197	12	1.833777183	12
7	Hong Leong Bank Bhd.	1.551567677	10	1.576728095	10	1.727500765	10
8	Pacific Bank Bhd.	1.67444466	13	1.697189473	13	1.837664518	13
9	Oriental Bank Bhd.	1.740465999	14	1.763102847	14	1.907835042	14
10	Multi-Purpose Bank Bhd.	1.342172534	5	1.360515318	5	1.477034507	6
11	Southern Bank Bhd.	1.296306974	3	1.312208783	3	1.408457849	3
12	Ban Hin Lee Bank Bhd.	1.604689003	11	1.62504867	11	1.749736392	11
13	Bank Utama (Malaysia) Bhd.	1.442597576	8	1.458306439	9	1.548952336	9
14	BSN Commercial Bank (Malaysia)Bhd.	1.440976948	7	1.455963494	8	1.543941839	8
15	Hock Hua Bank Bhd.	1.3112218	4	1.327459582	4	1.426950897	4
16	Eon Bank Bhd.	1.444434817	9	1.454050557	7	1.5084934	7
17	Sabah Bank Bhd.	1.379365505	6	1.390568821	6	1.455419683	5
18	International Bank MalaysiaBhd.	1.251040525	2	1.255312307	2	1.273579386	2
19	Wah Tat Bank Bhd.	1	1	1	1	1	1

(1); Ranking of Total Assets
(2); Cost Inefficiency
(3); Ranking of Cost Efficiency

Table A1 Categories of Banks

(1000MYR)

Large Banks	Total assets
Malayan Banking Bhd.	52627016.33
Bank Bumiputra Malaysia Bhd.	29465249.95
Public Bank Bhd.	16914437.33
RHB Bank Bhd.	15019032.48
Bank of Commerce (M) Bhd.	10283606.51
Perwira Affin Bank Bhd.	7086573.54
Hong Leong Bank Bhd.	5712616.94
Southern Bank Bhd.	3684103.08
Multi-Purpose Bank Bhd.	3609364.37
Small Banks	
Pacific Bank Bhd.	4468472.59
Oriental Bank Bhd.	4388046.00
Ban Hin Lee Bank Bhd.	3382396.59
Bank Utama (Malaysia) Bhd.	2981019.11
Hock Hua Bank Bhd.	2658610.84
BSN Commercial Bank (Malaysia)Bhd.	2425907.00
Eon Bank Bhd.	2034304.83
Sabah Bank Bhd.	1214851.53
International Bank MalaysiaBhd.	638718.31
Wah Tat Bank Bhd.	392727.53

(Source) Bureau Van Dijk-Bank Scope.

Total assets is calculated by average from 1991 to 1997 in real term.

Table A2 Basic statistics

	C	Y1	Y2	P1	P2	P3
Mean	505313.45	662061.14	74780.97	0.00469485	26.503012	0.2314705
Standard Deviation	79167.32	1062686.1	117860.61	0.0092382	5.7691643	0.2111477
Minimum	15311	19803	1927	0.00292999	17.060837	0.0231402
Maximum	4963725.5	6803066	647278.6	0.0760778	48.699131	1.3945178