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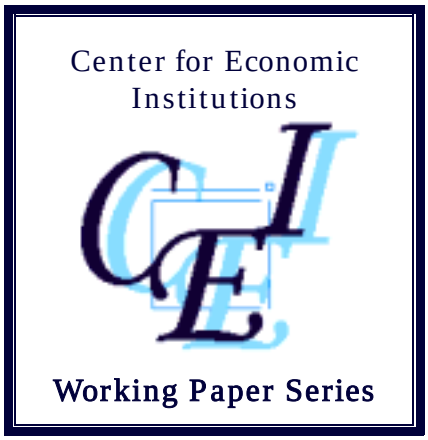

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The Estimation of Stochastic Cost Functions of Malaysian Commercial Banks and Its Policy Implications to Bank Restructuring[i]

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The present paper examines stochastic cost functions of Malaysian commercial banks from 1991 to 1997 periods and catches the changes in their management structure and technical efficiency. Then, we also discuss policy implications for bank integration and competition policy which is the part of current financial reform that reinforces the banking sector. However, little microeconomic analysis of the Malaysian banking business has been conducted. The only known serious academic research in this area is by (Katib and Mathews, 2000). The present paper contributes to the expansion of their study in two respects. Firstly, we have estimated the cost function, availing ourselves of SEA based on a parametric approach. Secondly, our model also includes as a factor the existence of bad debts. According to our results, we observed economies of scale clearly, but economies of scope and technological progress were not observed. Regarding the policy implication, the result of our analysis suggests strongly that the current policy is appropriate.

Keywords: Economies of scale; Economies of scope; Technical efficiency; Cost function; Banking; Malaysia; Financial liberalization.

JEL classification codes: C13, D24, F36, G21, G28, O31.

1. Purpose and Structure

The Asian economic crisis in 1997 gave serious damage to the banking sectors of the ASEAN countries. After the crisis, the countries' authorities concentrated for a while on relieving the banking sector and settling the problem of non-performing loans. However, as the economic situation stabilized, they started advancing reforms in order to strengthen the banking sectors. In these reforms, we can observe two common characteristics. Firstly, the improvement in soundness of bank management is set as a main goal. This is based on the recognition that before the Asian economic crisis, the soundness of bank management was not well considered, although the financial deregulation policy intensified the market competition[ii]. Secondly, integration and merger of banks are being accelerated in every country, because of the need to create an internationally competitive banking sector that can deal with the financial globalization.

As shown by (Chin and Jomo, 2001; Soo-Nam, 1999), such a reform that strengthens the banking sector has also been advanced in Malaysia. In this reform, the prudential regulation was strengthened, and also reorganization of banks is being carried out under the strong leadership of the government since 2000. The bank reorganization in Malaysia is the most extensive one in the ASEAN countries, and main financial institutions, including commercial banks, investment banks, securities companies and insurance companies, have been integrated to 10 groups.

To say that the present financial reform in Malaysia is rational, the bank management in Malaysia must have certain characteristics. For example, expanding the scale of banks by reorganization or integration can be effective only if economy of scale holds true in the banking sector of Malaysia. Similarly, it can be beneficial that commercial banks form groups with investment banks, insurance companies, and securities companies, only when commercial banks are not able to materialize economies of scope within themselves.

In order to appraise the present financial reform in Malaysia, it is essential to conduct a formal analysis of the management structure of the banking sector in Malaysia, using analytic techniques of economics. In reality, there has been little microeconomic study conducted in this field to date[iii]. The only past study done in this area using microeconomic data is that by (Katib and Mathews, 2000).

The purpose of this paper is to make a microeconomic examination of domestic commercial banks in Malaysia, the core of the financial sector of the country, mapping the changes in their management structure and technical efficiency. First and foremost, therefore, this paper will undertake fact-finding to get a grasp of 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 implications for future financial policies.

This paper has the following merits. Firstly, unlike Katib and Mathews, we identify the characteristics of the management structure from a new perspective by employing a parametric approach, and also extend our analysis to aspects not analyzed in the existing report. Katib and Mathews measured the technical efficiency of domestic 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, setting our observation period at about the same period as theirs.

Secondly, we 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 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, taking into account the actual conditions of bad debts as revealed during the Asian crisis where possible. Specifically, we make separate estimates for a case where the existence of bad debts is ignored and a case where credit quality is taken into consideration, and examine the impacts thereof. We wish to use this method as a first step of taking into consideration both managerial efficiency and strength in our analysis.

The structure and outlines of this paper are as follows. In the second section, we will briefly summarize the method of analyzing the production structure of the banking business, and we will set up the framework for analyzing the banking business. Especially, we will clear the differences between our analysis method and that of (Katib and Mathews, 2000), and then we will explain how we handled the non-performing loans which do not appear in data outwardly. In the third section and fourth section, based on the framework from the preceding section, we will estimate the cost functions for domestic commercial banks using panel data. In the third section, we will explain the concrete estimation method. In the fourth section we will examine the management characteristics of Malaysian domestic commercial banks such as economies of scale, economies of scope, and technological progress based on our estimation result. Moreover, we will compare our estimation result with that of (Katib and Mathews,

2000) and explain the relationship of the two. In the fifth section, we will mention briefly about the policy implications that our analysis suggests for the reform in Malaysia.

2. Analytical Approach and Estimation Method

2.1 Production Technology of Banking Industry

As financial liberalization progressed starting in the 1980s, many microeconomic analyses of banking industry were conducted, mainly focusing on banks in developed countries, especially the U.S. While there is no clear agreement on how to identify banks' outputs and their factor inputs, generally there are two different approaches: production approach, and intermediation approach. The production approach recognizes banks as institutions that produce financial services such as loans, deposits, and investments in securities business using factor inputs such as labor and capital. The intermediation approach views banks as institutions that absorb funds from the public to re-lend them. According to this approach, loans are outputs and deposits are inputs.

Which approach should be adopted depends on the purpose of analysis. Actually, a wide range of variables has been taken for banks' outputs and factor inputs. In this paper, basically following the production approach, we recognize banks as profit maximizing institutions that make use of a set of inputs to produce a set of financial services. The inputs used by banks in their production process are acquired 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, and dealing with foreign exchanges. Here, we categorize these financial services into two: those provided through traditional bank loan business, and those provided through other businesses, including investments in securities and the so-called "fee business".

According to (Clark, 1984), production activities of a bank can be summarized formally by the production function $\boldsymbol{F} : R_5 \rightarrow R$ shown below. Here, Y_1 and Y_2 are banks' outputs, representing financial services provided through loan business and those provided through other businesses, respectively. Q_1, Q_2, and Q_3 are banks' inputs, each representing funds acquired in various forms, labor, and physical capital.

(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 equals 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, the "incomes" correspond to the quantitative indices based on the Divisia index. Therefore, we assume that Y_1 is measured by the interest income from loans and deposits, and Y_2 is measured by the 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 acquired funds, number of workers, and the total market value of physical capital such as buildings and equipments.

If $\boldsymbol{F}$ has a strictly convex structure, a unique multi-product joint cost function $\boldsymbol{C}$, shown by equation (2), can be constructed. Here, P_1, P_2, and P_3 represent the prices of the factors of production. Thus P_1Q_1, P_2Q_2, and P_3Q_3 are expenses for acquiring funds, workers, and physical capital, respectively, each roughly corresponding to the total interest expense, payroll expense, and equipment expense. Function $\boldsymbol{C}$ is homogenous of degree one, non-decreasing, and concave in P_1, P_2, and P_3. Since there is duality between the production function $\boldsymbol{F}$ and the cost function $\boldsymbol{C}$, the two functions contain 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) $\boldsymbol{C}=\boldsymbol{C}\,(Y_1, Y_2, P_1, P_2, P_3) = P_1Q_1 + P_2\,Q_2 + P_3Q_3$

2.2 Method of Measuring Production Technology

As shown by (Hori, 1998; Coelli, Rao and Battese, 1998), the method of measuring the production technology of banking industry can be classified into two: parametric approach, and non-parametric approach. In the former, under the assumption that production behaviors can be represented by a specific production function, the production technology is estimated using econometric techniques. In the latter, a specific function is not assumed, but the optimal production behaviors are measured as the best practice.

The most widely used form of the non-parametric approach is the Data Envelopment Analysis (DEA), and that of the parametric approach is the Stochastic Estimation Analysis (SEA). The relation of the two can be expressed as in Figure 1. In SEA, in order to derive information from a set of observed values, a single regression

plane that best corresponds to the whole data is derived. This is shown with the dotted line in Figure 1. On the other hand, in DEA, optimization is conducted at every observation point. This is shown with the curved solid line in Figure 1.

Figure 1: DEA and SEA

(Katib and Mathews, 2000), the pioneers of microeconomic analysis of the Malaysian banking industry, use DEA to measure the technical efficiency of twenty domestic commercial banks during the 1989 to 1995 period. According to their study, scale diseconomies were a major cause of technical inefficiency. Their estimation analysis suggests that technical efficiency is negatively related to the number of bank branches and employment expenses, but positively related to market power.

DEA has the advantages that one can estimate the production frontier without specifying the production function, and that one can conduct DEA using a small number of samples. However DEA has the following limitations and problems. That is, measurement errors and other noises may influence the shape and position of the frontier, the results of DEA may be influenced by outliers, and DEA cannot be used to conduct conventional tests of hypotheses[iv].

In this paper, unlike (Katib and Mathews, 2000) we adopt the parametric approach and estimate the banks' cost function (2) under the assumption that the observed values of the samples contain measurement errors. While parametric approach is restricted by the specification of cost frontier function, it has the merit that cost frontier can be handled stochastically by separating the term of inefficiency from statistical error term.

2.3 Estimation of the Production Technology Taking into Account the Quality of Credit

In the case of estimating the production technology, the most difficult problem is how the quality of service should be measured. Especially, if there is a difference in the level of risks taken by banks, there will be a resulting difference in the banks' 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 the 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. As long as the difference in the

quality of financing is not considered, it appears to outsiders that the management costs of conservative banks in relation to earnings are high and their cost efficiency low, relative to banks that have reckless managerial policies[v]. In order to measure operational efficiency and production technology correctly, we need to estimate the interest income from only the sound credits that each bank holds, and conduct our analysis on that basis.

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 difference in the quality of finance becomes visible[vi].

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 qualities of finance among individual banks. Table 1 shows the non-performing loan ratios of domestic commercial banks in Malaysia as of March 1998. Generally speaking, non-performing loan ratios of the small banks are higher than those of the large banks. However, it is necessary to take account of the fact that the non-performing loan ratios vary enormously among individual banks, even within a group: some larger banks have comparatively high non-performing loan ratios, while some smaller banks have low non-performing loan ratios.

Table 1 NPL Ratio of Domestic Commercial Banks

Now, we must consider how to estimate the interest income composed of only the sound credits. There are several ways of taking risks into account in the estimation. In recent years, (Mester, 1996) used the method that treats non-performing loans as products that differ from sound credits. (Hori, 1997) conducted the estimation using credit amount from which non-performing loans were deducted[vii]. However, in the case of Malaysia, it was impossible to collect the data of each bank's non-performing loans through the observation period. Besides these methods, there is a method that treats the loan loss provision as a proxy variable for the non-performing loans. However, while the sum of the loan loss provisions was 10.8 billion ringgit in 1997, the sum of the non-performing loans was 23.3 billion ringgit in March 1998 and reached 42.5 billion ringgit in September of the same year[viii]. The actual sum of the non-performing loans is much bigger than the loan loss provisions, therefore, we can say that it is not appropriate to use the loan loss provision as a proxy variable for the non-performing loans. Here, we estimate the cost function by adjusting the quality of a bank's credit

under the following four assumptions:

Assumption 1: We assume that there was no hidden damage in lending credits from 1991 to 1997. In this case, we can use the financial data as it is for the estimation of the cost function.

Assumption 2: We assume that there had been damage in credits since 1991. In this case we discount the interest income of each bank in and after 1991 by the non-performing loan ratio as of March 1998, and use this to estimate the cost function.

Assumption 3: We assume that there had been damage in credits since 1993. In this case we discount the interest income of each bank in and after 1993 by the non-performing loan ratio as of March 1998, and use this to estimate the cost function.

Assumption 4: We assume that there had been damage in credits since1995. In this case we discount the interest income of each bank in and after 1995 by the non-performing loan ratio as of March 1998, and use this to estimate the cost function.

2.4 Technological Characteristics of Banking Industry Regarding the Financial Reform

In our study, our investigation focuses on three points. Firstly, we focus on economies of scale and economies of scope. As stated by (Leland and Pyle, 1977), it is widely recognized that efficient banking operation is intrinsically characterized by economies of scale and economies of scope[ix].

In the joint production process, it is said that there exists economy 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, there are economies of scale. The banking industry requires a significant amount of fixed cost to maintain branch networks and computer on-line systems regardless of the differences in business operation.

Economies of scope emerge in the joint process of production when certain factors of production are shared or utilized for more than one type of product without congestion. The various financial services provided by banks require similar skills[x] and 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. Progress in technology is a major source of reducing banking operational cost. For example, new technologies such as computer on-line systems and ATMs 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. Even if banks share the common production technology, not all banks can make use of it with maximum efficiency. Due to either internal or external causes, some banks may not make the best use of technology. We describe the technical and allocative efficiencies of individual banks as distinguished from scale and scope efficiencies and technological progress over time.

3. The Estimation of Cost Function of Malaysian Commercial Banks

3.1 The Estimated Cost Function

In order to handle the problem of small sample, 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[xi]. A time dummy variable is introduced in the cost function in order to explicitly measure the 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).[xii] The t-th (t = 1,2,・・・, M) period cost function for the i-th (i = 1,2,・・・, N) bank is assumed to be represented by the trans-log cost function with three factors and two products (3).[xiii] In addition, it is assumed that operating efficiency in equation (3) differs in each bank, and that the efficiency factor for the i-th bank is a stochastic variable μ_i, where $\mu_i \geq 0$, $Var(\mu) = \sigma^2$[xiv]. Time trend variable T ($T = t$) represents the effect of time passage over the production cost. By normalizing the values of all variables around the mean values, the trans-log cost function can be recognized to be a second order approximation of the cost function based on the mean values.

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

In order for this cost function to be meaningful in the economics sense, the following four constraints should be met: symmetry between cross partial derivatives (4a), monotonicity in products and factor prices (4b), homogeneity of degree one in factor prices (4c), and weak 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) $Hp\left[\frac{\partial^2 C}{\partial P_j \partial P_k} \right] \leq 0 \quad (j, k = 1,2,3)$

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

For statistical estimation, since the unbiased estimates of the parameters can be obtained without specifying the distribution of μ_i or the correlation between the statistical error term and the explanatory variables, the method of within-estimation are used[xv]. Moreover, we consider the asset gap among commercial banks, and use the estimator of (White, 1980) by which we can obtain a robust estimator even in the case where heteroscedasticity exists and its form is unknown. Equation (3) is transformed using the "within conversion" first, and the obtained cost function is estimated with constraints by the Seemingly Unrelated Regression (SUR) simultaneously with cost share functions[xvi]. 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.

3.2 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 changes are not imposed[xvii]. 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 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 do not depend on time passing exist if $\alpha_1 + \alpha_2 < 1$, and vice versa. Economies of scale will be tested using the maximum likelihood test for the hypothesis that cost function (3) has constant return to scale, satisfying $\alpha_1 + \alpha_2 = 1$.

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

Second, economies of scope will be tested. Economies of scope exist if the following complementarity of scope holds.[xviii] 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 $\ln Y_{1it} = \ln Y_{2it} = 0$. Therefore, the condition for economies of scope holds if $\alpha_{12} + \alpha_1\alpha_2 < 0$. Economies of scope will be tested using the maximum likelihood test for the hypothesis that cost function (3) satisfies $\alpha_{12} + \alpha_1\alpha_2 = 0$.

$$(6)\quad \frac{\partial^2 C}{\partial Y_{1it}\partial Y_{2it}} = \frac{C}{Y_{1it}Y_{2it}}\left\{\alpha_{12} + \left(\alpha_1 + \alpha_{11}\ln Y_{1it} + \alpha_{12}\ln Y_{1it}\right)\bullet\left(\alpha_2 + \alpha_{21}\ln Y_{2it} + \alpha_{22}\ln Y_{2it}\right)\right\}$$

Third, technical progress of the banking sector is defined as the increase in outputs over time with all factor inputs held fixed. For cost function (3), it is represented by 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, $a_0 + \mu_i$, is given by (8) where the upper bars of the variables represent the average levels of the 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 $\bar{\lambda} \equiv \sum_{1}^{N-1}\exp(\lambda_i) \Big/ (N-1)$.

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

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

3.3 Data Used

Data used in the estimation are based on the banks' self-issued annual reports made at the end of each fiscal year from 1991 to 1997. 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[xix]. All variables are normalized by the GDP.

Y_1 = (Income from loans and deposits)
Y_2 = (Total non-interest income)
P_1 = (Total interest expense) / (Total liabilities)
P_2 = (Payroll expenses) / (Number of employees)
P_3 = {(Equipment expenses)+(Premise expenses)} / (Fixed assets)
C = (Total interest expenses) +(Payroll expenses)+ (Equipment expenses)+(Premise expense)

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 is available continuously over the sample period. The operational patterns of these banks are more stable and established. In estimating the cost function by SUR method, the biyearly panel data from 1991 to 1997 for 19 banks are used. The other banks are excluded from the estimation, since data spanning the entire observation period do not exist.

Moreover, not all banks do the closing of accounts in December in Malaysia. According to A3, June settlement and March settlement exists other than December settlement. In addition, there are cases where the closing period was changed even within the observation period. While there is no established method for adjusting the closing period and (Katib and Mathews, 2000) did not adjust it, in this paper, we treated December as the standard, and regarding other banks, we made proxy variables for December closing by calculating the weighted average between two continuous periods.

4. Technical Characteristics of Banking Industry

4.1 Results of Estimation(Ⅰ): In the case that we assume hidden damage is absent

The estimation results using the panel data of the 1991-1997 period are described in Table 2. The estimation of the cost function was conducted for two different variations of equation (3). Since some parameters did not satisfy either the theoretically expected signs or statistical significance, these variables were omitted from the estimated equation. In general, the fitness of the estimation in Table 2 is fairly good, and all major estimated parameters, $\alpha_1, \alpha_2, \beta_1, \beta_2, \beta_3, \lambda_T, \lambda_{TT}, \lambda_{TP1}, \lambda_{TP2}, \lambda_{TP3}$, show high statistical significance with no theoretically opposite signs.

Table 2 Estimation Results of Cost Function (Ⅰ)

Since the calculated value of formula (5) was 0.784, which fulfills the condition for economies of scale $\alpha_1 + \alpha_2 < 1$, economies of scale were observed clearly. The statistical significance of this observation was tested using the Wald test for the hypothesis that cost function (3) has constant return to scale, satisfying $\alpha_1 + \alpha_2 = 1$. Since the Wald statistics was 20.599 and its P-value 0.000, statistical significance is high enough.

The calculated value of the conditioning formula (6) was 0.099, which does not satisfy $\alpha_{12} + \alpha_1\alpha_2 < 0$. This fact implies that diseconomies of scope exist. For testing the observation, the likelihood-ratio chi-square test was done for the hypothesis that the

cost function (3) satisfies $\delta_{12}+\alpha_1\alpha_2<0$. Since the Wald statistics was 13.979 and its P-value 0.000, statistical significance is high enough.

Technical progress was calculated by formula (7). According to (7), the change in the operational cost λ_T during the observation period of seven years was positive. Among the coefficients in formula (7), the parameters of all intersection terms of time and factor prices $\lambda_{TP1}, \lambda_{TP2}, \lambda_{TP3}$ had high statistical significance. These suggest two interesting things. First, the observed technical progress of the Malaysian domestic banks is of fund-saving type. This observation suggests that the domestic banks cautiously suppressed the expansion of their assets despite the enlarged capability to extend loans. This business behavior helped improve the rate of return on banks' raised funds, resulting in the technological progress of the fund-saving type.

Secondly, the technical progress had the character of both labor and physical capital using biases. In Malaysia, the improvement in labor productivity in response to intensifying market competition and rising cost of labor resulted in the expansion of physical capital. However, as production became more capital intensive in the 1990s, physical capital productivity declined, and labor productivity rose. Even though Malaysian banks expanded modernization investments in the 1990s, their performance fell short of expectations. It seems that the 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 resulting from improvements in labor productivity. Consequently, production technology became more capital using and more labor using.

For the 1991-1997 period, the indices for the relative operational inefficiency of Malaysian commercial banks $\overline{\lambda}_i$ are given by Table 3. Interestingly, it is observed that the level of cost inefficiency is lower in small sized banks than in large sized banks. However, the level of operational inefficiency also varies within banks of similar sizes.

Table 3 Cost Inefficiency of Individual Banks (Ⅰ)

4.2 Results of Estimation(Ⅱ): In the case that we assume hidden damage exists

The estimation results under the assumption that hidden damage exists are described in Table 4. The estimation results are basically the same as the results in Table 2. In general, the fitness of the estimation in Table 4 is fairly good, and all major estimated parameters, $\alpha_1, \alpha_2, \beta_1, \beta_2, \beta_3, \lambda_T, \lambda_{TT}, \lambda_{TP1}, \lambda_{TP2}, \lambda_{TP3}$, have high statistical significance

with no theoretically opposite signs.

Table 4 Estimation Results of Cost Function (Ⅱ)

Economies of scale were observed clearly, with scale elasticity below 1 regarding all three assumptions. Economies of scope were evaluated by the complementarity of scope (6); since Malaysia's scale complementarity is positive, it is considered that there exist diseconomies of scope.

With respect to technological progress, no cost decline over time was confirmed since the value of expression (7) was positive. The bias of technological progress was of fund-saving type and of labor and physical capital using type. These results are basically the same as the results in Assumption 1.

Table 5 summarizes the cost inefficiency of individual banks. The ranking is almost identical to the result in table 3: that is, larger banks tend to be more cost inefficient than smaller banks. However, the ranking of banks with a high percentage of bad debts differs substantially from that mentioned in Section 4.1.

Table 5 Cost Inefficiency of Individual Banks (Ⅱ)

As mentioned above, we could not find any difference among the results of the estimations that adopted several assumptions about the existence of non-performing loans. It has been pointed out that quality of credits should be considered in the case where the production structure of banking business is analyzed, because if quality of credits is considered, the characteristics of the structure of banking business may be largely changed. However, our estimation result contradicted this opinion.

It is seemingly effective to discount the interest income by the rate of non-performing loans which has a maximum of about 15%. However, because relevancy was not observed between the scale of the bank and the level of non-performing loan ratio, the shape of production function did not change remarkably. Moreover, because we converted trans-log cost function by the within conversion, all variables were converted first by logarithm conversion and then into distance from the mean value. Therefore, these modifications did not affect the results.

4.3Technical Characteristics of Banking Industry: Comparison with DEA

Comparing the estimation result of our study with that of the DEA by (Katib and Mathews, 2000), the following findings are observed. First, according to (Katib and Mathews, 2000), while economies of scale exist in small banks, diseconomies of scale exist in large banks. On the other hand, in our study, economies of scale exist in commercial banks. This difference resulted from the difference in the method of analysis. In the analysis by (Katib and Mathews, 2000) which used DEA, under the assumption that there was no observation error, the envelope was measured from the samples directly, and was considered as the production technology of the bank of best practice. Therefore, the observation result of (Katib and Mathews, 2000) only describes the characteristics of the samples on the envelope, and does not refer to the average characteristics of the whole sample. To the contrary, in our study, we estimated the cost function assuming that there was an observation error, and analyzed the characteristics of the production technology of Malaysian domestic banks. Thus, the observation result of our study refers to the average characteristics of the whole sample.

Secondly, according to our study, the operational cost of Malaysian commercial banks has the tendency to increase over time, suggesting that there is negative technological progress. Corresponding to our results, the study of (Katib and Mathews, 2000) suggests the deterioration of operational efficiency of banks. In their study, the efficiency scores show that the overall technical efficiency of Banks deteriorated in the 1990's. Both studies observed the same decline in the cost efficiency of Malaysian domestic banks in the 1990's. However, we must note the difference between the analytical approach in our study and that taken by (Katib and Mathews, 2000). (Katib and Mathews, 2000) observe the numbers of banks in best practice in 1989 and 1995 respectively and pointed out the reduction in the number of banks in best practice between 1989 and 1995. On the other hand, in our study, we observed how the production technology of the whole banking sector changed over time and pointed out that the cost had the trend to increase over time.

Third, regarding the efficiency of individual banks, our findings are different from those of (Katib and Mathews, 2000). According to (Katib and Mathews, 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. Differing from (Katib and Mathews, 2000), our results suggest that, in general, small sized banks are more cost efficient than large sized banks. This result may give the impression that there is a disagreement between our study and (Katib and Mathews, 2000). However, while we observed the average

technological characteristics of the whole sample and then measured the efficiency of individual banks as the distance from the average, (Katib and Mathews, 2000) measured the efficiency of individual banks as the distance from the envelope. This difference is causing the difference in the observation results.

Finally, in (Katib and Mathews, 2000), economies of scope were not discussed clearly. In our study, we obtained the result that diseconomies of scope exist in the Malaysian commercial banks as an average characteristic of the whole sample. Therefore, we can say that this result gives additional information to the analysis of (Katib and Mathews, 2000).

5. Concluding Remarks：Implications for financial reform

5.1 The Analytical Result

Few microeconomic analyses of the banking business in Malaysia have been conducted in the past. The only known serious academic research in this area is that by (Katib and Mathews, 2000). This paper contributes to the expansion of the empirical study by (Katib and Mathews, 2000) in two respects.

Firstly, this paper has clarified the technical characteristics of Malaysian commercial banks using an analytical method that differs from that of (Katib and Mathews, 2000), who used Data Envelop Analysis (DEA) based on a non-parametric approach. In this paper, we have estimated the cost function of Malaysian commercial banks using almost the same analysis period as theirs, availing ourselves of SEA analysis based on a parametric approach.

The second contribution of this paper is that the existence of bad debts is included as a factor in our estimation, in consideration of the fact that there is a difference in the response to risks and the quality of finance among individual banks. In the analysis of (Katib and Mathews, 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 assumed a set of several different amounts of sound credits for individual banks, and made an estimation of the cost function for each case.

In our analysis, we observed economies of scale clearly, but economies of scope were not observed for commercial banks in Malaysia, which are said to be intrinsic to the banking industry[xx]. Moreover, no technological progress was observed in the sense that cost increased over time despite the increases in capital equipment ratio and labor productivity 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. Regarding the technological change in Malaysia, it had the characters of both labor and physical capital using biases. Therefore, our observation result suggests that Malaysian domestic banks were making unproductive capital investments.

5.2 Policy Implications

In the process of reorganization of banks after the Asian crisis, it is expected that efficient investment in equipments and the pursuit of economies of scale and scope through expansion in management scale improve the productivity. The result of our analysis suggests strongly that the current policy is appropriate.

First is related to our analytical result in this paper regarding the economies of scale of the banks. In the process of reorganization of banks which has been carried out since after the Asian crisis, it is expected that economies of scale are realized and strengthened by the expansion in management scale. According to our analytical result, economies of scale clearly exist in Malaysia, therefore we obtained a conclusion that scale expansion is extremely important for the improvement in management efficiency. Therefore, we can say that the policy of bank reorganization in Malaysia is appropriate.

Second is related to our analytical result regarding the economies of scope of the banks. Although business regulations were loosened by financial deregulation in the 1990's, because the England style banking system is adopted in Malaysia, scope of business of commercial banks is restricted and they are not able to handle investment banking[xxi]. According to our analytical result, economies of scope do not exist. This suggests the need for a system reform that enables commercial banks to offer investment banking and insurance and securities businesses to realize economies of scope in the banking business. In the present financial sector reform in Malaysia, main financial institutions including commercial and investment banks, securities companies and insurance companies, are integrated to 10 groups. Such integration and reorganization are effective for promoting the removal of regulations and barriers between the types of businesses. In this sense, we can say the present financial reform in

Malaysia is taking an appropriate step for realizing economies of scope.

On the other hand, our analytical result suggests several problems about the present financial reform in Malaysia. First is related to the technological progress of the banks. In the process of reorganization of banks in Malaysia, a measure to strengthen the capital power of banks is being taken, allowing banks to make active investments. The promotion of technological progress and improvement in production efficiency are expected through this action. However, according to the result of our econometric analysis, technological progress was not observed in Malaysia in the 1990's, suggesting that Malaysian domestic banks were making unproductive capital investments. Therefore, in expanding investments in the future, Malaysian commercial banks need to pay attention to preventing not only waste expenditures such as those on pompous stores, but also over-investment. We can say that screening investments with high productivities has become more important than ever.

Second is related to the grouping of financial institutions. According to our analytical result, cost efficiencies of anchor banks are generally low. In selecting the core of the group, it is important to have as criteria not only the efficiency of management, but also the management scale and the form of business organization, etc. However, if the anchor bank's management efficiency is low, there remains a doubt as to whether the group can operate efficient management. Thus, after the reorganization, the anchor bank is expected to put more effort on efficient management.

Third is related to market competition. While 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 competition with foreign banks. In this market environment, it would not be surprising if Hicks's "quiet life hypothesis" held good. In other words, it may be that there was little incentive for domestic banks to implement serious management streamlining measures because the market environment was favorable for domestic banks during the 1990s.

If the strengthening of a competitive market environment is an important factor for improving the management structure of banks, there is a problem left in the financial reform of Malaysia because even after the Asian crisis, severe restrictions were imposed on foreign banks as pointed out by (Shutou, 1998, 2001; Masuyama, Vandenbrink and Yue, 1999). As we mentioned above, these market regulations may restrict competition and prevent the improvement in management efficiency of Malaysian domestic commercial banks. The question of how to secure the incentives for improving the operational efficiency will become an important issue for the financial reform in

Malaysia [xxii].

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Figure 1 DEA and SEA

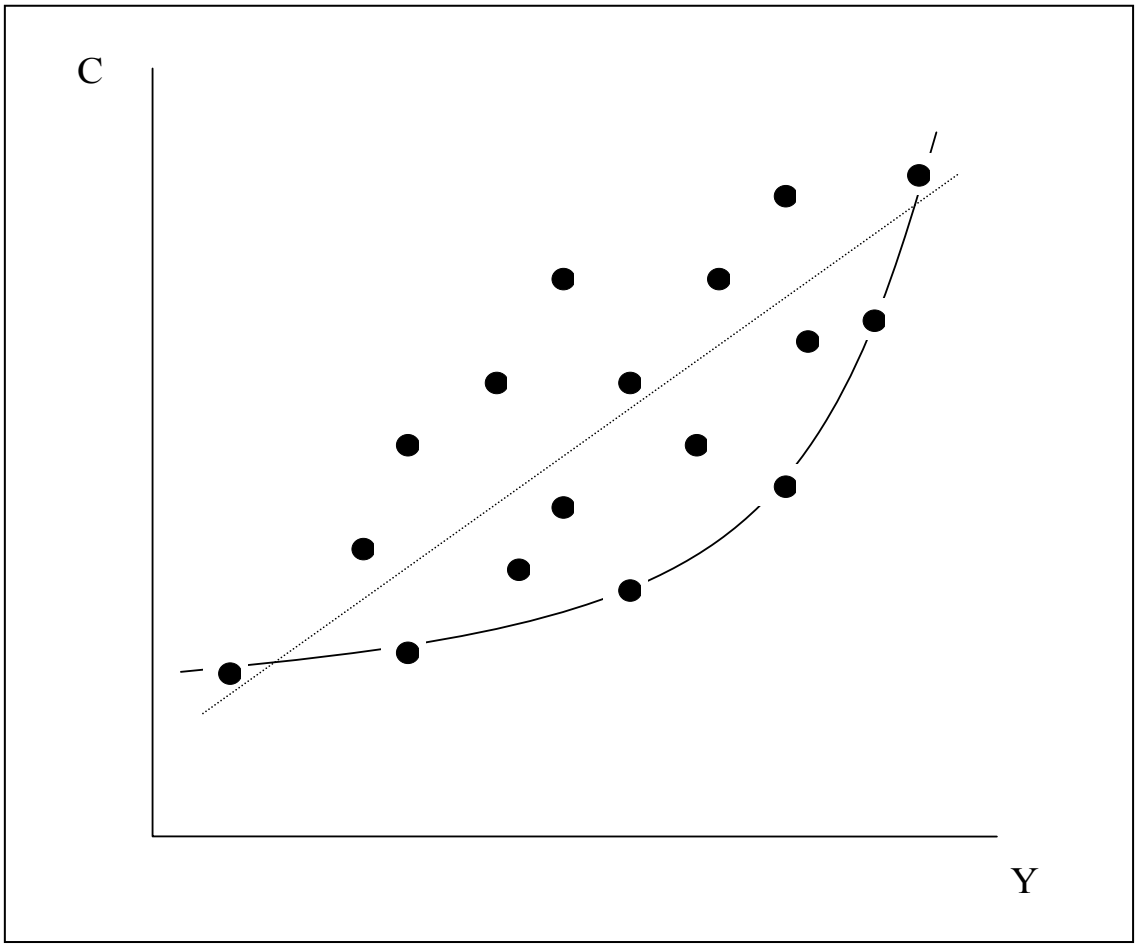

Table 1 NPL Ratio of Domestic Commercial Banks

(%)

Large Banks	
Malayan Banking Bhd.	2.410
Bank Bumiputra Malaysia Bhd.	15.650
Public Bank Bhd.	1.100
RHB Bank Bhd.	3.200
Bank of Commerce (M) Bhd.	4.490
Perwira Affin Bank Bhd.	5.100
Hong Leong Bank Bhd.	4.200
Southern Bank Bhd.	5.000
Multi-Purpose Bank Bhd.	4.000
Average	5.017
Small Banks	
Pacific Bank Bhd.	4.910
Oriental Bank Bhd.	12.200
Ban Hin Lee Bank Bhd.	4.270
Bank Utama (Malaysia) Bhd.	7.060
Hock Hua Bank Bhd.	5.500
BSN Commercial Bank (Malaysia)Bhd.	9.890
Eon Bank Bhd.	6.120
Sabah Bank Bhd.	12.700
International Bank MalaysiaBhd.	8.360
Wah Tat Bank Bhd.	4.200
Average	7.512

(Source) Annually issued reports of individual banks.

Table 2 Estimation Results of Cost Function (Ⅰ)

Parameter	Estimated Value	t-statistic
α_1	0.625	8.350***
α_2	0.159	2.867***
β_1	0.794	100.113***
β_2	0.176	24.868***
β_3	0.030	15.275***
λ_T	0.231	3.062***
λ_{TT}	-0.111	-4.432***
λ_{TP1}	-0.041	-2.975***
λ_{TP2}	0.033	2.656***
λ_{TP3}	0.008	2.391***
Economies of scale		0.784
Wald statistics		20.599
Economies of scope		0.099
Wald statistics		13.979

(Notes)*, **, and *** represent significance of 10%, 5%, 1%

Table 3 Cost Inefficiency of Individual Banks (Ⅰ)

Ranking for Total Assets	Name of Bank	Cost Inefficiency	Ranking for Cost Efficiency
1	Malayan Banking Bhd.	1.960	12
2	Bank Bumiputra Malaysia Bhd.	2.167	16
3	Public Bank Bhd.	2.751	19
4	RHB Bank Bhd.	1.562	7
5	Bank of Commerce (M) Bhd.	1.901	11
6	Perwira Affin Bank Bhd.	2.171	17
7	Hong Leong Bank Bhd.	1.816	9
8	Pacific Bank Bhd.	2.051	14
9	Oriental Bank Bhd.	1.895	10
10	Multi-Purpose Bank Bhd.	1.000	1
11	Southern Bank Bhd.	1.387	3
12	Ban Hin Lee Bank Bhd.	2.078	15
13	Bank Utama (Malaysia) Bhd.	1.689	8
14	BSN Commercial Bank (Malaysia)Bhd.	1.469	5
15	Hock Hua Bank Bhd.	1.462	4
16	Eon Bank Bhd.	2.007	13
17	Sabah Bank Bhd.	1.472	6
18	International Bank MalaysiaBhd.	2.410	18
19	Wah Tat Bank Bhd.	1.142	2

Table 4 Estimated Results of Cost Function (Ⅱ)

Parameter	Assumption2		Assumption3		Assumption4	
	Estimated Value	t-value	Estimated Value	t-value	Estimated Value	t-value
α_1	0.627	8.207***	0.619	8.143***	0.573	7.170***
α_2	0.152	2.700***	0.154	2.742***	0.164	2.727***
β_1	0.794	100.011***	0.794	100.097***	0.794	99.970***
β_2	0.176	24.884***	0.176	24.877***	0.176	24.856***
β_3	0.030	15.273***	0.030	15.273***	0.030	15.281***
λ_T	0.277	3.626***	0.359	4.690***	0.288	3.609***
λ_{TT}	-0.137	-5.221***	-0.161	-6.026***	-0.126	-4.540***
λ_{TP1}	-0.042	-3.043***	-0.041	-2.975***	-0.042	-3.021***
λ_{TP2}	0.034	2.723***	0.033	2.656***	0.033	2.695***
λ_{TP3}	0.008	2.426***	0.008	2.392***	0.008	2.447***
Economies of scale		0.779		0.773		0.737
Wald statistics		20.872		22.344		27.719
Economies of scope		0.095		0.096		0.094
Wald statistics		12.174		12.728		13.513

(Notes)*, **, and *** represent significance of 10%, 5%, 1%

Table 5 Cost Inefficiency of Individual Banks (Ⅱ)

		Assumption2		Assumption3		Assumption4	
Name of Bank (in order of Total Assets)		Cost Inefficiency (Ranking for Cost Efficiency)		Cost Inefficiency (Ranking for Cost Efficiency)		Cost Inefficiency (Ranking for Cost Efficiency)	
1	Malayan Banking Bhd.	2.446	(18)	2.526	(18)	3.017	(19)
2	Bank Bumiputra Malaysia Bhd.	2.542	(19)	2.544	(19)	2.892	(18)
3	Public Bank Bhd.	2.181	(17)	2.241	(17)	2.562	(17)
4	RHB Bank Bhd.	1.935	(15)	1.981	(15)	2.254	(16)
5	Bank of Commerce (M) Bhd.	1.956	(16)	1.992	(16)	2.226	(15)
6	Perwira Affin Bank Bhd.	1.643	(12)	1.667	(12)	1.827	(12)
7	Hong Leong Bank Bhd.	1.552	(10)	1.577	(10)	1.728	(10)
8	Pacific Bank Bhd.	1.674	(13)	1.695	(13)	1.833	(13)
9	Oriental Bank Bhd.	1.740	(14)	1.734	(14)	1.847	(14)
10	Multi-Purpose Bank Bhd.	1.342	(5)	1.361	(5)	1.478	(6)
11	Southern Bank Bhd.	1.296	(3)	1.310	(3)	1.404	(3)
12	Ban Hin Lee Bank Bhd.	1.605	(11)	1.625	(11)	1.749	(11)
13	Bank Utama (Malaysia) Bhd.	1.443	(8)	1.450	(9)	1.532	(9)
14	BSN Commercial Bank (Malaysia)Bhd.	1.441	(7)	1.439	(7)	1.509	(8)
15	Hock Hua Bank Bhd.	1.311	(4)	1.324	(4)	1.420	(5)
16	Eon Bank Bhd.	1.444	(9)	1.448	(8)	1.497	(7)
17	Sabah Bank Bhd.	1.379	(6)	1.366	(6)	1.406	(4)
18	International Bank MalaysiaBhd.	1.251	(2)	1.245	(2)	1.253	(2)
19	Wah Tat Bank Bhd.	1.000	(1)	1.000	(1)	1.000	(1)

Table A1 Average Loan-Deposit Ratio of Domestic Commercial Banks

(%)

Large Banks	
Malayan Banking Bhd.	92.850
Bank Bumiputra Malaysia Bhd.	82.543
Public Bank Bhd.	48.200
RHB Bank Bhd.	112.033
Bank of Commerce (M) Bhd.	89.100
Perwira Affin Bank Bhd.	91.117
Hong Leong Bank Bhd.	79.283
Southern Bank Bhd.	83.633
Multi-Purpose Bank Bhd.	84.100
Average	84.762
Small Banks	
Pacific Bank Bhd.	87.900
Oriental Bank Bhd.	105.517
Ban Hin Lee Bank Bhd.	75.017
Bank Utama (Malaysia) Bhd.	78.883
Hock Hua Bank Bhd.	75.150
BSN Commercial Bank (Malaysia)Bhd.	168.680
Eon Bank Bhd.	89.483
Sabah Bank Bhd.	84.417
International Bank MalaysiaBhd.	79.717
Wah Tat Bank Bhd.	93.583
Average	93.8347

(Source) Annually issued reports of individual banks

Table A2 Basic Statistics

	C	Y1	Y2	P1	P2	P3
Mean	505313.450	662061.140	74780.970	0.047	26.503	0.231
Standard Deviation	79167.320	1062686.100	117860.610	0.009	5.769	0.211
Minimum	15311.000	19803.000	1927.000	0.029	17.061	0.023
Maximum	4963725.500	6803066	647278.600	0.076	48.699	1.395

Table A3 Settlement Date of Domestic Commercial Banks

Name of Bank (in order of Total Assets)	Settlement Date
Public Bank Bhd.	December
Bank of Commerce (M) Bhd.	
Perwira Affin Bank Bhd.	
Hong Leong Bank Bhd.	
Pacific Bank Bhd.	
Multi-Purpose Bank Bhd.	
Southern Bank Bhd.	
Ban Hin Lee Bank Bhd.	
Bank Utama (Malaysia) Bhd.	
Hock Hua Bank Bhd.	
Eon Bank Bhd.	
Sabah Bank Bhd.	
International Bank MalaysiaBhd.	
Wah Tat Bank Bhd.	
Bank Bumiputra Malaysia Bhd.	March
Oriental Bank Bhd.	
Malayan Banking Bhd.	June
RHB Bank Bhd.	June, December
BSN Commercial Bank (Malaysia)Bhd.	

(Source) Annually issued reports of individual banks

[i] This is the revised version of the authors' paper which was presented at the 8th convention of EAEA at Kuala Lumpur, Malaysia, on November 3-5, 2002.

[ii] In Journal of Economics and Business (1998) No. 50 (2), the financial deregulation is featured and the influences of financial deregulation policies on the banks in Korea and Thailand are analyzed by (Leightner and Lovell, 1998; Gilbert and Wilson, 1998) respectively.

[iii] Regarding the banking sector of the ASEAN countries, there is one recent study done by (Laeven, 1999). Regarding the analysis of the Malaysian banking sector from the macroeconomics viewpoint, refer to (Demirguc-Kunt and Huizinga, 2000; Ghani and Suri, 1999).

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

[v] It is said that the management policies of individual banks are also reflected in their loan-deposit rates. 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 favors risks sometimes uses the deposits it has absorbed to extend reckless loans. Thus, banks with conservative stances tend to have a low loan-deposit ratio relative to reckless banks.

[vi] Regarding the loan-deposit ratio of Malaysian domestic commercial banks, according to Table A1, the average loan-deposit ratio of the large banks is generally lower than that of the small banks. However, major difference 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. 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 of banks to liquidity risks.

Table A1 Average Loan-Deposit Ratio of Domestic Commercial Banks

[vii] Refer to (Hori, 1998) for details.

[viii] Loan loss provision is calculated in the annual reports of commercial banks. For the sum of non-performing loans, we used the data of Bank Negara Malaysia, Monthly Statistical Bulletin.

[ix] In developed countries, empirical studies on economies of scale and economies of scope have progressed since the financial deregulation of the 1980's. The representative study that verified both economies of scale and economies of scope are (Gilligan and Smirlock, 1984; Gilligan, Smirlock, and Marshall, 1984). Moreover, (Kasuya, 1993) pointed out that economies of scope are being observed more and more with the progressing of financial deregulation.

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

[xi] 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.

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

[xiii] All notations have the same representations as the ones used in the previous section.

[xiv] This is a strong assumption that the efficiency of each bank is not changed throughout the observation period. However, in order to keep the degree of freedom in the case of small sample, it is a necessary assumption.

[xv] Using the "within-estimation," the unbiased estimates of parameters can be estimated without specifying the distribution of μ_i.

[xvi] 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.

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

[xvii] "Economies of scale" and "economies of scope" 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 an important policy objective in the Philippine financial reforms.

[xviii] See (Kasuya, 1993) for more detailed discussion.

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

[xx] In Malaysia, a commercial bank is unable to operate business in the securities market. Thus it is difficult to realize economies of scope by diversification.

[xxi] The financial system of England, the suzerain of Malaysia, strongly influenced the financial system of Malaysia: the scope of business of commercial banks and merchant banks had been divided strictly （Bank Negara Malaysia, Money and Banking in Malaysia：1994）. The main businesses of commercial banks consisted only of short-term commercial finance businesses (deposit-taking business, loan business and domestic and foreign exchange business), and securities business was prohibited. On the other hand, the merchant bank was permitted to conduct both banking and securities businesses. The scope of business of a merchant bank was broader than that of a commercial bank (main businesses of a merchant bank were deposit-taking business, loan business, factoring business, lease business, acceptance of bills, listing agent business, investment advisory service etc), and a merchant bank was obligated to have their fee income occupy more than 30% of the total income. This financial system may have restricted the diversification of business of commercial banks in Malaysia.

[xxii] It is said that the Malaysian banking market was under various forms of strong government influence till the 1980s. This may also be hampering the streamlining of bank management.