

THE PRODUCTION TECHNOLOGY OF PHILIPPINE DOMESTIC BANKS IN THE PRE-ASIAN CRISIS PERIOD: ESTIMATION OF COST FUNCTION IN THE 1990-96 PERIOD*

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Abstract

This is to analyze the operational behavior and technical progress among Philippine domestic banks, using micro-level data on individual banks. First, we summarize their major business activities and gain insight on how the structure is changing. Then, we formally estimate the cost function of Philippine domestic banks using panel data covering a seven-year period (1990-96). The presence of economies of scale and economies of scope is investigated and technical progress in the banking industry is measured. In addition, the results of analysis for the Philippines are compared with those of similar studies on Thailand conducted by the author previously.

Key Words: Economies of scale; Economies of scope; Cost function; Banking; Philippine
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I. Introduction

The Asian crisis dealt a major economic blow to all ASEAN countries, although, the Philippine economy escaped comparatively lightly. The financial sector in particular, was

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hardest hit in other ASEAN countries, and many financial institutions failed, whereas in the Philippines, financial institutions continued to operate despite the difficult economic situation and only a few went bankrupt. Like its neighboring countries, the Philippines had promoted a policy of financial liberalization and opened its financial market to foreign investors but unlike those in Thailand and Indonesia, financial institutions in the Philippines had a comparatively robust management structure that was able to withstand the crisis.

Along with the appropriate macroeconomic policy¹ there were historical reasons why the financial sector in the Philippines did not suffer to the extent of its neighboring countries, Thailand and Indonesia. In the early 1980s, the Philippines led other ASEAN countries in initiating a full-scale financial liberalization policy and in the second half of the 1980s, the country started to implement a structural adjustment policy with the aid of the World Bank and other overseas organizations. As a result, the management structure of financial institutions in the country was substantially improved; in terms of prudential regulations when the Asian crisis occurred, the capital asset ratio in the Philippines was the highest among neighboring countries. It is significant that the financial sector in the Philippines continued to grow under this strict market discipline in the 1990. As shown in Table 1, these financial reform policies were ultimately intended to achieve efficient allocation of resources through sound-market competition based on self-responsibility of financial institutions.²

In the Philippine economy, financial regulations were tightened and the management structure of financial institutions was improved through a structural adjustment policy, a policy that was similar to the policies implemented in neighboring countries following the Asian crisis. An analysis of the structure of the financial sector in the Philippines would suggest what effects the financial regulations currently being introduced in each ASEAN country will have on the production structure of the respective financial institutions of each country in the future and on the nature of the financial structures that will be formed. The case example of the Philippines will have implications for financial administration in the financial sector of developing countries in the global economy.

This paper analyzes the operational behavior and technical progress among Philippine domestic commercial banks, which constitute the country's core financial institutions, using micro-level data on individual bank. The central issues to be considered are how the production and cost structure of local commercial banks changed as market competition intensified, and what effects the country's prudential regulations, which were more stringent than those in other neighboring countries, had on the production activities of local commercial banks. In addition, the distinctive features of the results of the analysis for the Philippines and their implications for policy-making are examined in comparison with similar studies on Thailand conducted by the author previously.³

In order to examine these issues, a formal econometric analysis using panel data is conducted in this paper. Such an analysis is essential for understanding the characteristics of the Philippine banking industry under financial reforms, and supplements the findings in

¹ First, there had been no excessively large flows of private short-term funds into the financial market in the country. Secondly, exchange rates had shown relatively major fluctuations and therefore, the financial institutions had become extremely wary of exchange risks. Thirdly, the Philippine government had implemented a healthy macroeconomic policy. These macroeconomic factors cannot be disregarded.

² See Gochoco-Bautista (1999) and Milo (2000) for more details.

³ Okuda and Mieno (1999) investigates the production technology of Thai commercial banks.

TABLE 1. CHRONOLOGY OF MAJOR FINANCIAL REFORMS: 1989-1996

<i>Further Deregulation of interest rates</i>	
1994	Revision of the Central Bank rediscount system. Elimination of prohibition of interest payment to demand deposits.
<i>Deregulation of operational regulations and competition-promoting policy</i>	
1989	Measures to promote competition among banks. Abolition of regulation of opening new branches in preferentially treated agricultural area. Unification of legal reserve ratios
1990	Abolition of moratorium of new entry by domestic banks. Raising the minimum paid-in capital of savings banks. Approved off-site ATMs.
1991	Liberalization of regulation on opening bank branches. Approval of opening branches across the country was given to agricultural bank. Measure to promote bank mergers/consolidation. The Central Bank's approval became unnecessary for installing ATM in areas where branch does not exist.
1992	Measure to promote the opening of branches.
1993	Deregulation of ATM installation criteria
1994	Liberalization of market entry by foreign banks. Reduction of required equivalent capital for opening branches for savings banks
<i>Deregulation of Foreign Exchange Transaction</i>	
1992	Raised the ceiling on the ratio of foreign exchange holding to receipts from exports to 40%. Abolition of foreign exchange regulation as a principle
1993	Further deregulation measures of foreign exchange transactions. Suspension of debt-equity swap
1994	Liberalization of foreign bank entry
<i>Maintenance of credit order and relief of financial institutions</i>	
1990	Raised minimum paid-in capital of savings banks.
1991	Raised minimum paid-in capital of enlarged commercial banks and commercial banks. Measure to promote bank mergers and consolidation
1992	Rural Bank Act of 1992.
1993	Capital ratio, liquidity and profitability and sound management became criteria for approving the opening of bank branches. The New Central Bank Act was enacted. Legal reserves were introduced to common trust funds.
1994	Revision of minimum paid-in capital for savings banks.
1995	Increase in the minimum paid-in capital for banks. Thrift Bank Act of 1995

Source: Paderanga (1996) and Bangko Sentral ng Pilipinas, *Annual Report*, various issues.

macroeconomic studies on the Philippine financial reform policies.⁴ The investigation period of this study spans from 1990 to 1996. The year 1990 marks the year when the deregulation policies were re-instated, and it was during this period that the Philippine banking industry experienced steady growth under restored macroeconomic stability. The year 1996 was one year before the Philippine economy was hit by the Asian crisis.

The organization and outline of this paper are as follows. In Section 2, we briefly describe the production technology of the banking industry and the behavior of banking institutions. Then, using financial data on the domestic commercial banks, we summarize their major

⁴ Among the major studies, Lamberte and Lim (1992), Lamberte and Lalanto (1995), and Paderanga (1996), Abola (1999) overviewed the process of financial reforms in relation with financial development in the Philippines. Gochoko (1989), Tan (1991) Ravallo (1993), investigated the financial market structure. However, no one except Lamberte (1982, 1983) and Tolentino (1986) examined rigorously, and Unite and Sullivan (2001) the production technology of Philippine commercial banks.

business activities and gain insight on how the structure is changing. In Section 3, we estimate the cost function of Philippine domestic banks using panel data covering a seven-year period (1990-96). The presence of economies of scale and economies of scope will be investigated formally and technical progress in the banking industry will be measured. In Section 4, using the estimated results, the production technology of Philippine banking industry will be discussed in comparison with the Thai banking industry. Lastly, Section 5 concludes by evaluating progress in rationalization and efficiency gains for Philippine banks following the financial reforms.

II. *Changes in Production Activities of Domestic Commercial Banks*

Before estimating the cost function in the following two sections, we look at the shifting production activities of domestic banks in the economic analytical framework. First, we will summarize banking activities, then outline the recent features of the Philippine domestic banking industry from four viewpoints: change in products, input of factors, price of factors, and cost and profit. These arguments will provide a basis for the subsequent formal estimation analysis and interpretation of the results.

A. *Production Activity of Banks*⁵

Just like other industries, a bank can be thought of as an organization that uses factors of production as inputs and produces financial services as outputs. Bank products are financial services provided through various business operations. These services include extending loans, issuing deposits, dealing with foreign exchange, trust operations, and many others. Major factors of production include funds raised through various forms, physical capital, and labor.

According to Clark (1984), the production activities of a bank can be summarized formally by the production function $F: R_{m+n} \rightarrow R$. Here, $Y = (Y_1, Y_2, \dots, Y_m)$ and is an m -dimensional vector of the bank's outputs. $Q = (Q_1, Q_2, \dots, Q_n)$ is an n -dimensional vector of the bank's inputs.

$$F(Y, Q) = 0 \quad (1)$$

$P = (P_1, P_2, \dots, P_n)$ and is an n -dimensional vector of each factor price. If F is a strictly convex structure, a unique multi-product joint cost function C given by equation (2) can be constructed. Function C is homogenous of degree one, non-decreasing, and concave in P . Since duality exists between the production function F and the cost function C , either function contains the same information about the bank's production technology.

$$C = C(Y, P) = \min P \cdot Q \quad (2)$$

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 a number of studies beginning with Gilligan and Smirlock (1984) and Gilligan et al (1984), economies of scale and economies of scope can be observed in the banking

⁵ The analytical framework is basically the same as the one used in Okuda and Mieno (1999).

industry of industrialized countries.

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

Economies of scope emerge 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 skills⁶ and banks maintain similar information on customer profiles. Therefore, physical capital such as branch networks, computer systems, and personnel can be utilized jointly without congestion.

Over time, progress in technology will be seen as the major source of reducing bank operating cost. For example, new technologies such as on-line computer systems and ATM help reduce the operating cost. New technologies also allow the banks to increase their income and expand product services into new fields such as the credit card business, telephone banking, and virtual banking.

In the following analysis in Section 3 we will focus on these three factors of production technology. Production technology is also the major policy target of recent financial reforms in the Philippines. We will look at the existence of economies of scale and scope and the characteristics of technical progress in the Philippine banking industry.

B. Outputs of Philippine Domestic Banks

If banks can meet the changing needs of financial services that arise from the relaxing of financial regulations, banking operations will become multi-faceted. The Philippines eased its banking regulations and introduced universal banking in the early 1980s. As a result, the volume of off-balance sheet business operations⁷ in the Philippine banking sector grew, unlike the situation in other ASEAN countries. This illustrates the importance of fee-based businesses in recent banking operations.

Looking at the Philippine domestic banking industry, we need to categorize the financial services. This is necessary in order to appropriately examine both the traditional loan business based on balance sheet, and the fee-based business accompanied by off-balance sheet transactions. In examining bank business operations in the simplest way, we divide the financial services of the Philippine banks into two categories: the first is the so-called loan business category, or services that accompany traditional bank loan extending operations. The other is the fee-based business category, or all other activities that center around fee-based banking services.

In the previous study, the amount of bank outputs was usually measured in three different ways: firstly in terms of the outstanding value of bank assets (loans extended); secondly, in

⁶ These skills include skills of screening, monitoring, and handling customers.

⁷ Such business operations include the use of foreign currency deposits to extend foreign currency loans, the use of trust accounts in securities investment, etc. See Lambelte (1993) for more details.

TABLE 2. SHARE OF NON-INTEREST INCOME TO TOTAL INCOME: $Y_2/(Y_1+Y_2)$ (%)

	1990	1991	1992	1993	1994	1995	1996
Large	22.4	15.7	18.6	23.0	17.8	16.9	16.9
Medium	25.2	18.9	22.4	22.4	17.9	19.1	17.7
Small	27.9	15.0	21.5	21.1	17.3	18.4	17.8

Source: Annual reports issued by individual banks, various issues.

terms of the number of operations (i.e. number of deposit accounts); and thirdly, in terms of bank income (i.e. interest or non-interest income). However, the amount of fee-based business cannot be measured by the first or the second method. In this study, we measure the sum of bank products by the current income of banks: Y_1 is the output of loan business which is measured by the interest income from loans, securities and deposits; and Y_2 is the output of fee-based business measured by the sum of commissions and fees.

Table 3 shows the diversification of bank operations. This is indicated by the ratio of revenues unrelated with loan business to total bank revenues, $Y_2/(Y_1+Y_2)$. According to this table, the indicator exceeded 20% in the second half of the 1980s, higher than the other countries in the region and even higher than some developed countries. In the following discussions, we classify Philippine commercial banks into three categories, large, medium, and small, according to the size of their total assets. This gives nine large-sized banks, eight medium-sized banks, and the remaining are small-sized banks. The names of banks and their categories are listed in Appendix A.

However, a high diversification ratio for Philippine banks may have been exaggerated on account of special economic circumstances. In the late 1980s, large volumes of high-yield Treasury Bills were issued due to the growing budget deficit. This occurred while corporate demand for funds remained low in face of the economic slump. As a result, banks shifted their portfolios from loans to public securities, and thus the diversification ratio rose.⁸

Interestingly in Table 2, this ratio shows a declining trend even though financial reform progressed in the 1990s. The surge in bank loans contributed to this trend as the economy turned around in the 1990s. The ratio of loan revenues to total revenues can be considered to be returning to a normal level, which may indicate that previous bank operations actually reflected of a distortion in the economy.

C. Factor Inputs

Using Kasuya (1993) as a reference, in this study we assume three major inputs of factors in banking activities: raised funds Q_1 , labor Q_2 , and banks' physical capital Q_3 . The funds are raised through deposits and other types of borrowings. Physical capital consists of branch office buildings and business equipment such as computer systems, on-line systems, etc. Labor includes bank tellers, managers, and executive officers. The three factors, Q_1 , Q_2 , and Q_3 , are measured respectively by the total amount of borrowed funds, the number of banks' employ-

⁸ Two reasons for high diversification ratio among Philippine banks are commonly mentioned: (1) Trust business ratio is high; its operations are biased towards wealthy clients. (2) Non-lending income is bolstered by the sale of collateral (usually real estate) from bad debts. See Okuda (1996) and Paderanga (1996).

TABLE 3. PHYSICAL CAPITAL PER EMPLOYEE: Q_3/Q_2 (million Peso)

	1990	1991	1992	1993	1994	1995	1996
Large	0.30	0.35	0.40	0.43	0.48	0.57	0.74
Medium	0.13	0.19	0.28	0.31	0.35	0.51	0.61
Small	0.11	0.14	0.22	0.26	0.35	0.50	0.49

Source: Same as Table 2.

ees, and fixed assets belonging to banks.

Judging from Table 3, one notable change in the recent pattern of factor inputs among Philippine banks is the steadily increasing trend of capital-labor ratio (physical capital per bank employee) Q_3/Q_2 . While both inputs of labor and physical capital have risen continuously, the rate of increase is faster for physical capital, indicating that the banking industry is moving toward a more capital-intensive structure.

Against the background of policies that were aimed at rejuvenating economic growth and competition-promoting measures such as new branch office de-regulations, ATM and branch office openings have increased rapidly. Modernization investments such as on-line computer networks have also been on the rise. New services based on new technology such as ATM, telephone and virtual banking, have become important for attracting customers in the more competitive market.⁹ Large banks have a higher rate of new service offerings than small and medium-sized banks, an indication of a more capital-intensive production method. However, in terms of the relative speed of increase in new services, small and medium-sized banks outstrip the large banks.

According to Table 4, changes in the factor productivity of Philippine banks correspond to those in the factor input ratio. Average labor productivity, $(Y_1 + Y_2)/Q_2$, improved significantly from the end of the 1980s to the early 1990s, though it has remained stagnant since. However, if adjusted for price changes, the improvement has been moderate. Productivity has always been higher in large banks than in small and medium-sized banks, illustrating the superior labor productivity of large banks. Average productivity of physical capital $(Y_1 + Y_2)/Q_3$ rose at the end of the 1980s, but declined in the 1990s. The fluctuation in the productivity of physical capital for small and medium-sized banks is even greater than in large banks.

Comparing banks of different sizes, large banks having higher capital-labor ratio than small and medium-sized banks. Large banks also engage in more capital intensive operations. Their capital-labor ratio is high, resulting in the highest labor productivity among the three types of banks. Like the large banks, the small and medium-sized commercial banks have also increased physical capital investment, hence the steady rise in the capital-labor ratios.

However, these banks still have lower ratios relative to large banks, and their operations are more labor intensive. Although they have exceeded large banks in the productivity of physical capital, the gap narrowed significantly in the 1990s. Large banks are gradually enjoying an advantageous position in factor productivity.

⁹ See, for instance, Paderanga (1996).

TABLE 4. CHANGE IN AVERAGE FACTOR PRODUCTIVITY

Ratio of total income to borrowed funds (%) : $(Y_1 + Y_2)/Q_1$							
	1990	1991	1992	1993	1994	1995	1996
Large	18.4	17.6	15.7	13.4	12.8	13.0	13.6
Medium	18.7	20.5	15.5	14.2	13.3	14.5	13.9
Small	23.6	21.6	17.5	17.2	17.4	13.2	12.9
Average productivity of labor (million Peso) : $(Y_1 + Y_2)/Q_2$							
	1990	1991	1992	1993	1994	1995	1996
Large	1.59	1.72	1.65	1.51	1.63	2.21	2.77
Medium	1.29	1.41	1.30	1.27	1.35	1.80	2.34
Small	0.96	0.97	1.00	1.25	1.37	1.43	1.52
Average productivity of physical capita : $(Y_1 + Y_2)/Q_3$							
	1990	1991	1992	1993	1994	1995	1996
Large	5.24	4.99	4.08	3.52	3.59	3.46	3.72
Medium	9.93	7.24	4.71	4.10	3.91	3.53	3.79
Small	8.98	6.93	3.98	4.82	4.03	2.88	3.11

Source: Same as Table 2.

D. The Change in Costs of Factors

The movements of factor prices are summarized in Table 5. Price of raised funds P_1 is measured by average interest rate on banks borrowed funds. P_1 is calculated by $P_1 = (\text{Total interest expense}) / \{(\text{Deposits}) + (\text{Borrowing from financial institutions}) + (\text{Other debts})\}$. It is generally believed that large banks have advantages over small banks with the ability to raise low-cost funds through their deposits, with the help of extensive branch office networks. In the Philippines however, the cost of raising funds is higher for large banks with a large number of branch offices, so some large banks borrow from small banks in order to compensate for lack of funds.

Savings deposits account for a major part of bank deposits in the Philippines, yet interest rates are extremely low and almost always negative in real terms. In fact, real fund-raising costs have been negative except for one period and stayed well below regional standards. Fund shortages in large banks and negative real deposit rates are key features of the Philippine banking industry.

Judging from Table 5, we can observe that while the price of labor P_2 kept rising, the price of physical capital P_3 did not change discernibly. P_2 and P_3 are measured respectively by average wage of bank employees and average rental rate. They are calculated by $P_2 = (\text{Payroll expenses}) / (\text{Number of bank employees})$ and $P_3 = \{(\text{Equipment expenses}) + (\text{Premise expenses})\} / (\text{Fixed assets})$. The rise in wages can be attributed to the recovery of the Philippine economy in the 1990s. This resulted in wide-spread activities for senior and junior bank executives. The wage rise has also been attributed to the entry of new foreign banks into the domestic market, intensifying competition among local and foreign banks for experienced employees.¹⁰

¹⁰ Interviews conducted by the authors reveals that general office workers have lower wages than public servants. Headhunting activities do not apply to these workers. See Okuda (1996).

TABLE 5. CHANGE IN FACTOR PRICES

Price of raised funds (%) : Total Interest Expenses/ Q_1							
	1990	1991	1992	1993	1994	1995	1996
Large	9.35	8.81	6.81	4.97	5.23	5.74	6.00
Medium	7.68	9.74	6.75	5.71	5.15	5.81	6.17
Small	8.98	9.75	7.29	6.05	5.59	5.31	5.25
Price of labor (thousand Peso) : Total Payroll Expenses/ Q_2							
	1990	1991	1992	1993	1994	1995	1996
Large	159.5	186.0	203.2	215.6	226.3	293.9	338.4
Medium	148.1	153.6	166.9	186.7	198.2	257.8	285.6
Small	139.4	147.9	143.2	171.1	172.8	192.6	200.1
Average Cost of Physical Capital (%) : Equipment Expenses/ Q_3							
	1990	1991	1992	1993	1994	1995	1996
Large	30.4	28.8	27.6	30.2	30.4	24.7	23.7
Medium	38.3	29.7	31.1	35.3	40.5	22.5	21.1
Small	35.4	33.3	33.1	36.3	35.5	23.2	23.8

Source: Same as Table 2.

The highest average wage is found in the large banks, and the lowest average wage is found in the medium-sized banks. Although wage levels have risen in real terms, there has been no change in the wage structure; the larger the bank, the higher the wage. While it is difficult to conceive an appropriate cost-indicator of physical capital, no clear difference is observable among banks of different sizes.

It appears that changes in the relative price of labor and physical capital correspond to the change in factor intensity. Relative cost of labor keeps growing, suggesting that the change in relative factor prices may help explain the shift toward a more capital-intensive production structure.

E. Operating Costs and Profits

The composition of bank operating expenses is shown in Table 6 using the formula of operating expense ratios. Concerning operating expenses of Philippine banks, the largest share is taken up by fund-raising cost P_1Q_1 , followed by payroll expenses P_2Q_2 , and equipment cost P_3Q_3 . The fund-raising cost is the total interest expenses due to total borrowed funds. The personnel expenses are the sum of salaries and employees' benefits. The equipment expenses are the sum of amortization and depreciation. The income of total operating cost C is calculated by the sum of these three expenses.

According to Table 6, the composition of the ratio of bank operating expenses to total costs varies greatly in the Philippines. This is caused mainly by fluctuations in the fund-raising cost. Interest rates in the Philippines rose in the early 1990s, which led to an initial rise in the ratio of fund raising cost $P_1Q_1/(Y_1+Y_2)$ and later, a decline. In contrast to the ratio of fund raising cost, the ratio of payroll expense $P_2Q_2/(Y_1+Y_2)$ and the ratio of equipment expense $P_3Q_3/(Y_1+Y_2)$ were relatively stable. When we compare these ratios for banks of different

TABLE 6. OPERATING EXPENSE RATIOS

Ratio of fund-raising expense to total income (%) : $P_1Q_1/(Y_1+Y_2)$							
	1990	1991	1992	1993	1994	1995	1996
Large	50.7	50.2	43.2	37.5	41.0	44.2	44.3
Medium	40.7	48.5	44.1	40.2	39.0	40.3	44.3
Small	39.7	44.8	42.3	36.4	32.5	41.9	41.9
Ratio of payroll expense to total income (%) : $P_1Q_2/(Y_1+Y_2)$							
	1990	1991	1992	1993	1994	1995	1996
Large	10.5	11.2	12.8	14.7	14.1	13.3	12.3
Medium	12.3	11.4	13.7	15.4	15.2	14.5	13.3
Small	14.8	15.9	16.1	15.3	13.9	13.8	12.7
Ratio of equipment expense to total income (%) : $P_3Q_3/(Y_1+Y_2)$							
	1990	1991	1992	1993	1994	1995	1996
Large	5.6	5.7	6.8	8.7	8.6	7.4	6.8
Medium	4.0	4.5	7.3	9.3	9.8	6.2	5.2
Small	3.7	4.8	8.5	9.3	9.8	8.8	8.5

Source: Same as Table 2.

sizes, large banks have lower payroll expense ratio, suggesting higher labor productivity. With respect to ratios for fund-raising and equipment expense, no consistent trend is observable as the ranking changed for all groups at different time periods.

The sum of the ratios of fund raising cost, payroll expense and equipment expense relative to total income is found to be less than 60%. This is due to the fact that a high implicit tax is levied upon bank operating incomes; for instance, the reserve requirement reached exceeded 20% in the Philippines.

As illustrated in Table 7, while the profit ratio of total assets rose in the early 1990s, it later decreased. The profit was measured in terms of the net income before tax, which is equal to operating income before tax minus operating expense. Comparing the change in the profit ratio of banks of different sizes, large banks are the most profitable. Small and medium-sized banks often experience volatile fluctuations in their profits, suggesting unstable business.¹¹

III. *The Estimation of Cost Function: A Shift of Bank Cost Function over Time and Technical Progress*

The previous section suggests that domestic banks in the Philippines are diversifying their business operations and expanding their branch networks, as well as actively investing in modernization in response to the recent financial reforms and new market competition. 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 section, the production structure of the

¹¹ Comparing with the profit ratio in OECD countries, the averaged profit rate in the Philippines was neither extremely high nor extremely low.

TABLE 7. RATIO OF BEFORE TAX NET INCOME TO TOTAL ASSETS (%)

	1990	1991	1992	1993	1994	1995	1996
Large	2.92	2.91	2.83	2.54	2.33	2.21	2.47
Medium	3.42	3.03	2.42	2.20	2.17	2.46	2.24
Small	3.94	3.21	2.52	3.30	3.29	2.24	2.61

Source: Same as Table 2.

cost function of the Philippine banking industry will be investigated in a formal econometric analysis.

A. The Estimated Cost Function

In order to handle the small sample problem, we compile the cross-section data throughout the observed period so as to estimate the Philippine commercial banks' cost function using the panel data.¹² 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).¹³ The t -th ($t=1,2,\dots,M$) period-cost function for the i -th ($i=1,2,\dots,N$) bank is assumed to be represented by the trans-log cost function with three factors and two products (3).¹⁴ Assume further that the operating efficiency in equation (3) differs from bank to bank, and that the efficiency factor for the i -th bank is a stochastic variable μ_i , where $\mu_i \geq 0$, $Var(\mu) = \sigma^2$. 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.

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

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 weak concavity in factor prices which is satisfied by (4d). Furthermore, to ensure a sufficient degree of freedom in the 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).

¹² 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.

¹³ For more details in time trend approach, see Caves et al. (1981).

¹⁴ All notations have the same representation as the ones used in the previous section.

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

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

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

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

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

The trans-log cost function (3) has a general form in the sense that the restrictions of "economies of scale," "economies of scope," and "Hicks neutrality" with respect to technical change are not imposed.¹⁵ 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 formula (5) for the cost function $C = C(\ln Y_1, \ln Y_2, \ln P_1, \ln P_2, \ln P_3)$. 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 $\alpha_1 + \alpha_2 = 1$.

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

Second, "economies of scope" will be tested. "Economies of scope" exist if the following complementarity of scope holds.¹⁶ In other words, if the value of formula (6) is strictly less than zero, then economies of scope exist. As mentioned 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 $\alpha_{12} + \alpha_1\alpha_2 < 0$. "Economies of scope" will be tested by using the maximum likelihood test for the hypothesis that the cost function (3) satisfies $\alpha_{12} + \alpha_1\alpha_2 = 0$.

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

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 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 ($j=1, 2, 3$) factor.

¹⁵ Promotion of these economies and technical progress was generally recognized to be the important policy objectives in the Philippine financial reforms. See Gochoco-Bautista (1999).

¹⁶ See Kasuya (1996) for more detailed discussion.

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

C. Estimation Method

For statistical estimation, since the unbiased estimates of parameters can be obtained without specifying the distribution of μ_i , the method of "within estimation" will be used.¹⁷ 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.¹⁸ In the actual estimation process, the procedure is first to estimate equation (3) given constraints (4a), (4c), (4d), and (4e).¹⁹ Then the consistency of the estimated parameters with constraint (4b) is checked.

D. Data Used

Data used in the estimation are based on the financial statements issued by the banks themselves at the end of each fiscal year. The financial data of individual banks listed at the stock market are available from the Philippine Stock Exchange. The number of bank employees for each bank is taken from various issues of *A Study of Commercial Banks in The Philippines*, published annually by SGV & Co.²⁰ Data availability of individual banks are summarized in Table A1 in Appendix. The sources of data and the calculation of individual variables used in the estimation are presented in Table A2 in Appendix.

One of the basic difficulties in estimating the cost function of the Philippine banking industry is the availability of data. First, the number of domestic banks is limited. Although new banks have been entering the market since the 1990s, the total number of domestic commercial banks was thirty five even in 1996. Moreover, since it is difficult for us to collect data on many small-sized banks, the data actually available is mainly that of large-sized banks. Second, except for relatively large-sized banks, data is not available for the whole period except for a limited number of banks. For the remaining small banks, available data is fragmented in intermittent periods. Third, some small banks that newly entered the domestic banking business in the 1990s differ from the existing banks in their scope of business and cost structure.²¹

¹⁷ Using the "within-estimation," the unbiased estimates of parameters can be estimated without specifying the distribution of μ_i .

¹⁸ 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.

$$\frac{P_i X_i}{C_{it}} = \beta_j + \beta_{ki} \ln P_{ki} + \gamma_{jk} \ln Y_{ki} + \lambda_{TP_j} T$$

¹⁹ In the actual estimation process, we assumed $\beta_{jk} = 0$, which is the sufficient condition for (4d). See Kasuya (1996) for details.

²⁰ Sycip Gorres Velayo & Co. is one of the largest accounting and consulting company in the Philippines and is a member firm of Arthur Andersen & Co.

²¹ Some new small-sized banks operate as deposit-taking companies. These banks simply re-lend the funds to other large banks or invest in public bonds. These new banks seem to lack the ability to operate banking business.

In order for our analysis to be credible, it is more appropriate to select a data set that covers domestic private commercial 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 the SUR method, annual panel data from 1990 to 1996 for the fifteen banks is used; the other banks were excluded from the estimation, since data is not available for the entire observation period as shown in Table A1 in Appendix.

D. Results of Estimation

The estimated results using the panel data during the 1990-1996 period are given in Table 8. Table 8 is the estimated result of equation (3) with all variables included. In general, the fitness of the estimation in Table 8a is fairly good, and no variable has the theoretically opposite sign with high statistical significance. For some estimated parameters, $\alpha_1, \beta_1, \beta_2, \beta_3, \lambda_T, \lambda_{TP1}, \lambda_{TP2}, \lambda_{TP3}$, their signs fulfill the theoretically predicted signs and significance conditions. For the remaining estimated parameters, they do not have the opposite signs with highly statistical significance.

Economies of scale were observed from the fact that coefficient estimates in the observation period fulfill the condition $\alpha_1 + \alpha_2 < 1$. The statistical significance of this observation was tested by using the likelihood chi-square test for the hypothesis that the cost function (3) is constant return to scale, $\alpha_1 + \alpha_2 = 1$. The computed chi-square statistics for this hypothesis was 27.171 with one degree of freedom. Since the critical value at the 0.01 level is 6.63, economies of scale are accepted at the 0.01 significance level.

The calculated value of the conditioning formula satisfies $\alpha_{12} + \alpha_1\alpha_2 < 0$, which implies that economies of scope were observed. For testing the observation, the likelihood chi-square test for the hypothesis that the cost function (3) satisfies $\alpha_{12} + \alpha_1\alpha_2 = 0$ was used. The computed chi-square statistics for this hypothesis was 24.717 with one degree of freedom. Since the critical value at the 0.01 level is 6.63, economies of scope were observed at the 0.01 significance level.

As described in the financial analysis of Section 2, investments in physical capital have been on the rise since the 1990s, as the country prepares itself for future market competitions. Responding to the new market circumstances, Philippine domestic banks expanded their branch networks and invested in modernization such as on-line computer systems and ATM installations.

Recent investment in modernization in the Philippine banking industry is incurring a significant fixed cost. This suggests two things. Firstly, large fixed costs imply decreasing average cost, that is economies of scale. Secondly, physical capital such as branch networks and computer systems can be shared jointly by different operations without congestion, which implies economies of scope. As in industrial countries, the banking industry is intrinsically characterized by economies of scale and economies of scope in the Philippines.

Technical progress was calculated by formula (7). According to (7), the yearly reduction in the operating cost λ_T during the observation period of seven years was 0.032. Among the coefficients in formula (7), the parameters of all intersection terms of time and factor prices $\lambda_{TP1}, \lambda_{TP2}, \lambda_{TP3}$ have high statistical significance. This suggests two interesting things. Firstly, the observed technical progress of the Philippine domestic banks is of the fund saving type ($\lambda_{TP1} < 0$). This observation suggests that the Philippine domestic banks cautiously suppressed

TABLE 8. ESTIMATED RESULTS

Observation periods: annual data during the 1990-1996 period			
Variables	Parameter	Estimated value	(t-value)
Y1	α_1	0.476	6.543***
Y2	α_2	0.126	2.900***
Y1Y1	α_{11}	0.218	0.759
Y1Y2	α_{12}	-0.218	-0.769
Y2Y2	α_{22}	0.159	0.943
P1	β_1	0.738	39.804***
P2	β_2	0.186	14.568***
P3	β_3	0.076	7.734***
T	λ_T	-0.032	-5.603***
TT	λ_{TT}	-	-
TP1	λ_{TP1}	-0.029	-3.509***
TP2	λ_{TP2}	0.013	2.197***
TP3	λ_{TP3}	0.017	3.752***
Economies of scale		0.984*** (LR statistics=27.171)	
Economies of scope		-0.005*** (LR statistics=24.717)	
Technical progress		0.032 (annual average of cost reduction)	
Bias in technical progress (in the Hicks' sense)		fund-saving ($\lambda_{TP1} < 0$) labor using ($\lambda_{TP2} > 0$) physical capital using ($\lambda_{TP3} > 0$)	

Note: *, **, and *** represent significance level of 10%, 5%, and 1%

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 labor as well as physical capital using bias ($\lambda_{TP2} > 0$, $\lambda_{TP3} > 0$). As shown in Section 2, expansion in physical capital in response to intensifying market competition and rising cost of labor resulted in the improvement in labor productivity. As production became more capital intensive, however physical capital productivity declined in the 1990s, while labor productivity rose parallel to this development. Even though Philippine banks increased their investment in modernization in the 1990s, 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 operating cost that resulted from improvements in labor productivity. Consequently, production technology became more capital as well as labor-intensive.

IV. Comparison with Thai Domestic Banks

The financial analysis of Philippine domestic banks (section 2) and the estimation of their cost functions (section 3) have revealed several features characterizing the production and cost structure of Philippine domestic banks. This section briefly compares these features regarding the business operations of Philippine domestic banks with those of Thai commercial banks. The features of Thai commercial banks come from the study of Okuda and Mieno (1999) on the microeconomic behavior of Thai domestic banks using a similar analytical framework.

A. Comparison of Business Operations

The market circumstances surrounding domestic banks in the Philippines and Thailand in the 1990s were rather similar. In both countries, a series of financial reforms were undertaken in the late 1980s and 1990s, which were strongly characterized by competition-promoting policies. And their macroeconomic environments were favorable: Thailand experienced high economic growth and the Philippines achieved a certain degree of economic stability. While the market competition intensified in the banking sector, favorable business chances expanded for domestic banks.

In response to this change in the market environment, domestic banks shifted their business operations. Based on our discussions in the previous sections and Okuda and Mieno (1999), Table 9 summarizes the changes in business operations of Thai and Philippine domestic commercial banks. From this table, we can see the similarities and the differences between the Philippines and Thailand.

Regarding the similarities, in both countries, domestic commercial banks increased their investments in modernization and expanded their branch networks. At the same time, the production of banking services become more capital intensive in both countries. Corresponding to the change in the capital-labor ratio, labor productivity improved significantly. However, in comparison with Thai domestic banks, the Philippine banks lagged far behind in their capital-labor ratio as well as in their labor productivity.

Regarding the differences, while the business operations of Thai domestic banks diversified in the 1990s, the operational income of Philippine domestic banks became more heavily dependent on the traditional loan business. Although domestic banks in the Philippines earn a higher proportion of non-interest income compared with Thai banks, the share of non-interest income in their total operational income tended to decline in the mid 1990s. The second difference is that whereas the profit ratio measured in terms of ROA rose in Thailand, it fell in the Philippines.

The first observation suggests that as Philippine macroeconomic conditions improved in the 1990s, the Philippine domestic banks expanded the volume of their loan business. The second observation suggests that the total assets of the Philippine domestic banks expanded more rapidly than their operating income. This reflects the intensive effort of domestic banks to enhance their capitalization in response to the intensifying prudential regulations imposed in the 1990s.

B. Comparison of Estimated Cost Functions

Table 9 shows that both the Philippine and Thai domestic banks experienced economies of scale and technical progress. In this sense, the Philippine domestic banks share basic similarities with Thai domestic banks. However, the type of technical progress of domestic banks observed in the Philippines differs from that in Thailand.

First, economies of scale were observed in the Philippines but not in Thailand. The business diversification of Thai domestic banks was so primitive that it did not help reduce the cost of business operations. In contrast to Thailand, the Philippine banks earned a higher proportion of non-interest income under the universal banking system and achieved better cost performance.

TABLE 9. PRODUCTION STRUCTURE OF PHILIPPINE AND THAI DOMESTIC BANKS

	Philippine		Thailand	
Principal indexes of production activities				
Observation period	1990-1996		1985-1993	
Capital-labor ratio (thousand Bhat/Peso)	<i>large</i>	190 → 740	<i>large</i>	210 → 710
	<i>medium</i>	110 → 610	<i>medium</i>	220 → 450
	<i>small</i>	120 → 490	<i>small</i>	220 → 710
Labor productivity (thousand Bhat/Peso)	<i>large</i>	820 → 2770	<i>large</i>	1340 → 2490
	<i>medium</i>	690 → 2340	<i>medium</i>	1070 → 2400
	<i>small</i>	600 → 1520	<i>small</i>	980 → 1850
Share of non-interest income (%)	<i>large</i>	23 → 17	<i>large</i>	4 → 10
	<i>medium</i>	25 → 18	<i>medium</i>	5 → 8
	<i>small</i>	24 → 18	<i>small</i>	6 → 9
ROA (%)	<i>large</i>	2.0 → 2.5	<i>large</i>	0.7 → 2.3
	<i>medium</i>	1.8 → 2.2	<i>medium</i>	0.5 → 1.6
	<i>small</i>	1.8 → 2.6	<i>small</i>	0.5 → 1.4
Characteristics of production technology				
Observation period	1990-1996		1985-1993	
Economies of scale	observed		observed	
Economies of scope	observed		not observed	
Technical progress	observed		observed	
	fund-saving type		labor-saving type	
	labor-using type			
	physical capital-using type			

Source: For the Philippines, Tables contained in this paper. For Thailand, Okuda and Mieno (1999)

Secondly, while the technical progress among Thai banks was of a labor-saving type, the technical progress among the Philippine banks was of a fund-saving type. In both countries, intensifying market competition in the 1990s prompted the domestic banks to invest in modernization and branch networks, which raised the labor productivity. However, since the financial regulations, such as capital adequacy ratio and required reserved ratio, were more stringent in the Philippines than in Thailand, the Philippine banks responded to the intensifying market competition by minimizing the expansion of assets. This business behavior helped improve the rate of return on banks' raised funds, which resulted in technological progress of the fund-saving type.

V. Conclusions

A. Summary

As the Philippines entered the 1990s, and as its macroeconomic environment achieved a certain degree of stability, various financial reform measures were once again undertaken. The primary thrust of these reforms is competition-promoting policy. In response to this change in the environment, domestic banks in the Philippines are making vigorous investments, trying to modernize and expand their branch networks.

A changing picture of the banks' business operations can be observed from the financial data in Section 2. First, as production became more capital intensive, the capital-labor ratio consistently declined. Second, the average productivity of labor rose parallel to this development, while average productivity of physical capital declined. And third, the relative price of labor in the factor market rose.

It is widely recognized that banking involves economies of scale and economies of scope as its characteristics. Setting the objective of realizing these economies, in the early 1980s the Philippines took the lead among the ASEAN countries in introducing universal banking. The results of econometric investigation in Section 3 indicate the existence of economies of scale as well as economies of scope for thirteen relatively large-sized domestic banks.

While it has often been cited that the banking industry in the Philippines has an oligopolistic market structure and cost-minimization is not fully realized, the findings fulfill the expected characteristic of such a market in this respect. The results of econometric estimation in Section 3 indicate that both economies of scale and economies of scope exist.²² Similar to banking industries of developed countries, the Philippine banking industry fulfills the expected characteristics of banks' production technology.

Section 3 concludes that technical progress among the Philippine banks is of a labor and physical capital using type. As stated earlier, intensifying market competition has prompted domestic banks to actively make new investments. The findings in Section 3 show that Philippine banks expanded their investment in modernization in the 1990s. This improved the labor productivity, but deteriorated the productivity of physical capital. Expansion in physical capital in response to competition was so rapid that the increase in the cost of physical investment overwhelmed the reduction of operating cost that resulted from improvements in labor productivity.

The technical progress of Philippine commercial banks is also characterized by a fund-saving type. Intensifying market competition gives the Philippine domestic banks strong incentive to suppress expansion of their loan assets to satisfy the stringent financial regulations such as minimum capital adequacy ratio and minimum required reserved ratio. Such efforts include enlarging the off-balance sheet transactions and capitalizing loan assets. These business behaviors help improve the rate of return on banks' raised funds, which results in technological progress of the fund-saving type.

B. Remarks for Further Investigation

Our study has shed some light on production technology in the Philippine banking industry in the 1990s using econometric analysis. However, the examination reflects several limitations. First, the results are strongly sample dependent. The number of banks involved in our econometric analysis is limited to fifteen relatively large banks and only balance sheet information obtained from the banks is used. Secondly, the results are dependent on the analytical approach. While our estimation analysis follows the stochastic parametric approach, there are alternative approaches to measure the technology of the banking industry. Thirdly,

²² It is necessary that in the future, the financial authorities will continue to make further efforts and will take measures to prompt mergers and integration of banking institutions. One possible way of achieving this goal is to open the financial sector to foreign financial institutions with high potential to enter the market at any time and to keep the market competitive.

our results are dependent on assumptions. Since it is difficult to discuss appropriately the factors of risk, uncertainty and incomplete information, our analysis does not take into account the quality of bank outputs. Our estimation analysis, like many other previous studies, assumes perfect competition in the markets.

Our findings are inconclusive and should be followed by further investigation using different analytical methodologies. Further research would expand our study to include other measures of bank outputs and inputs and take into account factors such as the quality of bank outputs and imperfect competition in markets.

REFERENCES

- Abola, V. A. (1999), "Evolution of the Philippine Financial System," in: Masuyama, Seiichi, Donna Vandenbrink, and Chia Siow Yue eds., *East Asia's Financial Systems: Evolution & Crisis*, Singapore: Institute of Southeast Asian Studies, pp.166-199.
- Caves, D.W., L.R. Christensen, and M.W. Tretheway (1981) "U.S. Trunk Air Carriers, 1972-1977: A Multilateral Comparison of Total Factor Productivity," in: Cowing, T. G. and R. E. Stevenson eds., *Productivity Measurement in Regulated Industries*, New York: Academic Press.
- Clark, J.M. (1984) "Estimation of Economies of Scale in Banking Using a Generalized Functional Form," *Journal of Money, Credit and Banking* 16, pp.28-45.
- Gilligan, T.W. and M. L. Smirlock (1984) "An Empirical Study of Joint Production and Scale Economies in Commercial Banking," *Journal of Banking and Finance* 8, pp.67-77.
- Gilligan, T.W. and M. L. Smirlock, and W. Marshall (1984) "Scale and Scope Economies in the Multiproduct Banking Firm," *Journal of Monetary Economics* 13, pp.393-405.
- Gochoko, M. S. H. (1989) "Financial Liberalization and Interest Rate Determination: The Case of the Philippines, 1981-1985," *Working Paper*, No.89-06, Manila: Philippine Institute for Development Studies.
- Gochoco-Bautista, M. S. (1999) "The Past Performance of the Philippine Banking Sector and Challenges in the Postcrisis Period," in Asian Development Bank ed. *Rising to the Challenge in Asia: A study of Financial Markets, Volume 10 Philippines*, Manila: Asian Development Bank, pp.29-78.
- Kasuya, M. (1996), *Nihon no Kinyukikan Keiei (Management of Financial Institutions in Japan)*, Tokyo: Toyokeizai-shinpo-sha.
- Lamberte, M. B. (1982), "Behavior of Commercial Banks: A Multi-product Joint Cost Function Approach," Ph.D. Dissertation submitted to the School of Economics, Quezon City: University of the Philippines.
- Lamberte, M. B. (1983) "Outputs and Inputs of Philippine Commercial Banks," *Journal of Philippine Development* 10, pp.129-145.
- Lamberte, M. B. (1993), "Assesment of the Financial Market Reforms in the Philippines, 1980-1992," *Journal of Philippine Development* 20 (No.2), pp.231-262.
- Lamberte, M. B. and G. M. Llanto (1995), "A Study of Financial Sector Policies: The Philippine Case," in Zahid, S.N. ed. *Financial Sector Development in Asia: Country Study*, Manila: Asian Development Bank.
- Lamberte, M. B. and J. Y. Lim, R. Vos, J. T. Yap, E. S. Tan, and M. S. V. Zingapanan (1992),

- Philippine External Finance, Domestic Resource Mobilization and Development in the 1970s and 1980s*, Manila: Philippine Institute for Development Studies.
- Leyland, E.H. and D. H. Pyle, (1977), "Information asymmetries, Financial Structure, and Financial Intermediation," *The Journal of Finance*, pp.371-387.
- Milo, M. M. R. S. (2000) "Analysis of the State of Competition and Market Structure of the Banking and Insurance Sectors," *PASCN Discussion Paper*, PASCN DP2000-11, Manila: Philippine Institute for Development Studies.
- Paderanga, C. (1996) "Philippine Financial Developments: 1980-1995," in Favella, R. and K. Ito ed., *Financial Sector Issues in the Philippines*, Tokyo: Institute of Developing Economies.
- Okuda, H. and Mieno F. (2001), "What happened to Thai Commercial Banks in the Pre-Asian Crisis Period: Microeconomic Analysis of Thai Banking Industry," *Hitotsubashi Journal of Economics* 40 (No.2), pp.97-122.
- Ravalo, J. N. E. (1993) "Interest Rate Spreads in A Theory of Financial Economics," unpublished paper.
- Tan, E. (1991) Interlocking Directorates, "Commercial Banks, and Other Financial Institutions and Non-financial Corporations," *Discussion Paper* No.9110, Quezon City: School of Economics, University of the Philippines.
- Tolentino, V. B. J. (1986) "Economies of Scale in Philippine Financial Intermediaries," *The Philippine Economic Journal* 3 & 4, pp228-275.
- Unite, A. A. and M. Sullivan, "The Impact of Liberalization of Foreign Bank Entry on the Philippine Domestic Banking Market," mimeo.

APPENDIX

TABLE A1. DATA AVAILABILITY OF INDIVIDUAL BANKS

[Large Banks]
Metropolitan Bank*; Bank of The Philippine Islands*; Philippine Commercial Int. Bank*; Far East Bank & Trust Company*; Rizal Commercial Banking Corp.*; United Coconut Planters Bank*; Allied Banking Corporation*; Equitable Banking Corp.*; China Banking Corp.*
[Medium Banks]
Union Bank of the Philippines*; Citytrust Banking Corp.(96); Solidbank Corp.*; Security Bank*; Prudential Bank*; Banco de Oro Commercial Bank(90,91,92,95); Philippine Bank of Communications*; Asian bank Corp.(95)
[Small Banks]
Piltrust Bank(90,91,92); International Corporate Bank(93,94,95); Traders Royal Bank*; Pilipinas Bank; Philippine Banking Corp.(90,91); Urban Bank Inc(90,91); Bank of Commerce(90,91); Philippine Veterans Bank(90,91,92); East West Banking Corp.(90,91,92,93)

Note: * -the banks which are involved in the estimation analysis in Section 3.

()-the year when data is not available

TABLE A2. SOURCE OF DATA

Items	Source of Data
(1)Income from loans, securities,and deposits, (2) Commissions and fees, (3)Total interest expense, (4)Payroll expenses, (5)Equipment expenses, (6) Premise expenses, (7)Deposits, (8)Borrowing from financial institutions, (9)Other debts, (10)Fixed assets, (11)Total assets before tax	The annual reports of individual banks listed at the Philippine Stock Exchange, various issues. The annual reports are available from the Philippine Stock Exchange.
(1)Number of bank employees	Sycip Gorres Velayo & Co., <i>A Study of Commercial Banks in The Philippines</i> , various issues.

TABLE A3. SUMMARY STATISTICS ON COST OUTPUTS, AND INPUT PRICES

Variable	Symbol	Mean	Std Dev	Maximum	Minimum
Operating cost	C	1674.510	1345.948	6133.568	170.180
Output of Loan busines	Y1	2123.852	1723.473	8394.991	206.089
Output of Fee-based business	Y2	479.016	405.572	2171.353	54.605
Price of raised funds	P1	0.068	0.021	0.132	0.038
Price of labor	P2	0.116	0.022	0.163	0.063
Price of physical capital	P3	0.304	0.149	1.061	0.058