Chapter 2

LITERATURE REVIEW

The literature review is divided into three parts: a survey of the role of finance in economic development; a survey of financial institution efficiency; and a survey of studies examining economies of both scale and scope in Thailand.

2.1 Role of finance in economic development

Financial development plays a positive role and significantly contributes to economic growth. For example, Irving Fisher (1930) demonstrated that an efficient financial market will benefit the economy by optimizing both the consumption and investment decisions of economic units. However, the role of financial intermediates in accelerating economic growth in lesser developed countries (LDCs) has gone unrecognized. Some of the pioneering work in this area includes Patrick (1966), Gurley and Shaw (1967), Goldsmith (1969), and McKinnon (1973). Among these economists, Gurley and Shaw propose the testable "supply-leading" hypothesis, stating that the creation of financial services is a necessary pre-condition for sustained economic growth. This hypothesis has been thoroughly tested through many empirical studies, but the answer is still unclear.

Aphimeteetamrong (1980) was motivated by the works of these economists and studied the contributions financial development made to Thailand's economic growth during the period of 1962-1977. He investigated the relationships between financial development and economic growth by using correlation analysis. The relationships were evaluated in terms of the changes in gross domestic product (GDP) and the changes in financial intermediation variables such as outstanding financial assets of the nation, financial savings mobilized by financial institutions,

total assets of financial institutions, and domestic credits. He also evaluated the importance of financial institutions by measuring the ratios of financial variables to GDP, the distribution of credits extended to different sectors, and the distribution of credits and deposits classified by geographical area. The results from his study indicate that the development of financial institutions has a positive relationship with economic growth. Aphimeteetamrong also concluded that as resource allocations shifted, more funds were allocated to international and domestic trade than to the manufacturing and agricultural sectors. Judging from commercial bank credit, he also concluded that commercial banks, despite being the most important financial institution, played a relatively minor role in the development of rural areas and in reducing socioeconomic disparities. The overall results seem to support the hypotheses postulated by the earlier studies of Gurley and Shaw (1955, 1960, 1967), Goldsmith (1969), and Wai (1967).

Gurley and Shaw hypothesized that as countries experienced economic growth, financial asset ratios would rise accordingly. However, these relationships may differ in each developing country. Goldsmith (1969) studied the relationship between financial development and economic growth. The major finding shows that financial assets in most countries increased along with the process of economic growth and the ratios of financial assets in developing countries are lower than in developed countries. In the study by Wai (1967), the regression models are constructed to study the influence of financial intermediation on national savings. The results show that there are significant positive correlations between financial intermediation and savings in developed countries; the correlations are less clear cut for developing countries.

Jansen (1990) used Thailand as a case study but used an approach different from the one taken by Aphimeteetamrong (1980). Jansen argues that the causes and effects of financial development cannot be meaningfully analyzed at the level of macroeconomic aggregates such as the rate of growth or aggregate savings. Effects should instead be studied at the microeconomic level. Her paper follows a structuralist approach, individually examining the main sectors of the

economy during the years 1960-1986. All indicators in the study show financial development in Thailand has progressed rapidly over that 25 year span. The key aspects of growth in financial intermediation are: 1) the rise in the household saving ratio and the growing share of household savings deposited in financial institutions; and 2) the increasing role in financial intermediation played by international financial markets in Thailand. Jansen noted that the major microeconomic problem for Thailand during 1960-1986 was the structural imbalance in the public sector. The large public sector borrowing requirements were met by borrowing abroad, leading to larger current account deficits and higher foreign debt. The paper suggests reducing the public sector deficit as a means to correct the structural imbalance. Jansen concludes that an optimal financial policy may be designed only when the sectoral allocation function of the financial system is recognized and the patterns of intersectoral flows of funds are identified.

Many recent studies explored empirical testing of the two competing schools of thought ("supply-leading" and "demand-following") to clarify the relationship between financial development and growth as introduced in Patrick (1966). Darrat, Labarge, and Labarge (1989) employed the method of Granger causality testing with Akaike's final prediction error (FPE) criterion to test for the nature of the causality linkage between financial and economic growth in four Asian countries: Hong Kong, Singapore, Taiwan and South Korea. The authors argue that the FPE criterion determines the appropriate lag length for each variable, overcoming the biased results from using common lag length for all variables. The variables used in the test are: real economic growth as represented by the annual percentage change in real gross domestic product (GDP); the financial variable is represented by a proxy--the annual percentage change in the ratio of broad money assets (M2) to nominal GDP. Export expansion and inflationary expectation are included in the analysis to gain more insight and avoid the problem of omitted variables. These two variables are represented by the annual percentage change in real exports and the annual percentage change in the GDP deflator. Since the Granger causality tests require a stationary series with zero mean, all the variable were expressed in logarithmic first-difference form and a

constant term is included in all regressions. The empirical results show that there is no uniform pattern for economic growth across these four countries. Strong support for the "supply-leading" approach is found only in Hong Kong but strongly rejected in South Korea. Singapore and Taiwan provide only minor support. The authors do, however, suggest use of a simultaneous-equation model instead of single equation for future research.

Hill (1992) examined the various stages of banking development to find some implications for economic development. Hill's paper draws on the stages theory of banking proposed by Chick (1983 and 1988) and Chick and Dow (1988). Hill examines the causal relationship between financial development and economic growth with the Granger causality test. Hill shows that financial development shifts from supply-leading to demand-following when the banking sector has developed past Stage 2 (the development of markets for some non-bank financial instruments) into a well-integrated financial system. The variables representing financial development are the currency ratios and monetization ratios; real per capita GDP represents economic growth. Hill notes that financial development and economic development are closely linked, especially in the early stages of financial development. Given this interdependence, Hill suggests that some government intervention designed to enhance bank liabilities would be justifiable.

King and Levine (1993), drawing on the work of Schumpeter (1911), pose the question of whether higher levels of financial development are significantly correlated with faster current and future rates of economic growth, physical capital accumulation, and economic efficiency improvement. The authors construct four variables to represent financial development: the ratio of liquid liabilities to GDP, the ratio of deposit money bank domestic assets to deposit money bank domestic assets plus central bank domestic assets, and two variables measuring the ratio of claims on the non-financial private sector to GDP: 1) credit issued to private non-financial firms divided by total credit (excluding credit to banks); and 2) credit issued to private non-financial

firms divided by GDP. Another four variables are defined to represent economic growth: real per capita GDP growth, the rate of physical capital accumulation, the ratio of domestic investment to GDP, and a residual measure of improvements in the efficiency of physical capital allocation. King and Levine conduct both pure cross-country and pooled cross-country analyses covering the period 1960-1989. The database includes about 80 countries. Using simple correlation analysis, the results show the financial indicators are strongly and significantly correlated with each economic growth indicator. Based on their investigation, the authors state that:

> *"Although we will note some qualification, the evidence suggests that the predetermined component of financial development is a good predictor of long-term growth and that financial development predicts both the rate of physical capital accumulation and the rate of improvement in the efficiency with which economies allocate physical capital..."* (King and Levine, 1993, p. 730).

Thus, they conclude that the development of financial services have an influence on economic growth.

Sheide (1993) analyzes the effect of external capital on economic growth by applying the simple regression equation with the ratio of net external assets to GNP as an explanatory variable and real per capita GDP as the dependent variable. The sample of 116 countries is divided into two subgroups: industrial countries and highly indebted countries. The results do not show any relationship between external capital and growth in the high debt countries as has been hypothesized before. However, the results can vary due to the different time frames in the analyses. Chowdhury (1994) also studied the impact of external debt on economic growth. The Granger causality tests are applied to data from Asia and Pacific countries. Among the mixed results reported in the study, the results for Thailand and Sri Lanka indicate no feedback relationship exists between external debt and growth. The primary conclusion of the study is that the external debt of developing countries does not cause an economic slowdown.

Sharma and Dhakal (1994) test the Granger causality linkages between exports and economic growth in developing countries in the framework of a multivariate model. The variables used in the output model are domestic output, exports, labour, and capital while the variables used in the exports model are exports, domestic output, exchange rate, and foreign output. The sample countries are divided into three groups: low-, middle-, and upper middle-income countries. The study time frame is from 1960-1988. Even though the results cannot identify a systematic pattern of the relationship among the sample sizes, most outcomes support the hypothesis that exports are the leading factor of economic growth. The authors conclude that both exports and growth rate can be caused by the underlying economic policies.

De Gregorio and Guidotti (1995) re-examine the empirical relationship between financial development and long-run growth. The study uses the ratio of bank credit extended to the private sector to GDP as a representative measure of financial development. The authors argue that this ratio has more advantages than the commonly used measures of monetary aggregates such as M1, M2, or M3. The ratio of bank credit extended to the private sector to GDP shows the volume of funds allocated to the private sector. The authors feel that their definition of financial intermediation *"...should be more closely related to the level and efficiency of investment, and hence to economic growth..."* (De Gregorio and Guidotti, 1995, p. 438). The study uses Barro's (1991) data set which includes other explanatory variables of human capital accumulation based on primary and secondary school enrollment ratios in 1960, GDP per capita in 1960, the average level of government spending over GDP, and Barro's proxies for political instability. These variables plus the financial variable and average GDP per capita growth as dependent variables are estimated using ordinary least square (OLS). The sample comprises about 100 countries during the years 1960-1985. The main result is that financial development positively effects long-run economic growth. However, this effect varies between countries and over time.

When the original sample was divided into high-, medium-, and low-income countries and into a smaller sub-period (1970-1985), the authors found that the effect of financial development on growth is smaller in the high-income countries and the correlations between financial development and growth during 1970-1985 is weaker than the whole period. After adding the volume of investment in the regression equations, the results show that the effect of financial development on the volume of investment is large only in the high-income countries. These results suggest that the positive effect is due to the efficiency of investment (the allocation of funds to the best possible use) rather than level of investment.

De Gregorio and Guidotti also conduct a similar test on the panel data of 12 Latin American countries used by De Gregorio (1992). In this test, they find that financial development has a negative effect on economic growth. However, this observation may be explained by the recent extreme financial liberalization experiments undertaken in these countries coupled with a poor regulatory environment which led to massive overlending in the banking system. Thus, the negative relationship also results from the negative effect of the efficiency of investment rather than the level of investment.

The recent study by Aretis and Demetriades (1997) examined the relationship between financial development and economic growth by introducing the role of stock market development as new evidence of financial deepening. The samples include two countries: Germany and the United States and the data required in the analyses consists of four variables: the logarithms of real GDP per capita, the stock market capitalization ratio, the index of stock market volatility, and the logarithm of the ratio of M2 to nominal GDP. The last variable only applies for Germany. For the United States, the fourth variable is the logarithm of the ratio of domestic bank credit to nominal GDP. Quarterly data for the variables listed above were collected for the period 1979 (first quarter) - 1991 (fourth quarter).

The Johanson cointegration analyses were conducted and the results are mixed. Germany tends to reflect a unidirectional relationship leading from financial development to growth. In the United States, there is not sufficient evidence to support this supply-leading hypothesis; instead the evidence suggests that the demand-following hypothesis results from the positive contribution GDP makes to both bank and stock market development. The authors also study the impact of financial liberalization by using Korea as a case study and the results of the study show financial repression has a positive effect on financial development and growth. Despite the illustrative results as claimed by the authors, this paper strongly suggests the application of time-series analyses rather than the cross-sectional estimation techniques. In addition, the role of the stock market should be included in the future analysis of economic growth.

2.2 *The efficiency of financial institutions*

This dissertation also examines the impact of financial development on investment efficiency where development is defined as the allocation of funds to the best possible use. As mentioned before, the traditional function of a financial system is to act as an intermediary. By performing their task, financial institutions can collect and analyze information from many potential investors, placing themselves in a position where they can choose to lend to the best investors and make investments be more efficient.

In Thailand, as in many other developing countries, commercial banks are the major component of the financial system and most financial development takes place in the banking industry. Thus, the more efficient these institutions, the more we can expect investment and growth.

In general, efficiency means doing something as well as possible. One way to assess the efficiency of a firm is to analyze economies of scale and economies of scope. Murray and White (1983) introduce the use of a translog cost function to evaluate the scale and scope economies of credit unions in Canada. Unlike many earlier studies that rely on the Cobb-Douglas production process (Benston, 1965, and Bell and Murphy, 1968 for example), Murray and White recognize the multiproduct nature of financial institutions. Thus, the translog cost function is derived from the cost minimized function. However, it should be noted that this cost function assumes the outputs as exogenous variables, *i.e.* perfect competitive markets. By using a Taylor series expansion the cost function can be written as:

$$\ln C = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln y_i + \sum_{j=1}^{m} \beta_j \ln p_j + \tfrac{1}{2}\sum_{i}^{n}\sum_{k}^{n} \sigma_{ik} \ln y_i \ln y_k + \tfrac{1}{2}\sum_{j}^{m}\sum_{h}^{m} \gamma_{jh} \ln p_j \ln p_h + \sum_{j}^{n}\sum_{j}^{m} \delta_{ij} \ln y_i \ln p_j \quad \text{----- (3)}$$

The homogeneity condition is satisfied when:

$$\sum_{j}^{m} \beta_j = 1$$
$$\sum_{j}^{m} \delta_{ij} = 0$$
$$\sum_{j}^{m} \gamma_{jh} = 0$$

The economies of scale are measured by differentiating the cost function (3) with respect to all Y_i:

$$\eta = \sum_{i}^{n} \alpha_i + \sum_{i}^{n}\sum_{k}^{n} \delta_{ik} \ln y_k + \sum_{i}^{n}\sum_{j}^{m} \delta_{ij} \ln p_j \quad \text{--------- (4)}$$

The economies of scope are measured by:

$$\frac{\partial^2 C}{\partial y_i \partial y_k} < 0 \quad i \neq k\,; \; i, k=1, \ldots\ldots, n \quad \text{--------- (5)}$$

An approximate test is: $\alpha_k + \delta_{ik} < 0$ --------- (6)

Murray and White also derive a system of cost sharing equations by differentiating the cost function (3) with respect to P_j :

$$\frac{\partial \ln C}{\partial \ln p_j} = \frac{p_i x_j}{C} = S_j = \beta_j + \sum_h \gamma_{jh} \ln p_h + \sum_i \sigma_{ij} \ln y_i ; \; j = 1, \; \ldots \; , m \qquad \text{------ (7)}$$

An iterative Zellner procedure is used to estimate the system of cost equations; the various outputs are treated separately and many interesting results are obtained. The study finds that economies of scale varying inversely with firm size, although not perfectly so. Significant economies of scope are uncovered when comparing mortgage lending and other lending activities. The study concludes that large multiproduct credit unions are more cost efficient than small, single-product credit unions. In addition, Murray and White found slight overall and product-specific economies of scale in mortgage loans and investment activities.

Kim (1986) extended the work of Murray and White (1983) by deriving product-specific scale and scope economies from the translog multiproduct cost function developed by Murray and White. With the same data set, the results contrast with the findings of Murray and White. Kim found diseconomies of both scale and scope in non-mortgage loans. Kim also found that credit unions have both overall and product-specific economies of scope associated with joint provision of loans and investment activities. Gilligan, Smirlok, and Marshall (1984) also utilized the translog cost function to examine scale and scope economies in US banking firms. The data is from the Federal Reserves Functional Cost Analysis (FCA) program for 1978. They found significant economies of scope yet found no indication of economies of scale beyond relatively low output levels. Finally, they suggest that a policy of controlling entry or encouraging mergers in order to increase bank size may not be justifiable.

Mester (1987) investigated the cost structure of California saving and loans (S&Ls) by using the translog cost function. The author claims that the study improves previous translog process studies by calculating the approximate standard errors for all the statistics that characterize the cost function. The results of the paper show no economies of scope.

Realizing the difficulties inherent with the translog cost function, Berger, Henweck, and Humphrey (1987) developed other general measures of multiproduct economies which are not constrained by the assumptions of fixed product mix or complete specialization (setting same scale of production for each output). Berger *et al.* examine the relative efficiencies in the US banking firms in 1983. The evaluation was done with both the cost economies of the overall mean and the representative firms located at the means of nine size classes. Instead of using the conventional ray scale of economies and conventional economies of scope measurements, the authors use expansion path scale economies (EPSCE) and expansion path subadditivity (EPSUB) to assess the effect of the competitive challenges facing the firms. The EPSCE allows the changing of product mix as the economies of scale increase. This variable is defined as the elasticity of incremental cost with respect to incremental output of the firms in the analysis. Thus, the conventional ray scale of economies is a sub-set of EPSCE. Similarly, the conventional scope economies measurement can be seen as sub-set of EPSUB because EPSUB does not require the scale of production to be the same throughout the analysis. The study results conflict with prior studies. The results show slight diseconomies of scale and product mix; large banks show large scope diseconomies. The authors conclude that the source of conflicts may be due to methodological difficulties.

However, all of the above studies and many empirical studies of the banking industry do not bring the market structure of the banking business into consideration. Gilbert (1984) is among the few studies that indicate that the market structure of banking is not perfectly competitive in nature as presumed by most researchers. Therefore, analyses that assume the

output to be exogenous and use the method of cost minimization are not suitable. Gilbert suggests that as the output of the bank becomes endogenous, some measurement of market structure must be included in the analysis.

Berg and Kim (1994) pick up the idea of incorporating the oligopolistic nature of the banking industry into the production model by formulating a "conjectural variation" model based on the work of Iwata (1974), Gollop and Roberts (1979), Appelbaum (1982), and Bresnaham (1981). Iwata (1974) proposes an econometric model for empirically estimating the values of conjectural variations (the firm's conjecture about other firms' reactions to output change initiated by the first firm) for firms in oligopolistic market. Iwata derives the value of the conjectural variation, γ_j as:

$$\gamma_j = \alpha \frac{c_j - p}{p} \cdot \frac{D}{q_j} - 1$$

where α is the price elasticity, c_j is the marginal cost of firm j , p is price, D is total demand and q_j is the supply of firm j (Iwata 1974).

For empirical testing, the author estimates the cost function and demand function of the Japanese flat glass industry from 1956 to 1965. The industry consists of three firms but only the conjectural variations of two firms (Asahi and Nippon, both established before 1956) are estimated. The result of the study shows conjectural variation exists as one factor determining the price function in an oligopolistic market. Although the statistical tests are not very satisfactory, the author concludes that the approach used should apply to the study of an oligopolistic market. Following the work of Iwata, a paper by Gollop and Roberts (1979) presented an econometric model for estimating conjectural variations. The difference is that their model can identify the pattern of the interdependence among firms. Gollop and Roberts measure the conjectural

variation of the firm with respect to its rivals' reaction(s). In a homogeneous product market, this conjecture is a function of the rival's size.

Gollop and Roberts rank all the firms in the market by output size and divide them into some subsets (size classes). The important assumption underlying the test is that all firms in the same size class have the same conjectural variation vector, and to overcome the conflict between the continuous nature of the data and the homogeneity assumption, Gollop and Roberts construct a benchmark set consisting of *r* firms which require that the largest and the smallest firms be included in the set. The estimating equations are then expressed in terms of the conjectures of the neighboring benchmark firms. Since there is a similarity between Gollop and Roberts' model and Berg and Kim's model, this paper will review only the development of the model as it appeared in Berg and Kim (1994).

The model is derived in the framework of the banking sector with "n" banks producing a single output. The formulation follows.

The demand function is defined by:

$$P = D(Y) = D(\sum_j y_j); \quad j = 1,\ldots\ldots\ldots, n \qquad \text{---------} \quad (1)$$

Where P = market price (average interest margin of banking sector)

Y = output

y_j = j^{th} bank's output

Each bank's production function is specified by

$$y_j = F(x_j), \qquad \text{---------} \quad (2)$$

x_j = j^{th} bank's vector of input quantities

The j^{th} bank's profits are:

$$\pi_j = Py_j - W * X_j; \qquad \text{--------} \quad (3)$$

where W = vector of exogenously determined input prices.

Take the derivative with respect to the input level:

$$\frac{\partial \pi}{\partial x_{kj}} = \frac{\partial [Py_j]}{\partial x_{kj}} - W_k = 0$$

The first term on the right hand side can be expressed as:

$$\frac{\partial [Py_j]}{\partial x_{kj}} = \frac{[\partial (Py_j)]}{\partial y_j} \frac{[\partial y_j]}{\partial x_{kj}} \quad \text{where} \quad \frac{\partial y_j}{\partial x_{kj}} \quad \text{is the marginal product } F_k$$

and the term

$$\frac{\partial [Py_j]}{\partial y_j} = y_j \frac{[\partial P]}{\partial Y} \frac{\partial Y}{\partial y_j} + P$$

where $\frac{\partial P}{\partial Y}$ can be rewritten as $-\frac{P}{Y\varepsilon}$; ε is the price elasticity of demand and $Y = \sum_i y_i$ thus, $\frac{\partial Y}{\partial y_j} = 1 + \sum_{i \neq j} \frac{\partial y_i}{\partial y_j}$ where the sum is the conjectural variation of firm i with respect to the change in output of firm j.

From the above formulation, it follows:

$$\frac{\partial (Py_j)}{\partial y_j} = P + y_j \left[\frac{-P}{Y\varepsilon}\right] \left[1 + \sum_{i \neq j} \frac{\partial y_i}{\partial y_j}\right]$$

$$= P \left[1 - \frac{y_j}{Y\varepsilon} \left(1 + \sum_{i \neq j} \frac{\partial y_i}{\partial y_j}\right)\right]$$

$$\frac{\partial \pi}{\partial x_{kj}} = PF_k \left[1 - (y_j/Y\varepsilon) - (y_j/Y\varepsilon) \sum_{i \neq j} \frac{\partial y_i}{\partial y_j}\right] - w_k = 0 \qquad \text{--------} \quad (4)$$

As in Gollop and Roberts (1979), the authors rank all n banks by output size by formulating g groups with $T_g = r$ ($r = 1, \ldots\ldots, g$) banks in each group. A bank's conjectures about competitors' reactions are modeled in terms of the competitor's position in the size distribution.

The first order conditions are transformed to include conjectures expressed in relative terms:

$$\frac{\partial \pi_j}{\partial x_{kj}} = PF_k [1 - (y_j/Y\varepsilon) - (y_j/Y\varepsilon) \sum_r \left(\sum_{i \in r, i \neq j} y_i \right) CVS_{jr}] - w_k = 0 \quad \text{---------} \quad (5)$$

where $CVS_{jr} = \partial \ln \left(\sum_{i \in r, i \neq j} y_i \right) / \partial y_j$

Also the definition of conjectures in from of elasticities are defined as:

$$\frac{\partial \pi_j}{\partial x_{kj}} = PF_k [1 - (y_j/Y\varepsilon) - (y_j/Y\varepsilon) \sum_r \left(\sum_{i \in r, i \neq j} y_i / y_j \right) CV_{jr}] - w_k = 0 \quad \text{------} \quad (6)$$

where $CV_{jr} = \partial ln \left(\sum_{i \in r, i \neq j} y_i \right) / \partial \ln y_j$

In order to allow all banks within a given size class to have nonidentical vectors of conjectures across size classes, the authors select an arbitrary number of benchmark sets by requiring both the largest and smallest bank be included in the set.

Equations 5 and 6 will be expressed in terms of conjectures of neighboring benchmark banks (e.g. between benchmark banks b_t and b_{t+1}).

$$\frac{\partial \pi_j}{\partial x_{kj}} = PF_k [1 - (y_j/Y\varepsilon) -$$

$$(y_j/Y\varepsilon) \sum_r \left(\sum_{i \in r, i \neq j} y_i \right) x (\Phi_t CVS_{t_r} + \Phi_{t+1} CVS_{t+1,r})] - w_k = 0 \quad \text{-------} \quad (7)$$

and

$$\frac{\partial \pi_j}{\partial x_{kj}} = PF_k [1 - (y_j/Y\varepsilon) -$$

$$(y_j/Y\varepsilon) \sum_r \left(\sum_{i \in r, i \neq j} y_i / y_j \right) x (\Phi_t CV_{t_r} + \Phi_{t+1} CV_{t+1,r})] - w_k = 0 \quad \text{------} \quad (8)$$

where Φs are the weights to be determined by the output distances from bank j to benchmark banks b_t and b_{t+1} ; $\phi_t = (y_t - y_j)/(y_t - y_{t+1})$ and $\phi_{t+1} = (y_j - y_{t+1})/(y_t - y_{t+1})$, thus, sum of the weights $(\phi_t + \phi_{t+1}) = 1$.

Equation 7 and 8 are constrained by the production function:

$$y_j = F(X_j ; B_j) \qquad \text{--------} \quad (9)$$

where B_j captures differences in banks' operating characteristics (e.g. number of branches).

Equation 9 is approximated by the second-order Taylor series expansion around the point (X, B) = 1 and is represented by the translog functional form:

$$\ln(y_j) = \alpha_0 + \sum_k \alpha_k \ln(x_{kj}) + \frac{1}{2} \sum_k \sum_s \delta_{ks} \ln(x_{kj}) \ln(x_{sj}) \qquad \text{--------} \quad (10)$$

The marginal products F_k are:

$$M_{kj} = \partial ln(y_j) / \partial ln(x_{kj}) \quad j = 1, \ldots\ldots, n \qquad \text{--------} \quad (11)$$

$$= \alpha_k + \sum \partial_{ks} ln(x_{sj}) \quad k = 1, \ldots\ldots, m$$

Substituting Eqn. 11 into Eqns. 7 and 8 yields:

$$(W_k X_{kj}) / (P_{yi}) = M_{kj} \left\{ 1 - (y_j / Y\varepsilon) - (y_j / Y\varepsilon) \times \sum_r \left[\left(\sum_{i \in r, i \neq j} y_i \right) (\phi_t CVS_{tr} + \phi_{t+1} CVS_{t+1,r}) \right] \right\} \text{---- (12)}$$

and

$$(W_k X_{kj}) / (P_{yi}) = M_{kj} \left\{ 1 - (y_j / Y\varepsilon) - (y_j / Y\varepsilon) \times \sum_r \left[\left(\sum_{i \in r, i \neq j} y_i / y_j \right) (\phi_t CV_{tr} + \phi_{t+1} CV_{t+1,r}) \right] \right\} \text{---- (13)}$$

The model to be estimated consists of equation 10 and 13 (the preferred form of CV in terms of elasticities). The estimation method is the full information maximum likelihood

method. All data was taken from the annual financial statements of 173 Norwegian banks in 1988 (cross-sectional data).

The paper uses the value-added approach (Berger and Humphrey 1991a,b) to measure the outputs which are investments, home loans, other loans, and produced deposits. These four primary output variables are aggregated into one variable. The three inputs are labour, materials and physical capital.

In the estimation process, three models of bank production have been estimated: the Cournot model, where all conjecture variation parameters are zero; the cost-minimization model; and the conjectural variation (CV) model. The results show the CV model is a superior description of the data generation process. Economies of scale are found to be increasing in the CV model, where as in the Cournot and the cost-minimizing models, they are found to be decreasing and constant respectively.

There are some other works in the banking industry that are also related to the method developed by Iwata (1974) and Gollop and Roberts (1979). Spiller and Favaro (1984) modified the original model by assuming that the conjectural variations can change due to structural changes in the industry. The authors introduce two dummy variables into the model to capture two regulatory changes in the Uruguayan banking sector that occurred during the late 1970s. The findings in this paper reject all the models that specify homogeneous conjectural variations across firms. The results tend to support a von Stackelberg model with the existence of different conjectures in the industry.

2.3 The studies of scale and scope economies in Thailand

The efficiency of Thai financial institutions has been examined by some previous researchers. One of the early works is Koomsup (1972), who completed a study of economies of scale of Thai commercial banks using the Cobb-Douglas cost function. In his study, Koomsup finds that economies of scale exist.

Nidhiprapha and Arya (1987) use various indirect methods to evaluate the efficiency of commercial banks and finance companies. The authors chose measures to find the profitability of intermediation and measures to calculate the spread between lending and deposit rates. The authors also create a measure to check the efficiency of financialization and allocation of resources by measuring saving and by examining the ratio of credit extended to investment. The results of the study show that financial institutions have increased operational efficiency over the years.

Dhanwattanachai (1990) measures the scale and scope economies using both the Cobb-Douglas and translog cost function. The sample in her study is the pooled data of fifteen Thai banks during the years 1984-1988. The results from both estimation methods show economies of scale. Dhanwattanachai also finds economies of scope between lending and investment activities and between lending and bank guarantee and obligation.

Phromsopa (1992) studies the economies of scale of commercial bank branches by using the Cobb-Douglas cost function. The study uses cross-sectional data from the year 1990 divided into three sizes: small, medium, and large-sized branches. All 148 branches chosen for study are located in the provinces, away from metropolitan Bangkok. Phromsopa finds economies of scale for all sizes, but small-sized branches show the clearest effect.

The most recent work is Okuda and Mieno (1996) who study the impact of financial liberalization policy on Thai commercial banks. Similar to most of the studies in this area, Okuda and Mieno use an ordinal type of translog cost function to assess the degree of economies of scale and scope in Thai commercial banks. The paper starts by summarizing the recent development of the financial liberalization policies and describes the changing market environment in the Thai banking industry. By studying the interest rate differentials between commercial banks and finance companies and between Thai and international financial markets, Okuda and Mieno conclude that before the 1980s, the interest rate differentials are substantially high implying segmentation in both the domestic market between commercial banks and finance companies and in the international market between Thai and foreign financial markets. However, by the late 1980s, segmentation has been reduced and the markets are more integrated resulting in a more competitive environment. The authors next assume a competitive market structure in the Thai banking industry and apply the translog cost function to check for economies of scale and scope. The results show economies of scale exist for the sample of all banks in 1987 and 1993. However, for the large banks, the economies of scale are clearly observed before financial reform while the economies for medium and small banks can be observed more clearly after liberalization. Moreover, the paper has no clear evidence to support the existence of economies of scope.

The last section of the paper is the study of the technological progress and operational inefficiency in Thai commercial banks. These measurements can be made by introducing a time factor into the cost function and estimating this function which may not minimize the cost of the operations. The degree of inefficiency for i-th commercial bank is measured by the stochastic variable μ_i where $\mu \geq 0$, Var. (μ) = δ^2 and T (T = t) as a time factor. Thus, the modified cost function is as follows:

$$\ln C_{it} = \alpha_0 + \alpha_1 \ln y_{it} + \frac{1}{2}\alpha_2 \left(\ln y_{it}\right)^2 + \sum_{k}^{3} b_k \ln p_{kit} + \frac{1}{2}\sum_{l}^{3}\sum_{m}^{3} C_{lm} \ln p_{li} \ln p_{mi}$$

$$+ d_1 T + d_2 T^2 + \frac{1}{2}\sum_{1}^{3} e_n T \ln p_{nit} + \mu_i + \nu_{it} \qquad (i=1,2,\ldots,N)$$

The results of the estimation show that there are differences in operational inefficiency among commercial banks. The medium banks have the lowest level of inefficiency while the large and small banks have higher levels of inefficiency .

In conclusion, we can say that there is no study of operational efficiency in Thai commercial banks that accounts for the unique market structure of the banking industry. Even though the marketing environment is more competitive after liberalization, when we realize that the market share of the five largest banks still totals over 70 percent in both deposits and lending, we must still describe the Thai banking industry as an oligopolistic market. Thus, a direct application of the translog cost function might not be the best way to analyze efficiency in the banking business. In this study we will follow Gollop and Roberts (1979) and Berg and Kim (1994) with some modifications in order to measure the efficiency of Thai commercial banks.