The efficiency in Thai financial sector after the financial crisis

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Abstract

This study aims to investigate the efficiency in Thai financial sector after the financial crisis (1998 – 2004) by looking at the total factor productivity (TFP) growth. Furthermore, the study also investigate the efficiency in commercial bank sector, finance and securities company sector and insurance company sector, and the efficiency in domestic and foreign financial companies. Based on the sample of 12 commercial banks, 13 finance and securities companies and 20 insurance companies listed on the Stock Exchange of Thailand (SET) over the period of 1998 – 2204, our finding reveals that the efficiency in Thai financial sector, commercial bank sector and finance and securities company sector was diminishing over the period of 1998 – 2004, while the efficiency in insurance company sector remained unchanged over the same period. However, the sharp decrease in efficiency in these three sectors occurred only over the period of 1998 – 1999, while the efficiency was decreasing very slightly over the period of 1999 – 2004. The study also suggests that, in overall, domestic financial companies are more efficient than foreign ones. Domestic finance and securities companies are also more efficient than foreign ones, whereas domestic and foreign commercial banks are not different in efficiency. Moreover, domestic and foreign insurance companies are not different in efficiency as well.

Background and Signification of the Problem

Generally, the financial sector in Thailand is composed of three sectors: commercial banks, finance and securities companies, and insurance companies. The financial sector in Thailand has long been dominated by commercial banks whereas finance and securities companies and insurance companies have gained importance in recent years. In 2005, there are 13 commercial banks, 35 finance and securities companies and 20 insurance companies which are the members of the Stock Exchange of Thailand (SET).

In 2005, total deposits (or equivalents) at Thai financial institutions are 8,086,648 million baht. Commercial banks, dominating the financial sector in Thailand, collect total deposits (or equivalents) of 6,196,052 million baht, accounting approximately for 76.62 percent of total deposits (or equivalents) at financial institutions, whereas finance and securities companies and insurance companies approximately account for 0.99 percent and 5.93 percent of total deposits (or equivalents) at financial institutions, respectively.

Moreover, deposits of 5,520,256 million baht are household savings mobilized by financial institutions in Thailand. Of the total deposits of 6,196,052 million baht at commercial banks, deposits of 4,083,856 million baht are household savings, while deposits of 29,593 and 479,603 million baht are household savings mobilized by finance and securities companies and insurance companies, respectively.

As well, commercial banks have been the most crucial source of credit in Thailand. In 2005, credit extended by commercial banks has total value of 5,488,434 million baht, whereas total credit extended by Thai financial institutions has total value of 7,106,631 million baht. In addition, housing loans for personal consumption

extended by commercial banks have total value of 624,377 million baht, accounting roughly for 51.50 percent of total housing loans extended by Thai financial institutions. However, credit extended by finance and securities companies and insurance companies have total value of 162,058 and 50,422 million baht, respectively.

Accordingly, we can see that there are 6,755,931million baht deposits at commercial banks, finance and securities companies and insurance companies, accounting for almost 84 percent of total deposits at Thai financial institutions. Furthermore, 5,700,934 million baht credit is extended by commercial banks, finance and securities companies and insurance companies account for nearly 81 percent of total credit extended by Thai financial institutions. It is therefore reasonable to conclude that the efficiency of financial sector is very important to Thai economy.

Before the bursting of the bubble in July 1997, Thai economy had grown rapidly, as well as the East Asian countries' economy had been dramatically boom. There was an "East Asian Miracle" with high Total Factor Productivity (TFP) growth. However, since 1997, Thai and East Asian financial crisis has been eroded. After the devaluation of Thai baht in July 1997, Thailand has faced the currency crisis and switched to the floating exchange rate currency base. There was the basket exchange rate or pegged currency in Thailand that provided on US dollar usually equal to twenty five baht, yet immediately after the crisis, the baht depreciated to reach the worst point at fifty five baht per one US dollar within a few months later and then now (2005) approximately forty one baht per one US dollar. The business environment for financial institutions deteriorated even further. The corporate borrowers' repayment burden on Banks with foreign currency liabilities increased suddenly. Moreover, the corporations also came under enormous financial pressure, since they had substantial foreign currency exposures without the hedging against exchange rate. Thus, many commercial banks and finance and securities companies faced loss and bankruptcy. The inefficiency in financial sector was claimed to be a major factor in the currency crisis.

After new regulations of restrictions on the issue of new banking, called financial market deregulation, and the establishment of Bangkok International Banking Facilities (BIBF) were implemented in 1993, Thai banking system which was based on client-based relationship banking was replaced by a new market-oriented competitive banking situation which may lead to inexperienced banks lending inappropriately and thus contributing to financial crisis. The performance of finance and securities companies was also claimed to be a factor in the crisis. Commercial banks and finance and securities companies lent inappropriately to real estate business (borrowing short but lending long), leading to enormous NPLs in every commercial banks and bankruptcy of 56 finance companies after the collapse.

Now, eight years after the crisis, there are several changes in Thai financial sector. Several privately owned banks no longer exist in the aftermath of the 1997 financial crisis. Some were merged with Thai commercial banks, while others were acquired by foreign commercial banks. For instance, the assets of Bangkok Bank of Commerce were transferred to Krungthai Bank. Union Bank was merged with Krung Thai Thanakit (a subsidiary of Krung Thai Bank) to become Thai Bank. Laem Thong Bank was merged with a new state owned bank called Radanasin Bank which was later acquired by United Overseas Bank Limited (UOB) of Singapore and then was renamed UOB Radanasin Bank Public Company Limited. Nakornthon bank was also acquired by Standard Chartered Bank of the Great Britain and then was renamed Standard Chartered Nakornthon Bank Public Company Limited. Moreover, Thai

Danu Bank was acquired by DBS Bank of Singapore and then was renamed DBS Thai Danu Bank Public Company Limited. Accordingly, it is clear that there is a change in ownership of Thai financial sector, that is, many commercial banks became foreign.

However, Thai economy as well as Thai financial sector has been said by the government and the authorities to be recovered. After struggling with NPLs and liquidity problems for several years, Thai financial sector can now make higher profit and has regained people and investors' trust. Almost all companies in Thai financial sector are capable of making higher profits during the period of 1998 - 2004. Apparently, during the period of 1998 – 2000, a large number of companies were in trouble when they could make awfully low profit or even a negative profit (loss), especially in commercial bank sector in which all twelve commercial banks faced a huge loss in 1998. The situation of Thai financial sector has been better since 2001 when all companies could have continuously earned profit. Still, people and investors have been questioning the performance in Thai financial sector, though. The efficiency in Thai financial sector after the crisis is one of the most interesting issues of both Thai and foreign investors.

According to the dictionary, the word "efficiency" means "the ability to accomplish a job with a minimum expenditure of time and effort". Meanwhile, in economics, the productivity is the efficiency with which output is produced by a given set of inputs. Productivity is generally measured by the ratio of output to input. An increase in the ratio indicates an increase in productivity. Conversely, a decrease in the output/input ratio indicates a decline in productivity. Accordingly, it is sensible to conclude that the efficiency and the productivity are presumably the same. Therefore, we can simply say that the efficiency or the productivity in financial sector is the ability to generate the desired total revenue with a minimum cost. On the other hand, it is also the ability of the firm to maximize its total revenue given a budget.

Consequently, in this paper, I wish to look at three issues. First of all, I would like to investigate the efficiency in term of the productivity in Thai financial sector after the financial crisis in 1997 (1998 – 2004). Then, I would like to examine if commercial banks, finance and securities companies, and insurance companies in Thailand are different in efficiency. Eventually, I would like to study the efficiency in an individual company in Thai financial sector after the financial crisis.

Objectives of the Study

1) To investigate the efficiency in Thai financial sector after the financial crisis in 1997.
2) To examine whether commercial banks, finance and securities companies, and insurance companies in Thailand are different in efficiency.
3) To examine the efficiency in an individual company in Thai financial sector after the financial crisis.

Scope of the Study

1) The study covers the period of time after the financial crisis (1998-2004)
2) The study examines the efficiency only in Thai financial sector.
3) Thai financial sector in this study Thailand is composed of three sectors: commercial banks, finance and securities companies, and insurance companies.

4) Commercial banks, finance and securities companies, and insurance companies selected for this study are all the members of the Stock Exchange of Thailand (SET).

Review of the Literatures

There are several previous research papers studying efficiency. Some examined efficiency in the whole economy, other examined efficiency in a specific industry. Unfortunately, there are a few research papers examining efficiency in financial sector. One of them is the study of Dr. Mark Bailey, Dr. Deb Ghosh, and Dr. Sailesh Tanna (2002).

They examined whether differences in the form of ownership were not the cause of the productivity differences but that these differences were due to individual firm effects. This paper also examined the belief that inefficiency in the Thai financial sector was not one of the causal factors in the currency crisis in 1997 with high level of overall efficiency and some firms outperforming this norm. The data for banking and insurance firms is pooled giving 173 observations on 27 firms over an 8 year period prior to the East Asian currency crisis and a standard neo-classical production function is assumed for this paper.

After a regression of total revenue on capita, labor, company dummies and time dummies is carried out, then it is found that the average growth rate of total revenue allowing for changes in labor and capital and inter-firm efficiency differences, is 3.6% for the data for this period of 1989 to 1996. Also, this regression provides evidence that in the Thai insurance sector, larger companies are more efficient. However, no such similar evidence exists for the Thai banking sector.

However, there are many studies investigating the efficiency (in term of total factor productivity growth) in Thailand's economy. Achara Chandrachai, Tubtimtong Bangorn, and Kanjana Chockpaisansin (2004) examined the total factor productivity (TFP) growth in Thailand during 1977-1999, utilizing the trans-log production function and growth accounting method developed by Oguchi (2001). The study also examined TFP growth in eight economic sectors. Moreover, the study attempted to decompose TFP growth to separate the business fluctuation effect, the improved quality of labor, and the industrial shift effect, as well as to investigate the source of TFP growth with the structural change because of the financial crisis.

According to the study, TFP growth rate during 1977-1999 was 1.27% whereas TFP growth rate during 1997-1999 which was the period after the financial crisis was negative -4.60% implying recession. Furthermore, during 1977-1999 mining and quarrying sector had the highest TFP growth rate of 4.07%, while construction sector had the lowest one of -3.72%. TFP growth rates during 1977-1999 adjusted for the improved quality of labor, and the industrial shift effect were only 0.52% and 0.35%, respectively.

Pranee Tinakorn, Chalongphob Sussangkarn (1996) used the Solow-Dension growth accounting framework to analyze the sources of output growth in Thailand. The study attempted to calculate growth rate of total factor productivity (TFP) during 1972-1990, without adjustment for the improvement of labor quality, as well as growth rate of TFP, adjusted for improved quality labor during 1978-1990. In addition, the calculation for TFP growth was also performed in four economic sectors: agriculture sector, industry sector, manufacturing sector, and services and others sector.

The study revealed that during 1972-1990 TFP growth rates were 2.6067% when using number of employment as labor input and 2.5850% when using working

hours as labor input. TFP growth rates adjusted for the improvement of labor quality during 1978-1990 were 0.7745% when using net capital stock as capital input and 1.1983% when using composite index of capital stock as capital input. The study, moreover, indicated that TFP growth rates adjusted for the improvement of labor quality during 1978-1990 were 1.2929%, -0.6137%,-0.3554%, and -0.2596% in agriculture sector, industry sector, manufacturing sector, and services and others sector, respectively.

Furthermore, Michael Sarel (1997) utilized the growth accounting framework to examine growth rates of total factor productivity (TFP) for the period of 1978-1996 in five ASEAN countries: Indonesia, Malaysia, Philippines, Singapore, and Thailand and the USA. This study estimated the growth rates of per capita output, capital, and labor in five ASEAN countries mentioned above and the USA, and used a new method which is free of the problems associated with traditional methods, the regression and the national accounts approaches, to estimate the capital and labor income share.

The study indicated that the estimated capital income shares for six countries over the 1978-1996 period cover a relatively narrow range: (0.28-0.35), average capital share of 0.29 for Thailand, and that the capital shares in five ASEAN countries are higher than in the USA. Finally, growth rates of total factor productivity (TFP) were calculated as the differences between the growth rates of output and the growth rates of inputs, weighted by capital and labor shares. During 1978-1996, growth rates of total factor productivity (TFP) were 1.16%, 2.00%, -0.78%, 2.23%, 2.03% and 0.29% in Indonesia, Malaysia, Philippines, Singapore, Thailand and the USA, respectively. Moreover, during 1992-1996, growth rates of total factor productivity (TFP) were 2.20%, 2.00%, 0.67%, 2.46%, 2.25% and 0.61% in Indonesia, Malaysia, Philippines, Singapore, Thailand and the USA, respectively.

Efficiency and Total Factor Productivity

Perhaps the most comprehensive indicator for measuring the usefulness of the financial sector for the whole economy is its contribution to real growth. The problem is that there is no measure for capturing this contribution directly. However, there does seem to be a plausible way of accounting for the performance of the financial sector: the size of national financial sector is positively related to macroeconomic growth. Going even deeper into this relationship, it has been argued that the most important function of financial sector lies in the efficient allocation of resources within the economy.

One may thus expect this argument to imply that efficient resource allocation or the efficiency (productivity) is reflected in comparatively favorable “total factor productivity growth” which is usually related to efficient factor allocation including that of lending.Total factor productivity addresses any effect in total output not caused by inputs. Efficiency and technology growth are regarded as two of the biggest sub-section of total factor productivity. Consequently, the growth in TFP implies the higher efficiency and level of technology, meaning that a production unit is able to produce more level of output from the same amount of input. It is thus reasonable to conclude that the higher TFP also implies the higher efficiency. Therefore, this study utilizes total factor productivity growth which represents growth in total output not accounted for by the growth in inputs to indicate the efficiency in Thai financial sector.

Data to Analyze

Secondary time series data in annual format for commercial banks, finance and securities companies and insurance companies is observed over the seven year period (1998-2004) which is the time period after the financial crisis (1997). Data analyzed in this study is composed of:

1) Amount of Output

Amount of output is represented by total revenue in thousand Baht deflated by consumer price index (1998 =100).

2) Amount of Capital Input

Amount of capital input is represented by current asset in thousand Baht deflated by consumer price index (1998 =100).

3) Amount of Labor Input

Amount of labor input is represented by total expenditure on employees in thousand Baht deflated by consumer price index (1998 =100).

According to the theory, amount of output, capital input and labor input is measured in term of physical unit. However, in this study, amount of these three variables is instead measured in term of total value because the amount in physical unit is not available.

Total revenue is used as a proxy of the amount of output because the major business of financial institutions is services, implying that there is no physical product or output. Moreover, this study attempts to investigate the efficiency and the ability of financial institutions in utilizing capital and labor input to generate income not only from lending but also from every other service such as brokerage services, fund management, money transferring, credit card service, or foreign currency exchange, thus it is inappropriate to use only interest income as a proxy of output despite the fact that lending is the major source of income of financial institutions. As a result, the use of total revenue is reasonable.

In accounting, total assets will typically be classified into current assets and long-term assets. Current asset is the asset on the balance sheet which is expected to be sold or otherwise used up in the near future, usually within one year or one business cycle. Typical current assets include cash, cash equivalents, accounts receivable, inventory, accrued income, the portion of prepaid accounts which will be used within a year, and short-term investments. Whereas long-term assets or non-current assets are those assets usually in service over one year such as lands and buildings, plants and equipments, and long-term investments.

Current asset, instead of total asset, is used as a proxy of the amount of capital input since long-term assets such as land and building are not directly relevant to operation of financial institutions of which major business is financial service. On the other hand, long-term asset is considered as fixed factor of production which can be assumed constant. On the contrary, current asset such as cash and cash equivalents is apparently the major factor that financial institutions directly use to earn income. As a result, the use of current asset is appropriate.

Furthermore, total expenditure on employees is the total payroll that financial institutions pay out to their employees in one year. It can also be considered as the total income which employees receive in one year. The reason that total expenditure on employees is used as a proxy of the amount of labor input is the difference in labor quality. In the matter of fact, the greater amount of labor input does not always guarantee the increase in total output, but the higher labor quality does. Moreover, we assume, in this study, that the greater quality the labor has, the higher he gets paid.

Thus, the total expenditure on employees reflects the amount of high quality labor or augmented labor.

Total revenue, current asset, and total expenditures on employees of each company are shown in the balance sheet of each company as of December 31st of each year (1998 – 2004), obtained from Stock Exchange of Thailand (SET) whereas consumer price index data is obtained from the Bank of Thailand (BOT). All commercial banks, finance and securities companies, and insurance companies selected for this study are the current members of the Stock Exchange of Thailand (SET) in the first quarter of 2005, listed in the SET in 1998 or prior to 1998 and giving us all required data. Consequently, there are totally 47 companies: 12 commercial banks, 13 finance and securities companies and 20 insurance companies.

Furthermore, among these 12 commercial banks, 13 finance and securities companies and 20 insurance companies, there are 3 foreign commercial banks, 3 foreign finance and securities companies and 2 foreign insurance companies according to their major shareholders.

These 3 foreign commercial banks are

1. The Bank of Asia Public Company Limited (BOA)
2. Standard Chartered Nakornthon Bank Public Company Limited (SCNB)
3. UOB Radanasin Bank Public Company Limited (UOBR)

3 foreign finance and securities companies are

1. Asia Credit Public Company Limited (ACL)
2. Capital Nomura Securities Public Company Limited (CNS)
3. KGI Securities (Thailand) Public Company Limited (KGI)

2 foreign insurance companies are

1. Interlife John Hancock Assurance Public Company Limited (INLIFE)
2. Siam Commercial New York Life Insurance Public Company Limited (SCNYL)

According to the Stock Exchange of Thailand (SET), we have total revenues, current assets and expenditures on employees data over seven year period (1998-2004) for 44 companies and over six year period (1999-2004) for one company which is KGI Securities (Thailand) Public Company Limited.

However, it is very important to remember that only financial institutions which are the current members of the Stock Exchange of Thailand (SET) in the first quarter of 2005, listed in the SET in 1998 or prior to 1998 would be selected for the study. Commercial banks or finance and securities companies which no longer exist, as well as, those emerging after 2004 are not either selected for the study.

For instance, The Industrial Finance Corporation of Thailand and DBS Thai Danu Bank Public Company Limited are not selected for this study since they were already merged with TMB Bank Public Company Limited. Tisco Bank and Kiatnakin Bank PCL are not selected for the study since they appear after 2004.

Assumptions for the Study

1) Standard Cobb Douglas production function is assumed for this study, implying constant elasticity of output with respect to capital and labor inputs.
2) Production function of the overall financial sector, banking sector, finance and securities sector, insurance sector, and each individual company may perform different properties: increasing return to scale, constant return to scale, or decreasing return to scale.
3) Output and the amount of capital are positively related. That is, more amount of capital leads to the increase in output.

4) Output and the amount of labor are positively related. That is, more amount of labor leads to the increase in output.
5) Total factor productivity (TFP) is constant at a certain point of time and changes over the period of time

Econometric Model and Empirical Results

In this study, we assume the standard Cobb-Douglas production function defined as:

$$Q_t = A_t K_t^{\alpha} L_t^{\beta} e^{\mu_t}$$

Taking the natural logarithms to make the equation linear, here we have:

$$\ln Q_t = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \mu_t$$

In this study, there are totally 10 econometric models as follow.

Model 1: $\ln Q_t = \ln A_t + \alpha \ln K_t + \beta \ln L_t + \mu_t$

Model 1 estimates production function for Thai financial sector in attempt to test whether the production function of Thai financial sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing Model 1, the OLS result yields the following production function.

$$Q = 12.48702 K^{0.35298} L^{0.50005}$$

We can reject the null hypothesis of constant return to scale at 1% significance level with the sum of $\alpha + \beta$ of 0.85303, implying decreasing return to scale. Moreover, after performing the test for decreasing return to scale using Wald test, the test result confirms that the capital factor and labor factor yield the decreasing return to scale to the total revenue of financial companies.

In addition, the coefficient of labor factor (0.50005) is greater than the coefficient of capital factor (0.35298), indicating that a change in expenditure on employee has a greater effect on total revenue of financial companies than a change in capital factor. This is probably because labors are the augmented labors or white-collar labors with high efficiency in production.

Model 2: $\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \mu_{it}$

Model 2 estimates production functions for Thai financial sector over the seven year period in attempt to investigate TFP and TFP growth in Thai financial sector during 1998-2004 by looking at changes in constant A_{it} over the study period and to test whether the production function of Thai financial sector performs increasing return to scale, constant return to scale or decreasing return to scale. After including the dummy variables for year ($y_{99} - y_{04}$) into the model to see a change in level of total factor productivity (TFP), the OLS result yields the production functions of overall financial sector from 1998 to 2004 as follow.

1998: $Q = 15.36036 K^{0.3505} L^{0.50571}$

1999: $Q = 11.92241 K^{0.3505} L^{0.50571}$

2000: $Q = 11.4092 K^{0.3505} L^{0.50571}$

2001: $Q = 10.99323 K^{0.3505} L^{0.50571}$

2002: $Q = 11.72778 K^{0.3505} L^{0.50571}$

2003: $Q = 12.08844K^{0.3505}L^{0.50571}$

2004: $Q = 11.81914K^{0.3505}L^{0.50571}$

The coefficient of capital factor is 0.3505 while that of labor factor is 0.50571, implying that a change in expenditure on employees has a greater effect on the total revenue of financial companies than a change in capital factor due to the same reason mentioned above. The sum of $\alpha + \beta$ is 0.85621 which is less than 1, indicating that the production function of overall financial sector perform decreasing return to scale. A couple of tests are carried out and yield the results also showing that the capital factor and labor factor yield the decreasing return to scale to the total revenue of financial companies.

Model 2 reveals that the efficiency or productivity in Thai overall financial sector was diminishing in average over the period 1998 – 2004. The productivity growth measured as the TFP growth is – 23.05% over the seven year period and, in average, – 4.27% per annum (using average annual compound rate of growth), meaning that the efficiency in Thai financial sector declined by 23.05% over the period 1998 – 2004 and declined, in average, by 4.27% per annum.

Roughly, it seems that the efficiency in overall financial sector over the period 1998 -2004 is very poor. But if we focus on only the period 1999 -2004, we can see that the productivity growth over this six period is only -0.87% and, in average, -0.17% per annum, implying only 0.87% decrease in efficiency over the six year period and 0.17% decrease in efficiency per annum. The problem is the period 1998 – 1999. From 1998 to 1999, the TFP growth rate is -22.38% or the efficiency in financial sector reduced by 22.38%. As mentioned before, total revenue, current asset, and expenditure on employee data in 1998 and 1999 are recorded on December 31st 1998 and 1999, respectively, meaning that this sharp decline in efficiency in Thai financial sector occurred in 1999. What happened in 1999?

After the Bank of Thailand (BOT) switched from fixed exchange rate currency to floating exchange rate currency on July 2nd 1997, the Baht suddenly depreciated from only twenty five Baht per one US Dollar to reach fifty five Baht per one US Dollar within a few months later, and then has been remained at about forty Baht per one US Dollar, causing a dramatic increase in the financial institutions' repayment burden with foreign currency liabilities. This put all financial institutions under enormous financial pressure, because they had substantial foreign currency exposures without the hedging against exchange rate. Moreover, Commercial banks and finance and securities companies lent inappropriately to real estate business (borrowing short but lending long), making the business environment for financial institutions deteriorate even further. This lead to enormous NPLs (Non-Performing Loans) in every financial institution.

Throughout 1998, Thai financial sector had struggled with NPLs, and liquidity problems. Commercial banks and finance and securities companies had to repay more foreign debt due to the depreciation of the Baht while a huge amount of loan must be considered as NPLs. This caused the sharp decrease in current assets of commercial banks and finance and securities companies and a number of employees to be laid off, of course, following by the reduction in total revenue of the companies. The sharp decrease in total revenue of every financial institution due to current asset and a lay off had continued in 1999, leading to the dramatic decrease in efficiency in Thai financial sector as mentioned above. Then, the situation got better in year 2000 when most financial institutions were able to handle the problems, as a result, the average productivity growth over the period 1999 – 2004 is only -0.17% per annum.

Model 3: $\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 bank + \delta_2 finance + \mu_{it}$

Model 3 estimates the production functions of banking sector, finance and securities sector and insurance sector, also in attempt to investigate TFP and TFP growth in Thai financial sector during 1998-2004 and to examine whether commercial banks, finance and securities companies, and insurance companies in Thailand are different in efficiency. Model 3, as well, aims to test if the production function of Thai financial sector performs increasing return to scale, constant return to scale or decreasing return to scale.

After dummy variables for year (y_{99} – y_{04}) and dummy variables for sector (*bank* and *finance*) are included in the model, we have the production functions of banking sector, finance and securities sector and insurance sector over the period 1998 – 2004 as follow.

Year	Banking Sector	Finance and Securities Sector	Insurance Sector
1998	$Q = 0.2395K^{0.55358}L^{0.51872}$	$Q = 0.35144K^{0.55358}L^{0.51872}$	$Q = K^{0.55358}L^{0.51872}$
1999	$Q = 0.18344K^{0.55358}L^{0.51872}$	$Q = 0.26917K^{0.55358}L^{0.51872}$	$Q = 0.7659K^{0.55358}L^{0.51872}$
2000	$Q = 0.1776K^{0.55358}L^{0.51872}$	$Q = 0.2606K^{0.55358}L^{0.51872}$	$Q = 0.74151K^{0.55358}L^{0.51872}$
2001	$Q = 0.1688K^{0.55358}L^{0.51872}$	$Q = 0.2477K^{0.55358}L^{0.51872}$	$Q = 0.70482K^{0.55358}L^{0.51872}$
2002	$Q = 0.17787K^{0.55358}L^{0.51872}$	$Q = 0.261K^{0.55358}L^{0.51872}$	$Q = 0.74267K^{0.55358}L^{0.51872}$
2003	$Q = 0.17585K^{0.55358}L^{0.51872}$	$Q = 0.258K^{0.55358}L^{0.51872}$	$Q = 0.73424K^{0.55358}L^{0.51872}$
2004	$Q = 0.17219K^{0.55358}L^{0.51872}$	$Q = 0.25267K^{0.55358}L^{0.51872}$	$Q = 0.71895K^{0.55358}L^{0.51872}$

What interesting here is the sum of $\alpha + \beta$ which is 1.0723 (α, the coefficient of capital factor, is 0.55358 and β, the coefficient of labor factor, is 0.51872), indicating that capital factor and labor factor yields the increasing return to scale to the total revenue of financial companies. The Wald tests also confirm that conclusion. Moreover, the capital and labor factors have fairly the same effect on total revenue. Obviously, this result is contrast to that in Model 1 and Model 2 where production function of overall financial sector perform decreasing return to scale and the change in expenditure on employee has a greater effect on total revenue of financial companies than the change in capital factor.

Now, let's take a look at the productivity growth of financial sector after dummy variables for years and sectors are included in the model. Model 3 also shows that efficiency, measured as the productivity growth, in overall financial sector is diminishing over the period 1998 – 2004. During the period 1998 – 2004, productivity of overall financial sector approximately declines by 28.1% over the seven year period and declines, in average, 5.35% per annum. These figures are fairly close to those discovered in Model 2.

However, it is clear that the dramatic decrease in efficiency in financial sector, measured as the TFP growth, occurred during the period 1998 – 1999 when the productivity of financial sector declines by 23.41% within a year, whereas during the period 1999 – 2004, the productivity declined by 6.13% over the six year period and declined, in average, by only 1.26% per annum. These results are the same as those in Model 2 because of the liquidity and NPLs problems described above.

Furthermore, as mentioned before the previous part, the total factor productivity (TFP) is represented by the constant term (A). Consequently, the higher A (TFP) the production function has, the more efficient the company is. Model 3 reveals that insurance company sector is the most efficient sector, whereas commercial bank sector is the least efficient sector. It seems that this is a very surprising result. This is because banking sector was affected most by the crisis, whereas insurance sector was barely affected. Even now, several commercial banks still cannot straight the NPLs problem out.

Model 4: $$\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 bay + \delta_2 bbl + \delta_3 boa + \delta_4 bt + \delta_5 kbank + \delta_6 ktb + \delta_7 scb + \delta_8 scib + \delta_9 scnb + \delta_{10} tmb + \delta_{11} uobr + \mu_{it}$$

Model 4 estimates the production function of each company in banking sector, in order to examine if commercial banks are different in efficiency by looking at TFP and to examine efficiency in banking sector by calculating TFP and TFP growth of banking sector during 1998-2004. As a matter of comparison, we will compare TFP growth of banking sector to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2. Moreover, Model 4 aims to test if the production function of banking sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing total revenue ($\ln Q$) on every explanatory variables, we found that the coefficients of constant term, *bay*, *bbl*, *boa*, *kbank*, *ktb*, *scb*, *scib*, *scnb*, and *tmb* are not significant at any usual level of significant, while coefficients of the other variables are significant at 1% or 5% significance level. Therefore, BAY, BBL, BOA, KBANK, KTB, NBANK, SCB, SCIB, SCNB, and TMB have the same production functions, while the production functions of BT and UOBR are different.

Year	BAY, BBL, BOA, KBANK, KTB, NBANK, SCB, SCIB, SCNB, and TMB	BT	UOBR
1998	$Q = K^{0.74125} L^{0.38497}$	$Q = 0.52047 K^{0.74125} L^{0.38497}$	$Q = 0.52007 K^{0.74125} L^{0.38497}$
1999	$Q = 0.58352 K^{0.74125} L^{0.38497}$	$Q = 0.3037 K^{0.74125} L^{0.38497}$	$Q = 0.30347 K^{0.74125} L^{0.38497}$
2000	$Q = 0.51849 K^{0.74125} L^{0.38497}$	$Q = 0.26986 K^{0.74125} L^{0.38497}$	$Q = 0.26965 K^{0.74125} L^{0.38497}$
2001	$Q = 0.56191 K^{0.74125} L^{0.38497}$	$Q = 0.29246 K^{0.74125} L^{0.38497}$	$Q = 0.29223 K^{0.74125} L^{0.38497}$
2002	$Q = 0.57127 K^{0.74125} L^{0.38497}$	$Q = 0.29733 K^{0.74125} L^{0.38497}$	$Q = 0.2971 K^{0.74125} L^{0.38497}$
2003	$Q = 0.5454 K^{0.74125} L^{0.38497}$	$Q = 0.28386 K^{0.74125} L^{0.38497}$	$Q = 0.28364 K^{0.74125} L^{0.38497}$
2004	$Q = 0.48855 K^{0.74125} L^{0.38497}$	$Q = 0.25428 K^{0.74125} L^{0.38497}$	$Q = 0.25408 K^{0.74125} L^{0.38497}$

The coefficients of capital factor (α) and labor factor (β) are 0.74125 and 0.38497, respectively, implying that the change in capital factor has a greater influence on total revenue of commercial banks than the change in expenditure on worker. This is because commercial banks are now utilizing more technology and computer in business such as on-line banking, automatic tailor machine (ATM), or pass book updating machine. These innovations make banks less dependent on labor. Moreover, we cannot reject the null hypothesis of constant return to scale at any usual

level of significance, even though the sum of $\alpha + \beta$ is 1.1262. Therefore, capital and labor factor yield constant return to scale to total revenue of commercial banks.

Model 4 reveals that commercial bank sector is far less efficient than overall financial sector. During the period 1998 – 2004, productivity growth of Thai banking sector is -51.14% over this seven year period, and the average productivity growth per annum is -11.25%, indicating that from 1998 to 2004, the productivity of banking sector declined by 51.14% and declined, in average, by 11.25% per annum. It seems that the efficiency in banking sector is very terrible. Let's consider the productivity growth during the period 1998 – 1999. It is noticeable that the productivity growth of banking sector decreased by 41.65% within a year whereas during the period 1999 – 2004, the productivity decreased by only 16.27% over this five year period and decreased in average by 3.49% per annum. Undoubtedly, this is because banking had struggled with the severe liquidity and NPLs problem during 1998 -1999 as described above.

One may argue that this result may be wrong due to the fact that all commercial banks included in this study could earn higher profit during the period 1998 – 2004. However, higher profit does not imply efficiency. As mentioned in Chapter 1, efficiency means the ability of the company to maximize its total revenue given the amount of inputs, implying that firms may achieve higher efficiency if they can generate higher revenues with the same amount of inputs or generate the same level of revenue with the lower cost. In order to do that, firms may have to improve their technology, administration, or management. On the contrary, firms can earn higher revenues and profits only by employing more and more amount of inputs. It is obvious that both the amount of capital and labor (measured as current asset and expenditure on employees, respectively) have been increasing during the period 1998 – 2004, leading to the increase in revenue and profit. That is why the study indicates that banking sector is less efficient despite the higher profit.

According to production functions of commercial banks shown above, it is reasonable to conclude that Bank of Ayudhya, Bangkok Bank, The Bank of Asia, Kasikornbank, Krung Thai Bank, Thanachart Bank, The Siam Commercial Bank, Siam City Bank, Standard Chartered Nakornthon Bank, and The Thai Military Bank are not different in efficiency, whereas Bankthai and UOB Radanasin Bank are less efficient than the others.

Model 5: $$\begin{aligned}\ln Q_{it} &= \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} \\ &+ \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 acl + \delta_2 aitco + \delta_3 asl + \delta_4 asp + \delta_5 bc + \delta_6 bfit \\ &+ \delta_7 cns + \delta_8 kgi + \delta_9 kk + \delta_{10} mfc + \delta_{11} sicco + \delta_{12} tisco + \mu_{it}\end{aligned}$$

Model 5 estimates the production function of each company in finance and securities sector, in order to examine if finance and securities companies are different in efficiency by looking at TFP and to investigate efficiency in finance and securities sector by calculating TFP and TFP growth of finance and securities sector during 1998-2004. As a matter of comparison, we will compare TFP growth of finance and securities sector to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2. Moreover, Model 5 aims to test if the production function of finance and securities sector performs increasing return to scale, constant return to scale or decreasing return to scale. The OLS results indicates that the intercept and the coefficient of *aitco*, *asp*, *bc*, *bfit*, *kk*, *sicco*, and *tisco* are not statistically significant at any usual level of significance, while the coefficient of the others are significant at most 10% level of significance. Thus, we can assume that the intercept and the

coefficient of *aitco*, *asp*, *bc*, *bfit*, *kk*, *sicco*, and *tisco* equal zero. As a result, we have the production functions of finance and securities companies as follow.

Year	AITCO, ASP, BC, BFIT, KK, SICCO, TISCO and ZMICO	ACL	ASP
1998	$Q = K^{0.60455}L^{0.4444}$	$Q = 0.41052\,K^{0.60455}L^{0.4444}$	$Q = 0.51357\,K^{0.60455}L^{0.4444}$
1999	$Q = 0.72195\,K^{0.60455}L^{0.4444}$	$Q = 0.29637\,K^{0.60455}L^{0.4444}$	$Q = 0.37077\,K^{0.60455}L^{0.4444}$
2000	$Q = 0.7221\,K^{0.60455}L^{0.4444}$	$Q = 0.29643\,K^{0.60455}L^{0.4444}$	$Q = 0.37085\,K^{0.60455}L^{0.4444}$
2001	$Q = 0.5349\,K^{0.60455}L^{0.4444}$	$Q = 0.21959\,K^{0.60455}L^{0.4444}$	$Q = 0.27471\,K^{0.60455}L^{0.4444}$
2002	$Q = 0.64227\,K^{0.60455}L^{0.4444}$	$Q = 0.26366\,K^{0.60455}L^{0.4444}$	$Q = 0.32985\,K^{0.60455}L^{0.4444}$
2003	$Q = 0.6491\,K^{0.60455}L^{0.4444}$	$Q = 0.26647\,K^{0.60455}L^{0.4444}$	$Q = 0.33336\,K^{0.60455}L^{0.4444}$
2004	$Q = 0.63655\,K^{0.60455}L^{0.4444}$	$Q = 0.26132\,K^{0.60455}L^{0.4444}$	$Q = 0.32691\,K^{0.60455}L^{0.4444}$

Year	CNS	KGI	MFC
1998	$Q = 0.58796\,K^{0.60455}L^{0.4444}$	$Q = 0.55794\,K^{0.60455}L^{0.4444}$	$Q = 0.66936\,K^{0.60455}L^{0.4444}$
1999	$Q = 0.42448\,K^{0.60455}L^{0.4444}$	$Q = 0.4028\,K^{0.60455}L^{0.4444}$	$Q = 0.48324\,K^{0.60455}L^{0.4444}$
2000	$Q = 0.42456\,K^{0.60455}L^{0.4444}$	$Q = 0.40289\,K^{0.60455}L^{0.4444}$	$Q = 0.48334\,K^{0.60455}L^{0.4444}$
2001	$Q = 0.3145\,K^{0.60455}L^{0.4444}$	$Q = 0.29845\,K^{0.60455}L^{0.4444}$	$Q = 0.35804\,K^{0.60455}L^{0.4444}$
2002	$Q = 0.37763\,K^{0.60455}L^{0.4444}$	$Q = 0.35835\,K^{0.60455}L^{0.4444}$	$Q = 0.42991\,K^{0.60455}L^{0.4444}$
2003	$Q = 0.38164\,K^{0.60455}L^{0.4444}$	$Q = 0.36216\,K^{0.60455}L^{0.4444}$	$Q = 0.43448\,K^{0.60455}L^{0.4444}$
2004	$Q = 0.37427\,K^{0.60455}L^{0.4444}$	$Q = 0.35516\,K^{0.60455}L^{0.4444}$	$Q = 0.4261\,K^{0.60455}L^{0.4444}$

The coefficient of capital factor (α) which is 0.60455 is greater than that of labor factor (β) which is 0.4444, meaning that the change in expenditure on employee has a greater effect on the total revenue of finance and securities companies than the change in capital input. The reason is that finance and securities companies are now less dependent on labor factor by utilizing more technology in business. Let's take a look at the sum of $\alpha + \beta$. Though, the sum of $\alpha + \beta$ is 1.04895 which is greater than 1, the test result indicates the production function of finance and securities company sector performs constant return to scale. In other word, capital and labor factor yield constant return to scale to total revenue of finance and securities companies.

Like commercial bank sector, finance and securities company sector is less efficient than overall financial sector. Nevertheless, it is more efficient than commercial bank sector. Model 5 reveals that during the period 1998 – 2004, the productivity of finance and securities sector declined by 36.34% over the seven year period, moreover, the average productivity also declined by 7.25% per annum. The reason is that the major business of finance and securities sector is brokerage services which highly depend on economic condition. Therefore, the economic slump ruined the investors' confidence and the efficiency in finance and securities sector.

However, during the period 1999 – 2004, the productivity of this sector decreased only 11.83% over this six year period, and the average productivity decreased by 2.5% per annum, while the sharp decrease in the productivity of this sector occurred during 1998 – 1999 when the productivity declined by 27.8%. This

result reveals that finance and securities sector was severely affected by the financial crisis and was not able to adjust itself to the shift in economic condition, leading to the dramatic decrease in efficiency during 1998 – 1999. After that period, companies may find the ways to deal with this change, so that the efficiency is not as low as it was.

Now, let's take a look at the efficiency in individual finance and securities company. According to Model 5, it is rational to say that Ayudhya Investment and Trust, Asia Plus Securities, The Book Club Finance, Bangkok First Investment and Trust, Kiatnakin Finance, The Siam Industrial Credit, Tisco Finance, and Seamico Securities are not different in efficiency, whereas Asia Credit, Adkinson Securities, Capital Nomura Securities, KGI Securities (Thailand), and MFC Asset Management are less efficient than the others mentioned before.

Model 6: $$\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 ayud + \delta_2 bki + \delta_3 bui + \delta_4 charan + \delta_5 dvs + \delta_6 inlife + \delta_7 nki + \delta_8 nsi + \delta_9 pha + \delta_{10} safe + \delta_{11} scnyl + \delta_{12} smg + \delta_{13} smk + \delta_{14} tci + \delta_{15} thre + \delta_{16} tic + \delta_{17} tip + \delta_{18} tsi + \delta_{19} tvi + \mu_{it}$$

Model 6 estimates the production function of each company in insurance sector, in order to examine if insurance companies are different in efficiency by looking at TFP and to investigate efficiency in insurance sector by calculating TFP and TFP growth of insurance sector during 1998-2004. As a matter of comparison, we will compare TFP growth of insurance sector to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2. Moreover, Model 6 aims to test if the production function of insurance sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing ln$Q$ (total revenue) on ln$K$ (capital factor), ln$L$ (labor factor), dummy variables for year (y_{99} – y_{04}) and dummy variables for insurance company, the OLS result shows that only the coefficients of ln$K$, ln$L$, *bki*, *bui*, *dvs*, *safe*, *smk*, *thre*, and *tsi* are significant at most 10% level of significance, while the intercept, the coefficients of all dummy variables for year (y_{99} – y_{04}), *ayud*, *charan*, *inlife*, *nki*, *nsi*, *pha*, *scnyl*, *smg*, *tci*, *tic*, *tip*, and *tvi* are not significant at any usual level of significance. Since the coefficients of all dummy variables for year are not statistically significant, implying that they equal zero, the production functions of insurance companies remained unchanged over the period 1998 -2004. The production functions of insurance companies are shown as follow.

AYUD, CHARAN, INLIFE, INSURE, NKI, NSI, PHA, SCNYL, SMG, TCI, TIC, TIP and TVI: $Q = K^{0.31931} L^{0.97357}$

BKI: $Q = 2.161 K^{0.31931} L^{0.97357}$

BUI: $Q = 1.4388 K^{0.31931} L^{0.97357}$

DVS: $Q = 0.6545 K^{0.31931} L^{0.97357}$

SAFE: $Q = 2.083 K^{0.31931} L^{0.97357}$

SMK: $Q = 1.9864 K^{0.31931} L^{0.97357}$

THRE: $Q = 4.5712 K^{0.31931} L^{0.97357}$

TSI: $Q = 2.1278 K^{0.31931} L^{0.97357}$

Firstly, the coefficient of capital factor is 0.31931, whereas the coefficient of labor factor is 0.97357, implying that for insurance sector, labor factor is more important than capital factor, since the change in expenditure on employee has a greater effect on total revenue of insurance companies than the change in capital factor. In addition, we can reject the null hypothesis of constant return to scale at 5% level of significance. The sum of $\alpha + \beta$ is 1.29288 which is greater than 1, implying that the production function of insurance company sector performs increasing return to scale. The Wald test confirms that capital and labor factor yield increasing return to scale to total revenue of insurance companies.

Model 6 reveals that insurance company sector is more efficient than overall financial sector. It is more efficient than commercial bank sector and finance and securities company sector, as well. As described above, the coefficient of all dummy variables for year (y_{99} – y_{04}) are not significant at any usual significance level; consequently, they are assumed to equal zero, meaning that total factor productivity represented by constant term (A) remained unchanged over the seven year period (1998 – 2004). As a result, the productivity growth of insurance sector is 0%. In other word, the efficiency in insurance sector remained unchanged over this six year period. This result confirms the result discovered in Model 3 that insurance company sector is the most efficient sector, while commercial bank sector is the least efficient one.

The result mentioned above is not surprising. Insurance sector is barely affected by the crisis, since the demand for products of insurance companies, such as life insurance, or car insurance, does not directly rely on economic condition. Consumers buy insurance since they are afraid of uncertainty and risk, therefore there is still the demand for insurance no matter how bad the economic condition is. That is why insurance sector is the most efficient.

According to the production functions of insurance companies above, we can see that The Ayudhya Insurance, Charan Insurance, Interlife John Hancock Assurance, Indara Insurance, The Navakij Insurance, Nam Seng Insurance, Phatra Insurance, Siam Commercial New York Life Insurance, The Samaggi Insurance, The Thai Commercial Insurance, The Thai Insurance, Dhipaya Insurance, and Thaivivat Insurance are not different in efficiency. In addition, Bangkok Insurance, Bangkok Union Insurance, The Safety Insurance, Syn Mun Kong Insurance, Thai Reinsurance, and The Thai Setakij Insurance are more efficient than those mentioned above, while The Deves Insurance is less efficient than any other insurance companies.

Model 7: $$\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 foreign + \mu_{it}$$

Model 7 estimates the production functions of domestic companies and foreign companies in overall Thai financial sector in attempt to examine if there is the difference in efficiency between domestic and foreign companies in overall Thai financial sector by looking at TFP and to investigate TFP and TFP growth in Thai financial sector during 1998-2004. Model 7, also, aims to test if the production function of Thai financial sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing the total revenue ($\ln Q$) on all explanatory variables including dummy variable for foreign company (*foreign*), we have the production functions of domestic and foreign financial companies as follow.

Year	Domestic Financial Companies	Foreign Financial Companies
1998	$Q = 14.1188\, K^{0.34843} L^{0.52043}$	$Q = 9.5463\, K^{0.34843} L^{0.52043}$
1999	$Q = 11.024\, K^{0.34843} L^{0.52043}$	$Q = 7.4538\, K^{0.34843} L^{0.52043}$
2000	$Q = 10.5487\, K^{0.34843} L^{0.52043}$	$Q = 7.1323\, K^{0.34843} L^{0.52043}$
2001	$Q = 10.1655\, K^{0.34843} L^{0.52043}$	$Q = 6.8733\, K^{0.34843} L^{0.52043}$
2002	$Q = 10.832\, K^{0.34843} L^{0.52043}$	$Q = 7.324\, K^{0.34843} L^{0.52043}$
2003	$Q = 11.15\, K^{0.34843} L^{0.52043}$	$Q = 7.5391\, K^{0.34843} L^{0.52043}$
2004	$Q = 10.8866\, K^{0.34843} L^{0.52043}$	$Q = 7.361\, K^{0.34843} L^{0.52043}$

Like Model 1 and Model 2, Model 7 reveals that the change in expenditure on employee has the greater effect on the total revenue of financial companies than the change in capital input, since the coefficient of capital factor ($\alpha = 0.34843$) is smaller than that of labor factor ($\beta = 0.52043$). In addition, we can reject the null hypothesis of constant return to scale at 1% significance level with the sum of $\alpha + \beta$ of 0.86886, which is less than 1. This implies that capital factor and labor factor seem to yield decreasing return to scale to the total revenue of financial companies. The Wald test also support that production function of overall financial sector performs decreasing to scale.

According to the change in total factor productivity (TFP) measured as the change in constant term (A), we can see that the efficiency in overall financial sector was diminishing in average over the period 1998 – 2004. During that period of time, the productivity growth is -22.89% over the seven year period and, in average, -4.24% per annum, meaning that the productivity of overall financial sector decreased by 22.89% over the period 1998 – 2004 and decreased in average 4.29% per annum. However, it does not mean that the efficiency in overall financial sector is very poor, since this sharp decrease in productivity over the period 1998 – 2004 (22.89% decrease) is mainly influenced by the dramatic reduction in productivity only over the period 1998 - 1999 when the productivity declined by 21.92%. If we focus on the productivity over the period 1999 – 2004, we can see that the productivity in overall financial sector declined by only 1.25% over the six year period and declined in average by only 0.25% per annum. The reason for the dramatic decrease in productivity over the period 1999 – 2004 is the uncontrollable NPLs and liquidity problem stemming from the financial crisis.

Model 7 also investigates whether domestic and foreign financial companies are different in efficiency (productivity) which is represented by the constant term (A). According to the production functions of domestic and foreign financial companies shown above, it is rational to conclude that domestic financial companies is more efficient than foreign financial companies.

The result shown above may surprise someone who thinks that foreign financial companies are supposed to be more efficient that domestic ones. This is probably because Thai financial companies included in this study are mostly well-established and large, occupied a huge amount of assets, while most of foreign companies are smaller, recently emerging aftermath of the financial crisis.

Model 8: $\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 foreignb + \mu_{it}$

Model 8 estimates the production functions of domestic banks and foreign banks in order to examine if there is the difference in efficiency between domestic banks and foreign banks by looking at TFP and to examine efficiency in banking sector by calculating TFP and TFP growth of banking sector during 1998-2004, comparison to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2 and Model 7. Furthermore, Model 8 aims to test if the production function of banking sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing ln$Q$ (total revenue) on all independent variables, the OLS result shows that the coefficients of all dummy variables for year are significant at 1% level of significance, while the intercept and the coefficient of dummy variable for foreign bank (*foreignb*) are not significant at any usual level of significance, meaning that the production function of domestic and foreign commercial banks are the same.

Year	Domestic and Foreign Commercial Banks
1998	$Q = K^{0.66311} L^{0.33508}$
1999	$Q = 0.5912\, K^{0.66311} L^{0.33508}$
2000	$Q = 0.5299\, K^{0.66311} L^{0.33508}$
2001	$Q = 0.5767\, K^{0.66311} L^{0.33508}$
2002	$Q = 0.589\, K^{0.66311} L^{0.33508}$
2003	$Q = 0.5645\, K^{0.66311} L^{0.33508}$
2004	$Q = 0.511\, K^{0.66311} L^{0.33508}$

Like Model 4, Model 8 reveals that the coefficient of capital factor (α = 0.66311) is greater than that of labor factor (β = 0.33508), implying that commercial bank sector relies on capital factor more than on labor factor. In other word, the change in capital input has a greater effect on the total revenue of commercial banks than the change in expenditure on employee. Moreover, with the sum of $\alpha + \beta$ of 0.99819, we cannot reject the null hypothesis of constant return to scale at any usual level of significance, giving the conclusion that the production functions of commercial bank sector performs constant return to scale. It means that capital and labor factor yield the constant return to scale to the total revenue of commercial banks.

Like Model 4, Model 8 reveals that commercial bank sector is much less efficient than overall financial sector. During the period 1998 – 2004, the productivity of commercial bank sector declined by 48.94% over this seven year period (TFP growth rate is -48.94% during 1998 – 2004), and declined in average by 10.6% per annum (average TFP growth is -10.6% per annum). However, it is clear that the worst time period for banking sector is the period 1998 -1999 when the productivity of banking sector decreased by 40.88% within a year due to the liquidity and NPLs problem erupting immediately aftermath of the financial crisis. We can see that the efficiency in banking sector after 1999 was not that poor. Over the six year period 1999 – 2004, the productivity of commercial bank sector decreased only by 13.62%, and in average decreased only by 2.89% per annum.

Eventually, since the production function of domestic and foreign commercial banks are the same as shown above, domestic commercial banks and foreign commercial banks are not different in efficiency which is represented by the total factor productivity (constant term, *A*). This result should not be surprising since all foreign banks in this study were domestic banks before the crisis. They were just acquired by foreign financial companies after the crisis due to a huge loss. Therefore, only the ownership of these commercial banks had changed. Moreover, both domestic and foreign commercial banks were affected by the crisis, putting them all in trouble with liquidity and NPLs problems; they were thus highly regulated by the Bank of Thailand and required to follow the same direction. That is why both domestic and foreign banks are indifferent in efficiency.

Model 9: $\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 foreignf + \mu_{it}$

Model 9 estimates the production functions of domestic finance and securities companies and foreign companies in order to examine if there is the difference in efficiency between domestic finance and securities companies and foreign finance and securities companies by looking at TFP and to examine efficiency in finance and securities sector by calculating TFP and TFP growth of finance and securities sector during 1998-2004, comparison to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2 and Model 7. Furthermore, Model 9 aims to test if the production function of finance and securities sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing the total revenue of finance and securities companies on all explanatory variables, the OLS result shows that the coefficients of all variables in the model are significant at most 2% level of significance. The table below illustrates the production functions of domestic and foreign finance and securities companies.

Year	Domestic Finance and securities Companies	Foreign Finance and securities Companies
1998	$Q = 0.083\, K^{0.58164} L^{0.62433}$	$Q = 0.0532\, K^{0.58164} L^{0.62433}$
1999	$Q = 0.0581\, K^{0.58164} L^{0.62433}$	$Q = 0.0372\, K^{0.58164} L^{0.62433}$
2000	$Q = 0.0593\, K^{0.58164} L^{0.62433}$	$Q = 0.038\, K^{0.58164} L^{0.62433}$
2001	$Q = 0.045\, K^{0.58164} L^{0.62433}$	$Q = 0.0288\, K^{0.58164} L^{0.62433}$
2002	$Q = 0.0524\, K^{0.58164} L^{0.62433}$	$Q = 0.0336\, K^{0.58164} L^{0.62433}$
2003	$Q = 0.0505\, K^{0.58164} L^{0.62433}$	$Q = 0.0324\, K^{0.58164} L^{0.62433}$
2004	$Q = 0.0487\, K^{0.58164} L^{0.62433}$	$Q = 0.0312\, K^{0.58164} L^{0.62433}$

The coefficient of capital factor ($\alpha = 0.66311$) is somewhat smaller than that of labor factor ($\beta = 0.33508$), meaning that finance and securities companies rely on labor input more than on capital input. In other word, the change in capital input has a smaller influence on the total revenue of finance and securities companies than the change in expenditure on worker. In addition, unlike Model 5, Model 9 reveals that the production function of finance and securities company sector performs the increasing return to scale with the sum of $\alpha + \beta$ of 1.20597. We can reject the null hypothesis of constant return to scale at 1% significance level. Moreover, the Wald

supports that capital and labor input yield the increasing return to scale to the total revenue of finance and securities companies.

Like Model 5, Model 9 shows that finance and securities company sector is less efficient than the overall financial sector, but it is more efficient than commercial bank sector. Over the seven year period 1998 – 2004, the productivity of finance and securities sector, represented by the constant term (*A*), declined by 41.28% and declined in average by 8.49% per annum. In the matter of fact, this 41.28% decrease in efficiency in finance and securities sector during the period 1998 – 2004 is mainly influenced by the dramatic decrease in productivity during the period 1998 -1999 when the productivity declined by 29.92%. After that, the productivity of finance and securities sector decreased by 16.20% over the six year period 1999 – 2004 and decreased in average by 3.47% per annum.

According the production functions of domestic and foreign finance and securities companies in the table above, it is reasonable to say that domestic finance and securities companies are more efficient (as measured by the total factor productivity) than foreign finance and securities companies. As stated before, the major business of finance and securities sector is brokerage service. The more branches the companies have, the better they are. Most of domestic finance and securities companies are larger and have more branches than foreign ones. That is why domestic finance and securities companies are more efficient than foreign ones**.**

Model 10: $\ln Q_{it} = \ln A_{it} + \alpha \ln K_{it} + \beta \ln L_{it} + \gamma_1 y_{99} + \gamma_2 y_{00} + \gamma_3 y_{01} + \gamma_4 y_{02} + \gamma_5 y_{03} + \gamma_6 y_{04} + \delta_1 foreigni + \mu_{it}$

Model 10 estimates the production functions of domestic insurance companies and foreign insurance companies in order to examine if there is the difference in efficiency between domestic insurance companies and foreign insurance companies by looking at TFP and to examine efficiency in insurance sector by calculating TFP and TFP growth of insurance sector during 1998-2004, comparison to TFP growth of the overall financial sector during 1998-2004 calculated in Model 2 and Model 7. Furthermore, Model 10 aims to test if the production function of insurance sector performs increasing return to scale, constant return to scale or decreasing return to scale. After regressing the total revenue on all explanatory variables including dummy variable for foreign insurance company, the OLS result shows that only the coefficients of capital factor and labor factor are significant at 1% significance level, whereas the coefficients of all dummy variables are not significant at any usual level of significance. This implies that the production functions of domestic and foreign insurance companies are not different and the production function remained unchanged over the period 1998 – 2004. The production function of domestic and foreign insurance companies over that period 1998 – 2004 is as follow.

$$Q = 0.0581\, K^{0.44934} L^{0.86235}$$

First of all, it is clear from the production function above that insurance company sector relies on labor input more than on capital input. The coefficient of labor factor ($\beta = 0.86235$) is greater than that of capital factor ($\alpha = 0.44934$), meaning that the change in capital input has a smaller effect on the total revenue of insurance companies than the change in expenditure on employee. Furthermore, we can reject the null hypothesis of constant return to scale at 1% level of significance with the sum of $\alpha + \beta$ of 1.31169, implying that the production function of insurance company sector performs the increasing return to scale. The test confirms that capital

input and labor input yield the increasing return to scale to the total revenue of insurance companies.

Because the coefficients of all dummy variables for year ($y_{99} - y_{04}$) are not statistically significant at any usual significance level and assumed to equal zero, the constant term (A) is considered to remain unchanged over the seven year period 1998 – 2004. As a result, the productivity growth in insurance sector is 0% over this seven year period, in other word, the productivity of insurance company sector remained constant over the period 1998 – 2004. This result is the same as that discovered in Model 6. Thus, we can conclude that insurance company sector is more efficient than overall financial sector, commercial bank sector, and finance and securities company sector. This is because insurance sector was merely affected by the financial crisis. It was affected by neither the liquidity problem nor the NPLs problem, since lending money is not the main business of insurance sector as described in Model 6.

Since the coefficient of dummy variable for foreign insurance companies (*foreigni*) is not significant at any usual significance level and assumed to equal zero, the production function of domestic and foreign insurance companies are the same. As a result, domestic and foreign insurance companies are not different in efficiency measured as the total factor productivity (TFP). Probably, the reason is that both domestic and foreign insurance companies are not significantly different in the way they do business or size of company measured as assets, expenditure on employees, or the number of branches. All insurance companies have a few branches located only in major provinces such as Chiang Mai, Songkla, or Nakorn Ratchasrima. Moreover, they sell the same products in the same business environment and regulation, relying on the same major input which is labor input (sales agents).

Nevertheless, there is still one unanswered question. That is, does the production function of Thai financial sector perform constant, increasing or decreasing return to scale? Model 1, Model 2 and Model 7 reveal that capital factor and labor factor yield the decreasing return to scale to the total revenue of Thai financial companies, but Model 3 reveal that capital factor and labor factor yield the increasing return to scale to the total revenue of Thai financial companies. Which conclusion is correct?

Firstly, let's consider commercial bank sector. Model 4 and Model 8 reveal that capital factor and labor factor yield the constant return to scale to the total revenue of commercial banks. Secondly, let's consider finance and securities company sector. Model 5 reveal that capital factor and labor factor yield the constant return to scale to the total revenue of finance and securities companies whereas Model 9 reveal that capital factor and labor factor yield the increasing return to scale to the total revenue. Consequently, it is reasonable to conclude that the production function of finance and securities sector must perform non-decreasing return to scale. Thirdly, let's consider insurance company sector. Model 6 and Model 10 reveal that capital factor and labor factor yield the increasing return to scale to the total revenue of insurance companies. Therefore, the conclusion from Model 3 is probably correct, whereas the conclusion from Model 1, Model 2 and Model 7 does not seem correct.

Thus, it is impossible that the production function of Thai financial sector performs decreasing return to scale. It must perform either constant or increasing return to scale.

Conclusion and Beyond

During the seven year period aftermath of the financial crisis (1998 – 2004), it seems that the efficiency in Thai overall financial sector is rather poor, since the productivity of the overall financial sector was diminishing over the time period. The results from three different models (Model 2, Model 3 and Model 7) reveal that the average total factor productivity (TFP) of the overall financial sector declined by 4.27%, 5.35%, and 4.24% per annum, respectively. Nevertheless, the efficiency in overall financial sector is not as poor as it seems. These figures are influenced by the dramatic decrease in the productivity of the financial sector during the period 1998 – 1999, when the productivity decreased by 22.38%, 23.41% and 21.92%, due to the liquidity and NPLs problem. If we focus only on the period 1999 – 2004, we can see that the average productivity of financial sector decreased only by 0.87%, 1.26% and 0.25% per annum, respectively. Furthermore, the study found that domestic financial companies are more efficient than foreign financial companies.

Commercial bank sector and finance and securities company sector are less efficient than the overall financial sector, while insurance company sector is more efficient than the overall financial sector. In addition, insurance company sector is the most efficient sector, whereas commercial bank sector is the least efficient one.

The efficiency in commercial bank sector was decreasing over the period 1998 – 2004, as well. The results from Model 4 and 8 show that over the period 1998 – 2004, the average productivity of banking sector declined by 11.25% and 10.6% per annum, respectively, influenced by the sharp decrease in productivity during the period 1998 – 1999 (41.65% and 40.88%). This is, of course, because of the liquidity and NPLs problem, stemming immediately after the crisis. The efficiency in banking sector after 1999 got better. We can see that the average productivity declined only by 3.49% and 2.89% per annum, respectively.

The study found that Bank of Ayudhya, Bangkok Bank, The Bank of Asia, Kasikornbank, Krung Thai Bank, Thanachart Bank, The Siam Commercial Bank, Siam City Bank, Standard Chartered Nakornthon Bank, and The Thai Military Bank are not different in efficiency, whereas Bankthai and UOB Radanasin Bank are less efficient than the others. Moreover, domestic and foreign commercial banks are not different in efficiency.

The efficiency in finance and securities company sector was also diminishing over the period 1998 – 2004. The statistical results from Model 5 and Model 9 show that the productivity in finance and securities sector sharply declined by 27.8% and 29.92% over the period 1998 – 1999, causing the productivity in finance and securities sector to decrease, in average, by 7.25% and 8.49% per annum, respectively over the period 1998 – 2004. The situation got better after 1999, when the average productivity of finance and securities sector decreased only by 2.5% and 3.47% per annum, respectively, over the period 1999 – 2004.

The study also discovered that Ayudhya Investment and Trust, Asia Plus Securities, The Book Club Finance, Bangkok First Investment and Trust, Kiatnakin Finance, The Siam Industrial Credit, Tisco Finance, and Seamico Securities are not different in efficiency, whereas Asia Credit, Adkinson Securities, Capital Nomura Securities, KGI Securities (Thailand), and MFC Asset Management are less efficient than the others mentioned before. Furthermore, domestic finance and securities companies are more efficient than foreign finance and securities companies.

As mentioned above that insurance company sector is the most efficient sector in Thai financial sector. The statistical result from Model 6 and Model 10 reveal that the efficiency, as represented by the TFP growth, in insurance sector remained

unchanged over the seven year period 1998 – 2004. This is because lending money is not the major business of insurance sector. That is why it was little affected by the liquidity or NPLs problem.

The study found that The Ayudhya Insurance, Charan Insurance, Interlife John Hancock Assurance, Indara Insurance, The Navakij Insurance, Nam Seng Insurance, Phatra Insurance, Siam Commercial New York Life Insurance, The Samaggi Insurance, The Thai Commercial Insurance, The Thai Insurance, Dhipaya Insurance, and Thaivivat Insurance are not different in efficiency. Moreover, Bangkok Insurance, Bangkok Union Insurance, The Safety Insurance, Syn Mun Kong Insurance, Thai Reinsurance, and The Thai Setakij Insurance are more efficient than those mentioned above, while The Deves Insurance is less efficient than any other insurance companies. In addition, domestic and foreign insurance companies are not different in efficiency

According to the study, we found that capital and labor input yield the constant return to scale to the total revenue of commercial banks, yield the constant or increasing return to scale to the total revenue of finance and securities companies and yield the increasing return to scale to the total revenue of insurance companies. Consequently, the production function of Thai overall financial sector must perform either constant or increasing return to scale.

However, there are several limitations for this study. First of all, this study covers only seven year period (1998 – 2004) which is not statistically long enough to analyze time-series data. Secondly, during the period 1998 – 1999, most of financial companies were severely affected by the financial crisis in 1997 and were not capable of adjusting themselves to the change in economic condition, leading to a sharp drop in efficiency in financial sector during this period. This dramatic decrease, perhaps, influences the efficiency during the period 1998 – 2004, causing the decrease in efficiency in Thai financial sector to be over-estimated. Probably, the results of the study will be better if the period 1998 – 1999 is excluded from the study. Eventually, the number of financial institutions changes every year due to the appearance of new companies, or the merger and acquisition of existing companies. Therefore, a group of financial institutions selected for the study is likely to be different from the group of current financial institutions in financial sector. This probably makes the study result is not as interesting and useful as it is supposed to be. Perhaps, the study should cover the longer period of time and investigate only the efficiency in the whole sector (not in individual company) to avoid the impact of the change in the number of financial institutions.

In summary, it is not a good idea for one who wishes to earn high return from investments to keep his money in commercial banks due to a very low rate of interest. Moreover, investors may find more difficulty in borrowing funds from commercial banks since the terrible experience in NPL problem make commercial banks more cautious in approving loans. Nevertheless, despite a low efficiency, commercial banks are still considered as the most important financial institutes in Thailand which dominate Thai financial sector in collecting deposit and lending.

In addition, finance and securities companies are still fairly efficient for one who wishes to put his investment in capital market despite a slight decrease during the period 1999 – 2004. As mentioned before, the brokerage services, the major business of finance and securities sector, heavily depends on the economic condition and investors' confidence. Thus, the efficiency in finance and securities sector and the expected return from investment in capital market should be higher as the economic condition is better.

Finally, there is nothing to worry about for one who wished to buy insurance since insurance sector is the most efficient sector in Thai financial sector which is barely affected by the economic cycle.

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Appendix A: List of Financial Institutions

The list of commercial banks, finance and securities companies and insurance companies is as follow:

Commercial Banks

1) Bank of Ayudhya Public Company Limited (BAY)
2) Bangkok Bank Public Company Limited (BBL)
3) The Bank of Asia Public Company Limited (BOA)
4) Bankthai Public Company Limited (BT)
5) Kasikornbank Public Company Limited (KBANK)
6) Krung Thai Bank Public Company Limited (KTB)
7) Thanachart Bank Public Company Limited (NBANK)
8) The Siam Commercial Bank Public Company Limited (SCB)
9) Siam City Bank Public Company Limited (SCIB)
10) Standard Chartered Nakornthon Bank Public Company Limited (SCNB)
11) The Thai Military Bank Public Company Limited (TMB)
12) UOB Radanasin Bank Public Company Limited (UOBR)

Finance and Securities Companies

1) Asia Credit Public Company Limited (ACL)
2) Ayudhya Investment and Trust Public Company Limited (AITCO)
3) Adkinson Securities Public Company Limited (ASL)
4) Asia Plus Securities Public Company Limited (ASP)
5) The Book Club Finance Public Company Limited (BC)
6) Bangkok First Investment and Trust Public Company Limited (BFIT)
7) Capital Nomura Securities Public Company Limited (CNS)
8) KGI Securities (Thailand) Public Company Limited (KGI)
9) Kiatnakin Finance Public Company Limited (KK)
10) MFC Asset Management Public Company Limited (MFC)
11) The Siam Industrial Credit Public Company Limited (SICCO)
12) Tisco Finance Public Company Limited (TISCO)
13) Seamico Securities Public Company Limited (ZMICO)

Insurance Companies

1) The Ayudhya Insurance Public Company Limited (AYUD)
2) Bangkok Insurance Public Company Limited (BKI)
3) Bangkok Union Insurance Public Company Limited (BUI)
4) Charan Insurance Public Company Limited (CHARAN)
5) The Deves Insurance Public Company Limited (DVS)
6) Interlife John Hancock Assurance Public Company Limited (INLIFE)
7) Indara Insurance Public Company Limited (INSURE)
8) The Navakij Insurance Public Company Limited (NKI)
9) Nam Seng Insurance Public Company Limited (NSI)
10) Phatra Insurance Public Company Limited (PHA)
11) The Safety Insurance Public Company Limited (SAFE)
12) Siam Commercial New York Life Insurance Public Company Limited (SCNYL)
13) The Samaggi Insurance Public Company Limited (SMG)
14) Syn Mun Kong Insurance Public Company Limited (SMK)
15) The Thai Commercial Insurance Public Company Limited (TCI)
16) Thai Reinsurance Public Company Limited (THRE)
17) The Thai Insurance Public Company Limited (TIC)

18) Dhipaya Insurance Public Company Limited (TIP)
19) The Thai Setakij Insurance Public Company Limited (TSI)
20) Thaivivat Insurance Public Company Limited (TVI)

Appendix B: Labels

Q_{it} = amount of output of company i in year t

A_{it} = constant representing total factor productivity of company i in year t

K_{it} = amount of capital input of company i in year t

L_{it} = amount of labor input of company i in year t

y_{99} = 1 if 1999; 0 if otherwise

y_{00} = 1 if 2000; 0 if otherwise

y_{01} = 1 if 2001; 0 if otherwise

y_{02} = 1 if 2002; 0 if otherwise

y_{03} = 1 if 2003; 0 if otherwise

y_{04} = 1 if 2004; 0 if otherwise

bank = 1 if bank; 0 if otherwise

finance = 1 if finance and securities company; 0 if otherwise

bay = 1 if BAY; 0 if otherwise
bbl = 1 if BBL; 0 if otherwise
boa = 1 if BOA; 0 if otherwise
bt = 1 if BT; 0 if otherwise
kbank = 1 if KBANK; 0 if otherwise
ktb = 1 if KTB; 0 if otherwise
scb = 1 if SCB; 0 if otherwise
scib = 1 if SCIB; 0 if otherwise
scnb = 1 if SCNB; 0 if otherwise
tmb = 1 if TMB; 0 if otherwise
uobr = 1 if UOBR; 0 if otherwise
acl = 1 if ACL; 0 if otherwise
aitco = 1 if AITCO; 0 if otherwise
asl = 1 if ASL; 0 if otherwise
asp = 1 if ASP; 0 if otherwise
bc = 1 if BC; 0 if otherwise
bfit = 1 if BFIT; 0 if otherwise
cns = 1 if CNS; 0 if otherwise
kgi = 1 if KGI; 0 if otherwise
kk = 1 if KK; 0 if otherwise
mfc = 1 if MFC; 0 if otherwise
sicco = 1 if SICCO; 0 if otherwise
tisco = 1 if TISCO; 0 if otherwise
ayud = 1 if AYUD; 0 if otherwise
bki = 1 if BKI; 0 if otherwise
bui = 1 if BUI; 0 if otherwise
charan = 1 if CHARAN; 0 if otherwise
dvs = 1 if DVS; 0 if otherwise
inlife = 1 if INLIFE; 0 if otherwise

nki = 1 if NKI; 0 if otherwise
nsi = 1 if NSI; 0 if otherwise
pha = 1 if PHA; 0 if otherwise
safe = 1 if SAFE; 0 if otherwise
scnyl = 1 if SCNYL; 0 if otherwise
smg = 1 if SMG; 0 if otherwise
smk = 1 if SMK; 0 if otherwise
tci = 1 if TCI; 0 if otherwise
thre = 1 if THRE; 0 if otherwise
tic = 1 if TIC; 0 if otherwise
tip = 1 if TIP; 0 if otherwise
tsi = 1 if TSI; 0 if otherwise
tvi = 1 if TVI; 0 if otherwise
foreign = 1 if foreign company; 0 if otherwise
foreignb = 1 if foreign bank; 0 if otherwise
foreignf = 1 if foreign finance and securities company; 0 if otherwise
foreigni = 1 if foreign insurance company; 0 if otherwise
μ_t = Stochastic disturbance term
e = base of natural logarithm
$\alpha, \beta, \gamma_i, \delta_i$ =parameters

Table 1: Statistical Result for Model 1

R-Square 0.8898			Adj R-Sq 0.8891		
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.52469	0.25966	9.72	<.0001
lnk	1	0.35298	0.02912	12.12	<.0001
lnl	1	0.50005	0.04610	10.85	<.0001

Table 2: Statistical Result for Model 2

R-Square 0.8934			Adj R-Sq 0.8906		
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.73179	0.26646	10.25	<.0001
lnk	1	0.35050	0.02898	12.09	<.0001
lnl	1	0.50571	0.04597	11.00	<.0001
y99	1	-0.25337	0.11717	-2.16	0.0314
y00	1	-0.29737	0.11720	-2.54	0.0117
y01	1	-0.33451	0.11716	-2.86	0.0046
y02	1	-0.26983	0.11725	-2.30	0.0220
y03	1	-0.23954	0.11733	-2.04	0.0421
y04	1	-0.26207	0.11761	-2.23	0.0266

Table 3: Statistical Result for Model 3

R-Square	0.9426	Adj R-Sq	0.9407		
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.04014	0.33986	0.12	0.9061
lnk	1	0.55358	0.02691	20.57	<.0001
lnl	1	0.51872	0.03447	15.05	<.0001
y99	1	-0.26670	0.08632	-3.09	0.0022
y00	1	-0.29906	0.08633	-3.46	0.0006
y01	1	-0.34982	0.08632	-4.05	<.0001
y02	1	-0.29751	0.08643	-3.44	0.0007
y03	1	-0.30892	0.08675	-3.56	0.0004
y04	1	-0.32996	0.08699	-3.79	0.0002
bank	1	-1.42918	0.12670	-11.28	<.0001
fin	1	-1.04572	0.06530	-16.01	<.0001

Table 4: Statistical Result for Model 4

R-Square	0.9774	Adj R-Sq	0.9707		
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.30346	1.85245	-1.24	0.2182
lnk	1	0.74125	0.10673	6.94	<.0001
lnl	1	0.38497	0.13585	2.83	0.0061
y99	1	-0.53868	0.08877	-6.07	<.0001
y00	1	-0.65684	0.09044	-7.26	<.0001
y01	1	-0.57641	0.09166	-6.29	<.0001
y02	1	-0.55989	0.09277	-6.04	<.0001
y03	1	-0.60624	0.09428	-6.43	<.0001
y04	1	-0.71631	0.10052	-7.13	<.0001
bay	1	-0.58578	0.46505	-1.26	0.2124
bbl	1	-0.61677	0.59054	-1.04	0.3002
boa	1	-0.49529	0.35302	-1.40	0.1655
bt	1	-0.65302	0.31991	-2.04	0.0454
kbank	1	-0.59288	0.54300	-1.09	0.2790
ktb	1	-0.77376	0.56327	-1.37	0.1743
scb	1	-0.48191	0.50802	-0.95	0.3464
scib	1	-0.63926	0.38869	-1.64	0.1049
scnb	1	-0.34673	0.33189	-1.04	0.3001
tmb	1	-0.59704	0.40740	-1.47	0.1477
uobr	1	-0.65380	0.23667	-2.76	0.0075

Table 5: Statistical Result for Model 5

R-Square 0.9084 Adj R-Sq 0.8818

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.38033	1.65958	-0.23	0.8194
lnk	1	0.60455	0.16138	3.75	0.0004
lnl	1	0.44440	0.15802	2.81	0.0064
y99	1	-0.32580	0.12912	-2.52	0.0139
y00	1	-0.32560	0.12834	-2.54	0.0134
y01	1	-0.62567	0.12839	-4.87	<.0001
y02	1	-0.44274	0.12782	-3.46	0.0009
y03	1	-0.43217	0.13568	-3.19	0.0022
y04	1	-0.45169	0.13899	-3.25	0.0018
acl	1	-0.89034	0.53009	-1.68	0.0976
aitco	1	-0.60313	0.44564	-1.35	0.1803
asl	1	-0.66637	0.22542	-2.96	0.0043
asp	1	-0.10595	0.18152	-0.58	0.5613
bc	1	-0.38982	0.49682	-0.78	0.4354
bfit	1	-0.52936	0.49092	-1.08	0.2847
cns	1	-0.53110	0.21780	-2.44	0.0173
kgi	1	-0.58350	0.26423	-2.21	0.0305
kk	1	-0.08382	0.52061	-0.16	0.8726
mfc	1	-0.40144	0.21377	-1.88	0.0646
sicco	1	-0.36052	0.55572	-0.65	0.5187
tisco	1	-0.33523	0.56502	-0.59	0.5549

Table 6: Statistical Result for Model 6

R-Square 0.9729 Adj R-Sq 0.9664

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.28901	1.56658	-1.46	0.1468
lnk	1	0.31931	0.11450	2.79	0.0062
lnl	1	0.97357	0.15011	6.49	<.0001
y99	1	-0.03362	0.05539	-0.61	0.5451
y00	1	-0.07484	0.05499	-1.36	0.1763
y01	1	-0.06515	0.05675	-1.15	0.2534
y02	1	-0.08914	0.06099	-1.46	0.1466
y03	1	-0.05873	0.07165	-0.82	0.4142
y04	1	-0.05422	0.07395	-0.73	0.4650
ayud	1	-0.08769	0.30013	-0.29	0.7707
bki	1	0.77056	0.33570	2.30	0.0236
bui	1	0.36381	0.12841	2.83	0.0055
charan	1	0.04904	0.10242	0.48	0.6330
dvs	1	-0.42392	0.22022	-1.92	0.0568
inlife	1	0.21379	0.20886	1.02	0.3082
nki	1	0.17725	0.18476	0.96	0.3394
nsi	1	0.23637	0.19971	1.18	0.2391
pha	1	-0.08822	0.24830	-0.36	0.7230
safe	1	0.73383	0.22575	3.25	0.0015
scnyl	1	0.09143	0.27139	0.34	0.7368
smg	1	0.10461	0.19568	0.53	0.5940
smk	1	0.68631	0.26573	2.58	0.0111
tci	1	0.02227	0.09474	0.24	0.8146
thre	1	1.51977	0.23804	6.38	<.0001
tic	1	0.17033	0.13199	1.29	0.1995
tip	1	0.08635	0.30571	0.28	0.7781
tsi	1	0.75507	0.14377	5.25	<.0001
tvi	1	0.19439	0.18614	1.04	0.2986

Table 7: Statistical Result for Model 7

R-Square 0.9013 Adj R-Sq 0.8983

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.64751	0.25747	10.28	<.0001
lnk	1	0.34843	0.02794	12.47	<.0001
lnl	1	0.52043	0.04442	11.72	<.0001
y99	1	-0.24743	0.11297	-2.19	0.0293
y00	1	-0.29151	0.11300	-2.58	0.0104
y01	1	-0.32851	0.11297	-2.91	0.0039
y02	1	-0.26500	0.11304	-2.34	0.0197
y03	1	-0.23605	0.11313	-2.09	0.0378
y04	1	-0.25998	0.11339	-2.29	0.0225
foreign	1	-0.39136	0.07969	-4.91	<.0001

Table 8: Statistical Result for Model 8

R-Square 0.9655 Adj R-Sq 0.9613

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.60680	0.81873	-0.74	0.4610
lnk	1	0.66311	0.09366	7.08	<.0001
lnl	1	0.33508	0.07885	4.25	<.0001
y99	1	-0.52564	0.10022	-5.24	<.0001
y00	1	-0.63504	0.10024	-6.33	<.0001
y01	1	-0.55045	0.10029	-5.49	<.0001
y02	1	-0.52924	0.10046	-5.27	<.0001
y03	1	-0.57186	0.10050	-5.69	<.0001
y04	1	-0.67209	0.10054	-6.68	<.0001
foreignb	1	-0.11756	0.10224	-1.15	0.2539

Table 9: Statistical Result for Model 9

R-Square 0.8797 Adj R-Sq 0.8661

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.49000	0.73585	-3.38	0.0011
lnk	1	0.58164	0.03110	18.70	<.0001
lnl	1	0.62433	0.04953	12.60	<.0001
y99	1	-0.35557	0.13559	-2.62	0.0104
y00	1	-0.33574	0.13520	-2.48	0.0151
y01	1	-0.61183	0.13512	-4.53	<.0001
y02	1	-0.45856	0.13527	-3.39	0.0011
y03	1	-0.49485	0.13707	-3.61	0.0005
y04	1	-0.53236	0.13774	-3.86	0.0002
foreignf	1	-0.44540	0.09294	-4.79	<.0001

Table 10: Statistical Result for Model 10

	R-Square	0.7850	Adj R-Sq	0.7701
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.55498	0.80146	-3.19	0.0018
lnk	1	0.44934	0.05908	7.61	<.0001
lnl	1	0.86235	0.10250	8.41	<.0001
y99	1	-0.04493	0.14257	-0.32	0.7531
y00	1	-0.07444	0.14254	-0.52	0.6024
y01	1	-0.06624	0.14273	-0.46	0.6433
y02	1	-0.09257	0.14317	-0.65	0.5190
y03	1	-0.08698	0.14374	-0.61	0.5462
y04	1	-0.07162	0.14430	-0.50	0.6205
foreigni	1	-0.20579	0.13016	-1.58	0.1163

Biography

Mr. Supachet Chansarn earned his Bachelor of Economics (2nd Class honor) from the Faculty of Economics, Chulalongkorn University. He was awarded the scholarship from Bangkok University to do his Master's Degree in the United State of America, where he earned his Master of Economics from North Carolina State University, North Carolina. Mr. Supachet Chansarn now works as a full-time lecturer and a secretary of the School of Economics, Bangkok University.