DETERMINANTS OF INTEREST RATE MARGINS AND

INCOME STRUCTURE OF THAI COMMERCIAL BANKS

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By

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Abstract

The studies in this paper examine the effects of bank's characteristics and macroeconomic conditions on interest rate margin and income structure of commercial banks. These studies were conducted using panel data regression with fixed and random effect on data of Thai commercial banks during the period of 1997 to 2nd quarter of 2008. Under interest rate margin studies, internal bank characteristics namely size of commercial banks, bank's capital and NPL have significant effects on banks' margin. For macroeconomic conditions, GDP growth has adversely impacted on bank's margin while inflation has positively supported bank's margin. Under income structure studies, capital is the sole factor affecting bank's income structure. However, when we conduct more analysis by comparing large and small banks, we discover that factor determining income structure between large and small banks are size and number of branches. With more branches opened, banks have more opportunities to generate fee based income.

I. Introduction

Since Thailand had faced financial crisis in 1997. Thai commercial banking sector regarded as a core of this crisis. Apart from inconsistent macroeconomic policies, aggressive lending by commercial banks was a major factor that caused the economic bubble and massive currency mismatch in the real sector. With the collapse of the exchange rate peg, defaults skyrocketed and banks' balance sheets were severely distressed. When the banking sector was on a verge of bankruptcy, the situation had been severely worsened when the exchange rate had depreciated rapidly. Inflation, GDP growths are shown in figure 1.

[Figure 1 is here]

A decade after Thailand's worst economic calamity, Thai commercial banks have seen significant improvements in profitability, asset quality, and risk management. Since 1999, banks have improved the profitability which tends to increase net interest margins (NIM). NIM of Thai commercial banks is shown in Figure 2.

[Figure 2 is here]

The recession not only hindered the investment of business sectors but also increased bad debt within the Thai banking system. The high inflation was the result of depreciation of Thai Baht after changing the exchange rate regime to managed floating system. High inflation did affect cost of doing business which consequently creating problems (bad debts) to the banks.

As a result, the major concern for the sophisticated financial market is financial stability. So in recent years, regulators have focused more on financial stability and financial disclosure of the bank and introduced new accounting standard, IAS39 (International Accounting Standard 39, Financial Instruments: Recognition and Measurement).

IAS39 concerns several accounting areas, but one that mostly affected Thai banks is the provisioning of NPL. These reserves, however, has not just been introducing but the concept of loan loss reserve has been used in Thai commercial bank for a long time.

Due to the reserve on NPL, banks may have incentives to change income structure for two reasons. First, the reserves increase the cost of the banks since they have to reserve capital for some amounts depend on aging (quality) of the loan. Second, bank tends to increase non-interest income (fee based income) because bank regulators do not require them to hold capital against non-interest income activities. The ratio of bank interest income to total income is shown in figure 3.

[Figure 3 is here]

In December 2008, Thai commercial banks have applied new regulation called Basel II. Basel II setting up rigorous risk and capital management requirements that designed to ensure a bank who holds appropriate capital reserves to the risk that they exposes itself through its lending and investment practices. If they are unable to meet capital ratio requirements, there are several ways for them to increase the ratio. Firstly, they can opt to raise equity, if bank is listed in stock market, they can issue new stock. Secondly, they can reduce their assets to improve the capital ratio. However, shrinking the balance sheet is not attractive because it will affect profitability. So credit policy of the banks may change because if banks issue more loans, they must increase their capital to meet minimum requirement. On the other hand, if they just increase margin then they can generate more profit from loan.

This study use analyzed panel quarterly data of eight Thai commercial banks from 1997-quarter 2 2008 and two dependence variables, one for interest margin and one for banks' income structure. Then run regression which results are estimated with fixed effect and random effect. The results are then compared using Hausman test. The differences of the impacts of determinants to interest margin and bank's income structure of large banks and small banks are investigated by comparing the data set of these two groups. Results are expected to be significant for central bank to design the appropriate bank policy.

The rest of the paper is organized by order. Section 2 is to review the literature. Section 3 presents the theoretical models and methodology while Section 4 describes the data set. Section 5 reports our findings and analyzes the results and finally in Section 6 concludes the study and discusses some policy implications.

II. Literature review

2.1 Bank's credit decision

Under new capital record Fabrizio Fabi, Sebastiano Laviola, Paolo Marullo Reedtz (2005) which study whether the new regulatory treatment of credit risk is likely to alter banks' lending decisions or not. The reason is because the new regulatory proposal could change the lending policies of banks, only if the assessment of credit risk implicit in the risk-weight functions differed from banks' perception of risk as reflected in the interest rates they charge borrowers. They compared the change in the overall risk component of lending operations with the interest rates charged by banks on individual credit lines. They concluded that the new regulatory approach to measuring capital adequacy was consistent with banks' own risk evaluations and not effect banks' lending decision. For capital structure, Roman Inderst, Holger M. Mueller (2008) had developed model under two assumptions. First, as banks do not own the projects in which they invest, competition ensures that they will not be able to extract all of the proceeds from the project. Second, banks are conducting a credit risk analysis before originating new loans. They argued that bank, with all-equity financed, are conservative in their credit decisions. However, banks may take on too much leverage and consequently engage in excessive risk-taking in the presence of insured deposits finance without paying a fair premium.

2.2 Bank's loan pricing on Basel II

There are two approaches for banks to determine their capital requirements against credit risk, which are standardized approach and Internal rating based (IRB). There are some studies about loan

pricing between these two approaches and the results are quite similar. David Ruthenberg, Yoram Landskroner (2008) and Rafael Repullo, Javier Suarez (2004) found that most big banks normally adopt IRB approach. They will attract the high quality (low risk) customers, mostly big firms, by reducing in their loan rate. On the other hand, small banks normally adopt standardized approach by attracting low quality (high risk) customers with a decrease in loan rates. For retail customers, they will enjoy a loan rate reduction if they obtain loans from banks that adopt the IRB approach.

2.3   Bank's risk taking under capital requirement

The purpose of capital requirement is to promote safety for bank, some studies shown that capital standard are sometimes unexpected to promote bank safety such as by David Besanko (1996). This paper showed that capital standards may not promote bank safety under agency problem between insider and outsider investors. There are two alternatives to raise equity to meet higher capital requirement. First, raising equity; in the model it seems unlikely that investors would voluntarily provide addition equity. Wealth constraints may be an important factor in limiting this source of equity. Second, selling loan; this strategy may be costly for the bank because bank has some advantage in monitoring their particular loans, then selling loans would result in a reduction in their value. Jurg Blum (1999) shows that if capital requirements are implemented in the second period, banks may increase asset risk in first period. Because tightening the regulation have two effects. First, a tighter restriction lowers the expected profits of the bank. If profits are lower, the bank has less to lose in the event of bankruptcy. Therefore, increasing risk is less costly for the bank. Second, changes in the regulation affect the marginal return on risk. In the model, this marginal return on risk may be raised and may reinforce the first effect which leads to an overall increase in risk. Bertrand Rime (2001) confirms that bank close to the minimum regulatory capital requirement tends to increase their ratio of capital to risk weight assets but does not affect the level of risk. This indicates regulatory pressure has impact on bank's behavior.

2.4   Determinant of bank's interest rate margin

There are many papers studied about bank's interest rate margin. Samy Ben Naceur (2003) had studied the impact of bank's characteristics, financial structure and macroeconomic variables on bank's net interest rate margin and profitability. The results shows that banks with higher amount of capital and loan to assets ratio tend to have higher net interest margin and profitability while other factors like size have negative coefficient, this reflect scales inefficient. However, Macroeconomic factors like GDP growth and inflation have no impact on bank's net interest rate margin and profitability. For financial structure, this paper found that stock markets have positive impact on bank's profitability. Kit Pong Wong (1997) explored the determinants of optimal bank interest margins under credit and interest rate risk. The model demonstrates how cost, regulation, credit risk and interest rate risk conditions jointly determine the optimal bank spread decision. The bank interest margin is positively related to the bank's market power, operating costs, degree of credit risk, and interest rate risk. Increasing in the bank's equity capital has a negative effect on the spread when the bank faces little interest rate risk. The effect of rising interbank market rate on the spread depends on the net position of the bank in the interbank market. Sophie Claeys, Rudi Vander Vennet (2008) state that high margins are often associated with a low degree of efficiency and noncompetitive market conditions. In such circumstances, high margins are indicative of higher risk premium. Therefore, this paper will analyze whether high interest margin are caused by a low degree of efficiency (scale and X-efficiency) or by non-competitive market conditions (structure-conduct Performance: SCP). The result shown higher operational efficiency is reflected in lower bank interest margins. The source of the negative relationship between efficiency and interest margins differs, however. It is driven by X-efficiency, indicating that banks pass on cost management benefits to their customers in the form of better interest rate conditions.

III. The Theoretical Models and Research Methodology

There are two dependence variables in this study. The first variable used to measure the spread is net interest margin (NIM). In this study, NIM is calculated by net interest income and divided by total earning asset. The second variable used to measure banks' income structure is the ratio of banks' interest income to banks' total income (INT), which calculated by bank's interest income divided by bank's total income. In order to investigate the determinant of these two variables, we classify independence variables into internal and external variables.

The internal bank's characteristics are size, capital structure, branches and credit risk. In addition, the external variables are macroeconomic conditions namely economy growth and inflation. In terms of the variables used in the models, we discuss each variable as below. Based on this relationship, the function is shown as follow.

$$NIM = f \text{ (Bank's characteristic, Macroeconomic conditions)}$$

$$INT = f \text{ (Bank's characteristic, Macroeconomic conditions)}$$

3.1 Variables

3.1.1 Dependent variables

Net Interest Margin (NIM)

Bank's Interest Rate Margin is calculated by interest income minus interest expense and divided by interest earning asset. Interest Earning Asset derived from Loan plus inter bank (interest baring items) and bank's total investment excluding investments in subsidiaries and associates companies.

Banks' income structure (INT)

Bank income structure is the portion of income from interest income to bank's total income. This ratio provides information about the portion of bank's interest income to bank's total income. The higher the ratio, the more banks' income depends on interest income.

3.1.2   Independent variables

3.1.2.1   Internal factors: Bank's characteristic

(i) Log of assets (LA)

Generally, the effect of the growing size positively affects the profitability of firms due to the economies of scale. However, in case of extremely large banks, the size could negatively affect the profitability due to diseconomies of scale. The relationship between size and profitability is a non-linear relationship. Naceur (2003) found that ln of size has negative relationship with bank's net interest margin, so he suggested that larger banks tend to lower the margin.

(ii) Equity to assets (ETA)

The ratio of equity to assets (EA) used in this study is a proxy of the capital structure. The expected sign is positive because the bank capital reflects the strength of funds supporting the business and hence reducing the risk. Therefore, high capital leads to the strength of bank and increased creditability which directly result in their good performance. Moreover, it is expected that the high equity of asset ratio can decrease the need of external funding. It also encourages higher profitability and face lower costs of going bankrupt, causing the reduction of cost of funding (Neaur, 2003). The other effect is that bank with surplus capital (hold capital in excess of the regulatory minimum) has the possibility to increase portfolio risk in the form of loans or securities. This will increase the interest margin (Sophie Claeys and Rudi Vander Vennet, (2008).

(iii) Doubtful account to Loans (DAL)

This ratio is the portion of NPL to total loan which effects asset quality of bank's loan portfolio. If this ratio is increasing, bank are taking more risk. This variable thus is expected to have a negative relationship with interest margin.

(iv) Loan to deposit (LTD)

Bank is a financial institution whose primary activities include borrowing and lending money to business or household. They obtain revenue from the difference between deposit rate and lending rate. This ratio is used to show how banks funding their loan. If their main funding is deposits then they are expected to have positive sign of NIM. The more deposits will be transformed into loans which will eventually leads to the higher interest margin as the funding from deposit have lower cost of fund.

(v) Loan to assets (LTA)

Loan to Assets calculated by total loan divided by total assets. Bank loan are expected to be main source of income which positively effects on NIM. This ratio was used to figure credit risk level. Banks that provide more loans are expected to incur higher credit risk. Since loans are the most risky type of assets, which responsible for the highest operational costs, they need to be carefully serviced and monitored. When the bank applies markup pricing for its lending rates, the interest margin will increase (Sophie Claeys and Rudi VandervVennet, 2008). Therefore, this variable is expected to have a positive relationship with interest margin and income structure.

(vi) Bad debt and doubtful accounts to interest income (BDI)

This ratio is the provision for bad debt of bank loan. If bank have higher bad debt, they will have more provision due to new accounting standard. Rising in bad debts will definitely leads to the increase provision and money that bank have to reserve for bad loan. This study expected the ratio to be negatively related to interest margin, because banks' revenue will decrease when loan turns to default.

(vii) Number of banks' branch (BRA)

This variable is the number of branches that each bank possesses. With more branches, Bank has more chance to access wider range of customers, to extend their range of services and to gain more opportunities in selling their products. As a result, they will gain more non-interest income from service revenue. So we expected this variable would poise negative relationship with income structure.

3.1.2.1 External factors: Macroeconomic

(i) GDP growth (GDP)

GDP growth is a proxy of the growth of economy. With the economic growth, business units would expand the activities of their business which leads to the increasing corporate loans to the firms (David Ruthenberg, Yoram Landskroner (2008)). For household units, people tend to have increased purchasing power, which creates opportunities for banks to expand the consumer loan. Overall, the GDP growth leads to the increasing bank profit from the growth of lending. Therefore, GDP growth positively related to the profitability of banks.

(ii) Inflation (INF)

The inflation rate is assumed to be equal to the *ex ante* rate of the expected inflation. Generally, high inflation is associated with high interest rate. The effect of the inflation to interest margin is unclear, due to the ability of banks to manage the benefits from the inflation. If inflation is not anticipated and banks are sluggish in adjusting their interest rates, then there is a possibility that costs may increase faster than revenues and hence adversely affect bank profitability.

3.2   Methodology

3.2.1. Fixed effect

This study focuses on the determinants of banks' interest rate margin and income structure by using panel on quarterly data from 2001- Q2 2008. The relationship of bank's characteristic, credit risk, macroeconomic factors, net interest margin and income structure is estimated by fixed effect model. The fixed effects model in simple form is defined according to the following regression model:

$$Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \qquad i = 1,\ldots, N ; t = 1,\ldots,T \qquad (1)$$

y_{it} =   indicates the dependent variables (NIM) and bank income structure (INT)

α_i = $1,\ldots,N$ are constant coefficients specific to each bank.

X_{it} =   determines the vector of k explanatory variables.

β_i =   vector of individual coefficients comprising of variables of bank characteristics

We expand equation (1) for NIM model as follow:

y_{it} = α_i (constant term of bank i)

　　　　　　$+ \beta_1 LA_i + \beta_2 ETA_i + \beta_3 DAL_i + \beta_4 LTD_i + \beta_5 LTA_i + \beta_6 BDI_i$ (bank's characteristic)

　　　　　　$+ \beta_7 GDP + \beta_8 INF$ (Macroeconomic)

　　　　　　$+ \varepsilon_i$ (error term)   (2)

And for INT model as follow:

$$y_{it} \quad = \quad \alpha_i \qquad\qquad\qquad \text{(constant term of bank } i\text{)}$$

$$+ \beta_1 LA_i + \beta_2 ETA_i + \beta_3 LTA_i + \beta_4 BRA_i \qquad\qquad \text{(bank's characteristic)}$$

$$+ \beta_5 GDP + \beta_6 INF \qquad\qquad\qquad \text{(Macroeconomic)}$$

$$+ \varepsilon_i \qquad\qquad\qquad\qquad \text{(error term)} \qquad (3)$$

The fixed effects estimator allows for arbitrary correlation between α_i and the explanatory variable in any time period. Under a strict erogeneity assumption on the explanatory variables, the fixed effects estimator is unbiased. The idiosyncratic error ε_{it} should be uncorrelated with each explanatory variable across all time periods.

The fixed effect assumes that the marginal effect of the explanatory variables on the dependent variable is all the same for all units. To account for differences between the units, the constant terms α_i are allowed among units. In order to validate the fixed effects specification, the joint null hypothesis is to test whether the individual coefficients α_i = 1,…,N are not all equal. Since fixed effect model is used, the redundant fixed effect test is used to determine whether the null hypothesis among the intercept of eight banks are all equal.

$$H_0 : \alpha_1 = ... = \alpha_n = \alpha \qquad\qquad\qquad (4)$$

The fixed effect intercept means that there is different intercept estimated for each pooled variables ($\alpha_{it} = \alpha_i$). This study uses F-statistics to test whether fixed effect intercept is suitable for the model.

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3.2.2. Random effect

The random effects models are used in analysis of hierarchical or panel data when one assumes no fixed effects (i.e. no individual effects). The fixed effects model is a special case of the random effects model. To specify the model, this study compares the result from fixed effect to the random effect. In the random effects case, the model is defined as follows:

$$Y_{it} = \beta' X_{it} + \varepsilon_{iy} \qquad\qquad i = 1,\ldots, N \; ; t = 1,\ldots,T \qquad (5)$$

where $\qquad \varepsilon_{it} \;\; = \;\; u_i + v_{it}$ are the error component disturbances.

$\qquad\qquad\qquad u_i \;\; = \;\;$ The individual specific effects that are random and distributed normally

$\qquad\qquad\qquad (u_i \sim N(0, \sigma_u^2))$ and are independent of the residual terms.

$\qquad\qquad\qquad v_{it} \;\; = \;\;$ The residual terms that are distributed normally $(v_{it} \sim N(0, \sigma_v^2))$.

The random effect model (5) is estimated by the feasible generalized least squares method (FGLS), and the result of this model is then compared the estimation result from the fixed effect model (1).

3.3.3. Hausman specification test

Hausman specification test is conducted in order to compare the two categories of specification whether the fixed or random effects model should be used. It is proven that, under the null hypothesis, the two equations [equations (1) and (5)] could not differ systematically since they are both consistent. Thus, the test can be based on the difference. Under the null hypothesis, the Hausman statistic is asymptotically distributed as chi-square with k degrees of freedom and is written down as follows:

$$H = (\hat{\beta}_{GLS} - \hat{\beta}_F)' (\hat{V}(\hat{\beta}_F) - \hat{V}(\hat{\beta}_{GLS}))^{-1} (\hat{\beta}_{GLS} - \hat{\beta}_F) \qquad (5)$$

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Where $\hat{\beta}_F$ and $\hat{\beta}_{GLS}$ are the estimates of the fixed effects and random effects model respectively. $\hat{V}$ are the corresponding variance-covariance matrices of these estimated coefficients.

To study the effect of size, the sample is separated into large banks and small banks then regressed with fixed effect and random effect on model (4), then compare the results and specify these models.

VI. Data

4.1   Firms selection

The main focus of this study is Thai commercial banks, which their data are completed since 1997-quarter 2 2008 for quarterly balanced panel data. This study focused on the twelve banks being listed in SET excluding four new banks including Thanachart Bank, Tisco Bank, Keatnakin Bank and ACL Bank. The special banks that have limitation of the business scope and the foreign bank branches are also excluded from the sample. Consequently, the banks in this studied were totally comprised of eight Thai commercial banks. They are classified, by using size as criteria, into two groups as follow:

Large banks

Bangkok Bank Public Company Ltd.	(BBL)
Kasikorn Bank Public Company Ltd.	(KBANK)
Krung Thai Bank Public Company Ltd.	(KTB)
Siam Commercial Bank Public Company Ltd.	(SCB)

Small banks

Bank of Ayudhya Public Company Ltd.   (BAY)

Bank Thai Public Company Ltd.   (BT)

The Siam City Bank Public Company Ltd.   (SCIB)

The Thai Military Bank Public Company Ltd.   (TMB)

4.2   Bank's financial data

Banks' financial statement, which consists of balance sheet and income statement, are obtained from SETSMART. We obtain data from bank business rather than consolidated financial statement because this study focused on banks' core business. The number of banks' branches was collected form Bank of Thailand website.

In overall, there are eight variables reflecting the characteristics of banks which consisted of log of asset size (LA), equity to asset ratio (ETA), doubtful account to loans (DAL), loan to deposit (LTD), loan to asset (LTA), bad debt and doubtful accounts to interest income (BDI) and number of branches (BRA).

4.3   Macroeconomic data

The macroeconomic variables used in the models are GDP growth (GDP) and inflation rate (INF). GDP growth is a proxy of the growth of economy. With the economic growth, business units would expand the activities of their business which leads to the increasing corporate loans to the firms (David Ruthenberg, Yoram Landskroner (2008)). For household units, people tend to have increased purchasing power, which creates opportunities for banks to expand the consumer loan. Overall, the GDP growth leads to the increasing bank profit from the growth of lending. Therefore, GDP growth positively related to the profitability of banks. The GDP growth data is collected from the office of National Economic and Social Development Board.

The effect of the inflation to interest margin is unclear, due to the ability of banks to manage the benefits from the inflation. The inflation rate was collected from The Ministry of Commerce. The summary of the variables used in the model is in the table I; definition, notation and the expected sign of the explanatory variables of model on bank interest margin and income structure are provided.

[Table I is here]

Table II reports the descriptive statistic including the comparison of the basic statistics of large banks and small banks

[Table II is here]

By comparing the asset size of Thai banks in this sample at the quarter two of year 2008, Bangkok bank (BBL) is the largest bank with total assets of 1,604 billion baht. The second is Krung Thai bank (KTB) with 1,284 billions baht while Bank Thai is the smallest with 214 billions baht. By comparing the equity to asset ratio (ETA), large banks have the average ETA of 0.075, which is more than 0.052 of small banks. It indicates that on average, large banks have the stronger capital than small banks.

Moreover, the loan to deposit (LTD) ratio for large banks is 0.8832, which is less than small banks (0.9296). It indicates that smaller banks can transform deposit into loan better than large banks. For doubtful account to loan (DAL), ratio of large banks of 0.0805 that is substantially lowers than the small banks' ratio (0.0872). It reflects that the credit risk of large banks is lower than the small banks. The numbers of branches of large banks are much more than small banks. The numbers of branch for large banks are 600 branches compared to 319 branches for small banks. The correlation matrixes are shown in table III.

[Table III is here]

V. Empirical result

The table III reports estimation results from estimating equation 1). The model 1), which regards bank's net interest margin (NIM) as dependence variables, and the model 2), which regards bank's income structure (INT) as dependence variable, both models will be considered as the main study in the

paper about which factors determine banks' interest rate margin and income structure. Estimated results of the fixed effect model are shown in table IV

[Table IV is here]

In order to improve the model, this study has to estimate model with random effect and then compare the result with fixed effect by Hausman test. First of all, we will estimate NIM model. After estimating both fixed effect and random effect model, we will finally compare these results with Hausman test to find appropriate model. The result is shown in table V

[Table V Is here]

The result from Hausman test indicates that random effect is more appropriate to explain the equation than random effect with the Chi-square of 11.21 (prob. = 0.1900). Thus, the result confirms that the random model is appropriate test to explain net interest margin model.

From the result, some variables are demonstrated to be significant. The first one is log of bank's asset (LA) as it is positive and significant with coefficient of 0.0015. When others variable are set to equal, bank's NIM will increase by 0.0015 percent if log of asset (LA) increases by 1 percent. This result indicates the scale efficient of banks.

Equity to assets (ETA) is a proxy for capital strength. If bank have more capital, they will use internal fund instead of external fund and increase creditability. As a result, their cost of fund tends to be lower and thus results in higher margin. ETA is positive and significant, in line with our expectation, with coefficient of 0.0266. If the others variable are set to equal and ETA increases by 1 percent, bank's NIM will increase by 0.0266 percent. The result reconfirms our expectation that bank with higher capital will gain better margin.

Doubtful account to loans (DAL) is proxy for risk-taking of the bank. This variable is negative and significant with coefficient of 0.0142. If the others variable are set to equal and DAL increases by 1

percent, bank's NIM will decrease by 0.0142 percent. This variable indicates the risk of the bank. If bank expand its business by increasing more loan, then bank's loans could be turned to non-performing loan (NPL). NPL could eventually lead to default in which banks are unable to collect interest and principle from loan, and finally lead to reduction in interest revenue of the banks.

For macroeconomic variables, we found that GDP is negative with coefficient of 0.0133. The economic growth are not only associated with the expansion of businesses and the demand for loan but also bank-based economy. Normally, loan quality in the period of high economic growth tends to be good debt. During the period, bank will reduce their spread because of higher competition in lending to business units when economy grows.

Inflation (INF) is positive and significant to NIM with coefficient of 0.0765. If the others variable are set to equal and inflation increases by 1 percent, bank's NIM will increase by 0.0765 percent. This finding indicates that banks are adjusting their interest rates in respond to higher inflation rate. As a result, there is a possibility that bank costs may increase in slower pace compared to bank revenues.

For bank's income structure (INT) model after estimating both fixed effect and random effect model, we compare these results with Hausman test to find appropriate model as same as NIM model. The result is shown in table VI.

[Table VI Is here]

The result from Hausman test indicates that random effect is more appropriate to explain the equation than fixed effect with the Chi-square of 3.59 (prob. = 0.7322). Thus, the result confirms that the random model is appropriate to explain income structure model.

The factor that determines banks income structure is equity to asset ratio (ETA). Equity to assets (ETA) is a proxy for capital strength. From NIM model, we can see that if banks have more capital, banks will gain more margins which lead to the increase in the interest revenue. This variable is positive and

significant, in line with our expectation, with coefficient of 2.1614. If the others variable are set to equal and ETA increases 1 percent, bank's INT will increase by 2.1614 percent.

In order to analyze the difference of banks' size to the banks' behavior, we divided them into two groups: the large one and small one. Table VII shows the effect of size to the margin.

[Table VII is here]

In NIM model, when we divided banks into large group and small group, the coefficient is quite the same but some variables are significant while some are not. Surprisingly, the scale efficient is come from small bank.

The difference between large banks and small banks is the effect of loan to asset (LTA) to NIM. These variables are negative and significant in small banks since their asset is mostly depended on loan. In order to be more competitive, small banks tend to decrease their margin. For large banks, unlike all banks, BDI is negative and significant. Bad debt and doubtful account are provision that banks have to reserve for NPL, due to new accounting standard, which regarded as the expense for bank. Therefore, if this ratio is increasing, it indicates that banks have more NPL and their revenue will be decreased. As banks are unable to collect both principle and interest revenue from default loans, they consequently gain lower margin. The reason why only large banks are significant may come from the larger and higher margin they have.

Next, we analyze the difference of bank's size to the bank's income structure. Table VIII shows the effect of size to the income structure.

[Table VIII is here]

For INT, the coefficient of large versus all banks are quite difference. The coefficient of LA for large banks is negative and significant. This result indicates that large banks' income structure is not only depending on interest revenue but also on fee based income. As large banks have more branches and their

businesses are more varied than small banks, they have more chance to generate fee based income than small banks.

The factor determining income structure of large banks is number of branches (BRA). If bank have more branches in many area, banks will have opportunities to access new group of customers and generate more non-interest income (fee based income).

VI. Conclusion

This study focused on determinants of banks' interest rate margin and income structure of Thai commercial banks over period 1997 to 2nd quarter of 2008. In this study, we use two dependence variables, one for interest margin and one for banks' income structure. Then, we run regression which results are estimated with fixed effect and random effect, and finally compare with Hausman test. The differences of the impacts of determinants to interest margin and bank's income structure between large banks and small banks are investigated by comparing the data set of these two groups.

For banks' margin, almost all internal bank characteristic variables are significant. However, the results are mixed but in line with our expectation. The result indicates that there is scale efficient but mainly come from small banks. For capital strength, we find that banks with higher capital tend to have better margin because bank with more capital leads to the strength of bank and increase in creditability. As a result, they can obtain lower cost of fund and thus gain higher margin. For doubtful account to loan, it had shown significant to NIM. This result indicates that increasing in NPL will lead to the decrease of spread. The decrease in the spread is mainly from reduction in bank revenues due to the debt that turned to default.

For macroeconomic variable, the result indicate that both GDP and inflation effects on margin are mixed. GDP is shown to be negative to NIM. Normally when economy grows, demand for loan will increase and loan quality in the period of high economic growth tends to be good debt. So banks tend to

reduce their spread in order to be more competitive. On the contrary, inflation is positive and significant to NIM. This finding indicates that banks are adjusting their interest rates in respond to higher inflation rate. As a result, there is a possibility that bank costs may increase in slower pace compared to bank revenues.

When we analyze that whether large and small bank are different or not, the result of these two groups is quite similar. However, large banks will have more effect when NPL occurs. For small banks, the more they depend on loan, the lower margin they gain.

For income structure, internal bank characteristic determining banks' income structure is capital. This can be explained by the result from NIM model which indicates banks with higher equity will have more margin and gain more interest income. Comparing between large and small banks, the factor determining income structure of large banks is number of branch. This is because large banks have more branches and their businesses are more varied than small banks. As a result, large banks have ability to generate more fee based income than small banks. This could be reconfirmed by the result that number of branches has significant impact to income structure. If bank have more branches, banks will have opportunities to access new group of customers and generate more non-interest income (fee based income). Macroeconomic variables, which are GDP growth and inflation, have no impact on bank's income structure.

From the result of two models, we can identify the factors that determine bank interest margin and income structure. The results from this study could be usefully applied for the commercial bank to improve their profitability and income structure. In the near future, the commercial banks tend to be universal banking which will face more tough competition from foreign banks and non-banks due to the change of financial market structure. Thus, there are several areas of study in order to improve the profitability and efficiency of Thai banking system under changes of macroeconomic conditions, regulations, and financial market structure. These will ultimately lead to an improvement of the profitability, efficiency and stability of Thai banking system.

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Appendix A

Table I

Definitions, notation and the expected sign of the explanatory variables of model on bank interest

margin and income structure

Variables	Description	Symbol	Expected sign	
			NIM	INT
Dependent variable				
Net interest margin	Net interest income / Total earning asset*	NIM		
Banks' income structure	Interest income / Total income	INT		
Bank characteristic				
Assets	Log of assets	LA	+ / -	+ / -
Capital	Equity / total assets	ETA	+	+
Doubtful account to loans	Doubtful account over Total loans	DAL	-	
Loan to deposit	Total loans / Total deposit	LTD	+	
Loan to assets	Total loans / Total asset	LTA	+	+
Bad debt and doubtful accounts to interest income	Bad debt and doubtful accounts / Interest income	BDI	-	
Number of branches	Number of branches	BRA		-
Macroeconomic				
Economic growth	GDP growth	GDP	+ / -	+ / -
Inflation	Inflation rate	INF	+ / -	+ / -

*Total earning asset = Loan + inter bank (interest baring items) + (bank's total investment - investments in subsidiaries and associates companies)

Table II

Descriptive statistics

All banks

Variables	NIM	INT	LA	ETA	DAL	LTD	LTA	BDI	BRA	GDP	INF
Unit:	(%)	(%)	(Million baht)	(times)	(%)	(%)	(%)	(%)	(No.)	(%)	(%)
Mean	0.5350	83.9602	6.3722	0.0634	8.3869	90.6420	72.4273	36.7959	460.03	3.1262	0.407
Minimum	-0.8191	-360.8384	4.0721	-0.1882	0.0000	28.8081	24.1112	-72.5636	77.00	4.9973	-0.700
Maximum	1.5714	295.5136	7.3918	0.1340	42.0241	211.1499	153.1518	736.4045	910.00	0.2497	4.200
Standard deviation	0.3848	32.2725	0.6422	0.0304	7.0353	19.8142	13.5014	89.4181	188.09	-13.9229	0.831
Variance	0.0015	10.4151	0.4124	0.0009	0.4950	3.9260	1.8229	79.9560	35,376.70	8.4142	0.691
CV	1.3904	2.6016	9.9229	2.0869	1.1921	4.5746	5.3644	0.4115	2.4458	-0.2245	0.489
Observation	368	368	368	368	368	368	368	368	304	368	368

All banks comprise of BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

LA   =   Log of asset

ETA =   Equity to asset

DAL =   Doubtful account to loan

LTD =   Loan to deposit

LTA =   Loan to asset

BDI =   Bad debt and doubtful accounts / Interest income

BRA =   Number of branches

Large banks

Variables	NIM	INT	LA	ETA	DAL	LTD	LTA	BDI	BRA
Unit:	(%)	(%)	(Million baht)	(times)	(%)	(%)	(%)	(%)	(No.)
Mean	0.6663	81.4511	6.8712	0.0747	8.0526	88.3230	72.0031	36.8183	600.56
Minimum	-0.7673	48.9996	6.0679	0.0199	1.4287	46.1075	38.7363	-69.2407	476.00
Maximum	1.5714	143.3229	7.3918	0.1340	25.5036	119.3706	108.4480	602.7839	910.00
Standard deviation	0.3290	10.0053	0.2657	0.0234	4.8626	14.4415	10.0515	75.6870	100.75
Variance	0.0011	1.0011	0.0706	0.0005	0.2364	2.0856	1.0103	57.2853	10,150.34
CV	2.0255	8.1408	25.8651	3.1967	1.6560	6.1159	7.1634	0.4865	5.9610
Observation	184	184	184	184	184	184	184	184	152.00

Large banks comprise of BBL, KTB, SCB and KBANK

Small banks

Variables	NIM	INT	LA	ETA	DAL	LTD	LTA	BDI	BRA
Unit:	(%)	(%)	(Million baht)	(times)	(%)	(%)	(%)	(%)	(No.)
Mean	0.4037	86.4693	5.8733	0.0520	8.7213	92.9611	72.8515	36.7735	319.50
Minimum	-0.8191	-360.8384	4.0721	0.1882	0.0000	28.8081	24.1112	-72.5636	77.00
Maximum	1.4087	295.5136	6.6458	0.1230	42.0241	211.1499	153.1518	736.4045	570.00
Standard deviation	0.3925	44.4516	0.5059	0.0323	8.6829	23.8324	16.2534	101.5203	145.18
Variance	0.0015	19.7595	0.2559	0.0010	0.7539	5.6798	2.6417	103.0636	21,078.64
CV	1.0286	1.9452	11.6107	1.6100	1.0044	3.9006	4.4822	0.3622	2.2006
Observation	184	184	184	184	184	184	184	184	152.00

Small banks comprise of BAY, TMB, SCIB, and BT

Table III

Correlation matrix of independent variables

All banks

	LA	ETA	DAL	LTD	LTA	BDI	BRA	GDP	INF
LA	1.0000								
ETA	0.4994	1.0000							
DAL	-0.1879	-0.2134	1.0000						
LTD	-0.1642	-0.0105	0.2476	1.0000					
LTA	-0.0876	0.0189	0.2116	0.8707	1.0000				
BDI	-0.0530	-0.2059	0.2367	0.2514	0.1732	1.0000			
BRA	0.6745	0.3498	-0.0949	-0.3377	-0.1879	-0.0283	1.0000		
GDP	-0.1429	-0.2471	0.0999	0.1574	0.1599	0.0559	-0.0477	1.0000	
INF	0.0100	0.1302	-0.1659	0.1402	0.0584	-0.0939	-0.1676	-0.1266	1.0000

All banks comprise of BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

Large banks

	LA	ETA	DAL	LTD	LTA	BDI	BRA	GDP	INF
LA	1.0000								
ETA	0.0129	1.0000							
DAL	0.0952	-0.0561	1.0000						
LTD	0.0592	0.3837	0.2073	1.0000					
LTA	0.0329	0.2704	0.2067	0.9527	1.0000				
BDI	-0.1192	0.0373	0.3009	0.2349	0.2504	1.0000			
BRA	0.6695	0.3881	-0.1227	0.2381	0.1284	-0.1105	1.0000		
GDP	-0.2970	-0.3838	0.2629	-0.1866	-0.0983	0.1479	0.0396	1.0000	
INF	0.2208	0.2740	-0.1894	0.1726	0.1043	-0.1835	-0.0047	-0.2284	1.0000

Large banks comprise of BBL, KTB, SCB and KBANK

Small banks

	LA	ETA	DAL	LTD	LTA	BDI	BRA	GDP	INF
LA	1.0000								
ETA	0.5691	1.0000							
DAL	-0.5227	-0.2223	1.0000						
LTD	0.0548	-0.1354	0.4524	1.0000					
LTA	0.1522	-0.0873	0.3338	0.8869	1.0000				
BDI	-0.0352	-0.1810	0.1541	0.3085	0.1507	1.0000			
BRA	0.9174	0.5055	-0.5361	0.0767	0.2613	0.0028	1.0000		
GDP	-0.2076	-0.2719	0.0901	0.2416	0.2496	-0.0038	0.6800	1.0000	
INF	0.1751	0.2000	-0.0594	-0.1791	-0.2078	-0.0989	-0.0169	-0.2284	1.0000

Small banks comprise of BAY, TMB, SCIB, and BT

Table IV

Net interest margin and income structure: Fixed effect

Regression	(1)		(2)	
	NIM		INT	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	-0.0069	-1.36	1.0078	0.79
LA	0.0021***	2.99	-0.0371	-0.19
ETA	0.0233***	3.69	2.8010**	2.08
DAL	-0.0147***	-5.51		
LTD	-0.0013	-0.77		
LTA	-0.0011	-0.41	-0.2759	-0.98
BDI	0.0002	-1.19		
BRA			0.0030	0.15
GDP	.01296***	-4.09	1.0408	1.40
INF	0.0763***	5.07	2.9534	0.90
Observation	368		368	
R-sq: within	0.4124		0.1211	

*,**,*** indicate significant levels of 10, 5 and 1 percent respectively

Table V

Fixed effect and random effect estimation and specification test: NIM model

	Fixed effect		Random effect	
	Coefficient	t-Statistic	Coefficient	z-Statistic
Constant	-0.0069	-1.36	-0.0023	-1.25
LA	0.0021***	2.99	0.0015***	5.65
ETA	0.0233***	3.69	0.0266***	4.53
DAL	-0.0147***	-5.51	-0.0142***	-6.32
LTD	-0.0013	-0.77	-0.0013	-0.81
LTA	-0.0011	-0.41	-0.0021	-0.94
BDI	-0.0002	-1.19	-0.0002	-1.16
GDP	-0.0123***	-4.09	-0.0133***	-4.36
INF	0.0763***	5.07	0.0765***	5.06
Observation	368		368	
R-sq: within	0.4124		0.4109	
	Chi-square statistic		P-Value	
Hausman test	11.21		0.1900	

*,**,*** indicate significant levels of 10, 5 and 1 percent respectively

Table VI

Fixed effect and random effect estimation and specification test: INT model

	Fixed effect		Random effect	
	Coefficient	t-Statistic	Coefficient	z-Statistic
Constant	1.0078	0.79	0.9332**	2.15
LA	-0.0371	-0.19	-0.0294	-0.40
ETA	2.8010**	2.08	2.1614*	1.74
LTA	-0.2759	-0.98	-0.1944	-0.75
BRA	0.0030	0.15	-0.0072	0.20
GDP	1.0408	1.40	0.9213	1.38
INF	2.9534	0.90	3.2243	1.00
Observation	368		368	
R-sq: within	0.1211		0.1725	
	Chi-square statistic			P-Value
Hausman test	3.59			0.7322

*,**,*** indicate significant levels of 10, 5 and 1 percent respectively

Table VII

Regression result of NIM model for large and small banks

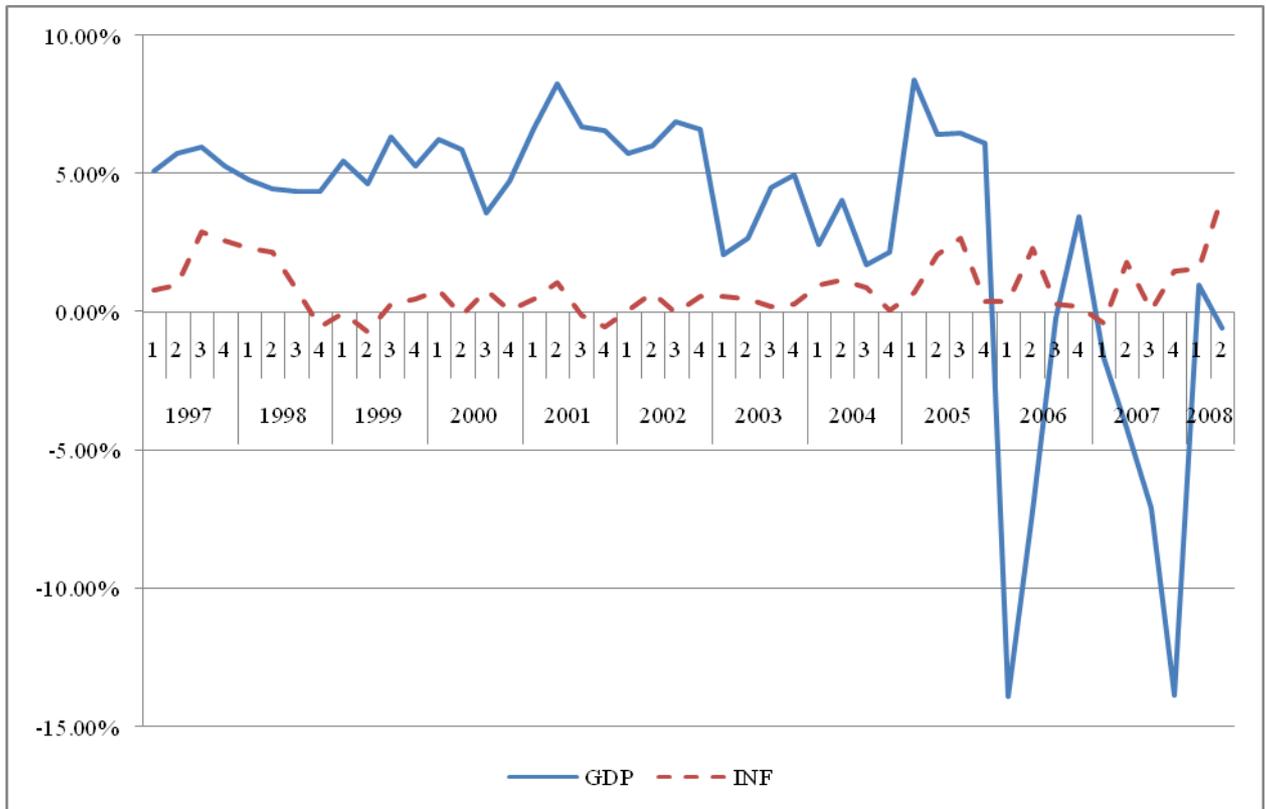|	All banks [1]		Large banks [2]		Small banks [3]	
	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
Constant	-0.0023	-1.25	0.0043	0.7	-0.0026	-0.87
LA	0.0015***	5.65	0.0000	-0.07	0.0018***	3.75
ETA	0.0266***	4.53	0.0331***	3.47	0.0240***	3.03
DAL	-0.0142***	-6.32	-0.0194***	-4.22	-0.0104***	-3.82
LTD	-0.0013	-0.81	-0.0054	-1.46	-0.0015	-0.81
LTA	-0.0021	-0.94	0.0095	1.87	-0.0041*	-1.91
BDI	-0.0002	-1.16	-0.0010***	-3.66	0.0001	0.61
GDP	-0.0133***	-4.36	-0.0106**	-2.34	-0.0132***	-2.95
INF	0.0765***	5.06	0.0539**	2.46	0.0816***	3.96
Observation	368		184		184	
R-sq: within	0.3544		0.3941		0.4989	
Redundant Fixed Effects Tests						
Chi-square	11.21		3.89		0.64	
P-Value	0.1900		0.8669		0.9997	

*,**,*** indicate significant levels of 10, 5 and 1 percent respectively

[1] BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

[2] BBL, KTB, SCB and KBANK,

[3] BAY, TMB, SCIB, and BT

Table VIII

Regression result of income structure model for large and small banks

	All banks [1]		Large banks [2]		Small banks [3]	
	Coefficient	z-Statistic	Coefficient	t-Statistic	Coefficient	z-Statistic
Constant	0.9332**	2.15	8.0432***	2.70	1.2223	1.48
LA	-0.0294	-0.40	-1.2877**	-2.38	0.1130	-0.21
ETA	2.1614*	1.74	-0.6716	-2.18	1.0814	0.58
LTA	-0.1944	-0.75	-0.0185	-0.28	-0.1906	-0.65
BRA	-0.0072	0.20	-0.0191**	2.30	-0.0026	0.14
GDP	0.9213	1.38	0.2286	0.15	1.0681	1.35
INF	3.2243	1.00	-0.5399	-0.83	-1.3254	-0.31
Observation	368		152		152	
R-sq: within	0.1725		0.3236		0.1695	
Redundant Fixed Effects Tests						
Chi-square	3.59		102.92		0.14	
P-Value	0.7322		0.0000		1.0000	

*,**,*** indicate significant levels of 10, 5 and 1 percent respectively

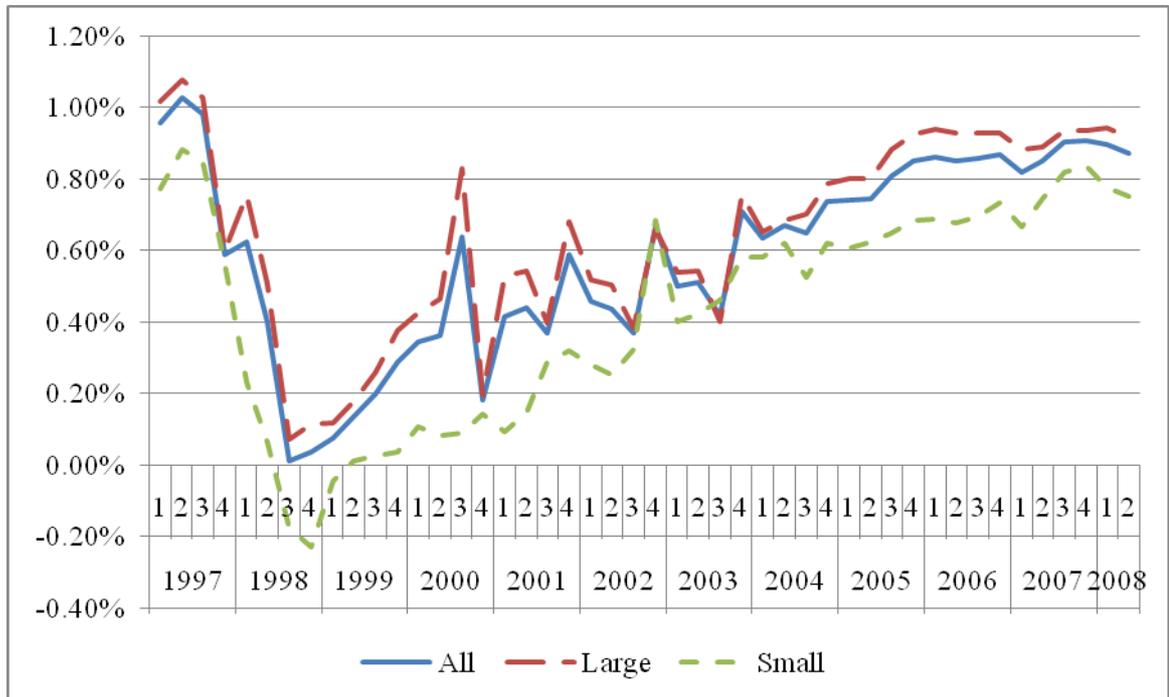[1]BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

[2]BBL, KTB, SCB and KBANK,

[3]BAY, TMB, SCIB, and BT

Figure 1

GDP growth and Inflation

Source: National Economic and Social Development Board and Ministry of Commerce
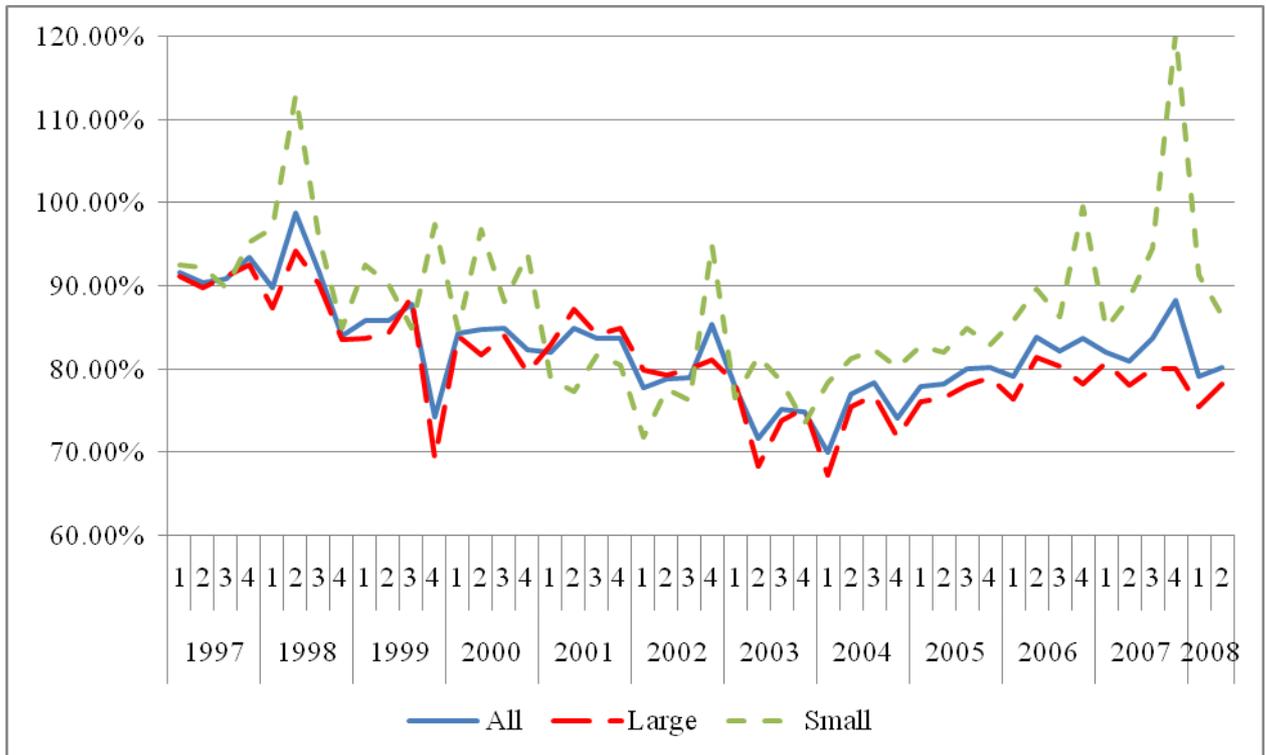
Figure 2

Net interest margins (NIM)

All banks comprise of BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

Large banks comprise of BBL, KTB, SCB and KBANK,

Small banks comprise of BAY, TMB, SCIB, and BT

Figure 3

The ratio of bank's interest income to total income

All banks comprise of BBL, KTB, SCB, KBANK, BAY, TMB, SCIB, and BT

Large banks comprise of BBL, KTB, SCB and KBANK,

Small banks comprise of BAY, TMB, SCIB, and BT