# Change in Bank Revenue; Change in Bank Risk? What Has Happened in Asia?

Williams, Barry; Rajaguru, Gulasekaran

*DOI:*
10.2139/ssrn.2307307

Change in bank revenue; change in bank risk? What has happened in Asia?

By Barry Williams* and Gulasekaran Rajaguru

School of Business

Bond University

Gold Coast

Queensland 4229 Australia

Abstract: Increased bank non interest income has been found to be associated with higher bank specific risk as well as increased systemic risk (Brunnermeier, et al. (2012), Stiroh and Rumble (2006)). We adopt a time series approach to this issue for Asian nations to present a different perspective to this literature. We find that declines in bank interest margins are associated with both increased non interest income as well as increased bank risk. We also find that bank capital holdings are insensitive to changes in bank revenue. We argue that these results provide an objective basis for regulatory intervention to reduce the potential for systemic risk.

## 1. Introduction.

The composition of bank revenue has changed globally over the past two decades, with an increased emphasis upon non interest income. In the case of the United States non interest income now accounts for up to half of all income earned by commercial banks (Nguyen (2012). This shift has resulted from a shift in the nature of the competitive environment facing banks (Allen and Santomero (2001). Competition from non bank providers of financial services (shadow banking) has placed increased price pressure upon both the asset and liability side of bank balance sheets. The result has been lower returns from providing traditional borrowing and lending services, as measured by bank interest margins. In response to this changing commercial environment banks have evolved their portfolio of products towards increased offering of fee based products. This change in bank revenue has been extensively studied in the United States by authors such as Stiroh and Rumble (2006), Stiroh (2004), DeYoung and Rice (2004b), as well as in Europe, Lepetit, et al. (2008a),

* Corresponding author: Barry Williams; School of Business, Bond University, Gold Coast, Queensland, 4229, Australia. Phone: + 617 5595 2259 Fax: +617 5595 1160. Email: Barry_Williams@bond.edu.au

Lepetit, et al. (2008b) and Australia; Williams and Prather (2010), Williams and Rajaguru (2013). However, studies of this issue in the Asian context are relatively rare, with only one paper tangentially addressing this question that these authors are aware of; Williams (2013).[1] Thus, there is a gap in this literature that this paper seeks to fill by considering the change in bank revenue in the Asian region from a time series perspective while also establishing if this evolution of bank revenue is accompanied by a change in bank risk. Furthermore, Brunnermeier, et al. (2012) demonstrated that higher levels of non interest income is associated with higher levels of systemic risk for bank holding companies in the United States. Thus the relationship between bank revenue composition and bank risk have important implications for the post financial crisis design of financial system regulation.

A number of studies have documented that increased bank non interest income is associated with increased bank risk (Stiroh and Rumble (2006), Lepetit, et al. (2008a) and that financial conglomeration is associated with a systematic discount (Laeven and Levine (2007). A recent study by Nguyen (2012) has found that increased bank non interest income is associated with reduced risk adjusted profits. Nguyen (2012) considered the relationship between traditional (interest margin) income and less traditional (non interest income) from the perspective of simultaneous Generalised Method of Moments estimation. This paper will adopt a different approach by modelling the relationship between margin and non interest income applying panel vector autoregressions. This will provide a strong control for the evolutionary nature of bank revenue over our study period while allowing us to simultaneously consider the evolution of bank risk.

This study is of interest because the evolution of bank revenue and risk has important implications for the formulation of prudential policy after the recent financial crisis. Studies of the Asian region can provide valuable contributions to this policy formulation as is has been some time since the Asian Financial Crisis and thus a post recovery perspective can be adopted.

This paper finds that there is a stable time series relationship between bank margin revenue and bank non interest income, in that declines in margin income over time are being compensated for by increased non interest income. Further, increased non interest income revenue is accompanied by increased bank risk. Of interest to bank regulators is the finding

[1] Williams (2013) considers the case of Indonesia only, rather than a wider study of the Asian experience as this study does.

that increased non interest income is not accompanied by changes in bank capital holdings. This finding is particularly relevant to post crisis prudential policy as changes in bank revenue provides an indicator as for potential increases in bank risk.

The rest of this paper is structured as follows. The next section provides a more detailed review of the relevant literature, the third section details our data and methodology. The fourth section presents and discusses the results of our estimations. The final section concludes our paper with some policy implications and additional comments.

## 2. Literature Review.

Models of intermediation presented by Diamond (1984) and Ramakrishnan and Thakor (1984) argue that bank diversification provides a credible signal to the credit market of the bank's ability to overcome information asymmetry, screen loan applications and monitor approved loans. Further, traditional mean-variance portfolio theory provides scope for arguments that diversification of bank revenue reduces volatility of the revenue portfolio. Additionally, co-delivery of both interest based as well as fee based financial products provides the bank with benefits from economies of scope. However, Jensen (1986) and Berger and Ofek (1996) have counter-argued that increased bank focus exploits returns from specialised managerial expertise as well as reducing potential agency conflicts. The conflict between these perspectives as well bank deregulation, in particular the Gramm-Leach-Bliley Act of 1999, removing the separation between commercial and investment banks in the United States, has resulted in a burgeoning literature addressing the role bank revenue composition plays in bank risk. This literature has occurred against a backdrop of banks increasingly evolving toward becoming financial conglomerates offering one-stop financial services (van Lelyveld and Knot (2009). The evolving sophistication of financial products and the on-going process of financial innovation has also seen the banking sector facing increased competition from the non-bank sector (shadow banking) (Lepetit, et al. (2008a); Slager (2006)), with a resulting change in the product mix provided by banks.

Empirical studies considering the portfolio diversification benefits of banks generating increased non interest income have adopted several different perspectives. Prior to the deregulation of the United States banking system simulated merger studies such as Lown, et al. (2000), Santomero and Chung (1992) and Saunders and Walter (1994) have found support for combining banks with other types of financial service firms, especially insurance. Smith, et al. (2003) found a weak negative correlation between interest and non interest income,

suggestive of portfolio diversification benefits. In contrast, more recent work has considered the actual revenue composition of banks and its relationship with observed bank risk. Studies such as DeYoung and Rice (2004a), Stiroh (2006) and Stiroh and Rumble (2006) have found that increased bank non interest income is associated with worsening risk-return trade-offs.[2] It was found that the volatility effect of riskier non interest income outweighed any portfolio diversification benefits. In explaining these results it has been argued that bank management were focussed upon absolute levels of returns as opposed to a risk-return trade-off and the negative incentives generated by too big to fail were culpable for at least part of these problems. Recently, Nguyen (2012) also found that increased non interest income is associated with worsening risk-return trade-off and concluded that it has no diversification benefits.

In contrast to the portfolio diversification argument, DeYoung and Roland (2001) present three explanations for the higher volatility of non interest income. First, the bank-borrower relationship has higher switching costs than the one-off contracts that are part of many fee-based relationships. Second, non interest income has a higher operational leverage due to its reliance upon fixed costs as inputs. Finally, generating non interest income is less reliant upon capital as an input and so this revenue has higher financial leverage.

A number of studies have explored the role of non interest income in a world of imperfect information. It has been argued that the bank-borrower relationship contains a valuable flow of information that can be used to cross-sell other financial services such as underwriting (Saunders and Walter (1994), Stein (2002)). In a similar vein underwriting and funds management can generate a flow of information valuable to the lending function (Laeven and Levine (2007). However, the evolution of the bank into a financial conglomerate generates increased complexity and thus information asymmetry with the associated scope for increased agency conflicts. Evidence from the United States (Schmid and Walter (2009)) and globally (Laeven and Levine (2007)), as well as China (Berger, et al. (2010)) finds that the negative agency effects of this increased complexity dominate any portfolio diversification benefits.[3]

[2] Stiroh (2004) found that the correlation between interest and non interest income in the United States is positive and increasing, thus providing further evidence against the portfolio diversification argument.
[3] Elyasiani and Wang (2008) argues that increased non interest income is associated with higher levels of information asymmetry.

Increased bank non interest income is not only associated with adverse outcomes for bank revenue volatility, but also with worsening loan quality. Lepetit, et al. (2008b) found in the European case that banks with higher levels of non interest income were more likely to misprice loan risk, in accord with the loss leader hypothesis. Under the loss leader hypothesis (also called the cross-selling hypothesis), banks choose to under-price credit risk on loans to establish an ongoing relationship, with the aim of extracting further revenue via non interest income at a later date. Lepetit, et al. (2008a) found that the loss leader strategy results in an inefficient under-pricing of default risk of bank loans.

To date only one study that these authors are aware of has considered the issue of bank revenue composition from a time series perspective. Williams and Rajaguru (2013) modelled the relationship between bank margin income and non interest income in Australia using panel vector autoreggressions. It was concluded that declines in margin income were being offset by increased non interest income, but that the increase in non interest income associated with declining margins was smaller than the decrease in interest margins, resulting in a wealth transfer in favour of those using banking services. It was further argued that Australian banks have responded to falling interest margins by increasing the range of non interest services into areas such as insurance and funds management.

The issue of changing income composition and bank risk is one that has been rarely explored in the Asian context; to date there is one paper that these authors are aware of addressing this issue; Williams (2013), which considered the Indonesian case. Williams (2013) found no evidence of bank non interest income impacting upon Indonesian bank risk. However, Williams (2013) had a focus upon the Indonesian banking experience during and after the Asian Financial Crisis, thus a wider cross nation study may be more appropriate.

## 3. Sample and Method.

This study will consider Asian region commercial and saving banks drawn from the *BankScope* database; banks operating in the ten member nations of the Association of South East Asian Nations (ASEAN) (Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam) as well as Australia, New Zealand and Japan ware studied.[4] The data covers the period 1998 to 2011, and has a total of 474

[4] The last three nations are included so that the sample includes both developed and developing nations. China was excluded due to the domination of its banking system by government owned banks which retain some degree of political direction in the lending function (Berger, et al. (2009), Zhang, et al. (2012)).

banks and 3856 observations (unbalanced panel). Table 1 details the national composition of the sample used.

Table 1 about here.

As discussed above, bank interest margins and non interest income are determined as a simultaneous process which interacts with bank level risk. We will thus consider the panel vector autoregressive (Panel VAR) model to establish the link between bank interest margins and non interest income. In this model we will control for bank level risk with a number of variables reflecting the different dimensions of bank risk. As discussed previously Lepetit, et al. (2008b) found that higher bank non interest income is associated with poorer quality loan portfolios. Details of the variables used to measure bank risk will be provided below. As discussed in the Ho and Saunders (1981) model of bank net interest margins, interest margins are a partial function of bank managerial risk aversion, which is conventionally measured using bank capital holdings.[5] Kwan and Eisenbeis (1997) argue that bank loan growth can represent bank risk, with loan to medium loan growth being necessary for ongoing bank profitability as well as economic asset formation However, high levels of loan growth are argued to be associated with increased bank risk. This argument was supported in the Indonesian case by Finally, a measure of bank revenue volatility will be included to determine if bank revenue risk is associated with bank non interest income, as discussed above.

Conventionally bank revenue risk is measured by the standard deviation of either return on equity or return on assets, calculated over a four to twelve period moving window.[6] This paper will adopt a different perspective; Parkinson (1980) argues that in small sample studies this conventional measure suffers from imprecision. Parkinson (1980) recommends using Log (high value / low value); but in this study such a measure would be ill-defined for loss making banks. Instead we adopt the method of Alizadeh, et al. (2002) and use Log (high value – low value ) for both return on average assets and return on average equity. As discussed in both Alizadeh, et al. (2002) and Parkinson (1980) as few as two observations can be used to generate an estimate of bank risk using this method. Table 2 has the descriptive statistics of the variables used in this study.

[5] See also Maudos and Guevara (2004), Williams (2007), and Nguyen (2012).
[6] As a recent example see De Haan and Poghosyan (2012).

Table 2 about here.

Examination of the loan growth statistic s showed a small number of extreme values. Thus we will conduct robustness analysis later in this paper to consider if these extreme values bias any results.

Method.

In order to analyse existence of systematic trade-off between interest and non interest income in ASEAN as found by Williams and Rajaguru (2013) in Australia, we estimate the following multivariate dynamic panel data model[7].

$$y_{i,t} = \sum_{j=1}^{q} \beta_j y_{i,t-j} + \gamma Risk_{i,t} + \mu_i + \eta_t + \varepsilon_{it}, \qquad (1)$$

where $y_{it} = \begin{pmatrix} MARGIN_{i,t} \\ FEES_{i,t} \end{pmatrix}$, *MARGIN* and *FEES* are, respectively, Net Interest Margin / Total Assets (%) and Non Interest Income to Total Assets (%) for banks $i$ (=1, …, $N$) at time $t$ (=1, …, $T$). $\mu_i = \begin{pmatrix} \mu_{1i} \\ \mu_{2i} \end{pmatrix}$ and $\eta_i = \begin{pmatrix} \eta_{1i} \\ \eta_{2i} \end{pmatrix}$ are bank-specific and time-specific fixed effects respectively. $\varepsilon_{i,t}$ is a multivariate normally distributed four components simultaneously in the risk vector namely: (i) Asset Quality, (ii) Loan Growth, (iii) Capital Holdings and (iv) Revenue Volatility.

(i) Asset Quality: In Europe Lepetit, et al. (2008b) and Lepetit, et al. (2008a) found that increased levels of bank noninterest income is associated with lower quality loans and an inefficient trade-off between risk and return. Williams (2007) found a negative relationship between Australian bank NIMS and bank asset quality, suggesting a perverse pricing for bank risk. There are a number of different measures of bank asset quality available, some are stocks, are some are flows, and they mostly tend to lag the economic cycle. (Laeven and Majnoni (2003) ), although they are supposed in some cases to be forward looking. We consider two different measures for asset quality: Impaired loan reserves divided by total loans and, loan loss provisions divided by total loans. Several other loan quality measures are available in BankScope but due to national differences in disclosure they result in significant

[7] Standard panel unit root tests confirm that all variables in the model are stationary. Hence, we estimate the short-run relationships between the variables of interest. For the sake of brevity, we do not report the panel unit root test results. However, it can be made available fro author upon request.

reductions in available data. These measures are considered independently one at a time to avoid the problem of inefficiency due to multicollinearity.

(ii) Loan Growth: Change in loans and (change in loans)$^2$ are jointly included in the model to capture the non-linearity arising from loan growth. It is conventionally argued that low to medium levels of loan growth are needed for on-going banking system and economic viability while high levels of loan growth are associated with increased risk of loan portfolios. (Kwan and Eisenbeis (1997). As discussed previously we will deal with the impact of outliers in the loan growth variable in our robustness analysis.

(iii) Capital Holdings: We consider one primary measure of capital holdings, total equity divided by total assets. Ideally a measure of Tier One capital holdings would be included in the model as a robustness test, but again data limitations due to differences in national disclosure would results in substantial reduction in degrees of freedom. However, the third iteration of the BIS capital adequacy framework places increased emphasis upon a simple gearing measure such as we employ in this study as well as a risk weighted capital holdings, thus the use of a simple gearing measure has increased relevance to current policy formulation.

(iv) Revenue volatility: Traditionally standard deviation or variance have been used in the finance literature to measure revenue risk, but as pointed out by Parkinson (1980), when small samples are used measures of this type tend to be biased and inefficient. We adapt the approach used by Alizadeh, et al. (2002), of log (high –low) to measure the revenue volatility. We consider two measures of revenue volatility: return on assets and return on equity. The model is estimated by including these measures independently and the results are reported in Table Three.

We estimate a fixed effects model with bank specific dummies, rather than a random effects model, as the $\mu_i$'s are likely to represent omitted bank-specific characteristics which are correlated with other explanatory variables.[8] Since $y_{it}$ is a function of $\mu_i$, then so too is $y_{it-1}$. Therefore, $y_{it-1}$ is correlated with $\varepsilon_{it}$ and OLS results in biased and inconsistent estimates, even if the $\varepsilon_{it}$'s are serially uncorrelated. Accordingly, we first difference equation (2) to eliminate the country-specific fixed effects, i.e.,

[8] Under an assumption of independence between the fixed effects and the explanatory variables, the generalised least squares estimator for the random effects model is biased (Hsaio, 1986).

$$\Delta y_{i,t} = \sum_{j=1}^{q} \beta_j \Delta y_{i,t-j} + \gamma \Delta Risk_{i,t} + \Delta \eta_t + \Delta \varepsilon_{it} \quad (2)$$

We estimate the parameters of equation (2) by the generalised methods of moments (GMM) technique proposed by Arellano and Bond (1991). The technique uses the pre-determined lags of the variables as instruments to exploit a potentially large set of over-identifying restrictions and provides consistent coefficient estimates.[9] The lag length $q$ is determined by Akaike Information Criteria (AIC) and Schwarz Criteria (SC). Both suggest the optimal length of 1 for all specifications.

The validity of the assumptions used to obtain equation (2) can be tested using the standard test of over-identifying restrictions, viz., a Sargan test. Note that $\Delta \varepsilon_{it}$ is MA(1) with a unit root. Hence, the key identifying assumption that there is no serial correlation in the disturbances can be tested by testing for no *second*-order serial correlation in the first-differenced residuals, while negative first-order serial correlation is expected in the first-differenced residuals.

In table Three, we present the GMM estimates for net interest income and non interest income.[10] First, note that the AR(1) and AR(2) test statistics indicate that the residuals in equation (1) are serially uncorrelated and that the Sargan test confirms the validity of the instruments

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4. Results.

It is found overall that changes (reductions) in net interest margins are offset by changes (increases) in non interest income. Margin income is observed to have fallen significantly over the study period by comparison to the reference year of 1998.

Unlike Lepetit, et al. (2008b), this paper finds no evidence that increased bank non interest income is associated with worsening asset quality. Generally measures of asset quality were found to have no relationship with non interest income. In a few cases a negative and significant relationship between asset quality and non interest income was found. This result

[9] Due to concerns about the number of instruments when using the GMM estimator, we collapse the number of instruments using Roodman's procedure (see Roodman, 2009).

[10] The statistical significance of the estimated parameters is determined through a bootstrap sample of 10,000 replications. We argue that this process reduces the any potential biases due to extreme values in the loan growth variable, but we will conduct robustness analysis of this question.

would indicate that banks are replacing income from loans with non interest income from loan substitutes such as debt underwriting or loan guarantees. Further, this change is resulting in those loans retained on the balance sheet being of higher quality. However, in some cases a negative relationship between bank asset quality and bank net interest margins is also found, contrary to the theoretical propositions (Ho and Saunders (1981), Angbazo (1997). However, Williams (2007) found a similar result in the Australian case and argued that banks were mispricing loans and effectively buying market share via under-pricing loan risk. Such a result is also consistent with Guiso, et al. (2006) who found that bank liberalisation in Italy has been accompanied by reduced bank interest margins and increased bad loans.

Table Three about here.

Consistent with the empirical results surveyed above, this study finds that higher levels of non interest income is associated with increased revenue volatility. However, there is limited support for a relationship between interest margin income and revenue volatility.[11] Evidence is also found of a U-shaped relationship between loan growth and non interest income (but no evidence found for a relationship between loan growth and margin income). Authors such as Foos, et al. (2010) and Laeven (2002) have argued that excessive loan growth is associated with worsening loan quality, indicating that increased non interest income is associated with deteriorating loan quality via the loan growth channel. Some evidence was found that banks with higher holdings of equity have higher interest margins, consistent with the Ho and Saunders (1981) model of bank interest margins, as supported by subsequent empirical evidence (Williams (2007), Maudos and Guevara (2004)). It is noteworthy however, that bank capital holdings are found to be insensitive to changes in non interest income. This is particularly important given the important role bank capital holdings play in the global benchmark capital adequacy process. After the 2008 financial crisis the major global regulatory reform process in banking has focussed upon developing and implementing the third variation of the capital adequacy process (commonly called capital adequacy mark III). However, this study finds in the Asian context that non interest income is risk increasing but has no relationship with capital holdings. As bank capital holdings are used as a buffer to protect depositors and other stakeholders against bank risk, this finding has the implication that bank regulators (at least in Asia) need to pay increased attention to bank revenue

[11] This is consistent with the argument that traditional margin income is less risky (Clarke, et al. (2007).

composition when determining bank capital holdings. Nations such as Australia have already implemented capital regimes that allow the national regulator to require individual banks to hold capital in addition to that required under national version of the capital adequacy regime.[12] Given the evidence found in this paper, requiring individual banks to hold additional capital to compensate for the additional risk induced by revenue composition would be a worthwhile consideration.

Robustness Tests.

In order to determine that the results were not driven by either size or growth effects we conducted two sets of robustness tests. In the first test we truncated our sample by size, removing those banks that made up the largest twenty five per cent of all banks and then re-estimating our models. We then also truncated our original sample by removing the smallest twenty five percent of all banks and re-estimating our models. These results are found in Table Four. The only discernable impact found was that for smaller banks no relationship between loan growth squared and non interest income was found. We then repeated the truncation exercise for loan growth, in that the fasted growing quarter of all banks were removed and the models re-estimated, and then the lowest growing quarter of all banks were removed and the models re-estimated. The results of these tests are also shown in Table Four, in this case any impact upon the estimated coefficients are shown in the shaded cells. In each case the shaded cell indicate no change in sign, but rather a change from insignificance to significance (or vice versa in one case).

Table Four about here.

## 5. Conclusions and policy implications.

We find that increased non interest income is associated with increased bank risk, consistent with Brunnermeier, et al. (2012), DeYoung and Rice (2004b) and Stiroh (2006). However, we also find that bank capital holdings are insensitive to these changes in bank revenue and bank risk. Bank capital shows no relationship with changes in bank non interest income. There is also evidence that bank loan pricing is perverse, in that bank net interest income is lower when loan risk is higher. While this outcome is inconsistent with the model presented by Ho and Saunders (1981), it is consistent with the empirical evidence presented by

[12] See: http://www.apra.gov.au/ADI/upload/Final-APS-110-November-2007.pdf The details of these additional capital holdings are not made public and are subject to confidentiality restrictions.

Williams (2007) and Guiso, et al. (2006). We argue, consistent with Lepetit, et al. (2008b) that banks are adopting a loss leader strategy, in that lower NIMS are being used to attract a customer base (resulting in under-pricing for risk). The intent is that later revenue from non interest sources will recoup the lost interest margin income. However, we also find that this strategy is inefficient in that no relationship between loan quality and non interest income is found, thus the later revenue streams are not compensating for bank risk created with the initial loan under-pricing.

We also find some evidence of a substitution effect in that fee income is negatively associated with asset quality, in that banks with higher levels of non interest income have lower levels of loan loss provisions. It is not clear if this effect is due to differences in accounting disclosure of loan loss provisions or if banks with lower quality loans in our sample choose to transfer the risk to other investors via securitisation, thus accounting for the observed increase in non interest income. Further work on the on quality of loans securitised by ASEAN regions banks before and after the financial crisis of 2007-2008 would assist in determining if this morally hazardous behaviour occurred. Another possibility is that poorer quality loans moved to the shadow banking system over this period, while the rise of shadow banking resulted in increased non interest incomes for bank in this region. Again this would be an issue worthy of further research, but one beyond the scope of the current paper.

From the perspective of the prudential regulator and those responsible for systemic stability this paper has found several relationships that should act as warning signs or tripwires that alert to the presence of increased bank risk. First, increased bank non interest income is associated increased bank risk, and bank management are not holding higher levels of capital to compensate for this increased risk. Given that the evidence from the United States, Brunnermeier, et al. (2012), demonstrates that increased non interest income is associated with higher systemic risk, this is a cause for concern. Further, we find that falling bank net interest margins is associated with worsening loan portfolio quality, with no compensating increase in revenue from other sources. Again this is a concern for those responsible for the ongoing viability of the financial system. Overall, both these indicators present objective evidence for increased surveillance of, and / or increased regulatory requirements imposed upon, those banks which present with these symptoms suggesting increased risk.

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Table 1: Nations and number of banks per year.

| | Number of Banks | | | | | |
|---|---|---|---|---|---|---|
| | 1998 | 2002 | 2006 | 2001 | 1998 - 2011 | Number of observations (1998-2011) |
| Australia | 10 | 3 | 21 | 11 | 33 | 168 |
| Brunei Darussalam | 1 | 1 | 1 | 0 | 1 | 14 |
| Cambodia | 0 | 1 | 2 | 1 | 3 | 20 |
| Indonesia | 35 | 36 | 45 | 21 | 67 | 590 |
| Japan | 33 | 136 | 130 | 107 | 173 | 1752 |
| Laos | 1 | 1 | 1 | 0 | 2 | 13 |
| Myanmar | 3 | 2 | 3 | 3 | 5 | 34 |
| Malaysia | 34 | 24 | 23 | 13 | 43 | 378 |
| New Zealand | 2 | 1 | 8 | 6 | 12 | 64 |
| Philippines | 6 | 1 | 28 | 15 | 39 | 210 |
| Singapore | 7 | 4 | 10 | 5 | 25 | 110 |
| Thailand | 13 | 17 | 19 | 13 | 26 | 257 |
| Vietnam | 4 | 9 | 27 | 10 | 45 | 246 |

Table 2 Dependent and independent variables.

| Variable | Mean | Std Dev | Min | Max | Observations |
|---|---|---|---|---|---|
| Net Interest Margin / Total Assets (%) | 2.719 | 2.705 | -41.730 | 31.750 | 3856 |
| Non Interest Income / Total Assets (%) | 0.851 | 1.271 | -7.926 | 17.942 | 3853 |
| Impaired Loan reserves/ Total Loans (%) | 0.033 | 0.782 | -43.000 | 8.026 | 3522 |
| Loan Loss Provisions / Total Loans (%) | 0.006 | 0.422 | -21.000 | 4.342 | 3696 |
| Tier 1 Capital ratio (%) | 12.072 | 17.097 | -122.610 | 300.840 | 2731 |
| Total Equity / Total Assets | 0.080 | 0.101 | -1.292 | 0.998 | 3867 |
| One year loan growth %[13] | 46.67 | 2799.00 | -55217.00 | 152055.00 | 3409 |
| Range based Volatility ROA = log (high ROA – Low ROA) | 1.284 | 5.533 | 0.000 | 100.390 | 3360 |
| Range based Volatility ROE = log (high ROE – Low ROE) | 17.868 | 61.509 | 0.000 | 1065.040 | 3359 |

[13] After removing five outliers: Mean = 17.55, Sd = 74.29, Minimum = -95.00, Maximum = 1617.00, Outliers are, Rakuten Bank Ltd – 2009,Seven Bank Ltd – 2011, ShinGinko Tokyo – 2006, Bank Artha Graha Internasional Tbk – 2005, Indonesia Eximbank – 2000,

Table 3. Panel A

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.755*** | -7.59E-05** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | -5.21** | 0.898*** |
| | (2.63) | (0.07) |
| *Asset Quality* | | |
| Impaired Loan Reserves/ Total Loans (%) | 1.019*** | -0.029 |
| | (0.38) | (0.02) |
| *Bank Capital Holdings* | | |
| Total Equity / Total Assets | 41.44** | 0.233 |
| | (19.79) | (0.21) |
| *Loan Growth* | | |
| Loan Growth | 6.73E-07 | -0.1.63E-08*** |
| | (0.00) | (0.00) |
| Loan Growth squared | -7.63E-14 | 6.91421E-16*** |
| | (0.00) | (0.00) |
| *Revenue Volatility* | | |
| Range based Volatility ROA | -2.44* | 0.011** |
| | (1.42) | (0.01) |
| Constant | 205.395*** | 0.622*** |
| | (32.29) | (0.23) |
| *Diagnostics:* | | |
| Sargan statistic | 48.3 | 30.5 |
| Sargan *p*-value | 0.341 | 0.952 |
| AR(1) | -3.436*** | -11.61*** |
| AR(2) | -0.36 | -0.43 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.729*** | -0.0001** |
| | (0.06) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | 0.06292 | 0.883*** |
| | (4.43) | (0.07) |
| *Asset Quality* | | |
| Impaired Loan Reserves/ Total Loans (%) | 2.858 | -0.037 |
| | (2.86) | (0.03) |
| *Bank Capital Holdings* | | |
| Total Equity / Total Assets | -35.08 | 0.196 |
| | (50.38) | (0.61) |
| *Loan Growth* | | |
| Loan Growth | 1.13E-06 | -2.40E-08** |
| | (0.00) | (0.00) |
| Loan Growth squared | -7.63E-14 | 3.58E-16*** |
| | (0.00) | (0.00) |
| *Revenue Volatility* | | |
| Risk_ROAE | -0.0301 | 0.0002** |
| | (0.05) | (0.00) |
| Constant | 238.18*** | 0.49* |
| | (30.67) | (0.26) |
| *Diagnostics:* | | |
| Sargan statistic | 52.9 | 28.8 |
| Sargan *p*-value | 0.195 | 0.971 |
| AR(1) | -2.898*** | -5.81*** |
| AR(2) | -0.79 | -0.52 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).

Table 3 Panel B.

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (t-1) | 0.742*** | -0.0009** |
| | (0.06) | (0.00) |
| Non Interest Income / Total Assets (t-1) | -4.606* | 0.80*** |
| | (2.48) | (0.04) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 3.81*** | -0.08** |
| | (1.01) | (0.04) |
| *Bank Capital Holdings* | | |
| Total Equity / Total Assets | 90.48* | 0.267097 |
| | (48.76) | (0.64) |
| Loan Growth | | |
| Loan Growth | 3.40E-07 | -1.99E-08* |
| | (0.00) | (0.00) |
| Loan Growth squared | -2.13E-14 | 6.26E-16 |
| | (0.00) | (0.00) |
| *Revenue Volatility* | | |
| Range based Volatility ROA | 3.92*** | 0.007* |
| | (1.50) | (0.00) |
| Constant | 160.05*** | 0.344 |
| | (38.82) | (0.27) |
| *Diagnostics:* | | |
| Sargan statistic | 29.02 | 45.86 |
| Sargan *p*-value | 0.969 | 0.436 |
| AR(1) | -3.548*** | -10.03*** |
| AR(2) | -0.31 | 1.29 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (t-1) | 0.706*** | -0.0008* |
| | (0.06) | (0.00) |
| Non Interest Income / Total Assets (t-1) | -8.77* | 0.792*** |
| | (5.20) | (0.04) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 10.412 | -0.07* |
| | (10.82) | (0.04) |
| *Bank Capital Holdings* | | |
| Total Equity / Total Assets | -31.31 | 0.17 |
| | (51.57) | (0.56) |
| Loan Growth | | |
| Loan Growth | 1.04E-06*** | 8.08E-09 |
| | (0.00) | (0.00) |
| Loan Growth squared | -1.0E-013* | -6.67354E-16* |
| | (0.00) | (0.00) |
| *Revenue Volatility* | | |
| Range based Volatility ROE | 0.026 | 0.0003** |
| | (0.05) | (0.00) |
| Constant | 208.856*** | 0.362824 |
| | (32.77) | (0.24) |
| *Diagnostics:* | | |
| Sargan statistic | 22.9 | 34.6 |
| Sargan *p*-value | 0.997 | 0.869 |
| AR(1) | -4.051*** | -4.95*** |
| AR(2) | -0.37 | -0.984 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).

## Table 4 Robustness Tests.

Table 4. Panel A (i) (Smallest 25% of Banks by assets removed)

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (t-1) | 0.761*** | -0.00036** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (t-1) | -8.71** | 0.956*** |
| | (3.61) | (0.04) |
| *Asset Quality* | | |
| Impaired Loan reserves/ Total Loans (%) | 4.56*** | -0.012 |
| | (1.74) | (0.02) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | 13.98* | 0.529 |
| | (8.47) | (1.67) |
| Loan Growth | | |
| Loan Growth | 9.19E-07 | -7.47E-09*** |
| | (0.00) | (0.00) |
| Loan Growth squared | -1.19E-13 | -8.58E-16** |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROA | -0.79** | 0.009* |
| | (0.40) | (0.00) |
| Constant | 130.33*** | 0.287*** |
| | (35.61) | (0.23) |
| *Diagnostics:* | | |
| Sargan statistic | 44.58 | 17.6 |
| Sargan *p*-value | 0.570 | 1.000 |
| AR(1) | -2.91*** | -2.36*** |
| AR(2) | 0.27 | 0.093 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (t-1) | 0.759*** | -0.0004** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (t-1) | 0.881 | 0.954*** |
| | (0.68) | (0.05) |
| *Asset Quality* | | |
| Impaired Loan reserves/ Total Loans (%) | 4.490 | -0.013 |
| | (2.78) | (0.02) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | -12.51 | 0.137 |
| | (53.94) | (1.03) |
| Loan Growth | | |
| Loan Growth | 1.10E-06 | -7.82E-09** |
| | (0.00) | (0.00) |
| Loan Growth squared | -1.26E-13* | -7.92E-16* |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Risk_ROAE | -0.1100 | 0.00016** |
| | (0.16) | (0.00) |
| Constant | 131.76*** | 0.21** |
| | (33.12) | (0.12) |
| *Diagnostics:* | | |
| Sargan statistic | 42.92 | 18.8 |
| Sargan *p*-value | 0.560 | 1.000 |
| AR(1) | -2.61*** | -2.79*** |
| AR(2) | 0.46 | 0.66 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).
c) Low 25% truncated means that the 25% of the smallest firms are removed from the sample and the model re-estimated.
d) The shaded cells indicate a change of significance when the bottom 25% of firms by loan growth are removed and the model is re-estimated. In no case was there a change of sign, only some changes in significance. Yellow means changes from significant to insignificant and green means changes from insignificant to significant.

Table 4 Panel A (ii) (Largest 25% of Banks by assets removed)

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (-1) | 0.703*** | -0.000589** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (-1) | -4.88** | 0.763*** |
| | (2.54) | (0.19) |
| *Asset Quality* | | |
| Impaired Loan reserves/ Total Loans (%) | 2.39*** | -0.043 |
| | (0.58) | (0.03) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | 59.77* | 0.373 |
| | (36.91) | (1.67) |
| Loan Growth | | |
| Loan Growth | 4.32E-07 | -5.83E-09*** |
| | (0.00) | (0.00) |
| Loan Growth squared | -5.40E-13 | 3.63E-16 |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROA | -1.64** | 0.021* |
| | (0.79) | (0.00) |
| Constant | 183.21*** | 0.961*** |
| | (96.11) | (0.30) |
| *Diagnostics:* | | |
| Sargan statistic | 40.31 | 22.5 |
| Sargan *p*-value | 0.570 | 0.998 |
| AR(1) | -3.42*** | -9.31*** |
| AR(2) | -0.86 | -0.89 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (-1) | 0.607*** | -0.0002** |
| | (0.05) | (0.00) |
| Non Interest Income / Total Assets (%) (-1) | 1.76 | 0.749*** |
| | (1.94) | (0.22) |
| *Asset Quality* | | |
| Impaired Loan reserves/ Total Loans (%) | 1.570 | -0.044 |
| | (1.49) | (0.04) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | -43.11 | 0.281 |
| | (68.02) | (0.99) |
| Loan Growth | | |
| Loan Growth | 2.10E-06 | -5.81E-09** |
| | (0.00) | (0.00) |
| Loan Growth squared | -2.09E-13 | -3.13E-16** |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROE | 0.0020 | 0.00024** |
| | (0.09) | (0.00) |
| Constant | 241.58*** | 0.59** |
| | (84.91) | (0.32) |
| *Diagnostics:* | | |
| Sargan statistic | 49.38 | 36.12 |
| Sargan *p*-value | 0.302 | 0.825 |
| AR(1) | -7.63*** | -6.11*** |
| AR(2) | -1.04 | -0.21 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).
c) Top 25% truncated means that the largest 25% of the firms are removed from the sample and the model re-estimated.
d) The shaded cells indicate a change of significance when the top 25% of firms by loan growth are removed and the model is re-estimated. In no case was there a change of sign, only some changes in significance. Yellow means changes from significant to insignificant and green means changes from insignificant to significant.

Table 4 Panel B (i) (Smallest 25% of banks by assets removed)

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.716*** | -0.0004** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | -10.41* | 0.845*** |
| | (6.06) | (0.04) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 6.845*** | -0.08** |
| | (2.29) | (0.04) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | 65.74* | -0.095 |
| | (34.37) | (1.15) |
| Loan Growth | | |
| Loan Growth | 6.55E-07 | -4.62E-09* |
| | (0.00) | (0.00) |
| Loan Growth squared | -5.38E-14 | 6.96E-16 |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROA | 1.89*** | 0.002* |
| | (0.21) | (0.00) |
| Constant | 117.83*** | 0.146 |
| | (39.62) | (0.23) |
| *Diagnostics:* | | |
| Sargan statistic | 42.12 | 25.62 |
| Sargan *p*-value | 0.595 | 0.991 |
| AR(1) | -5.158*** | -3.91*** |
| AR(2) | -1.15 | 0.81 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.719*** | -0.0004* |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | -11.08* | 0.843*** |
| | (6.33) | (0.03) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 7.29* | -0.08* |
| | (4.35) | (0.05) |
| Bank Capital Holdings | | |
| Total Equity / Total Assets | -53.05 | 0.125 |
| | (56.64) | (1.01) |
| Loan Growth | | |
| Loan Growth | 6.13E-08*** | 5.99E-09 |
| | (0.00) | (0.00) |
| Loan Growth squared | -7.33E-08* | -7.27E-16* |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROE | 0.274 | 0.0001** |
| | (0.16) | (0.00) |
| Constant | 120.44*** | 0.12 |
| | (39.51) | (0.23) |
| *Diagnostics:* | | |
| Sargan statistic | 36.65 | 18.31 |
| Sargan *p*-value | 0.808 | 1.000 |
| AR(1) | -4.457*** | -3.63*** |
| AR(2) | -0.83 | 1.358 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).
c) Low 25% truncated means that the smallest 25% of the firms are removed from the sample and the model re-estimated.
d) The shaded cells indicate a change of significance when the smallest 25% of firms by loan growth are removed and the model is re-estimated. In no case was there a change of sign, only some changes in significance. Yellow means changes from significant to insignificant and green means changes from insignificant to significant.

Table 4Panel B (ii) (Largest 25% of Bank by assets removed)

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.852*** | -0.0016** |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | -5.32* | 0.713*** |
| | (3.12) | (0.03) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 1.97*** | -0.07** |
| | (0.16) | (0.03) |
| Bank Capital Holdings | | |
| Total Equity / Total Asets | 120.52* | 0.387 |
| | (73.33) | (0.48) |
| Loan Growth | | |
| Loan Growth | 1.96E-07 | -2.81E-09* |
| | (0.00) | (0.00) |
| Loan Growth squared | -1.34E-14 | 5.49E-16 |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROA | 4.63*** | 0.014*** |
| | (1.88) | (0.00) |
| Constant | 183.78*** | 0.401 |
| | (49.19) | (37.00) |
| *Diagnostics:* | | |
| Sargan statistic | 22.36 | 51 |
| Sargan *p*-value | 0.998 | 0.250 |
| AR(1) | -2.94*** | -8.94*** |
| AR(2) | -0.77 | 0.02 |

| | Net Interest Margin / Total Assets (%) | Non Interest Income / Total Assets (%) |
|---|---|---|
| Net Interest Margin / Total Assets (%) (t-1) | 0.623*** | -0.0012* |
| | (0.07) | (0.00) |
| Non Interest Income / Total Assets (%) (t-1) | -5.91* | 0.665*** |
| | (3.01) | (0.08) |
| *Asset Quality* | | |
| Loan Loss Provisions / Total Loans (%) | 12.39* | -0.07* |
| | (7.62) | (0.04) |
| Bank Capital Holdings | | |
| Total Equity / Total Asets | -22.01 | 0.238 |
| | (33.83) | (0.72) |
| Loan Growth | | |
| Loan Growth | 6.10E+01 | 9.92E-09 |
| | (0.00) | (0.00) |
| Loan Growth squared | -4.64E-08* | -5.88E-16* |
| | (0.00) | (0.00) |
| Revenue Volatility | | |
| Range based Volatility ROE | -0.008 | 0.0006** |
| | (0.01) | (0.00) |
| Constant | 95.77*** | 0.497 |
| | (12.37) | (0.39) |
| *Diagnostics:* | | |
| Sargan statistic | 20.69 | 53.42 |
| Sargan *p*-value | 0.999 | 0.182 |
| AR(1) | -3.987*** | -2.96** |
| AR(2) | -0.27 | -0.563 |

Notes: a) Standard errors are in the parentheses. ***, ** and * denote rejection of null of zero restriction at 1%, 5% and 10% levels of significance (based on bootstrapping), respectively;
b) The Sargan statistic tests over-identifying restrictions (based on bootstrap samples). AR(1) and AR(2) are tests for first-order and second order serial correlation (based on bootstrap samples).
c) Top 25% truncated means that the largest 25% of the firms are removed from the sample and the model re-estimated.
d) The shaded cells indicate a change of significance when the top 25% of firms by loan growth are removed and the model is re-estimated. In no case was there a change of sign, only some changes in significance. Yellow means changes from significant to insignificant and green means changes from insignificant to significant.