

The Relationship between Inefficiency, Risk and Capital: Evidence from Commercial Banks in ASEAN

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ABSTRACT

This study examines the relationship between inefficiency, risk and capital in ASEAN banking. We test whether bank inefficiency is related to risk taking and its capital position. In this study, measures of inefficiency, risk, and capital are based on accounting ratios. Data for the study includes eight countries in Association of South East Nations (ASEAN): Indonesia, Malaysia, Thailand, the Philippines, Singapore, Cambodia, Brunei and Vietnam. The panel data is taken from Bankscope database for the period 2003 to 2008. A three-stage least squares (3SLS) method is employed to capture endogeneity between inefficiency, risk, and capital and to avoid simultaneous bias for estimated coefficients when they are estimated separately. In the first stage of analysis, INEFF is regressed against CAP, RISK, SIZE and OBSTA. In the second stage of analysis, RISK is regressed against CAP, INEFF, SIZE and NLTA. In the third stage of analysis, CAP is regressed against RISK, INEFF, SIZE, ROA and IRC. In the inefficiency equation, the results indicate that CAP and SIZE are negatively related to inefficiency. However, RISK, surprisingly, is not significant. On the risk equation, the results indicate that CAP and INEFF are negatively related with risk. On the capital equation, there is negative relationship between CAP and RISK but not with INEFF.

Keywords: risk, capital, inefficiency, 3 stage least squares method, ASEAN banking

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Any remaining errors or omissions rest solely with the author(s) of this paper.

INTRODUCTION

The banking system plays an important role in the economic development of any country. Commercial banks, which are the main component of the banking system, have to be efficient otherwise they will create maladjustments and impediments in the process of development in any economy. Technological advancements and globalisation have added to the pressure on the part of the banks to maintain market shares so as to survive and remain competitive. Competition from foreign banks as well from domestic banks themselves creates greater pressure. Commercial banks in ASEAN are of no exception. Therefore not only do commercial banks need to be profitable, but also efficient, since banks are exposed to intense competition both locally and globally. The basic benefit to enhance efficiency is a reduction in spreads between lending and deposit rates and this will likely stimulate both greater loan demand for industrial investment and greater mobilization of financial savings through the banking system (Ikhida, 2000).

Banking as we are aware is the most regulated industry in the world. Apart from the product and its service, banking regulations also cover its institution. The aim of the bank regulation is to increase prudential practices that will reduce the level of risks banks are exposed to. Furthermore, banks are also very important to the economy as the failure of banking will bring negative impact to the economy as well as financial system of a country. This motivation is known as systemic risk reduction motivation. In general, the banking regulation is for the interest of depositors. In general, capital regulation is very important because it plays an important role in the banks' health and risk taking behaviour, and its impact on the competitiveness of banks. In practice, a key aspect of the regulatory capital is calculated minimum regulatory capital, which is usually based on credit.

The most important part of banking regulation is regulation on capital. According to Mehta and Fung (2004), capital regulation has been rooted since 1930. USA is a pioneer in such regulation when they tabled a proposal in 1986 that required US banks to maintain capital that reflects the riskiness of bank assets. After the establishment of the Basel Committee on Banking Supervision (BCBS), in July 1988, Central bank governors endorsed BCBS's document "International Convergence of Capital Measurement and Capital Standards", or "Basel Capital Accord", to be implemented by the end of 1992. The aim is to prevent banks from excessive risk-taking, with regulators trying to relate this to the risk of the loan portfolio. By 1988, the time of the first international initiative (Basel Accord), most countries had already introduced one or the other form of risk-sensitive capital regulation. The Basel Accord was signed by the G10 countries and was intended to apply only to internationally active banks. The accord assigns assets to different risk buckets. The assets in a bucket have to be backed by a bucket-specific capital requirement and the total minimum requirement is set at 8% of capital to risk-weighted assets (BIS Web).

As capital availability is relatively constant, it is becoming a constraint to engage on expansion of other risky business. Thus, banks are forced to manage the risk efficiency to prevent them from putting more capital. The so called risk management process is aimed at allocation capital efficiently in order to obtain optimal benefits and reduce the cost of capital. The method used was: the bank earning assets as well choosing the activities that banks may be effectively measured in terms of risk and risk adjusted return of company culture; the ability of capital, organization and infrastructure. It is important for banks to understand business issues and investments in which the bank to invest so that the bank may benefit the optimum amount of capital, risk and return.

The objective of this study is to examine the relationship between inefficiency, risk and capital in ASEAN banking. This kind of study using ASEAN banks is, to our knowledge, is not available. Ahmad *et. al.* (2007) discussed the determinant of capital ratio in Asian banking as a one way process. Jeitschko and Shin (2007) on the other hand, study the relationship between portfolio risk and capitalization in Korean banking. In addition, Konishi and Yasuda (2004) analyze the factors determining the risk taking behaviour among Japanese commercial banks. This study is an effort to fill out the gap in empirical study on this area in the ASEAN setting.

The remainder of the paper is organized as follows. Section 2 briefly reviews the literature and Section 3 describes the data and variables used in the study. Section 4 describes the methodology, followed by empirical results in Section 5. The conclusion is given in Section 6.

LITERATURE REVIEW

Every study on capital in the banking industry departed from the same point with the theory of capital structure in the financial theory. The most referred paper is the theory of the frictionless world of Modigliani and Miller. The Capital Structure Theory is the first modern theory of Modigliani and Miller (MM theory). They argue that capital structure is irrelevant and does not affect the value of the company. However if we look at the bank capital structure, the MM is not valid because of two things; first, the presence of the regulatory safety net that protects the safety and soundness of the banking system and is likely to lower capital, second, regulatory capital requirement that raise the capital of some banks, may give a negative impact to the value of the banking firm.

Many studies focused on the relationship between risk and capital especially after the introduction of minimum capital regulation. Capital regulation is one of the important tools that are used to prevent banks from failure. However, theoretical literature offers contradictory results as to the optimum design of capital adequacy regulation and to the effect of capital regulation on bank risk taking incentive and

performance. It means the theoretical issue of how higher capital ratios reduce overall banking risk is not yet entirely solved. On the other hand, capital regulation should be set up as a part of other prudential regulations (Altunbas *et. al*, 2007).

Capital regulation is one of the key instruments of modern banking regulations. The regulation aims to increase a cushion during economic crisis and a mechanism to restrain banks from taking excessive risk. During an economic downturn, the quality of bank assets decreases and the impact is to reduce capital. As we know, theoretical foundation on the relationship between capital and risk is mainly based on the theory of moral hazard that existed because of agency problem. They tested whether increased capital regulation forces bank to increase their risks or vice versa (Jokipii and Milne, 2008). Shrieves and Dahl (1992) argue that positive relationship between key variables in line with several hypotheses which include the unintended effect of minimum capital regulation, regulatory cost; bankruptcy cost avoidance as well as managerial risk aversion. Jacques and Nigro (1997) on other hand, find a negative relationship between change in capital regulation and risk level.

Empirical evidence on the relationship between capital requirement and risk taking is mixed. In USA study by Sheldon (1996) find that asset volatility rose rise and decreased for both bank that increased capital and that did not. Calem and Rob (1999) quantified the effect of capital based regulation and find the U-shaped relationship between capital and risk taking. The U-shaped means that undercapitalized bank take maximum risk and a bank's capital rises as they take less risk. When capital increases again, they will take higher risk again. They found that undercapitalized bank took higher risk because the cost of bankruptcy is shifted to deposit insurance. For well capitalized banks, they took higher risk because it is more profitable and there is low probability of bankruptcy. In Japan, higher capital requirement is responded by lowering asset volatility. Konishi and Yasuda (2004) analyzed the factors determining the risk taking behaviour among Japanese commercial banks and found that risk taking activities are reduced when capital regulation is introduced (see Ford and Weston, 2008).

Iannota *et. al*. (2007) compared the performance and risk of 181 large banks from 15 European countries over the 1999 – 2004 related to the ownership type. After controlling for size, output mix, asset quality, country and years effects, they found that ownership type and ownership concentration play an important role on risk and performance. Private banks were more profitable than mutual and public banks. However, private banks were more profitable due to their earning asset structure rather than from superior cost efficiency. Public sector banks have poorer loan quality and higher insolvency risk. This means public banks are relatively less profitable and riskier than other types of ownership. Public banks rely their funding on wholesale interbank and capital market but they have higher liquidity and lower loan level. It is different from private banks that rely their funding from customer deposit and provide more loans. For the mutual banks, the behaviour is similar to private banks in terms of favourable customer relationship, higher loan ratio and

quality. In terms of cost, private and mutual banks have lower operating cost. In term of ownership concentration, there is not much significant impact on profitability. However when the ownership concentration is linked to other variables such as loan quality, asset risk and insolvency risk, higher concentration is attributable to better loan quality, better asset risk and lower insolvency risk. Dispersed ownership banks are incurring higher cost per dollar income than concentrated one. It is in accordance with agency theory framework.

Altunbas, *et. al.* (2007) investigated the relationship between capital, risk and efficiency for a large sample of European banks between 1992 and 2000. They did not find any strong relationship between inefficiency and bank risk-taking. Evidence from the full sample suggests that inefficient European banks do not seem to have an incentive to take on more risk. Stronger empirical evidence is found showing the positive relationship between risks on the level of capital, possibly indicating regulators' preference for capital as a means of restricting risk-taking activities. They also find evidence that the financial strength of the corporate sector has a positive influence in reducing bank risk-taking and capital levels. There are no major differences in the relationships between capital, risk and efficiency for commercial and savings banks although there are for co-operative banks. In the case of co-operative banks we do find that capital levels are inversely related to risks and we find that inefficient banks hold lower levels of capital.

Brewer *et. al.* (2009) studied the determinant of capital ratios across 12 countries in Europe, USA, and Japan. They model bank capital ratio as function of public policy, regulatory, bank specific, macroeconomic and country level financial condition. The model estimated using annual data from 1992 to 2005 for unbalanced panel of the 78 largest private banks. The study found that banks maintain their higher capital ratio when the banking sector is relatively smaller and when regulator practices prompt corrective actions more actively. Higher capital ratio is also related to the existence of stringent capital regulations and better good corporate governance mechanism. In general, capital ratio difference among counties under investigation is in part explained by the public policy and regulatory regime applied in the countries.

Kazion (2009) studied the role of capital in the bank's danger of a default and its implication for regulatory purposes. Using dynamic model, banks can adjust its deposit to a desired level in continuous –time model. Banks adjust the volume of its deposit voluntary, because of two purposes: reduce leverage; or increase deposit volume. As the banks must comply with the leverage regulation, any increase in deposit will end capital binding. If restructuring asset cost applies, when banks increase deposit, banks must incur the cost and reduce the deposit to prevent from a violation of the regulation in the future. The findings are in line with empirical studies that banks do not hold the minimum capital but have voluntary capital buffer. When banks do not have attractive investment possibility, banks prefer to reduce the deposit and increase it later in the future. This deposit reduction strategy also

reduces the default cost (asset quality) and can be considered as a countervailing effect. Surprisingly, when the higher volatility of asset value and a lower deposit growth exist, they tend to lower cost of default cost.

Lindquist (2004) studied the excess capital both for commercial and saving bank in Norway using panel data approach. In general, saving banks are holding more capital than commercial banks. In relation to the risk, a saving bank excess capital has negative relationship. The effect of credit risk to excess capital is not significant but previous profit is. In general, high risk banks are not poorly capitalized but in reality low risk banks are having too much capital. In connection to price of subordinated debt, there is negative relationship which supports the assumption that excess capital is insured against the cost related to market discipline and supervisory action due to lower capital condition. Small banks hold higher capital buffer than big banks. Gross domestic product (GDP) growth is not significant to influence the capital buffer.

DATA AND VARIABLES

Data

In this study we use a panel set of individual commercial bank from economically important countries in ASEAN region from 2003 to 2008. Data is collected from the bank's balance sheet, income statements and off-balance sheet obtained from the Fitch Bankscope database to construct standard accounting measure of banking activities. The sample comprises a large set of panel data of 668 banks over the six years under consideration. The sample covers banks from 8 countries in ASEAN; Indonesia, Malaysia, Thailand, the Philippines, Singapore, Cambodia, Brunei and Vietnam. Samples are selected merely based on the availability of the data in the Fitch Bankscope database. Table 1 presents the distribution of samples for the study.

Table 1 Sample distribution, 2003-2008

No	Countries	Samples	Contribution (%)
1	Indonesia	226	34
2	Malaysia	110	16
3	Thailand	95	14
4	The Philippines	71	11
5	Singapore	24	4
6	Cambodia	110	16
7	Brunei	26	4
8	Vietnam	6	1
Total		668	100

From the sample, Indonesian banks dominate the sample, comprising 34 percent of the total. This is followed by Malaysia and Cambodia (16 percent) each, Thailand 14 percent, Singapore and Brunei (4 percent) and Vietnam (1 percent). All variables in this study are measured in thousand US dollar.

Variables

Variables to be used in this study are variables that are theoretically and empirically plausible. The variables and definitions are presented in Table 2. We use accounting measures (total banking cost to total income) to measure bank cost inefficiency (Tahir, 1999, used both accounting and stochastic approaches to measure efficiency). To capture banking risk, we use loans to total assets (RISK). Following Shrieves and Dahl (1992), capital is proxied by ratio of equity to total assets (CAP). The bank specific variables consist of net loans to total assets (NLTA); growth in loans may increase risk and therefore have an unfavourable impact on capital and bank efficiency. To capture the effect of size in the bank's capital position, we use the variable logarithm of total assets (SIZE). Goldberg and Rai (1996) used this to account for cost differences related to bank size and for the greater ability of larger banks to diversify.

In addition to risk (RISK) and inefficiency (INEFF), the level of ASEAN banks capital is also likely to be related to profitability (ROA) and interest revenue (IRC), as earnings assist banks to improve their capital position. Finally, the ratio of off-balance sheet items to total assets (OBSTA) is also included to account for off-balance sheet activities. While OBS activities help banks in increasing their sources of revenue, they also increase risks. The "moral hazard" hypothesis states that OBS activities of banks increase bank risk and thus lead to inefficiency.

Table 2 Variables and definitions

Variables	Definitions
INEFF	Total banking cost to total income.
RISK	Loans to total assets.
CAP	Total equity to total assets.
NLTA	Net loans to total assets.
SIZE	Logarithm of total assets as indicator of bank size.
ROA	Profit before tax to total assets as indicator of profitability.
IRC	Total interest revenue to total assets.
OBSTA	Off-balance sheet items to total assets.

On the inefficiency side, we expect positive sign with CAP meaning that well capitalized banks operate less efficiently. RISK will have negative signs as riskier banks increase inefficiency. In term of SIZE, we expect negative sign as it means

the economies of scale hold. On the risk side, we expect that RISK has negative relationship with CAP, positive to INEFF, SIZE and NLTA. On the capital side, we expect that CAP has negative relationship with RISK meaning that less capitalized banks take excessive risk.

Table 3 presents the descriptive statistics of the variables used in this estimation. From 668 observations, we can see that variable INEFF as a measure of cost to income ratio indicates the inefficiency level; the higher the value, the higher the inefficiency level. The most inefficient is 3 percent and the most inefficient is 269 percent. The mean value is 52 percent with standard deviation of 25.6 percent. RISK has a mean value of 6.33 meaning that on average the ratio of loan loss reserve to total loan is around 6.33 percent with minimum ratio is zero and maximum value is four times of its loan. In terms of SIZE, the mean is 14.31 in log value. The loan is still very dominant asset in ASEAN banking. It can be seen from NLTA where the mean is 52.4 percent and the maximum value is 90 percent.

Table 3 Descriptive statistics of variables

Variable	Observations	Mean	Std. Dev.	Min	Max
INEFF	668	52.87	25.61	3.00	269.00
RISK	668	52.56	17.91	1.38	89.77
CAP	668	13.34	9.83	-35.02	74.12
NLTA	668	52.39	18.20	1.00	90.00
SIZE	668	14.31	1.84	9.89	19.00
ROA	668	1.74	1.55	-6.96	8.64
IRC	668	3.26	1.63	0.03	14.12
OBSTA	668	29.45	111.93	0.00	1524.05

IRC, as a ratio of interest income to asset, has mean value of 3.3 percent with standard deviation of 1.63 percent. The minimum value is 0.03 percent and maximum value is 14.11. For ROA, the mean value is 1.74 percent and standard deviation is 1.55 percent. The lowest is -6.96 percent, meaning that the bank is experiencing a loss. The highest value of ROA is 8.64 percent. Off balance sheet to total asset (OBSA) is also quite dominant in ASEAN banking. The mean value is 29.45 percent of asset and standard deviation is 112 percent.

METHODOLOGY

From the literatures above, researchers underline that the relationship between capital and risk are regressed simultaneously and are interrelated. This situation is known as endogeneity. Since the relationship between capital and risk is an over-identified simultaneous system, if we use the ordinary least square method (OLS) to run the estimation, we may have simultaneous bias and inconsistent problem in

the estimated results. Capital equation is over-identified, meaning the reduced-form method cannot be used to get the exact estimation indirectly, because there will be

more than one solution to obtain the original postulated parameters $\alpha(\alpha)$ from the estimated coefficients of reduced-form equations.

Implication in the modelling requires the use of a simultaneous equation specification and estimation methodology. To simplify, we follow the approach adopted by Altunbas *et. al.* (2007), using level data. This approach solves the availability of the data. To make possible for simultaneous estimation between bank operating inefficiency, bank risk, and bank capital, a system equation is used and estimated using three - stage least squares (3SLS) approach using panel data technique as follows:

$$INEFF_{ij} = \alpha_0 + \alpha_1 CAP_{ij} + \alpha_2 RISK_{ij} + \alpha_3 SIZE_{ij} + \alpha_4 OBSTA_{ij} + \varepsilon_i \quad (1)$$

$$RISK_{ij} = \beta_0 + \beta_1 CAP_{ij} + \beta_2 INEFF_{ij} + \beta_3 SIZE_{ij} + \beta_4 NLTA_{ij} + \varepsilon_i \quad (2)$$

$$CAP_{ij} = \gamma_0 + \gamma_1 RISK_{ij} + \gamma_2 INEFF_{ij} + \gamma_3 SIZE_{ij} + \gamma_4 ROA_{ij} + \gamma_5 IRC_{ij} + \varepsilon_i \quad (3)$$

Explanation on each equation

where,

- $INEFF_{ij}$ = Total banking cost to total income of bank i in market j ;
- CAP_{ij} = Total Equity to total assets of bank i in market j ;
- $RISK_{ij}$ = Loans to total assets of bank i in market j ;
- $SIZE_{ij}$ = Logarithm of total assets of bank i in market j as indicator of bank size;
- $OBSTA_{ij}$ = Off-balance sheet items to total assets of bank i in market j ;
- ROA_{ij} = Profit before tax to total assets of bank i in market j as indicator of profitability;
- IRC_{ij} = Total interest revenue to total assets of bank i in market j ;
- α, β, γ = Coefficients to be estimated; and
- ε_i = error term.

To estimate equation (1), equation (2) is used as instrumental variables. As the three -stage least squares (3SLS) has been programmed in STATA, we will use this software to estimate regression equation. The use of 3SLS is necessary as it will avoid simultaneous bias for estimated coefficients.

Several studies have focused on understanding the relationship between risk and capital. They tested whether an increase in capital regulation forces bank to increase their risk or *vice versa* (Jokipii and Milne, 2008). Shrieves and Dahl (1992) argue that positive relationship between capital and risk is in line to several

hypotheses which include the unintended effect of minimum capital regulation, regulatory cost, bankruptcy cost avoidance as well as managerial risk aversion. Jacques and Nigro (1997) on other hand, find a negative relationship between change in capital regulation and risk level.

According to Deelchand and Padgett (2009), their study confirmed that risk, capital and efficiency are determined simultaneously. Using Japanese cooperative banks, empirical model shows a negative relationship between risk and level of capital. Inefficient cooperative banks operate higher risk but also hold more capital. The situation may reflect the existence of moral hazards problem. In this study, we adopt an approach taken by Deelchand and Padgett (2009) and Heid *et. al.* (2003). These researchers treat efficiency, risk, and capital simultaneously. However, their approach is not fully adopted as their efficiency measure is specified using stochastic frontier approach (SFA). We use accounting ratio to measure inefficiency *i.e.*, cost to income ratio.

EMPIRICAL RESULTS

Capability of the Model

Before we conducted the estimation, we did unit root tests to see if the data is stationary or not. As the data is a mixture of time series and cross sectional, and the sample period is only six years, the risk that the data tend to be non-stationary is viable. In addition, some observations have been deleted due to the unavailability of data. This makes the time frame becomes less evident. To solve the problem, we conduct a simple Augmented Dickey Fuller (ADF) test and found that all variables are stationary at 1 percent level. We also conducted the Hausman specification test to investigate for the endogeneity of inefficiency, risk, and capital variables. We compared the residuals and predicted value to see the correlation and found that there is no significant correlation. It means that the endogeneity exist and the OLS and 3SLS estimator should differ only by sampling error.

Table 4 presents the capabilities of the model to link inefficiency, risk, and capital. In general, the model is capable to explain the relationship between inefficiency, capital, and risk. All chi-square values are significant at 1 percent meaning that at least one instrumental variable (IV) has non-zero relationship with endogenous variables: INEFF, RISK, and CAP. Exogenous variables used in this study are net loans to total assets (NLTA), log of total assets (SIZE), profit before tax (ROA), total interest revenue to total assets (IRC) and off-balance sheet items to total assets (OBSTA). We did not consider R-Squared as this measure is not usable in 3SLS as the model in 3SLS focuses more on structural relationship.

Table 4 Capability of the model

Equation	Observations	Parms	RMSE	R-sq	Chi-square	P
INEFF	668	4	43.54805	-1.8841	654.74	0.0000
RISK	668	3	41.67017	-4.4476	60.36	0.0000
CAP	668	6	8.591538	0.0838	789.82	0.0000

Note: Parms – parameters, RMSE = Root mean square error

Inefficiency Equation

Table 5 presents the results for INEFF equation. From the table, we can see that the coefficient for bank capital (CAP) is negative and significant, meaning that banks with higher capital operate more efficiently. This finding is consistent with previous research which concludes that more capitalized bank operates efficiently than banks with less capital (Shrieves and Dahl, 1992; Berger and Young, 1997; Altunbas *et. al.*, 2007). According to Berger and Young (1997), well capitalized banks are better run.

RISK also provides very provocative results. Banks with higher risk profile, tend to operate more efficient than less risky banks. Higher risk means lower inefficiency. It is rational because higher risk banks tend to get higher revenue and so reduce the operating inefficiency score. However RISK is not significant. SIZE, measured by logarithm of asset has negative coefficient with inefficiency. In other words, larger banks are more efficient. The relationship is theoretically strong and can be explained by both economies of scale as well as economic of scope. Banks can enjoy higher efficiency when they can manage a larger amount of loan.

Bank with higher portion of loan in its portfolio tend to operate more efficiently. In line with RISK, we expect OBSTA to also provide similar results that more banks are involved in off balance sheet activities, tends to operate more efficiently. This situation can be explained by the revenue side of OBS activities that generates more revenue.

Table 5 Inefficiency Equation

Variable	Coefficients	Standard error	z	P>z
_cons	295.8286	26.92864	10.99	0.000
CAP	-4.755307	.4834654	-9.84	0.000
RISK	-.0714054	.0869631	-0.82	0.412
SIZE	-12.22023	1.472972	-8.30	0.000
OBSTA	-.0005254	.0124289	-0.04	0.966

Risk Equation

Table 6 presents the regression result for the estimation of the risk equation derived from the simultaneous regression. In this model, an accounting measure of bank risk (loan to total assets, RISK) is used as the dependent variable. We use this term to link with the relationship between risk and return with the portfolio theory. The bigger the loan portion,, the bigger the profitability of the bank in the future. The use of non-performing loan breaches this relationship.

In the table, CAP is negative and significant with risk. It means a stronger capital is associated with less risk taking behaviour. This relationship provides further evidence that the banking sector in ASEAN behaves similarly to other studies that provide negative coefficient. It means that the possibility of moral hazard by increasing risk to get higher return on the cost of depositors is valid. When the deposit insurance exists, the evidence points to similar evidence from the US setting that lower capital tends to increase risk. The moral hazard problem may exist due to various reasons, for example, binding capital regulation in the area is less effective.

Table 6 Risk equation

Variable	Coefficients	Standard error	z	P>z
Constant	1.760	.5420	3.25	0.001
CAP	-.0338	.0107	-3.13	0.002
INEFF	-.0075	.0022	-3.30	0.001
SIZE	-.0934	.0287	-3.25	0.001
NLTA	.9994	.0006	1431	0.000

In terms of cost to income ratio (INEFF), the result is quite plausible. The coefficient of INEFF is negative, meaning that inefficient banks tend to be prudential by reducing risk. This situation is supported by unsophisticated market where basically small banks are very difficult to find investment opportunities other than loans. Inefficient banks are more sensitive to risk because they understand when they make loss their banks will be easily operating under less capital that may cause bank regulators to act. Their action may lead to the closure of the bank or bank being taken over by other investors. This finding also supports the view that inefficient banks are more sensitive to risk taking than efficient banks because the implication of risk taking behaviour can be substantial to their capital. Bank size (SIZE) is also risk sensitive. The coefficient for SIZE is negative and significant, meaning that large banks are relatively more capable to reduce risk by introducing more diversified portfolio and risk management especially credit risk management. Furthermore, if we look at the SIZE, the result provides evidence that large banks take lower credit risk as the coefficient is negative and significant.

The coefficient for NLTA is positive and significant meaning the existence of linear relationship between net loan and risk taking. Higher net loan to total asset is prone to higher credit risk. When the portion of loan to asset is bigger, it means bank asset is dominated by loan. In ASEAN countries, where the most important role of the banking industry is to perform intermediation, the higher portion of NLTA leads to a positive contribution to the credit risk.

Capital Equation

Table 7 presents the report for CAP equation. We expect that RISK to have negative relationship with CAP, meaning that bank with higher risk taking has higher capital. In this equation we found that higher risk has negative and not significant coefficient. The negative sign means higher risk taking has negative association with lower capital. This finding confirms that the capital regulation is not binding strictly in ASEAN countries and that there is enough room for banks to escape from this situation. Banks with substantial amount of problem loan are forced to provide more provision and this regulatory action usually leads to lower capital.

Table 7 Capital Equation

Variable	Coefficients	Standard error	z	P>z
_cons	48.2308	25.5799	1.89	0.059
RISK	-.0117	.0447	-0.26	0.794
INEF	-.1916	.3013	-0.64	0.525
SIZE	-2.5269	.6420	-3.94	0.000
ROA	318.5829	3658.523	0.09	0.931
IRC	-.0151	1.5399	-0.01	0.992

INEFF as a measure of operating inefficiency has negative sign and is not significant. The result confirms that less efficient banks will have weak capital position because of their incapability to accumulate more capital from profit. Banks with higher inefficiency level tend to be less capable to generate profit. As capital is largely depending on the capability to generate internally, inefficient banks will be not capable to generate capital internally.

SIZE has negative coefficient and significant. The explanation can be provided by the nature of market and regulatory conditions. Large banks enjoy bigger guarantee in terms of failure. The ideology of “too big to fail” may reduce the intention to inject more capital. In addition, additional capital is also costly to shareholders. In market perspective, large sized banks also enjoy reputational benefits because of various reasons such as network operation. As large banks own less capital ratio than small banks, public confidence is much higher in large banks than small banks and this reduces motivation for larger capital.

ROA has positive relationship with capital as predicted before. However this relationship is not significant. The reason may come from the 1998 banking crisis in the region that ended the inflow of foreign investors to provide more capital to their acquired banks. The domination of Indonesian bank in the sample is clear and at this time, foreign controlled banks occupy more than 65% of Indonesian banking asset. These reasons are also valid in other ASEAN countries. It means strong capital does not necessarily come from internal capital formation. The coefficient for IRC, ratio of interest revenue to total asset, an indicator how bank can generate revenue from its asset is negative but not significant. It means even the bank can generate higher interest revenue, if the profit is less, the impact is not plausible. Referring to ROA which has positive coefficient, we may conclude that higher interest may come from higher risk.

Summary of the Findings

The objective of this study is to examine the relationship between inefficiency, capital, and risk. A three- stage least squares (3SLS) method is used to avoid simultaneous bias for the estimated coefficients when they are individually separated Table 8 presents the summary of the results to enable us to have a clearer view.

For all the results, in general, there exists a relationship between inefficiency, risk and capital in ASEAN commercial banks.

Table 8 Summary of the results

Equation 1		Equation 2		Equation 3	
Dependent variable is INEFF		Dependent variable is RISK		Dependent variable is CAP	
Variables	Sign/Significant	Variables	Sign/Significant	Variables	Sign/Significant
CAP	-ve / Yes	CAP	-ve / Yes	RISK	-ve / Not
RISK	-ve / Not	INEFF	-ve / Yes	INEFF	-ve / Not
SIZE	-ve / Yes	SIZE	-ve / Yes	SIZE	-ve / Yes
OBSTA	-ve / Not	NLTA	+ve /Yes	ROA	+ve / Not
				IRC	-ve / Not

CONCLUSION

This study investigates the relationship between inefficiency, risk and capital for a large sample of eight ASEAN banks between 2003 and 2008. We adopt a simultaneous equation model i.e. using a three-stage least squares (3SLS) regression model in which cost inefficiency, risk and capital are modelled as dependent variables. The results confirm that inefficiency, risk and capital are simultaneously determined. Unlike Deelchand and Padgett (2009) who used stochastic frontier

approach to measure inefficiency, we used accounting data to measure cost inefficiency (cost to income ratios).

In inefficiency equation, we found that capital is negative and significant. It indicates a bigger capital ratio increases efficiency of banking firms in ASEAN. However, RISK is not significant. In terms of SIZE, large banks enjoy better efficiency than smaller banks. This relationship can be explained by economies of scale and scope. RISK is not significant to efficiency. Off-balance sheet to total assets (OBSTA) has a negative relationship though not significant. It means bigger OBS activities increase operating efficiency. In this equation, we can conclude that inefficiency is determined by capital and size meaning more capital and large sized banks can improve the operating efficiency of banking firms in ASEAN. The effort by banking regulators in ASEAN to implement a policy that requires banks to inject in more capital should be intensified.

In risk equation, the results show an inverse relationship between RSIK and CAP position meaning that higher capital banks tend to reduce the risk taking. Inefficient banks tend to reduce risk because of two reasons. First, they do not want to get regulatory action when their risk taking ends in loss. Second, because they are inefficient, they tend not to take more risks. Furthermore, large banks tend to have lower risk than smaller ones because the larger ones can generate income from other businesses such as cash management and other fee generated activities. Banks that own more portions on loans in their portfolio have positive relation to risk. In this risk equation, we can conclude that in general inefficiency, capital and size are negatively related while loans to total assets are positively related.

In capital equation, there is a negative relationship between risk and capital. Banks that have higher risk tend to have lower capital but this relationship is not significant. Inefficient banks have a negative relationship with capital but not significant. Size has negative relationship with capital meaning larger banks tend to own less capital. This finding is not surprising because for large banks, they can attract more capital at faster and lower cost than smaller banks. In addition, large sized banks have lower capital because they enjoy implicit guarantee from “too big to fail” principle.

However, this study is without limitations. The data in this study is an annual data that means a dynamic relationship between inefficiency, risk, and capital cannot be tested. We can conclude in this study that in general, the relationship between inefficiency, risk, and capital does exist. This study is different from study by Shrives and Dahl (1992) that used time series data that can cover the impact of capital regulation on risk taking. This study also excludes macroeconomic and regulatory variables. However, as this kind of study is not performed before, future research should cover regulatory as well as macroeconomic condition of each country. More importantly, the definition of risk and capital should be changed to observe stronger theoretical foundation and be more realistic and based on regional characteristic.

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For inefficiency variable, future study should use economic inefficiency to insulate the data from managerial as well as accounting bias.

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