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CREDIT RISK-TAKING AND CAPITAL POSITION: EVIDENCE FROM TWO-STAGE REGRESSION

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ABSTRACT

Research on credit risk and its relationship with capital in a company is important. This is because the information about such thing can be considered very beneficial. This study examines the relationship between risk and capital in Indonesia Banking Market. It tested whether bank credit risk taking is correlated with its capital position. In this study, risk and capital were based on accounting ratios. Data for the study were taken from Banks cope database for the period 2003 to 2008. A two-stage-Regression analysis was used to estimate the relationship. On the risk taking model, it is correlated with ex post risk, portion of loan loss provision to capital (RISKCAP), and ratio of net loans to asset (NLTA), and negatively to size and inefficiency. On the capital equation, there is negative relationship with risk taking but not with inefficiency. Asset size has negative impact on capital positions and profitable banks hold more capital. It is clear that risk taking is not influenced by capital and capital is negatively determined by risk taking. In short, the relationship between risk taking and capital is not two-way but one way.

Key words: *Ex Ante Risk, Capital, Size, Inefficiency.*

PENGAMBILAN RISIKO KREDIT DAN POSISI MODAL: SEBUAH TEMUAN DARI *TWO-STAGE REGRESSION*

ABSTRAK

Penelitian tentang risiko kredit dan hubungannya dengan modal dalam perusahaan merupakan kajian penting. Ini dikarenakan bahwa informasi tentang hal tersebut sangat bermanfaat. Penelitian ini menguji hubungan antara risiko dan modal di pasar perbankan Indonesia. Ini menguji apakah pengambilan risiko kredit bank berkorelasi dengan posisi modalnya. Dalam hal ini, risiko dan modal didasarkan pada rasio akuntansi. Datanya diambil dari database Bank cope periode 2003 - 2008. Dengan two-stage regression, hubungan tersebut dianalisis. Pada model pengambilan keputusan, ternyata berhubungan dengan risiko ex post, portion of loan loss provision pada modal (RISKCAP), dan rasio net loan to asset (NLTA), dan berkorelasi secara negatif dengan ukuran dan efisiensi. Pada capital equation berkorelasi negatif dengan risiko tetapi tidak dengan efisiensi. Ukuran aset berkorelasi secara negatif pada posisi modal dan bank-bank yang bermodal lebih besar. Jadi, jelas bahwa pengambilan risiko tidak dipengaruhi oleh modal dan modal itu sendiri ditentukan secara negatif oleh pengambilan risiko. Dengan kata lain, hubungan antara pengambilan risiko dan modal bukan dua arah melainkan satu arah.

Kata Kunci: *ex-anti-risk, modal, ukuran, inefisiensi.*

INTRODUCTION

So far, the role of capital in the financial institution has attracted a quite substantial attention especially among regulators. In fact, the regulator's attention is mainly to prevent from the failure. This is the background of the enforcement of minimum capital requirements on the banks. Quite substantial number of bank failure in the end of 1980s has regained the authority awareness on the importance of capital. Besides that, the widespread of establishment deposit insurance scheme has changed the behavior of banking firm.

For that reason, excessive risk-taking might otherwise have been encouraged by the principle of limited liability and by the availability of deposit insurance. Strengthened capital regulation has resulted in improved capital ratios for banks, and a more stable financial system. However, the changes to the regulatory system have been criticized on the grounds that an increased regulatory capital standard may encourage an increase in leverage and portfolio risk. Both the theoretical literature and the empirical literature on the impact of capital regulation have produced heterogeneous results concerning the capital and risk adjustment behavior of banks.

Such a situation is related to agency problem theory. According to Jensen and Meckling (1976), agency relationship is an agreement between two parties. One of them (agent) performs certain services on the behalf of other (principal). Jensen and Meckling started their model with identification of two types of interest conflicts that can be possible: conflict between manager and shareholders, conflict between debt holder and shareholders. Under capital regulation, the conflict exists between bank managers and regulators.

To test the agency problem related to capital regulation, many studies have been done. Using set of a cross-section time-series data on US commercial banks, Ashraf (2010) studied the effect of changes in portfolio risk on the capital adjustment and of risk-based capital regulation on portfolio risk adjustment. A Simultaneous equation model, originally developed by Shrieves and Dahl (1992), is used. This methodology is superior because it is allowing for simultaneous adjustment and interactions between portfolio risk and capital. The empirical results are broadly consistent with the results reported in the previous literature especially related to the capital buffer theory, which suggests that banks increase their capital holdings in response to an increase in portfolio risk, in order to avoid regulatory penalties. Empirical evidence support the hypotheses that commercial banks to adjust their capital and portfolio risk simultaneously. Furthermore, there is strong evidence that banks increase their loan portfolio concentration in order to increase their regulatory capital ratios, suggesting that improvements in banks' capital ratios are achieved at the expense of their ability to diversify their loans portfolios.

Banking is the most regulated industry in the world. Apart from the product and its service, banking regulation also cover its institution. The aim of the bank regulation is to increase prudential practices that will reduce the level of risk bank are exposed to. The most important part of banking regulation is regulation on capital. According to Mehta and Fung (2004), capital regulation has rooted since 1930. USA is a pioneer in such regulation when they proposed a proposal in 1986 that require US bank to maintain capita that reflect the riskiness of bank asset. After the establishment of Basel Committee on Banking Supervision (BCBS), in July 1988, Central bank governors endorse 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 of regulation is to prevent banks from excessive risk-taking that make banks prone to crisis. Finally, regulators tried to link the required capital 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 another 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, and becoming a constraint to engage on expansion other risky business. It makes banks are forced to manage the risk efficiency to prevent from putting more capital. The so-called risk management process is aimed to the purpose of allocating capital efficiently in order to obtain optimal benefits and reduce cost of capital. The method used was the Bank earning assets as well choose 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 investment in which the Bank to invest so that the Bank may benefit optimum amount of capital, risk and return.

This study attempts to assess the relationship between credit risk-taking and capital position in Indonesia banking. This kind of study using Indonesia banks is, as far it is concerned, is not yet available. Ahmad *et al*. (2007) discusses the determinant of capital ratio in Asian banking as a one way process. Jeitschko and Shin (2007) on the other hand, study on the relationship between portfolio risk and capitalization in Korean banking. In addition, Konishi and Yasuda (2004) analyze the factors determining the risk taking behavior among Japanese commercial bank. This study is an effort to fill the gap in empirical study on this area in Indonesia setting. This study will provide empirical evidence how Indonesia banking industry behaved amidst the effort of regulator to reduce risk by increasing capital in one side and to the risk taking behaviors related to the capital regulation on the other side.

THEORETICAL FRAMEWORK AND HYPOTHESIS

Modigliani and Miller (1958) argue that capital structure is irrelevant or does not affect the value of the company. However, when looking at the bank capital structure, the story is totally different. Since twenty years ago, many studies focused on the relationship between risk and capital especially after the introduction of minimum capital regulation. Capital regulation is one of the key instruments of modern banking regulation. It is a fact that theoretical foundation on the relationship between capital and risk 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, 2009). Shrieves and Dahl (1992) argue that positive relationship between risk and capital. Jacques and Nigro (1997) on other hand, find a negative relationship between change in capital regulation and risk level.

Calem and Rob (1999) quantified the effect of capital based regulation and found the U-shaped relationship between capital and risk taking. 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. Iannota *et al*. (2006) compared the performance and risk of 181 large banks from 15 European countries over the 1999 – 2004 related to the ownership type. They found that ownership type and ownership concentration play an important role on risk and performance.

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 capital and bank risk-taking. Brewer *et al*. (2009) studied the determinant of capital ratios across 12 countries in Europe, USA, and Japan.

The study found that banks maintain their higher capital ratio when the banking sector is relatively smaller and when regulator practice prompt corrective action more actively. Kazion (2009) studied the role of capital and find evidences that banks do not hold the minimum capital but have voluntary capital buffer. Lindquist (2004) studied the excess capital both for commercial and saving bank and finds that saving banks hold more capital

RESEARCH METHOD

Based on the theoretical framework, the researcher underlines that relationship between capital and risk is made simultaneously and is interrelated. This situation is called as endogenity. Since the relationship between capital and risk is an over-identified simultaneous system, this study uses the OLS to run the estimation; it may have simultaneous bias and inconsistent problem in the estimated results. Capital equation is over-identified, it means 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 (α) from the estimated coefficients of reduced-form equations.

The implication is that the modeling requires the use of a simultaneous equation specification and estimation methodology. To simplify, the researcher follows 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 risk, bank capital and bank operating efficiency, a system equation is used and estimated using a two-stage least square (2SLS) approach using panel data technique as follows:

$$\text{Risk (LTA)} = \alpha_0 + \alpha_1 \text{ ETA} + \alpha_2 \text{ RISKCAP} + \alpha_3 \text{ Size} + \alpha_4 \text{ NLTA} + \alpha_5 \text{ CIR} + \alpha 6 \text{ RISK} + \varepsilon \quad (1)$$

$$\textit{CAPITAL (ETA)} = \alpha_0 + \alpha_1 \textit{ LTA} + \alpha_2 \textit{ RISK} + \alpha_3 \textit{ LDR} + \alpha_4 \textit{ CIR} + \alpha_5 \textit{ ROA} + \alpha 6 \textit{ Size} + \varepsilon \quad (2)$$

To estimate the equation (1 and 2), we use a statistical Package programmed. 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 vise versa (Jokipii and Alistair & Milne, 2009). 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.

Deelchand and Padgett (2009) 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, basically we adopt approach taken by Deelchand and Padget (2009) and Heid *et al*. (2003) treated risk, capital, and efficiency 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 efficiency *i.e.,* cost to income ratio.

DATA ANALYSIS AND DISCUSSION

A panel set of individual commercial bank from 2003 to 2008 was used. The data were collected from the bank's balance sheet, income statements, and off-balance sheet obtained from the Banks cope database to construct standard accounting measure of banking activities. At least, asset size is IDR 300 billion (USD 32 million) as shown in Table 1.

Variables

The variables used are those that are theoretically and empirically plausible. This research mainly follows Deelchand and Padgett (2009).The variables and definition

Table 1
Sample Distribution, 2003 – 2008

Number	Year	Samples
1	2003	34
2	2004	32
3	2005	40
4	2006	40
5	2007	40
6	2008	43
	Total	229

Table 2
The Definition of the Variables

Variables	Definitions
Risk	Loan Loss Reserve to total loan *(ex post*)
CIR	Cost inefficiency is measured by total banking cost divided by total income
NLTA	Net loan to total asset
SIZE	Logarithm of total asset as indicator of bank size operation.
ROA	Profit before tax to total asset as indicator of profitability.
ETA	Equity to total assets (Capital position)
LTA	Loan to total assets (credit risk taking)
RISKCAP	Loan loss reserve to capital
LDR	Loan to Deposit Ratio (Liquidity risk)

are presented in the Table 2.

It is expected that risk has negative relationship with capital, positive to size and net loan to total asset. On the capital side, it is expected that the negative relationship with risk meaning that less capitalized bank take excessive risk. In term of size, the researcher expects negative sign as it means the economies of scale hold. The researcher also expects negative sign meaning that bigger bank enjoy market power to select other non lending business.

Table 3 presents the description of the variables under investigation. In total, there are 229 observations spans from 2003 to 2008. The Equity to total asset (ETA) has mean value 14.5% with standard deviation is 10%. At minimum, it is 3.4% of asset and maximum is 74% of asset. The ratio indicates the strength of capital position. Higher ratio means bank has stronger capital than the lower one. The Loan to Total Asset (LTA) is used to describe the risk taking decision of the management. If the ratio is high, bank risk taking is also high.

Risk is to describe the *ex post risk*. It is measured using loan loss provision to total loan. Higher ratio means higher *ex post* credit risk. LDR is liquidity ratio and it is used to relate with profitability. Higher liquidity risk tends to increase profit. Higher LDR tends to increase liquidity risk and means higher profit. The means of LDR is 85%. Cost to income ratio (CIR) is efficiency ratio based on accounting data. Higher ratio is assumed to have lower efficiency. The means value is 54% and the highest is 175%.

LASSET is used to describe the size. Higher the ratio means the bigger the size of the bank. The means is 13.81 with the lowest is 10.37 and the biggest is 17.34. ROA is a profitability measure. Higher ratio means bank has higher in profitability. When the ratio is negative, bank experiences loses. The mean is 2.4% and the highest is 8%.

RISCAP is ratio of loan loss provision to total capital. Higher the ratio, it is indicating that the bank has capital problem because it is indicating that bank spend most of its capital already used to cover loan losses. The NLTA is the ratio of net loan to total asset. When the ratio is high, means the net loan contribute to most of total asset. Bank with higher loan size means bank performs the function as intermediary institution. On average the ratio is 50% maximum 84%. When problem loan is too much, the ratio can be negative.

Before we perform estimation using 2SLS, we test the endogenity of capital. To do the testing, we use the Hausman test. It is basically testing if the residual of ETA (Resid_ETA) is significant in the risk taking equation or not. We find that that residual of capital equation (Resid_ETA) is significant at 1%. The coefficient of resid_ETA is 1.599 with SE 0.303 with t-value 5.27. It means, the use of 2 SLS is necessary for better result.

As our data is panel in nature (unbalanced panel). To make the model more appropriate, we also test whether fixed effect or random effect is more appropriate. When the model is carried out using Random Effect (RE) that applies G2SLS random-effects IV regression, we find that *rho* is very low (9.769e-15). It means the correlation with error is very low. When the estimation is carried out using Fixed Effect (FE) assuming that all u_i=0, we find that ANOVA Table (F(5.217)) is 6.55. The probability is 1% (Prob > F = 0.0000). It is clear that FE is more appropriate. That result directs the estimation using FE.

The model must pass the order condition test as the failure produce inconsistent coefficient. We can say that it is the sufficient condition for system of equations. The application of the three stage least square method to the estimation of a system of equations requires that the model be identified in a manner that allows the estimation of the correct coefficients of the parameters. The problem of identification requires that two conditions be satisfied. The first condition, the 'order condition' requires that the total number of variables excluded from a particular equation but included in the other equations must be at least equal to the number of equations of the system less one. Mathematically, this is expressed as follows:

$(K-M) \geq (G-1)$

[excluded variables] ≥ [total number of equations -1]

G = total number of equations (= total number of exogenous variables)

K = total number of variables in the model

M = number of variables (endogenous and exogenous) included in a particular equation.

There are three possibilities to achieve. The first is Identified situation when K-M = G-1. The second, is Over identified when K-M> G-1. The third, is under identified when K-M< G-1. Table 4 presents the order condition of the model. The model is identified.

From the estimation result using two stage regressions, we can explain the fit of model. Our parsimonies variables are six and the RMSE are all below 5%. For capital equation we have RMSE 5% and for credit risk taking equation, we have 1%. The R-Squared is at least 76% meaning that at least 76% of the variability can be explained by the model. For capital equation, the R-squared is 76% and for credit risk taking equation is 99%. The F-Statistics (ANOVA), is at least 116. All equation is significant at 1%. In general, it can be stated that when the model is eligible to be used for further analysis as it is plausible.

Table 5 presents the capital equation. The model can explain 75% of the capital position variability's. The LTA (risk taking) is negative and significant at 1%. It means bank with higher risk taking (LTA) tend to have lower capital. As risk taking (LTA) is instrumental variables, the results confirm the endogenity of risk taking to capital. This situation confirms the existence of moral hazard theory that risk taking (*ex ante*) tend to have lower capital. The risk (ex-post) is not influence the capital position. In term of liquidity risk, the LDR is positive and sig-

Table 3
Descriptive Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
ETA (CAPITAL)	229	0.145	0.098	0.034	0.741
LTA (RISK)	229	0.532	0.160	0.013	0.853
RISK	229	0.060	0.270	0.000	4.037
LDR	229	0.853	0.925	0.015	9.813
CIR	229	0.541	0.199	0.117	1.755
LASSET	229	13.806	1.584	10.371	17.338
ROA	229	0.024	0.017	-0.016	0.086
RISKCAP	229	0.203	0.588	0.000	8.819
NLTA	229	0.505	0.193	-1.119	0.838

Table 4
The Order Condition of the Models

No.	Equation	G-1	K	M	Position
1.	**Risk Taking**	2-1 = 1	6	5	Identified
2.	**Capital**	2-1 = 1	6	5	Identified

Sources: Calculated from the model

nificant at 1%. We can infer that banks with higher liquidity risk tend to have higher capital to cover their liquidity risk position.

As previously expected, the size is negative and significant. We can infer here that big banks own less capita. Under the theory of capital, big banks basically have better position in the market in term of position such as the government protection. Under the theory of too big too fail, big banks own less but in reality, due to government implicit support, these banks in practice have higher capital position.

Profitability influences the capital position. Profitability is one of important sources of bank capital. By retaining the profit, banks do not have to issue new capital such as initial public offering (IPO). The ROA is positive and significant at 1%. It confirm that profitability is importance sources of capital

Table 6 presents the credit risk taking equation. The risk (*ex post* credit risk) is positive and significant. The result underlines the importance of moral hazard theory where higher credit risk (*ex post*) is also pushing the management to take more risk (*ex ante*). It can be explained by the moral hazard theory that problem banks tend to take more risk. Different from the capital equation, it is clear that capital is positive but significant. We can infer that risk taking is not a matter of capital but more on managerial decision. Under capita regulation theory, we expect that more capital bank will have more room to take higher risk. However, our result provides evidence differently. It is consistent to the fact when bank put more of their capital to support the problem loan; they also tend to take more risk that when the loan loss provision is lower. The RISKCAP is positive and significant at 1% confirm the results.

The asset has negative relationship with credit risk taking. The coefficient is negative and significant at 1%. It is understandable as the bigger the banks, they have more opportunity to generate income rather than from credit activities. Bigger banks have more opportunity to generate income from off-balance sheet (OBSA) and other income from payment service and other fee based income.

The cost efficiency variable (CIR) is

Table 5
The Capital Equation Model

Variables	Coef.	Std. Err.	t	P>t
LTA	-0.079	0.023	-3.460	0.001
RISK	0.000	0.014	0.000	0.999
LDR	0.054	0.004	13.120	0.000
CIR	-0.014	0.026	-0.540	0.589
LASSET	-0.021	0.002	-9.920	0.000
ROA	2.628	0.271	9.690	0.000
_cons	0.382	0.043	8.850	0.000

Table 6
The Risk Taking Equation Model

Variables	Coef.	Std. Err.	T	P>t
RISK	0.205	0.010	19.950	0.000
ETA	0.012	0.009	1.380	0.168
LASSET	-0.002	0.000	-5.190	0.000
RISKCAP	0.079	0.004	18.080	0.000
CIR	-0.019	0.003	-5.900	0.000
NLTA	1.017	0.003	324.660	v
_cons	0.023	0.007	3.340	0.001

negative and significant at 1%. It means inefficient bank take less risk taking (LTA). In other words, efficient bank takes more risk-taking than inefficient bank. The results is against the moral hazard theory that inefficient bank take more risk to compensate the lower efficiency. The NLTA is positive and significant. However, the NLTA seems to contain a multicollinearity to dependent variables.

The results confirm the interrelationship between credit risk taking and capital position. Bank with higher risk taking tend to have lower capital. It is not consistent to Altunbas , Carbo, Gardener and Molyneux (2003) on European banks. The results, in general, provide similar result from the US results. Unlike the evidence from the European literature, the result finds any strong relationship between capital position and bank credit risk-taking. Evidence from full sample suggests that inefficient European banks do not seem to have an incentive to take on more risk. The found stronger empirical evidence is showing the negative relationship between credit risk-taking (*ex ante*) on the level of capital, possibly indicating managerial' preference for moral hazards.

In contrast, stronger capital position does not inhibit higher credit risk taking. The direction of causality that explains the moral hazard hypothesis could also flow from capital to risk and can be derived from the (unintended) consequences of regulatory actions. Banks could respond to regulatory actions forcing them to increase their capital by increasing asset risk. A closely related extension to the moral hazard hypothesis could arise due to the existence of relevant agency problems between owners and stakeholders. In an unhealthy banking industry, a situation when it is more prone to moral hazard, entrenched managers will tend to take on more risk rather than less risk.

Our result shows that capital is not a determinant for risk taking but *ex ante* risk. It means capital (ETA) don not influence risk taking. Inderst and Muller (2008) support our result on the relationship between capital and risk taking. Bigger banks take less credit risk and efficient banks take higher *ex ante*

credit risk taking. In general, the study is considered consistent with Konishi and Yasuda (2004). On liquidity, the study consistent to Brewer, et al (2009).

CONCLUSION, IMPLICATION, SUGGESTION AND LIMITATIONS

This study investigated the relationship between risk and capital using two stage least square regression models (2SLS). We found that bank risk taking has positive but not significant with capital position. It means higher capitalized bank does not always take higher risk taking. It means capital is not the determinant for higher risk taking. Higher *ex post* risk, RISKCAP and net loans (NLTA) has positive impact on risk taking negative to inefficiency and asset size (LASSET). On the capital determinant, we find that higher credit risk taking tends to lower capital and positively related to liquidity risk. Gig banks tend to hold less capital. Higher profitability tends to own higher capital. In short, we can conclude that risk taking is not determined by capital and the capital is negatively determined by risk taking. The relationship between capital and risk taking is not two-way but one way.

However, this study renders some limitation. The data, for instance, were annual data that means a dynamic relationship between risk, capital and efficiency can not be tested. What can be concluded is on average relationship between risk, capital and efficiency exist. This study is different from study by Shrives and Dahl (1992) that used time series that can cover the impact of capital regulation on risk taking. The drawback of this study also arises from the exclusion on macroeconomic setting. Yet, it had not been performed before, so that in the future research should cover regulatory capital.

However, this study entails some limitation. The data, for instance, were annual data meaning that a dynamic relationship between risk, capital, and efficiency cannot be tested. The factors that can be concluded deal with the average relationship among risk, capital and efficiency exist. This study is different from study by Shrives and Dahl (1992) that used time series that can cover the impact of capital regulation on risk taking. The lack of this study also arises from the exclusion on macroeconomic setting. However as this kind of study is not performed before, future research should cover regulatory as well as macroeconomic condition of each countries. More importantly, definition of risk and capital should be changed to observe stronger theoretical foundation and to cope more realistic regional characteristic. For efficiency variable, future study should use economic efficiency to insulate the data from managerial as well as accounting bias.

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