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A Threshold Regression Study on the Impact of Capital Adequacy Ratio on the Profitability of ASEAN-5 Banks

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ABSTRACT

The main objective of this research is to find out the threshold effect Asean-5 banks' capital adequacy ratio (CAR) to its profitability which is measured by return on assets (ROA) and return on equity (ROE) by the threshold regression model. In order to obtain result with higher accuracy, a controlled variable, bank size which is determined by the banks total assets, is added into the model.

1. Introduction

Financial sector is one of the most important economy drivers of a country. The role of banking sector is very important in driving the public savings are productively invested that leads to economy growth (Saba, et al., 2018). Every central bank would require all banks in the country to hold certain amount of capital, which is also known as the minimum required capital. This minimum required capital protects the banks, and its stakeholders against the possible risks that the bank is exposed to. For instance, a bank will face risks like credit risk, operational risk, market risk and so forth whenever they issue loans to various sector. Therefore, it is important that the bank always hold sufficient capital reserve to compensate the losses due to the risk (if it happens) without becoming insolvent. A reasonable amount of capital reserve is not just to ensure the banks to cover the potential losses, but it can also be used for the company expansion or development (Bateni, et al., 2014).

To ensure every financial institution have sufficient capital adequacy, committee of banking supervisory authorities, Basel Committee on Banking Supervision (BCBS), published the Basel Accords, i.e. rule regarding capital requirements. BCBS is a comprehensive set of reform measures to strengthen the regulation, supervision and risk management of the banking sector. In 1988, BCBS introduced the capital measurement system commonly

referred to as Basel I. In 2004, BCBS published Basel II guidelines which were the refined, reformed and more complex version of Basel I. While Basel I focus only on credit risk, Basel II includes market and operational risks besides credit risks. In Basel II, BCBS obligates the banks to maintain a minimum of capital adequacy ratio of 8%. Basel III was released in December 2010 which lay more focus on quality, consistency and transparency of the capital base. The focus of Basel III is to foster a greater resilience at the individual bank level to reduce the risk of system-wide shocks. It also increases the minimum capital adequacy ratio to 10% (Fatima, 2014).

2. Literature Review

Capital adequacy ratio

Capital adequacy is an important proxy in banking industry as it determines the strength and soundness of a banking system. Capital adequacy ratio is the measurement of the amount of bank's capital expressed as a percentage of its risk-weighted assets. There are two types of capital involved in the measurement of the ratio. Tier one capital which has a higher liquidity such as ordinary shares capital, and tier two capital which can absorb the winding-up losses and so provides a lesser protection to the depositors such as subordinated debts. The risk weighted assets are also one of the capital adequacy ratio components. The risk weighted assets are determined by sum up all the risky assets according to their level of riskiness (Matthews,1996).

The committee of banking supervisory authority, Basel Committee on Banking Supervision (BSBC), is a comprehensive set of reform measures to strengthen the regulation, supervision and risk management of the banking sector. In 1988, BSBC introduced Basel I, the capital measurement system. In 2004, BSBC refined and reformed Basel I by including market and operation risk besides credit risk which was initially included in Basel I. This complex version of Basel I is known as Basel II In 2010, Basel III, which emphasis on the quality, consistency and transparency of the capital base, was implemented (Fatima,2014).

The capital which banks hold with themselves as required by financial regulatory is known as minimum capital requirement. Banks are often being exposed to various type of risk while granting loans and advances to various sector. Hence, it is crucial for a bank to have sufficient capital to absorb any losses that might occur in its business (Fatima,2014). Applying minimum capital adequacy ratios also serves to promote the stability and efficiency of the financial system by reducing the likelihood of banks to become insolvent. In other words, applying the minimum capital adequacy ratio ensures the banks are able to absorb a certain amount of losses before becoming insolvent (Matthews, 1996). The Basel Committee had suggested a minimum capital adequacy ratio required to be secured at 8% according to Basel II (Settlement, 2004). Later, when Basel III was suggested minimum capital adequacy ratio is increased to 10% (Supervision, 2010).

Profitability

Profitability is a firm's ability to generate profits and to measure the level of operational efficiency and efficiency in using its assets (Chen 2004). To measure profitability, some indicators can be used such as operating profit, net income, return on investment/ assets, and return on shareholders' equity (Saliban, 2017). The company's ability to generate profits from its operating activities is a key point in corporate performance appraisal. On top of that, the company's profit is also an element in determining the value of the company (Andriyansah et al., 2017).

Bank profitability is an important ingredient for financial development, its relevance spans through banking firm performance to macroeconomics stability. In the perspective of firms, higher profitability reduces its fragility. On the view of macroeconomics, increased in banks' profitability improve the

banking sector which promotes the economic growth of the country. However, the higher return on banks implies that higher interest rate on loans. This is where the monetary policy plays it roles in regulating the banking system (Osuagwu, 2014).

In the past studies, various ways have been used to measure the profitability of a firm. Some use qualitative performance aspect while others used quantitative indicators for the measurements (Silaban, 2017). Brealey and Myers (2003) had emphasized that there are various significant measurements for a firm's profitability. For instance, the net profit ratio, ratio of return on assets (ROA), and ratio of return on equity (ROE) were ideal for profitability measurement.

In most research paper that involve profitability, it is inevitable that the profitability is determine in the form of ratio which are normally being reported in the banks' financial reports. Profitability ratio will not be affected by the changes of price levels. Thus, is it say to be most appropriate to measure profitability by using the financial ratios (Bentum, 2012).

According to Siti et al. (2016), previous studies found that the profitability is normally measured by return on assets (ROA), return on equity (ROE) and net interest margin (NIM). In this research, ROA and ROE will be used as the proxy of the profitability of the banks. For the purpose of this study, profitability is being measured by the return on assets (ROA) and the return on equity (ROE).

ROA shows the income generated from the assets of the banks. This ratio is commonly used to determine the financial performance of a banks (Kharawish, 2011). ROA also shows the profit per unit of invest assets. It shows the profitability of a bank by utilizing its assets. ROA also has a significant positive impact on the capital of a bank (Aymen, 2013).

ROE indicates the ability of the bank to generate income by its capital or equity. It also shows the profit gain per capital invested. ROE is important for investor as it reveal the profitability of the bank they invested in (Aymen, 2013).

Bank Size

The size of a business means the ability it possesses and the variety number of production capability or the quantity and multiplicity of services the business van be offered concomitantly to its customer. In other words, the best indication of "bigness" of a firm is the size of its management group or the amount of assets it possesses compared to others in the same industry. Firm size is the speed and extent of growth that is ideal for a specific business. Normally, bank size is used to determine the economics or diseconomies of scale in the banking sector. bank with a larger size then to reduce its cost of production due to the economics of scale (Gatete, 2015). Omondi and Muturi (2013) suggested that firms should expand in a controlled way with the aim of achieving an optimum size so as to enjoy economies of scale which can ultimately result in higher level of profitability. However, firms that become exceptionally large, the effect of size could be negative due to some reasons for example bureaucracy (Yuqi, 2007).

Previous Findings

Parvin, et al. (2019) carried out a studies on the effect of liquidity and bank size on the ROA of Bangladesh commercial banks. The result of their research shows that bank size does not have significant influence on the ROA of Bangladesh commercial banks. Alex and Ngaba (2018) found that the is positive significant impact of Kenya bank firm sizes on the ROA of Kenya commercial banks. Apere (2016) also claims that the capital adequacy ratio (CAR) has a positive significant impact on the return on assets (ROA) in the Nigeria banking sector. According to Harapah (2018), CAR reflects the banks' ability to cover its risks of loss from its business activities as well as its ability of funding the operation activities. Based on the research result obtained, the author concluded that

CAR has negative significant effect on the performance of ROA of the banking industry in Indonesia Mendoza and Rivera (2017)also found that CAR has negative significant effect on the performance of ROA of the banking industry in Indonesia Mendoza and Rivera (2017)also found that CAR has insignificant impact on the return on assets and ROE of rural banks in Philippines. However, Setiawan (2017), Rotinsulu, et al. (2015), Osborne, et al. (2013) as well as Samangie and Prabhath (2013) found that there is no significant impact of capital adequacy ratio (CAR) on the return on assets (ROA). In Indonesia banking industry, capital adequacy ratio does not have significant effect on banks' ROA and ROE (Silaban, 2017). The author explained that this might be due to the reason that the capital owned by the banks is only used to meet the requirement of the Bank of Indonesia. On top of that, this situation can be explained by the bank focuses on investment in productive assets and provide less cautious in channeling funds to the real sector causing that the bank has to use some of its capital to cover the bank's risk. Similarly, the same result was obtained by Antwi (2019) for the banks in Ghana. The empirical findings of the research done by Kagecha (2014) shows that there is positive correlation between bank size and the ROE of Kenyan commercial banks, but the impact of bank size is insignificant to the ROE. Monica (2019) found that the CAR in Private Foreign Exchange National Bank in Indonesia does not have significant influence on its ROE. However, this result is contrast with Widayani (2005) stating that there is significant impact of CAR on the ROE of Indonesia banks.

3. Methodology

Research Framework

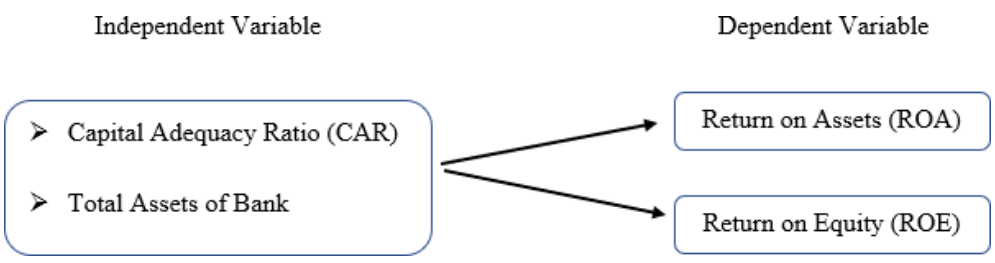

Figure 1: Research Framework

Figure 1 shows the threshold relationship between the Asean-5 banks capital adequacy ratio (in- dependent variable), total assets of banks (USD) as proxy for bank size (controlled variable) as well as the return on assets (ROA) and return on equity (ROE) as the proxy of the bank's profitability (dependent variables). The purpose of this study is to investigate the relationship between capital adequacy ratio and profitability (ROA and ROE). Apart from that, this research is also aimed to ex- amine the threshold level of the capital adequacy ratio (CAR) of Asean-5 banks to their profitability.

Research Design

This study will be qualitative in nature and it will be done through gathering the financial figures of the capital adequacy ratio (CAR), return on assets (ROA) and return on equity (ROE) from the financial of 32 banks in Asean-5 countries. The financial report can be obtained from the official website of the banks. The profitability of the banks will be regressed by taking ROA and ROE as the dependent variable, the independent variable will be the capital adequacy ratio and total assets of the banks as the proxy of the bank size, the control variable of the research. The relationship between the capital adequacy ratio and both profitability proxies will be determined. Then, the threshold level of capital adequacy ratio for the profitability will also be determined by threshold regression model.

Empirical Model and Estimation Technique

Threshold regression models have been developed rapidly over time since the seminal work of Tong (1983). Threshold regression model are a class of regression models where the predictors are associate with the outcome in a threshold-dependent way. By introducing a threshold parameter, threshold models provide a simple but elegant and interpretable way to model certain kinds of nonlinear rela- tionships between the outcome and a predictor (Fong, et al., 2017).

According to Hansen (2000), threshold models have is commonly applied in economics. Threshold models also emerge as special cases of more complex statistical frameworks, such as mixture models, switching models, Markov switching models and smooth transition threshold models (Hansen, 2000).

The discrete Threshold Regression (TR) model describes a simple form of nonlinear regression featuring piece wise linear specifications and regime switching that occurs when an observed variable cross unknown thresh-olds. TR specifications are quite popular as they are easy to estimate and interpret, and able to produce inter-esting nonlinearities and rich dynamics. Among the applications of TR are models for sample splitting, multiple equilibria, and the very popular Threshold Autoregression (TAR) and self-exciting Threshold Autoregression (SETAR) specifications (Hansen 1999, 2011; Potter 2003).

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \varepsilon \quad \text{---------- (1)}$$

Consider the multiple linear equation in (1) with *T* observation and *m* potential threshold variables which leads to *m*+1 regimes.

For the observation in regime *j*=0, 1, 2, . . . , *m* we have the following linear regression specification:

$y_t = X_t'\beta + Z_t'\delta_j + \varepsilon_t$ ---------- (2)

Where y_t denotes the dependent variable, X_t' denotes the independent variables whose parameters do not vary across regimes, also known as controlled variable, Z_t' denotes the regime varying variables, ε denotes the error term. (Note that *t* is used to index the *T* observations, there is nothing in the structure of the model that requires time series data.)
Suppose that there is an observable threshold variable q_t and strictly increasing threshold values $(\gamma_1 < \gamma_2 < \ldots < \gamma_j)$ such that we are in regime *j* if and only if:

$\gamma_j < q_t < \gamma_{j+1}$ ---------- (3)

Where γ_j is set as from ∞ to $-\infty$ and γ_{j+1} is also set between ∞ to $-\infty$

Thus, the model is in regime j^{th} if the value of the threshold variable is as large as the $(j+1)^{th}$ threshold value, but is not as large as the threshold value.

In order to fulfill the objectives of the research, a two-regime model is considered:
$y_t = x_t'\beta + Z_t'\delta_j + \varepsilon_t$ ---------- (4)
if $q_t \leq \gamma$

$y_t = x_t'\beta + Z_t'\delta_j + \varepsilon_t$ ---------- (5)
If $q_t > \gamma$

Where q_t denotes the threshold variable, splitting the observation values into two classes or regimes, γ denotes the critical threshold value. notice that when the threshold variable is below the threshold parameter, the model estimates the equation (4). Similarly, when the threshold variable is above the threshold parameter, the model estimates the equation (5).
Least squared is suggested to determine the threshold, which are the values that minimized the sum of squared residual:

$\hat{\gamma} = \arg\min S_1(\gamma)$ ---------- (6)

$\gamma \in (\gamma, \bar{\gamma})$

The "no reject region" method with a likelihood ratio (LR) statistic is used to construct the confidence interval because of the nuisance parameter problem (Hansen, 1999). To examine the threshold effect, the F statistic in the likelihood ratio test under of no threshold effect ($\beta_1=\beta_2$) is constructed as below:

$$F_1 = \frac{S_0 - S_1}{\hat{\sigma}^2} \text{ ------- (7)}$$

Furthermore, LR statistics and bootstrap approach are applied to examine the significance of the threshold effect in the model with the given thresholds (Munir Mansur, 2009). Thus, the nonlinear equation under a two-regime threshold regression model as below:

Return on Assets (ROA) Model

$ROA = \beta_0 + \beta_1 SIZE + \beta_2 CAR + \varepsilon$ if $CAR \leq \gamma$ ------- (8)

$ROA = \beta_0 + \beta_1 SIZE + \beta_3 CAR + \varepsilon$ if $CAR > \gamma$ ----------(9)

Return on Equity (ROE) Model

$ROE = \beta_0 + \beta_1 SIZE + \beta_2 CAR + \varepsilon$ if $CAR \leq \gamma$ ---------- (10)

$ROE = \beta_0 + \beta_1 SIZE + \beta_3 CAR + \varepsilon$ if $CAR > \gamma$ ---------- (11)

4. Results and Discussion

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAR < 0.20959999 -- 28 obs				
CAR	0.014214	0.046973	0.302590	0.7644
0.20959999 <= CAR -- 4 obs				
CAR	0.108168	0.036208	2.987396	0.0058
Non-Threshold Variables				
C	0.010199	0.007418	1.374784	0.1801
SIZE	1.24E-15	2.95E-14	0.042146	0.9667

R-squared	0.657725	Mean dependent var	0.015316
Adjusted R-squared	0.621053	S.D. dependent var	0.009231
S.E. of regression	0.005683	Akaike info criterion	-7.386286
Sum squared resid	0.000904	Schwarz criterion	-7.203069
Log likelihood	122.1806	Hannan-Quinn criter.	-7.325554
F-statistic	17.93518	Durbin-Watson stat	2.456436
Prob(F-statistic)	0.000001		

Figure 2: Asean-5 Banks ROA Multiple Regression Model

Referring to the output shown in Figure 2, a two-regime threshold regression is constructed as below:

$ROA = 0.010199 + (1.24 * 10^{-15})SIZE + 0.014214CAR \quad CAR < 0.20959999$ ----- (12)

$ROA = 0.010199 + (1.24 * 10^{-15})SIZE + 0.108168CAR \qquad CAR \geq 0.20959999$ ----- (13)

Based on the output, the threshold value of CAR is 0.20959999 or 20.959999%. For CAR value below 0.2096, when CAR increase by 1%, the ROA will increase by 0.014214%. When the CAR is above 0.20959999, 1% increase in CAR will increase 0.108168% of ROA. This implies that when the CAR is below the threshold value, the increase in CAR will not bring significant impact to the ROA. This can also be shown through the p-value of the coefficient. The p-value of CAR coefficient is 0.7644 (greater than 0.05) indicates that CAR is insignificant when its value is lower than 0.20959999. On the other hand, then CAR is greater than its threshold value. It will bring positive significant impact to the ROA as the p-value is 0.0058, which is lesser than 0.05.

For the non-threshold varying variable, also known as controlled variable, the coefficient remains the same. Whether the CAR exceed its threshold value or not, the controlled variable, bank size has a positive insignificant impact on the ROA.

By looking the output in Figure 3. The ROE threshold regression model can be constructed as below:

$ROE = -0.005493 + (-2.67 * 10^{-14})SIZE + 1.629744CAR \qquad CAR < 0.1330$ ----- (14)

$ROE = -0.005493 + (-2.67 * 10^{-14})SIZE + 0.682284CAR \qquad CAR \geq 0.1330$ ------- (15)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAR < 0.13299999 -- 5 obs				
CAR	1.629744	0.448450	3.634173	0.0011
0.13299999 <= CAR -- 27 obs				
CAR	0.682284	0.293839	2.321968	0.0277
Non-Threshold Variables				
C	-0.005493	0.052984	-0.103668	0.9182
SIZE	-2.67E-14	2.11E-13	-0.126402	0.9003

R-squared	0.449245	Mean dependent var	0.127625
Adjusted R-squared	0.390236	S.D. dependent var	0.051658
S.E. of regression	0.040338	Akaike info criterion	-3.466553
Sum squared resid	0.045561	Schwarz criterion	-3.283336
Log likelihood	59.46485	Hannan-Quinn criter.	-3.405822
F-statistic	7.613114	Durbin-Watson stat	1.587745
Prob(F-statistic)	0.000713		

Figure 3: Asean-5 Banks ROE Multiple Regression Model

As observed in Figure 3, the threshold value of CAR in this threshold regression model is 0.133 or 13.3%. For CAR less than 0.133, CAR will have positive significant impact on ROE where every percent increase in CAR will increase 1.629744% of ROE. The same applies to when CAR is above its threshold value, 0.1330, where

CAR has positive significant influence on the ROE. In this case, for every percent increase in CAR, the ROE will increase by 0.682284%. As for the controlled variable, bank size, it has insignificant negative impact on the ROE no matter the CAR is above or below the threshold value.

4.1 Discussion

Overall, the result obtained shows that capital adequacy ratio (CAR) is positively significant to the return on equity (ROE) of the banks but have partially significant affect to the return of assets of the banks (ROA). There is no significant impact of bank size to both profitability determinants. Then, the threshold level determined for the two-regime threshold regression model of return on asset (ROA) is 0.2096 or 20.96% while the threshold level for two-regime threshold regression model of return on equity (ROE) is 0.1330 or 13.3%. The capital adequacy ratio (CAR) will have a higher significant and positive impact on return on assets (ROA) when it is above the threshold level as compared to when it is lower than the threshold level. On the other hand, the capital adequacy ratio tends to have a higher significant positive impact to return on equity when it is below the threshold value as compared to when it is higher than the threshold value. As both of the threshold level for capital adequacy ratio (CAR) is greater than the latest capital adequacy ratio set in the Basel III of the Basel Accord. However, the higher rate proposed in this study would bring positive influence on the profitability of the banks. On the other hand, the minimum required capital amount has also been increasing as time goes. Therefore, if the minimum capital adequate ratio (CAR) required is increase again, it would not cause the profit of the banks to be negatively affected. On the other hand, the increase in minimum required capital adequacy ratio (CAR) would increase the profitability of the banks. This would indirectly stimulate the economy activity as banking sector one of the important driver of the economy of a country.

5. Conclusion and Recommendation

Conclusion

The paper had examined the relationship between of the CAR and bank size with two determinants of profitability as well as the threshold level of CAR of 32 banks from Asean-5 in 2018. The threshold level determined for the two-regime threshold regression model of return on asset (ROA) is 0.2096 or 20.96% while the threshold level for two-regime threshold regression model of return on equity (ROE) is 0.1330 or 13.3%. The capital adequacy ratio (CAR) will have a higher positive impact on return on assets (ROA) when it is above the threshold level as compared to when it is lower than the threshold level. Furthermore, the impact is only significant when it is above the threshold level. On the other hand, the capital adequacy ratio tends to have a higher significant positive impact to return on equity (ROE) when it is below the threshold value as compared to when it is higher than the threshold value. Apart from that, based on the result of this study, expanding the bank size would not be the primary strategy if the bank has the intention to increase its profitability.

Recommendation

The main focus of the study is to find the threshold level that would bring impact to the profitability of Asean-5 banks. Based on the Basel III in the Basel Accord, banks are required to have a minimum of 10.5% of its capital as reserved capital. Hence, Basel Committee on Banking Supervision (BCBS) could consider increase the minimum required capital of banks as it would bring positive impact to the banks' profitability. this would indirectly improve and stimulate the global economy and the overall living standard of the people all around the world would increase as well.

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