Capital Adequacy & Banking Risk – An empirical study on Vietnamese Banks

Version – 12 February 2015

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Abstract

Since the globally financial crisis occurred in 2008, Supervisory has become one of the most centric activities that all banks' governors over the world are focusing on and Vietnamese banking system is not an exception. The State Bank of Vietnam is required to loosen the entry barriers for foreign entity at the WTO integration as well as to tighten financial policies in banking industry, in which capital adequacy is a useful tool to assess and control the sector's performance. This paper aims to present a look on the relationship between degree of capital adequacy, risks and profitability indicators of Vietnamese commercial banks through both theoretical and empirical studies. The former provides the brief knowledge about capital regulation, the overview of Basel Capital Accord and the Vietnamese regulations on banks' capital adequacy in general. Using the secondary data, the empirical study examines the effects of several independent variables on banks' adequate capital. The paper reveals that the combination of capital risk, owner's equity risky assets ratio, return on equity, and return on assets have statistically significant influence on Vietnamese banks' capital adequacy.

Keywords: capital adequacy ratio, banking risk, bank performance, panel data

1. Introduction on rationale for capital adequacy requirement in banks

Analysts and specialists often open a discussion of bank capital adequacy requirements by mentioning their roles in creating a buffer, which supports bank losses, protecting debt holders from bank failures. Therefore, a capital buffer that reduces failure probability, is very important to debt holders. In banking system, an unregulated bank whose assets equal to liabilities will face struggle period whenever its assets decline in value due to an unexpected event, even go bankruptcy. More seriously, failure in banks will lead to dreadful "domino" effects on the overall economy, for instances, bankruptcy of Lehman Brothers windened the greatest global financial crisis in the 21st century.

Theoretically, the capital requirement establishment faces trade-off dilemma between operation stabilization and high cost of capital. While conservative lenders demand assurance to receive full amount of borrowers' obligation, owners tend to use a large ratio of debt for very high

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returns. Note that, Koehn and Santomero (1980), Kim and Santomero (1988), and Rochet (1992) found that the cost of equity is much higher than that of debt; therefore, the decrease in leverage will result in lower bank's rate of returns. In this case, under business point of view, bank's owners would consider the policy with higher risk and higher return, which might lead to a higher default probability. Lenders who always receive a fix payment for whatever level of operating profits do not want to experience unhealthy finance period. However, the fact that banks' owners have the advantage of approaching internal information that can be used in investment decisions raises lenders' fear of default. Thus, bank managers take time to set up an appropriate plan to satisfy all stakeholders with an adequate amount of permanent resource, namely core capital, to cover unexpected losses, which might decrease these moral hazards, thereby sharing the potential burden on depositors.

Historically, the capital regulation has been implemented by the largest creditor of a bank, the Government which desires to avoid taking the costs of financial distress. Like private lenders, the Government or Central bank requires deposit insurance system to protect them from unexpected losses. Acting as the lender-of-last-resort, practically, the Central bank still has to provide support for bank's obligations with few contract's terms in respect of finance or politic. Besides, the system is incapable of supporting regulators tracking whether a new deposit is insured. Consequently, the Government issues an on-going capital adequacy regulation to maintain bank's operation.

An additional rationale is that the government might use capital regulation to reduce the probability of bank failures that are the cause of remarkable negative externalities. A bank failure might endanger another related bank via interbank loan market or via account of customers expecting fund transfer from the first bank in payment system, which strongly spreads into overall sector, even whole economy. Specially, the too-big-to-fail arguments show that large banks know their important position in economy system; hence, they have incentives to take higher risks. As a result, the government has to support to stabilize the economy if these banks experience difficult periods. If the bailout is not enough, it will be an enormous disaster. These social costs, which would not be borne by solely investors of the bank, force the regulators require higher amount of capital as an effort to closely match social benefits and cost of operation.

Another negative externality is that bank failures might bring distracted information and damage borrower creditworthiness, which is costly to develop. A bank always develops expertise teams in information processing procedures. The experts are responsible for collecting, analyzing, rating and keeping valuable information in bank's system. Then, in case that the bank goes bankruptcy, all useful customers' assessment information for reference may be lost forever, which affects the entire banking sector.

The paper aims to make a link between the banking risk and the capital adequacy requirement. It contributes to the capital regulations perspective in several aspects. Firstly, it briefly explains the reasons of capital adequacy requirements, taking a brief review on previous researches of capital adequacy regulation's determinants in term of risks and profitability indicators, and summarizing the Basel Capital Accord. Secondly, the study examines the main banking regulations in Vietnam, making comparison with international standards. Thirdly, based on secondary data as the publications of State Bank of Vietnam, the official reports from commercial banks, the research is aimed to empirically find the effects of risks and profitability on adequate capital level. Finally, it discusses the findings and gives the conclusion for capital regulation situation.

The remainders of this paper are organized as follows. The second section is literature review on capital adequacy regulation, previous literatures on capital level's determinants, and basic ideas in Basel Capital Accords and the Vietnamese bank regulations. The third section examines the empirical studies on Vietnamese banks examining the relationship between change in capital comparing to change in risks factors and profit measurement, consisting of variables explanation, data description and results of regression. In the last section, conclusion and finding discussion as well as further research opportunities are presented.

2. Literature review on capital adequacy requirement

Initially, Moldigliani and Miller's (1958) illustrated that a firm's capital structure is irrelevant to its value in an efficient market. As banks are joint-stock corporations, the shareholders' losses are limited while their gains are much larger than the fix amount of interest payment for depositors and creditors. In an efficient market with all information published, creditors require higher loan interest to cover the higher risk, which forces managers to maximize both share value and bank total value. Hence, the market value of bank is independent of its capital structure. In other words, there is no need for capital regulation in this framework.

However, Sealey (1985), Baltensperger & Milde (1987) argued that M&M theorem is not appropriate for banks. According to the information theory, if market was efficient, banks which do not possess special information would not exist. Therefore, bank's appearance proves that M&M's assumptions have problems. Since creditors are unable to accurately assess the portfolio's risks, banks have incentives to increase leverage and take higher risk. As a result, regulators should implement certain requirements for banks, especially in terms of capital, to avoid default.

In addition, Koehn & Santomero (1980) found that capital requirement was not enough to reduce the failure probability. Because a high required capital level would have undesirable effects on banks' expected returns; forcing banks to balance their loss by investing in high risk assets. In other words, the degree of risk aversion played a key role in bankruptcy probability. Researchers indicated that the failure's probability was lower for sufficiently risk-averse banks and higher for low risk-averse bank. Consequently, capital regulations need to combine with asset requirements and take into account the liquidity problem.

In the later discussion, Kim and Santomero (1988) also suggested that policy makers might implement risk-sensitive capital requirements. Specifically, optimally chosen risk-weights with an upper bound on the bankruptcy's probability should depend on the expected returns and their variance - covariance structure. Hence, they were independent of individual risk aversion.

Mpuga (2002) believed that inadequate minimum capital requirements might induce banks going bankruptcy. He analyzed how new Ugandan capital regulations led to a large number of banks collapse when they took efforts to meet capital requirements in the 1998 crises. The research empirically further concluded that once new regulations took additional elements, such as deposits, paid-in capital, core capital, total capital, etc. into account, banks performance would be strengthened. Similarly, Choi (2000) found that banks changed their behaviors when an old regulation was replaced. In particular, banks satisfying CAR extended their credit and low-CAR banks had to reduce their lending to adapt with mandatory capital.

Back to the deposit insurance point, as a matter of fact that assets' risk cannot be reflected in the deposit-rate demanded by lenders; banks have the tendency to raise the riskiness of their portfolios. In order to deal with this issue, researchers developed various methods, one of which

is the Black and Scholes formula (1973) in option pricing, conducted by Merton (1977) and Pyle (1984). They assumed the deposit insurer as a put option and the predetermined payment to depositors as the strike price. In case of deposit insurance being underpriced, banks seek to maximize their equity and option value of deposit insurance simultaneously. Besides, Merton believed that deposit insurance influences on risk shifting process, which requires shareholders to post a "bond" in the form of suitable levels of capital.

Dowd (1999) proved that minimum capital regulations might be considered as a mean to enhance the safety and soundness of banking industry. He appreciated deposit insurance system to deal with information asymmetry. Its moral hazard made the Government establish intervention in bank performance by capital regulations. At the same time, Harold (1999) independently found that not only regulators but also residents concerned about the stabilization of financial system. By using the bank risk-based capital approach for banks and credit unions strength comparison, the research inferred that asset size was not a main source causing the difference in these bank risk-based capital ratios. Therefore, banks would maintain an appropriate capital level to optimize the return on equity as well as adapt capital adequacy regulations.

Jackson et al. (1999) conducted a study to verify the relationship between banks' profitability and capital requirement in banking sector of Germany, Canada, Holland, Japan, England, United States, and Switzerland. However, the authors found inconclusively divergent results from their data.

Bensaid (1995) profoundly examined the function of capital requirements in dealing with both adverse selection and moral hazard. Theoretically, the former derived from private quality of the bank's loans towards banks' owners while the latter arose as banks' profit depending on the unobservable decision.

Furlong and Keeley (1989) argued that the framework in which borrowing rates are constant and costs are independent of portfolio risk are incorrect because it ignores the states in which bank fails. Once bank fails, depositors are paid a deposit insurance agencies' compensation, decreasing the cost of debts. Therefore, the probability of bank to take more risk is greater at low capital levels, and it decreases with the increase in capital.

Under a financial perspective, Blose (2001) analyzed the influences of loan loss provision (LLP) on stock price during the period from 1980 to 1993. He explained investors' reaction from LLP announcement in terms of information asymmetry on asset value and cost of capital. The regression on cumulative average expected earnings indicated that LLP declaration brought negative effects on earnings. Thus, banks with lower capital adequacy faced a larger reduction in stock price in comparison to the ones with adequate CAR. Eventually, of plentiful types of LLP, real estate and loans provision made an enormously negative price reaction. Whilst, Powel (2002) believed that there was a shortage of provisioning capital rules in international agreement of Basel I, which cover both expected and unexpected loss.

In a research of financial structure and bank performance, Renolds (2000) found the structural variables by regressing independent financial ratios including liquidity, profitability, and loan preference. The study explored a positive relationship between banks' size and profitability, and a negative correlation of capital adequacy and banks' assets. In other words, larger banks would remain a small amount of capital buffer that is directly affected by profits.

Yu (2000) was also in favor of "too big to fail" theory, reporting that most of large banks have much lower capital ratio in comparison to small banks, in the Taiwanese sample. Basing on the assumption that well capitalization would earn high profit, the paper found that equity to asset ratio positively related to small banks but negatively related to medium-size banks. He also concluded that bank assets, liquidity and profitability are the main determinants of capital ratio.

Asarkaya and Ozcan (2007) considered the determinants of Turkish banks' capital structure, explaining reasons why banks held higher amount of required capital during the period 2002 – 2006. Through an empirical model, the study suggested that lagged capital, economic growth, portfolio risk, and return on equity positively related to capital adequacy ratio whereas deposits negatively affected capital buffer.

Newman (2010) considered that the variation in foreign exchange earnings was the main reason which generates the decrease in the dollar and foreign reserves, which remarkably affected bank capital. Marcus (1983) assumed that fluctuation in nominal interest rate caused changes in capital to assets ratio. Through time series – cross estimation, he showed a significant reduction in this ratio in US banking during the last two decades.

In efforts to define an adequate bank leverage amount in Hungary and Bulgaria, Bevan (2000) paid attention on banks size, risky assets, debts, and retained earnings effects. The study resulted in an inverse correlation between leverage and risky assets, debts, which emphasized the importance of capital in securing the depositors fund.

Song (1998) examined Korean banks' behavior towards Basel's capital adequacy regulations in 1992. He found that the risk weighted based methodology were effective in avoiding solvency because local banks tended not to make "cosmetic" adjustments to raise their capital ratios. Also, following risk management approach, Karles (1989) conducted an investigation on relationship between various market risk and capital adequacy ratio on both qualitative and quantitative methods. From sample of 24 banks, the research evidenced for a negatively related between market risk and capital buffer in theoretical statements.

Whilst, Saunders, Strock and Travlos (1990) found that managers' risk preferences might influence on capital buffer. According to the study, due to personal benefits, bank managers had incentives to reject risky projects. Hence, managers tended to offset high-risk asset portfolios by low leverage, which generated a positive relationship between changes in risk and change in capital as in Shrieves and Dahl (1992). In other words, banks would increase their capital amount to deal with higher loan portfolio risk.

In general, the merits of capital adequacy regulation theory is approved and appreciated by numerous researchers and analysts, but, the question of *how much capital that banks should be required to hold* stills remains controversial.

Basel Capital Accord

In 1998, the Basel Committee on Banking Supervision approved to publish the first version of Basel Capital Accord, which mainly aimed to tighten the adequacy of capital. In order to prevent banks from excessive risk-taking, as regulators linked the required capital to the risk of the loan portfolio, according to the Basel Accord I (risk-based capital standard), banks are expected to hold a certain level of capital for risk-weighted assets. Particularly, banks are required to maintain a minimum capital ratio of 8% of all risk-weighted assets.

The appliance of 1988 Basel Accord enables banks to reach two main aims: ensuring an

adequate level of capital in the international banking system and offering competitive environment for banks. In fact, there are over 100 countries applying the Basel framework to their banking system. However, the accord goes along with some major disadvantages. The capital requirement is softly tied to economic risk, which creates chances for regulatory capital arbitrage. As a result, the quality of bank loan portfolios is averagely reduced. Besides, amended 1996 version Basel Accord still ignores operational risk, inaccurate market risk measurement, and unclear level of risk. These shortcomings forced the Basel Committee to release two consultative packages with more risk-sensitive accord in June 1999 and January 2001 respectively. These papers comprise of three pillars: Minimum capital requirement, Supervisory review system, and Market discipline.

In accordance with the banking industry development, in June 2004, Basel Committee published the upgraded version of the Basel Accords. This document aims to ensure banks to mainly consider operating risks and make an adequate provision of capital against the risks. In the capital adequacy determination, Basel II adjusts risk conversion factors and risk-weighted assets calculation. Particularly, new total risk-weighted assets are computed as the sum of the credit-risk weighted assets with 12.5 times of market-risk capital charge and operation-risk capital charge combination. Basel II offers Standardized Approach and an Internal Rating Based (IRB) Approach for banks to choose. The former allows banks to assess the risk weights through external credit assessment institutions rating. In contrast, under IRB approach, a bank can develop its internal estimation system to assess borrower creditworthiness, with disclosure standards.

Similar to the older version, Basel II appears have several disadvantages. Firstly, Basel II adds Tier 2 capital of short-term subordinated debt covering market, which is reprimanded as one of the main reasons contributing to 2008 Financial Crisis. Secondly, while rating agencies have conflicts of interest, risk assessing approach primarily basing on credit degree of customers offers opportunities for inaccurately healthy financial institutions to invest in venture projects, which leads to higher risk. Besides, supervisory and risk assessment processes seem to ignore business cycle factor. Capital quality issues are also not seriously considered in risks evaluation.

In December 2010, Basel III Capital Accord was agreed upon the member of Basel Committee on Banking Supervision in the effort to get a handle on banking risks after 2008 Global Financial Crisis, implemented roadmaps for full Basel III standards appliance. Though Basel Accords are not compulsory towards all banking sectors, there are now more and more countries applying these policies in their practical situations. Understanding the importance of banking stabilization in economy development, countries' Central Banks pay significant attentions to adjusting regulations, especially minimum capital requirement. In order to establish an appropriate requirement for their banking systems, numerous authorities and banks' administrators have conducted empirical researches to analyze the interaction between capital requirement and economic variables, financial indicators and other related factors in real situations.

Vietnamese Banking regulation

In Vietnam, several regulations already mentioned numerous Basel Accord terms. The State Bank of Vietnam - SBV to put initial attempt on banking risk management, implemented decree 493/2005/QĐ-NHNN. The Decree content preliminarily reflects the relationship between capital and risk-weighted assets as well as provisions against credit risk in banking activity. Commercial banks themselves classified their loans based on private internal rating-based

approach and collection capability. However, Vietnamese commercial banks were failed to assess all types of operating risks, not establishing appropriate provisions of risks.

Decision 457/2005/QĐ-NHNN, announced safety ratios as well as weighted conversions in banks' operating concerned balance sheet and off-balance sheet risks, which is complied with Basel Capital Accord I. However, a difference between Vietnamese account standard and international account standard made CAR computation not accurately reflect banks' operating risks. In fact, according to Basel, the denominator was required to add capital offsetting market risk, which made few Vietnamese banks reach CAR of 8%. Besides, CAR of 8% was applied for all banks without considering scope, size and risk differences of banks.

The 2008 financial crisis began with a failure of Lehman Brothers giant, which made a warning of regulation for banking systems around the world, and, Vietnam was not an exception. At this time, Vietnam had just participated in the World Trade Organization (WTO), preparing to expand the market to foreign enterprises. Numerous challenges and opportunities created forced National Assembly enact new laws and simultaneously amend existed ones to accommodate radical business environment change. Hence, the Law on Credit Institutions in 2010 was approved to strengthen an operating environment, management, structure mechanism for banks and their clients, which stabilizes the banking sector as well as creates further challenges for certain credit institutions.

At the same time, in 2010, another very important document, namely Circular 13/2010/TT-NHNN, was implemented by the SBV to identified safety ratios for financial institutions. According to this law, the SBV established capital-related regulations to secure bank safety operation as well as limited new banks entering financial market, including the following: the minimum charter capital was raised from 1,000 billion VND to 3,000 billion VND; the compulsory reserve fund is now annually accumulated at a rate of 10% of net income, capturing 25% of the charter capital and the minimum required CAR (individual and consolidated) for commercial banks was raised from 8% to 9%.

$$CAR = \frac{Own\ Capital}{\sum Risk-Weighted\ Assets} = \frac{Tier\ 1 + Tier\ 2 - Deductible\ amount}{\sum Risk-Weighted\ Assets}$$

where:

- Own capital is the total of Tier 1 capital and Tier 2 capital, minus deductibles;

- Tier 1 capital includes is the aggregated amounts of chartered capital; reserve funds; the operation development investment fund; retained earnings; and surplus shares permitted;

- Tier 2 capital is the aggregated amounts of assets revaluation; financial reserve funds; convertible bonds and other debt instruments satisfying numerous conditions. However, Tier 2 capital is required to meet some limitations;

- Deductible amount is the sum of partial deductible from Tier 1 and Tier 2, consisting of goodwill, cumulated losses, share repurchases;

- Risk-weighted assets are total value of assets and equivalent value of off-balance-sheet assets in term of degree of risk. Based on the six-weight-framework (0%, 20%, 50%, 100%, 150%, 250% - this for the real-estate loans), risky assets will be converted into proper risk-weighted assets.

The formula above on the CAR calculation is based on standard of Basel I. However, the denominator takes into account only credit risk; ignoring other important risks comprising of

market risk and operating risk. The fact of the matter is that, now, recently, Vietnamese banks always sustain CAR, which is average of 12%. As a consequence, in spite of completing capital regulation requirements, many banks still have a high level of risk taking, such as, quality of loans or quality of secured properties and a low degree of profitability, hence, the CAR requirement of 9% is unable to accurately reflect the safety of commercial banks. In fact, the relationship between these factors tends to randomly vary across financial institutions.

3. An econometric model for banking risk and capital adequacy

3.1. Research Method, sample

This section is conducted to empirically analyze determinants of capital adequacy ratio and their effects on in Vietnamese banking systems. As mentioned in the above literature review, the moral hazard theory believes that risks and capital level are simultaneously determined by bank managers. The earlier research by Shrieves and Dahl (1992) shows the positive relationship between capital and risk whereas Jacques and Nigro (1997) on the other hand, argue a negative one. After that, numerous researchers, such as Newman (2010), Marcus (1983), Bevan (2000) focus on the interaction between degree of adequate capital and risks factors. Besides, Goddard et al. (2004), Javaid et al. (2011), Naceur (2003) conducting study on European banks during the 1990s, Pakistan over the period 2004 to 2008, and Tunisia for the period 1980 to 2000, respectively found the strong correlation between capital and profitability indicators. Hence, this paper aims to detailed focus on both banks' profitability and risks measurement's effects on banks' capital. The empirical test about relationship between capital adequacy level and its determinants will be conducted following the regression developing on earlier research in Jordan by Al-Tamimi (2013). Hence, the study found these factors' relationship based on the following regression equation:

$$CAR_{i,t} = \beta_1 + \beta_2 * CPR_{i,t} + \beta_3 * CR_{i,t} + \beta_4 * IR_{i,t} + \beta_5 * LR_{i,t} + \beta_6 * ER_{i,t} +$$
$$\beta_7 * ATO_{i,t} + \beta_8 * ROE_{i,t} + \beta_9 * ROA_{i,t} + \varepsilon_{i,t} \quad \text{for bank i at period t}$$

Where the variables are *CAR:* Capital adequacy ratio; *CPR*: Capital risk; *CR*: Credit risk; *IR*: Interest rate risk; *LR*: Liquidity risk; *ER*: Owner's equity risky assets ratio; *ATO*: Asset turnover ratio; *ROE*: Return on equity; *ROA*: Return on assets.

This paper examines statistical data from 11 Vietnamese commercial banks including ACB, BIDV, Eximbank, MB, Sacombank, SHB, Techcombank, VIB, Vietcombank, Vietinbank, and VPbank during 6 years (from 2008 to 2013). The data are mainly collected from officially published documents by Vietnamese reputational organizations. Most variables including capital adequacy ratio, risk ratios, profitability ratio during 2008 to 2012 are computed from banks' annual reports. The economic model, quantitative data and econometric equation are aimed to aggregately explain the questions of: (1) *"Do the banking risks and profitability influence on the capital adequacy level?"* and (2) *"In Vietnamese current framework, how should commercial banks improve the capital adequacy level to adapt with regulations?"*

3.2. Statistic Descriptive

The descriptive statistics for all variables are summarized as following table:

Table 1a: Descriptive statistics – all variables

	CAR	CPR	CR	ER	IR	LR	ATO	ROE	ROA
Mean	0.130583	1.768699	0.536691	0.136863	0.690902	0.214140	0.036499	0.164983	0.013429
Median	0.120900	1.722226	0.531941	0.136739	0.645954	0.183057	0.037761	0.150100	0.013250
Maximum	0.458900	5.161399	0.829032	0.414206	1.110227	0.490566	0.054023	0.365200	0.026800
Minimum	0.080000	0.971555	0.328605	0.064424	0.434056	0.021580	0.009734	0.006400	0.000700
Std. Dev.	0.055229	0.546425	0.124469	0.053819	0.171825	0.116813	0.010208	0.080965	0.006154
Observations	66	66	66	66	66	66	66	66	66

The descriptive statistics of these variables can be highlighted as follows. CAR *(Capital adequacy ratio)* variable reaches the highest value of 45.89% by Eximbank and has the lowest value of 8% by VIB during 6 years. CPR *(invested capital to risk-weighted assets ratio)* variable observes a range from 97% to 516% during the last six years, with 177% on average. CR *(Net loans to total assets ratio)* variable has a minimum value of 32.86% with ACB, a maximum value of 82.9% with BIDV in this period. In fact, Vietnamese banks only bear an average credit risk, at 53.67%. IR *(Interest rate sensitive assets to interest rate sensitive liabilities ratio)* variable varies from 43.4% of MBBank to 111% BIDV during a period of 2008 to 2013. LR *(liquid assets to deposits ratio)* variable fluctuates from 2.1% to 49%, with a mean of 21%. Of all these information, VIB stands at the highest rank, at averagely 49% and Eximbank takes the lowest one, at averagely 2.1%. ER (*Owner's equity risky assets ratio)* variable generally reaches a maximum value of 41.42%, drops to a minimum level at 6.4%, and takes the average amount of 13.68%. ROE *(Return on equity ratio)* observations range between 0.64% and 36.5%, with a mean of 16.49%. ATO *(Assets turnover ratio)* variable reaches its highest value, at 5.4%, and its lowest value, about 0.9%, with a mean and standard deviation of 3.64% and 1% respectively during last six years. ROA *(Return on assets ratio)* observations fluctuate from 0.07% to 2.68%, with a mean of 1.34%. On average, MBBank performs most efficiently, at 2.15% while VIB only earns 0.65% as its ROA.

Table 1b: Correlation matrix

Correlation	CAR	CPR	CR	ER	IR	LR	ATO	ROE	ROA
CAR	1.0000								
CPR	0.0261	1.0000							
CR	-0.1995	0.0787	1.0000						
ER	0.8357	-0.1423	-0.3713	1.0000					
IR	-0.1388	0.1865	0.9171	-0.3076	1.0000				
LR	-0.0232	0.0333	-0.1644	0.1762	-0.0535	1.0000			
ATO	0.0392	0.0326	0.2614	0.0783	0.3225	-0.0315	1.0000		
ROE	-0.4040	0.0431	-0.3229	-0.2774	-0.2552	-0.2866	0.0979	1.0000	
ROA	0.0102	-0.0664	-0.3919	0.2105	-0.2774	-0.2841	0.2272	0.8078	1.0000

As can be seen, the adequate capital *(CAR)* has positive relationship with capital risk *(CPR)*, owner's equity risky assets ratio *(ER)*, asset turnover *(ATO)*, and return on assets *(ROA)*. In contrast, the capital adequacy level inversely relates to credit risk *(CR)*, interest rate risks *(IR)*, liquidity risk *(LR)*, and return on equity *(ROE)*. In addition, from the correlation matrix, the negative correlation between ROE and risk factors, except capital risk, evidences the theory "high risk high return". Banks, which perform efficiently with high asset turnover indicator, tend to face high credit risk and interest rate risk. Besides, multi-colinearity issue might only occur between two couple of variables, namely credit risk CR and interest rate IR, and ROE and ROA, with the correlation of 91% and 80% respectively. However, the computations show the independent information between these two observations. The study also examines this error after running the regression model.

3.3. Regression analysis

The study would employ the regression on dependent variables based on three ways: Pooled Regression, Fixed Effect Model, and Random Effect Model. The first one is the simplest way for panel data regression. Theoretically, this regression presumes the average values and constant relationship among all variables, ignoring time and cross-section effects. The Fixed Effect Model (FEM) and Random Effect Model (REM) are taken into account for panel analysis. The former considers privately particular characteristics affecting independent variables. It also removes the time-invariant features to assess net effect of the explanatory variables. They are the reasons why FEM assumes that there exists no autocorrelation in the model. On the other hand, REM includes the time-invariant variables into its process. The variations across the entities here are presumed to be random and uncorrelated between errors and variables. Thus, autocorrelation is a serious problem that REM must deal with. Note that, is it generally believed that REM might exclude heteroscedasticity errors from the model. In this study, the study makes log transform of these variables to reduce heteroscedasticity probability. In order to examine which of these two models is more appropriate, the Correlated Random Effects – Haussmann Test is performed with the help of Eviews.

Regression analysis is used to explore the quantitative relationship between the dependent variable, **CAR**, and the independent variables including **CR, IR, CPR, LR, ER, ATO**, **ROE** and **ROA**. As mentioned above, the study performs both Fixed Effects Model (FEM) and Random Effects Model (REM), which show particular variables' relationship under two perspectives before suitability assessment. The table 2a and 2b below show the results of two-regression analysis.

Initial regression equations

Table 2a: Fixed Effect Mode - Regression Result			
Dependent Variable: **LOG(CAR)**			
Method: Panel Least Squares			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.234465	0.297711	0.787560	0.4349
LOG(CR)	0.056011	0.204666	0.273670	0.7855
LOG(IR)	0.198914	0.235310	0.845326	0.4022
LOG(CPR)	0.160401	0.054540	2.940961	**0.0051****
LOG(LR)	-0.011115	0.042713	-0.260217	0.7958
LOG(ER)	0.615252	0.124400	4.945749	**0.0000****
LOG(ATO)	0.163677	0.087457	1.871526	**0.0675***
LOG(ROE)	-0.376990	0.115711	-3.258036	**0.0021****
LOG(ROA)	0.278213	0.123962	2.244339	**0.0296****

Effects Specification		

Cross-section fixed (dummy variables)		

R-squared	**0.934494**	Mean dependent var	-2.091199
Adjusted R-squared	**0.909407**	S.D. dependent var	0.307222
S.E. of regression	0.092470	Akaike info criterion	-1.687620
Sum squared resid	0.401881	Schwarz criterion	-1.057265
Log likelihood	74.69146	Hannan-Quinn criter.	-1.438537
F-statistic	**37.24960**	**Durbin-Watson stat**	**2.326653**

** Significance at α = 5% confidence level; * Significance at α = 10 % confidence level

Table 2b: Random Effect Model - Regression Result			
Dependent Variable: **LOG(CAR)**			
Method: Panel EGLS (Cross-section random effects)			
Swamy and Arora estimator of compon nt variances			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.214904	0.256791	-0.836884	0.4062
LOG(CR)	-0.029528	0.185110	-0.159518	0.8738
LOG(IR)	0.159860	0.201124	0.794835	0.4300
LOG(CPR)	0.194768	0.053687	3.627833	**0.0006***
LOG(LR)	-0.025693	0.035930	-0.715088	0.4775
LOG(ER)	0.552724	0.113403	4.873966	**0.0000***
LOG(ATO)	0.070037	0.064301	1.089191	0.2807
LOG(ROE)	-0.433380	0.108710	-3.986586	**0.0002***
LOG(ROA)	0.327363	0.115229	2.840965	**0.0062***

Weighted Statistics		

R-squared	0.841233	Mean dependent var	-0.702973
Adjusted R-squared	0.818949	S.D. dependent var	0.237403
S.E. of regression	0.101015	Sum squared resid	0.581631
F-statistic	37.75195	Durbin-Watson stat	1.597370
Prob(F-statistic)	0.000000		

* Significance at α = 5% confidence level

Correlated Random Effects – Hausman Test is conducted to indicate which model is more appropriate by examining the following hypotheses:

H_0: *The random effects are uncorrelated with the explanatory variables (REM is preferred)*

H_A: *The random effects are correlated with the explanatory variables (FEM is preferred)*

Hence the rejection of H_0 hypothesis will favor the FEM.

The performed result is as follow:

Table 3: Correlated Random Effects – Hausman Test Result

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	19.021797	8	0.0147

As can be seen from the table 3, the p-value of cross-section random ($p \approx 0.0147$) is lower than level of significance ($\alpha = 0.05$), so the null hypothesis is not rejected. Hence, the study can conclude that the Fixed Effect Model is appropriate for this panel data at this stage.

Test of dropping insignificant variables

In general, based on the above result, the Fixed Effect Model is employed to analyze the relationship between CAR and its explanatory variables. Now, the insignificant variables, which include Credit risk (CR), Interest rate risks (IR), Liquidity risk (LR), and Asset turnover (ATO), are considered to be dropped out of the model with the support of the Wald Test for panel data. This test aims to examine the following hypotheses:

H_0: $C(2) = C(3) = C(5) = C(7) = 0$ *(All three variables should be dropped)*

H_A: *At least one coefficient is not equal zero (These variables should not be dropped)*

Table 4: Wald Test Result

Test Statistic	Value	df	Probability
F-statistic	1.894076	(4, 47)	0.1272
Chi-square	7.576303	4	0.1084

As can be seen from the table 4, the p-value of F-statistic ($p \approx 0.1272$) is higher than level of significance ($\alpha = 0.05$)

Since $p > \alpha$ ➔ There is *not enough evidence* to reject H_0.

Hence, the study can conclude that the *all four variables consisting of credit risk, interest rate risks, liquidity risk and asset turnover should be dropped* out of the model without affecting on other variables

New regression model

Since these steps indicate the insignificance of credit risks, interest rate risks, liquidity risk, and asset turnover, the model developing by Al-Tamimi (2013) seems to not effectively apply in Vietnamese situation. As a result, a new model between *capital adequacy level (CAR)* and its determinants which comprise of *capital risk (CPR), owner's equity risky assets ratio (ER)*, *return on equity (ROE)* and *return on assets (ROA)* is re-performed as the following equation:

$$CAR_{i,t} = \beta_1 + \beta_2 * CPR_{i,t} + \beta_3 * ER_{i,t} + \beta_4 * ROE_{i,t} + \beta_5 * ROA_{i,t} + \varepsilon_{i,t}$$

for bank i at period t

Similar to the previous model, the new one is regressed by **Pooled, REM**, and **FEM** with the results:

Table 5a: New Random Effects Model

Dependent Variable: LOG(CAR)

Method: Panel EGLS (Cross-section random effects)

Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.444755	0.156618	-2.839745	0.0061*
LOG(CPR)	0.217638	0.053705	4.052436	0.0001*
LOG(ER)	0.420565	0.089392	4.704717	0.0000*
LOG(ROE)	-0.546614	0.091417	-5.979336	0.0000*
LOG(ROA)	0.442218	0.094776	4.665949	0.0000*

Weighted Statistics

R-squared	0.820596	Mean dependent var	-0.921932
Adjusted R-squared	0.808832	S.D. dependent var	0.244638
S.E. of regression	0.106963	Sum squared resid	0.697903
F-statistic	69.75362	Durbin-Watson stat	1.424206

* Significance at α = 5% confidence level

Table 5b: New Fixed Effects Model

Dependent Variable: LOG(CAR)

Method: Panel Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.34967	0.168864	-2.070777	0.0435*
LOG (CPR)	0.162978	0.055239	2.950422	0.0048*
LOG(ER)	0.564869	0.109922	5.138834	0.0000*
LOG(ROE)	-0.459378	0.105829	-4.340772	0.0001*
LOG(ROA)	0.352214	0.111195	3.167528	0.0026*

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.923935	**Mean dependent var**	-2.091199
Adjusted R-squared	0.903054	**S.D. dependent var**	0.307222
S.E. of regression	0.095657	**Akaike info criterion**	-1.659380
Sum squared resid	0.466663	**Schwarz criterion**	-1.161731
Log likelihood	69.75954	**Hannan-Quinn criter.**	-1.462735
F-statistic	44.24833	**Durbin-Watson stat**	2.100334

* Significance at α = 5% confidence level

From the result, all four independent variables are significantly related to the CAR variables at α= 5% level. Now, the Correlated Random Effects – Hausman Test is employed to decide which model between REM and FEM is more appropriate through testing the hypotheses:

H_0: The random effects are uncorrelated with the explanatory variables (REM is preferred)

H_A: The random effects are correlated with the explanatory variables (FEM is preferred)

Table 6: Correlated Random Effects – Hausman Test for new model result

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	19.271426	4	0.0007

As can be seen from the table, the p value of cross-section random is 0.0007, which is lower than level of significance ($\alpha = 0.05$), there is ***enough evidence*** to reject H_0.

As conclusion, the Correlated Random Effects – Hausman Test indicates that FEM is preferred to REM, means the FEM is our final model, which is reported as follows:

Estimated LOG(CAR) = -0.35 + 0.16*LOG(CPR) + 0.56*LOG(ER) – 0.46*LOG(ROE) + 0.35*LOG(ROA)

R^2 = **92.39%,** where variables are *capital adequacy level (CAR), capital risk (CPR), owner's equity risky assets ratio (ER), return on equity (ROE)* and *return on assets (ROA)*

Interpretation of coefficients

After careful considering the model, the study examines the relationship between dependent variable CAR and its independent variables through the regression and T-test. The R^2 of 92.39% reveals the good fit of the regression equation. It means that the 92.39% of dependent variables can be explained by independent variables. In a light of these results, which are summarized in the table 5b, holding other variables constant:

- The statistical analysis reveals the ***significantly positive correlation between capital adequacy level CAR and capital risk CPR***, particularly, when the capital risk increases by 1%, the banks' capital adequacy level will grows by 0.16% on average. The p value $\approx$ 0.00 which is remarkably smaller than $\alpha = 0.05$ level shows the significant effect of capital risk on capital adequacy.

- The regression result shows the ***significantly positive relationship between capital adequacy level CAR and owner's equity risky assets ER.*** The owner's equity risky assets ratio variable takes the strongest influence on the degree of adequate capital. In fact, capital level is expected to increase by 0.56% on average, if the owner's equity risky assets ratio grows by 1%, holding other variables constant. Since the p value $\approx$ 0.00, this effect on capital level is significant at $\alpha = 0.05$ level.

- The empirical result indicates the ***significantly negative relationship between capital adequacy level CAR and return on equity ROE.*** Particularly, the p value $\approx$ 0.00 which is smaller than $\alpha = 0.05$ supports the study to reject the null hypothesis. It means that, this profitability indicator directly affects the level of banks capital. In other words, since the return on equity drops by 1%, the banks' capital level will experience an increase by 0.46% on average, holding other variables constant.

- The regression analysis proves the ***significantly positive relationship between capital adequacy level CAR and return on assets ROA.*** The p value $\approx$ 0.00 which is much smaller than $\alpha = 0.05$ level supports the study to reject the null hypothesis. In detailed, the banks' capital is expected to rise by 0.35% on average, if the return on assets increases by 1%, holding other variables constant.

In summary, while capital risk, owner's equity risky assets, and return on assets take positive effects on degree of banks' capital adequacy, the return on equity inversely influence on banks'

capital level. In contrast, credit risk, interest rate risk, liquidity risk and asset turnover factors unclearly affect capital adequacy level of banks.

4. Conclusion and discussion of the findings

Firstly, the capital risk is positively statistically significant to the degree of capital adequacy. However, this is contrary to the insignificance of Al-Tamimi (2013) research on Jordan banks. It might derive from the difference in Jordanian and Vietnamese banking sector's situations. Recall from the capital risk variable assessment, the ratio fluctuates in a high range during the last 6 years, illustrating the unstable environment of Vietnamese banking industry. The appropriate reasons for this issue might be the different risk management approach under competition and Government pressure, and the bank's capital withdrawn trend by giant corporations. These activities directly affect both invested capital and risk, which reasonably leads to a large change in capital risk. On the other hand, the Jordanian banking sector seems to be stable for a long time.

Based on the final regression model, since a bank follows a riskier investment portfolio for earnings, it generally faces a higher level of capital risk due to the increase in risk-weighted asset. The capital risk ratio, therefore, rationally decreases, which is followed by the capital adequacy ratio. Then, the commercial bank has incentives to raise equity or spend much more retained earnings on covering this risk to protect depositors' rights. The capital amount growth might make a contribution to invested capital as well as Tier 1 (Core) Capital, which are stipulated in the Circular 13 by SBV. Therefore, in capital risk controlling efforts, the Vietnamese commercial banks also strengthen their adequate capital level. In other word, the higher the degree of capital adequacy, the more safely banks might be able to deal with capital risk.

Secondly, owner's equity risky assets ratio has illustrated to be statistically significant for level of adequate capital. The data shows that owner's equity risky assets have a positive relation with the bank capital, which complies with previous findings by Al-Tamimi (2013). This indicator pays much attention on function of owner equity towards depositors in case of bankruptcy. When the risks are considered to increase for some reasons, banks tend to adjust their risky project to a reasonable level, lowering the degree of capital adequacy. As a result, the increase in owner's equity risky assets ratio enhances the banks' capital adequacy ratio.

However, return on equity is statistically significant at 95% confidence level for capital adequacy ratio. This result shows a negative correlation between return on equity and the degree of capital adequacy, which is similar to the findings of Al-Tamimi (2013). However, it is contradict to the positive relation between capital adequacy and profitability, which was suggested by Kosmidou (2008), Ben Naceur (2003), Valverde and Fernandez (2007), Brock and Suarez (2000), and Saunders and Schumacher (2000). As cited in previous literature sections, the equity level directly influences on the profitability of banks. In order to adapt SBV's safety and soundness regulations, Vietnamese banks are forced to increase their capital amount or reduce the level of risk assets. Since the cost of equity is much higher than cost of debt, the former drives the average cost to increase, reducing the net profit. On the other hand, the latter one decreases the probability of abnormal returns, directly declining the earning ability. Therefore, arise of capital ratio makes the return on equity lower.

Finally, the empirical findings for return on assets show that it has a positively significant effect at 95% confidence level for the capital adequacy, proving the same conclusion with Al-Tamimi (2013). Return on assets represents how effectively the banks are taking earnings advantage of

its base of assets. According to the formula, banks might enhance this indicator by increase in profit or decrease in total assets. While the latter option is unrealistic because of its negative signal about banks performance, the former seems to be a good choice for them. In general, thanks to low funding cost, banks often rely mainly on retained earnings to increase capital. Hence, if banks operate profitably, they would probably spend an amount of retained earnings for capital, which raises the banks' capital level. This empirical outcome is also similar to Gropp and Heider (2007). Besides, ROA and the capital ratio are most likely positively correlated because banks are expected to increase asset risk in order to get higher returns (Jeitschko and Jeung, 2007).

As per study findings, the interaction between the degree of adequate capital and the risk and profitability factors is proven to be statistically significant. In order to maintain safety and soundness, banks might upgrade their equity buffer, which is reflected in higher capital adequacy ratio. As mentioned above, this activity simultaneous makes capital risk ratio and owner's equity risky assets ratio higher. It sounds appropriate for banks managers to reduce risk factors, strengthening the banks' security level. In fact, there are several ways to attract external capital for banks, such as equity issuance, valued certificates issuance. However, valued certificates issuance temporarily support banks in raising their capital amount. At maturity, banks have to make payment for certificates holders, which might reduce their capital. Besides, many Vietnamese small commercial banks receive investments from other banks or financial institutions to enhance their adequate capital level. This cross owning phenomena would help small banks raise the capital adequacy ratio to adapt the regulations, but, do not increase the capital of the whole banking system. Therefore, this indicator is unable to illustrate the banks real situation. It is the reason why some poorly performed banks still reports a high capital adequacy ratio.

In contrast, banks should concentrate on investing in lower risky projects, developing an effective internal control system with clear policies and procedures. This option seems to be suitable for banks. A good risk controlling might save a large amount of losses for banks, reducing the risk taking. The capital risk and owner equity risks, in turn, declines. Consequently, the higher capital adequacy level derives from lower risky investment, which more accurately illustrates real banks' situation. Since this ratio is trusted, the State Bank of Vietnam (SBV)'s regulations become more closely appropriate in the sector supervision.

In addition, banks can improve their operations system to reinforce their revenues earning and costs saving as well. By this way, the increase in banks' profit creates a larger amount of retained earnings spending for capital funding. The leverage optimization should be considered because it indicates the relationship between return on assets and return on equity, which determines the overall cost of banks' capital. Obviously, this trade-off between profitability and safety needs precisely taking into banks' account.

Finally, regarding the implementation of Basel III, both the SBV and commercial banks might apply newly useful information to the Vietnamese practice. In term of adequacy capital, Vietnamese commercial banks should set up a detailed capital raising roadmap with effective investment plans for sustainable development, considering good strategic partners, which already successfully apply Basel Accords, to improve their brands and images. They should prepare a healthy financial position and take an adequate leverage in unstable environment for Basel III application. In addition, they also establish good plans for the efficient merger and acquisition activities. On the other hand, the SBV should consider a suitable period to entirely apply Basel II and Basel III into the banking industry. The banks classification procedure and capital adequacy

formula should be taken into account. Next, the SBV enhances supervisory activities to protect the banks' shareholders' right. Last but not least, conducting theoretical researches about effects of a bank's default on financial sector and the whole economy as well might facilitate the SBV's decision towards unhealthy commercial banks.

In term of future research opportunity, the research interests to specify and compare the different type of banks, which consist of former state-owned commercial banks, joint-stock commercial banks, joint-venture banks, and financial companies, in order to investigate whether type affects the decision of setting this capital level. Another direction for further research on this topic is to work on the simultaneous equation examines the relationship between risk and capital regulation as seen in the paper of Shrieves and Dahl (1992).

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