Journal of International Economics and Management
Journal homepage: http://jiem.ftu.edu.vn

Factors affecting capital adequacy ratio of joint-stock commercial banks in Vietnam

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Received: 16 July 2021; **Revised:** 17 January 2022; **Accepted:** 21 January 2022
https://doi.org/10.38203/jiem.022.1.0041

Abstract

This paper aims to empirically examine the factors affecting the capital adequacy ratio by using the data collected from the audited financial statements of 24 joint-stock commercial banks in Vietnam over the period from 2009 to 2019 and adopting the generalized least squares estimation method. The results show that financial leverage, deposits from clients, loans to customers, liquidity, and profitability negatively affect the capital adequacy ratio. In addition, the paper also recognizes that the difference between the actual capital adequacy ratio and the prescribed minimum ones can be explained by the negative influence of bank size, financial leverage, loans to customers, liquidity, and profitability. The study provides empirical evidence and useful information for bank managers to make rational decisions in maintaining and adjusting their level of capital adequacy.

Keywords: Capital adequacy ratio, Commercial banks, Factors

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1. Introduction

Capital adequacy ratio (CAR) is one of the essential measures indicating the level of safety in business activities of commercial banks. According to Basel II, all risks must be quantified by a specific number, which will indicate how much capital a bank needs to be able to cover its risks. In other words, any bank which can guarantee this rate can create a buffer against financial shocks to protect itself and its customers. Along with the restructuring process of the banking system in Vietnam in the context of regional and global economic integration, the requirement to ensure operational safety according to international standards is becoming more urgent. Statistics of the State Bank of Vietnam (2020) illustrate that as of 31 December 2019, the total assets of the entire system of credit institutions increased by 13.69% to reach 12.58 million billion VND. The capital equity increased by 13.10% to 911,731 billion VND. The minimum CAR increased to 11.95% from 11.57% in 2018. The minimum CAR of commercial banks controlled by the State was 10.19% by the end of 2019, which was higher than that at the end of 2018. The minimum CAR of the commercial banks, which are not controlled by the State at the end of 2019 was 10.52%, which was lower than that at the end of 2018. Commercial banks usually had their minimum CARs lower than those of other types of credit institutions. For example, by the end of 2019 and 2018, the CARs of joint-venture and foreign banks were 24.07% and 23.53%, respectively. The CARs of financial companies and financial leasing companies were 17.89% and 19.68%, respectively. The CARs of cooperative banks were 19.46% and 18.68%, respectively (The State Bank of Vietnam, 2020).

However, from the perspective of financial management, the commercial banks have to face a trade-off between return and risk; this again requires the bank managers to balance factors to maintain the CAR while ensuring compliance with regulations and achieving profitability targets. Accordingly, the arising question is about what factors Vietnamese joint-stock commercial banks can base to maintain their CAR. Our study will find the answer to this question. The results of the study provide useful information in adjusting the ratio in accordance with the characteristics of commercial banks as well as the requirements of the State Bank of Vietnam.

To answer the above research question, we used the data of 24 joint-stock commercial banks in Vietnam in the period from 2009 to 2019. The estimation results for panel data show that financial leverage, deposits from clients, loans to customers, liquidity, and profitability negatively affect the CAR. In addition, we also find that the difference between the actual CAR and the prescribed minimum ones can be explained by the negative effect of bank size, financial leverage, loans to customers, liquidity, and profitability.

The remaining of this paper is structured in four sections. Section 2 presents the literature review. Section 3 suggests the methodology. Section 4 analyzes the research results and presents the discussion based on these results. Section 5 concludes the paper.

2. Literature review

CAR is a financial indicator illustrating a bank's financial ability to withstand risks (Claessens, 2010). Therefore, this ratio is not only of interest among commercial bank managers but also

used by the State Bank, bank stock investors, and many other entities. CAR can be explained by many factors. Within the scope of this study, the characteristic elements of commercial banks will be considered.

The first element is bank size, which is one of the most common determinants of CAR in the existing literature. The signaling theory (Akerlof, 1970) states that bank size is proportional to CAR. An expansion of a bank will bring positive signals and create motivations for the bank to increase and diversify its asset portfolio. Many different methods of mobilization are also easily implemented, which increases liquidity and reduces risks for the bank. Keqa (2021), Kasmadi *et al.* (2017), and Workneh (2014) provide empirical evidence that bank size is positively related to CAR.

However, the too big to fail theory (Stern and Feldman, 2004) recommends that large banks tend to take on excessive risks by allocating more capital to risky assets with the expectation of increasing profits, leading to increased risks to their asset portfolios. A wide range of studies indicates an inverse relationship between bank size and CAR. Larger banks tend to have smaller CAR. For example, Hewaidy and Alyousef (2018) employed the data from all Kuwaiti listed banks in the period from 2009 to 2016 to examine determinants of CAR. The authors confirm that bank size has a significant impact on CAR. This outcome is also in accordance with the previous results of Alajmi and Alqasem (2015), who find that Kuwaiti bank size and return on assets (ROA) have significant negative relationships with CAR. More recently, Unvan (2020) also argues that the growth of banks is related to a reduction of the bank CAR when using the system generalized method of moments technique with data for commercial banks in Ghana in the period from 2008 to 2017. Usman *et al.* (2019) conducted a study on CAR with the data of 27 banks that have been listed on the Indonesia Stock Exchange and reveal that banks' capital adequacy level is significantly driven by bank size, leverage, loan loss reserve, net interest margin, and loan asset ratio. Larger banks often have a high level of security because they have capital large enough to bear any risky assets. This result supports previous studies in emerging countries such as Aktas *et al.* (2015), Vo *et al.* (2014), El-Ansary and Hafez (2015), and Bateni *et al.* (2014). It is likely that when larger banks preserve overtime flexibility, lower capital adequacy may not necessarily affect their operations. Moreover, larger banks can access capital market funds quickly and at lower transaction costs. Therefore, the sum of resources that larger banks hold can be overlooked. However, Masood and Ansari (2016), Pham and Nguyen (2017), and Vu and Dang (2020) do not find any evidence showing a statistically significant relationship between bank size and CAR.

The second factor is the loan-loss reserve. Thakor (1987) argues that the extent of the reserve provides information about the bank asset's quality and signals future performance changes. According to the income smoothing theory, the banks that operate favorably with higher profits will tend to increase their provisions for risks to make up for unfavorable periods and low profits. Such adjustments to loan-loss reserve can change the CAR. From the empirical evidence perspective, many studies find a correlation between loan-loss reserve and

CAR. The impact direction is still arguable. For instance, Masood and Ansari (2016) gathered data of Pakistani commercial banks for the period from 2008 to 2014 to investigate the factors that affect the CAR. They employed the random effect model and conclude that along with equity asset ratio, deposit asset ratio, the loan-loss reserve had a significant and positive impact on CAR. The positive relationship implies that the capital base of credit institutions is strengthened by the number of provisions the bank holds. Likewise, obtaining data from Turkish banks' annual reports for the period of 2006-2010, Buyuksalvarci and Abdioglu (2011) indicate that loan-loss reserve and ROA positively influence CAR. They suppose that the loan-loss reverses held by banks may act as a buffer against the delinquent advances. In general, the loan-loss reserve is expected to have positive impact on CAR. However, it is not true in some cases. In the Vietnam banking system, Pham and Nguyen (2017) show that the relationship between loan loss reserve and CAR is significantly negative, at least for the research period from 2011 to 2015. Vu and Dang (2020) use data of Vietnamese banks for the period from 2011 to 2018 and they also assert that loan-loss reserve has a negative impact on CAR. The authors explain that loan-loss reserves can be considered as a proxy for bank risks as they could indicate the financial health of banks. When a bank suffers from losses in lending, it has to set aside reserves from its earnings, and its equity if earnings are not enough to pay for the reserves, which will reduce its capital. Therefore, a negative relationship between loan loss reserves and the CAR is to show the financial difficulties that a bank could face. These results are in line with the findings of Usman *et al.* (2019) and Workneh (2014). Banks with a larger loan-loss reserve will cause a decrease in its value. If it continues to increase beyond the optimal level, it will reduce the CAR. Besides, El-Ansary and Hafez (2015) find that loan-loss reserve does not appear to have a significant effect on CAR. They explain that Egyptian banks consider reserves as a part of equity part to meet the non-performing loans. They do not consider reserves for loan losses when they are justifying CAR according to the regulations of the Egypt Central Bank.

The third element is banks' liquidity. Liquidity is a bank's ability to finance an increase in assets and to willingly meet its payment obligations due without incurring unacceptable losses (Basel Committee on Bank Supervision, 2008). Diamond and Rajan (2000) argue that banks can change their asset portfolio to create liquidity, which affects CAR. Most scholars agree that the effect of liquidity on capital is positive. The banks with a high level of liquidity can reduce their capital while increasing their risks. However, banks often retain liquidity as a form of self-insurance against liquidity shocks. High levels of liquidity may expose banks, especially small ones, to risk-taking. Therefore, it requires the capital of banks to increase to regulate risk-taking. Al-Tamimi and Obeidat (2013) show a direct relationship between liquidity risk and commercial banks' capital adequacy. They also add that a high level of liquidity means higher profits which can be added as retained earnings to the level of capital. Hence, the capital level will increase. El-Ansary and Hafez (2015) compared the impact of banks' specific characteristics on Egyptian banks' CAR before and after the period. They show that in the after-crisis period from 2009 to 2013, along with asset quality, size, credit risk, liquidity are the most significant variable that explains the variance of banks'

CAR. Likewise, Aktas *et al.* (2015) show that among the bank dimensional explanatory variables, bank size, ROA, leverage, and liquidity have statistically significant effects in determining CAR for 71 commercial banks in 10 South-Eastern European countries for the period from 2007 to 2012. These scholars also explain that according to the pecking order theory, a bank with higher liquid assets does not need to borrow and hold a higher degree of equity. Correspondingly, Workneh (2014) used 12 years of banks' data from 2002 to 2013 in Ethiopia and confirms that an increase in the proportion of capital in the form of cash or cash equivalents will reduce liquidity risk, and increase CAR. Keqa (2021) suggests that high levels of liquidity lead to increased CAR in order to control for the risks of banks in the Western Balkan region. In contrast, a few studies have figured out the negative effect of liquidity on CAR. The commercial banks that hold too many highly liquid assets will lose opportunities to return yields on assets and reduce capital accumulation, whereby CAR decreases (Hewaidy & Alyousef, 2018; Shingjergji & Hyseni, 2014). Hewaidy and Alyousef (2018) also conclude that such contradiction with previous studies might be explained by the dividends policy adopted by the bank.

The fourth element is profitability. As known to all, potential return rises with an increase in risk. By the same token, bank profit might increase along with the rise in the level of risky assets (Berger and DeYoung, 1997), which can reduce CAR. Keynes's theory of liquidity preference also suggests that "if a man hoards his savings in cash, he earns no interest, though he saves just as much as before. On the contrary, the mere definition of the rate of interest tells us in so many words that the rate of interest is the reward for parting with liquidity for a specified period" (Keynes, 1936). In other words, cash does not bring profits. Therefore, from the perspective of financial management, commercial banks will use the money for making profits by lending to customers or performing other profitable asset transactions. As a result, there exists a negative relationship between profitability and CAR.

Nevertheless, empirical studies have produced inconsistent outcomes. Some studies show a negative relationship between CAR and profitability. For example, Al-Tamimi and Obeidat (2013) studied determinants of the capital adequacy of commercial banks of Jordan in the Amman Stock Exchange for the period from 2000 to 2008. They affirm that there is an inverse relationship with statistical significance between the degree of capital adequacy of commercial banks and the rate of return on equity (ROE). In the same way, with the random effect model, Alajmi and Alqasem (2015) indicate that conventional Kuwaiti banks' CAR is adversely affected by ROA. Bokhari *et al.* (2012) also find a significant and negative relationship between Pakistan commercial banks' CAR meanwhile ROE does not appear to have significant effects on CAR. Bateni *et al.* (2014) find a significant and positive relationship between ROA and CARs but a negative relationship between ROE and CAR when they studied factors over capital adequacy in Iranian private banks for the period from 2006 to 2012. Vu and Dang (2020) identify the factors that significantly affect the CAR of Vietnamese commercial banks for the period from 2011 to 2018. They indicate that ROE has a negative impact and ROA has a positive impact on the CAR.

Some studies suggest a positive relationship between CAR and profitability. This relation was defended by the fact that different firms select to finance their operations depending on retained earnings rather than external and more exclusive financial supporting methods. A higher return also makes a bank more attractive in raising capital. El-Ansary and Hafez (2015) utilized data from 36 Egyptian commercial banks during the period from 2004 to 2013 to examine the determinants of CAR. They figure out that ROA of banks is significantly correlated positively with the CAR. They argue that when the Egyptian banks' ROA increases due to the increase in the portfolio of loans and assets, banks have to increase the CAR to match the associated risk. The rise of ROA is primarily due to the increase in the credit portfolio. However, this positive effect of ROA over CAR is statistically significant only before the 2008 financial crisis. Similarly, Keqa (2021) finds a strong positive relationship between capital and profitability that is measured by ROA and ROE for the banks in the Western Balkan region during the period from 2010 to 2018. Berger (1995) suggests that the banks with low profitability usually focus on increasing profits. They will invest in asset portfolios with high risks, leading to a decrease in CAR. If banks have high profitability, they can still focus on safety and limit risks to protect their achievements, and avoid the risk of default. In addition, the improvement in their profitability will help banks increase the ability to accumulate capital from internal resources, whereby CAR increases. The positive relationship between profitability and CAR is also confirmed by the empirical studies of Aktas *et al.* (2015) and Dreca (2013). In short, if capital requirements are necessary, the relationship between profitability and controlled capital will not be meaningful or positive and banks will retain more capital and become less profitable. As a result, the predicted sign of this variable's coefficient can be either positive or negative.

Besides, few research results raise a question about the sustainable relationship between bank profitability and CAR when the statistical significance of banks' ROE or ROA on CAR is not found (Hewaidy and Alyousef, 2018; Masood and Ansari, 2016; Unvan, 2020).

The fifth element is financial leverage. Functioning as a financial intermediary in nature, financial leverage is essential for commercial banks. Aktas *et al.* (2015), Vu and Dang (2020), and Unvan (2020) provide empirical evidence showing that financial leverage has an inverse relationship with CAR. More specifically, CAR can be lower when banks increase debts in the capital structure and then face additional risks leading to an increase in the cost of capital as well as the return required by owners and creating a barrier to increasing equity. However, Usman *et al.* (2019) and Workneh (2014) show that this relationship is positive because specialization allows banks to ensure the effectiveness of financial leverage, thereby amplifying the profit increase when financial leverage is higher, and improving the opportunity to accumulate a capital from internal resources, whereby CAR will increase. In addition, another assertion supported by studies of Vo *et al.* (2014) and Pham and Nguyen (2017) is that financial leverage is not statistically significant enough to explain CAR.

The sixth element is customer deposit. Deposits from customers usually account for the main proportion of capital at commercial banks. An increase in deposits proves that banks as financial

intermediaries have implemented the right capital mobilization strategies and their brands have been affirmed through trust and choice of customers. Masood and Ansari (2016) and Workneh (2014) show that customer deposits can explain the similar direction of CAR. If commercial banks have a larger customer deposit size, the bank's performance will be more strictly controlled to ensure its financial efficiency and its depositors' benefits, thereby increasing CAR.

In contrast, Vo *et al.* (2014) and Dreca (2013) argue that customer deposits have a negative effect on CAR. Along with an increase in customer deposits, commercial banks often have to raise their capital use to increase profitable assets to effectively achieve financial goals. As a result, they have to face additional risks and decrease CAR. Meanwhile, Bateni *et al.* (2014) and Vu and Dang (2020) present empirical evidence showing that the relationship between customer deposits and CAR does not guarantee statistical significance.

The final element is loaning to customers. Loans to customers are one of the risky asset items, often accounting for a major proportion in the portfolio of assets that are expected to bring interest income to commercial banks and improve CAR. From a different perspective, the higher total loans outstanding, the more risky a bank may be to default. That is a pressure for CAR to diminish. Some empirical studies on the issue have come to inconsistent conclusions. Bateni *et al.* (2014) show that customer loan size has a positive relationship with CAR. They argue that when interest income grows because of the increase in loans, banks have a high incentive to provide protection for the owner's capital.

Meanwhile, Dreca (2013) supports the opposite argument by saying that banks increasing lending to customers will lower the level of safety. They may have to accept higher risks from customer credit when expanding loans and CAR may reduce. In the study of Dreca (2013), loans to customer have a negative effect on CAR. Similarly, Pham and Nguyen (2017) and Than and Nguyen (2015) assert that the increase of outstanding loans to asset ratio determines the reduction of CAR in the Vietnamese banking system. Massood and Ansari (2016) and Usman *et al*. (2019) confirm that credit had a negative impact on CAR in the case of Pakistan and Indonesian banking system, respectively.

Alternatively, a wide range of studies in developing countries such as Alajmi and Alqasem (2015) in Kuwait, El-Ansary and Hafez (2015) in Egypt, Keqa (2021) in Western Balkan countries, Vu and Dang (2020) in Vietnam show evidence that no statistical significance can be guaranteed when considering the effects of customer loans on CAR.

3. Methodology

3.1 Sample selection

According to the purposive sampling method, we decided to study 24 joint-stock commercial banks in Vietnam. The names of these banks are presented in Table 1. Data were collected for 11 years from 2009 to 2019. After the global crisis in 2008, the banking system has gradually recovered and reached certain stability. Audited financial reports have also been provided sufficiently and continuously.

Table 1. Joint-stock commercial banks in Vietnam in the research

No	Full name of banks	No	Full name of banks
1	An Binh Commercial Joint Stock Bank	13	National Citizen Commercial Banks
2	Asia Commercial Joint Stock Bank	14	Orient Commercial Joint Stock Bank
3	Bank for Investment and Development of Vietnam	15	Petrolimex Group Commercial Joint-stock bank
4	Vietnam Joint Stock Commercial Bank for Industry and Trade	16	Southeast Asia Commercial Joint Stock Bank
5	Vietnam Commercial Joint Stock Export-Import Bank	17	Saigon Bank for Industry and Trade
6	Viet Capital Bank	18	Sai Gon - Ha Noi Commercial Joint Stock Bank
7	Ho Chi Minh City Development Joint Stock Commercial Bank	19	Saigon Thuong Tin Commercial Joint Stock Bank
8	Kien Long Commercial Joint Stock Bank	20	Vietnam Technological and Commercial Joint Stock Bank
9	LienViet Post Joint Stock Commercial Bank	21	Tien Phong Commercial Joint Stock Bank
10	Military Commercial Joint Stock Bank	22	Joint Stock Commercial Bank for Foreign Trade of Vietnam
11	Vietnam Maritime Commercial Joint Stock Bank	23	Vietnam International Commercial Joint Stock Bank
12	Nam A Commercial Joint Stock Bank	24	Vietnam Prosperity Joint Stock Commercial Bank

Source: The authors' compilation

The quantitative methods are employed in this study. The data processing techniques are as follows: descriptive statistics, correlation analysis, and panel data regression with pooled regression model (POLS), fixed effects model (FEM), and random effects model (REM). The study continues to use the Hausman test to choose between FEM and REM, the redundant fixed effects test to choose between FEM and POLS, the Breusch-Pagan test in the Lagrange multiplier group to choose between REM and POLS. However, the model has the problem of heteroskedasticity through White's test, so the generalized least squares (GLS) method will be used to overcome the obstacle to ensure the robustness of the estimated results.

3.2 Model specification

From the review of theories and empirical evidence in Section 2, the initial research model is built with capital adequacy ratio (CAR) as the dependent variable and bank size (SIZE), leverage (LEV), loan-loss reserve (LLR), customer deposits (DEP), loans to customers (LOA), liquidity (LIQ), and profitability (PROF) as the independent variables. The regression equation is as follows:

$$CAR_{i,t} = \beta_0 + \beta_1*SIZE_{i,t} + \beta_2*LEV_{i,t} + \beta_3*LLR_{i,t} + \beta_4*DEP_{i,t} + \beta_5*LOA_{i,t} + \beta_6*LIQ_{i,t} + \beta_7*PROF_{i,t} + \varepsilon_{i,t}$$

where i denotes the bank, t represents the year.

Table 2 presents how to measure and the expected signs of the regression coefficients of the variables in the research on factors affecting the CAR of joint-stock commercial banks in Vietnam.

Table 2. Measurements and variable sign expectations

Variable	Measurement	Expected sign and sources Sign	
CAR	$CAR = \frac{\text{Tier 1 capital \& Tier 2 capital}}{\text{Risk-adjusted total assets}}$		
SIZE	Natural logarithm of total assets	–	Hewaidy and Alyousef (2018), Unvan (2020), Usman *et al.* (2019), Aktas *et al.* (2015), Alajmi and Alqasem (2015), El-Ansary and Hafez (2015), Bateni *et al.* (2014), Dreca (2013), Vo *et al.* (2014), Than and Nguyen (2015)
LEV	$\text{Debt ratio} = \frac{\text{Debt}}{\text{Total assets}}$	–	Aktas *et al.* (2015), Vu and Dang (2020), Unvan (2020)
LLR	$\text{Provision ratio for credit risk} = \frac{\text{Provision for credit risks}}{\text{Customer Loan Balance}}$	–	Vu and Dang (2020), Hewaidy and Alyousef (2018), Pham and Nguyen (2017), Usman *et al.* (2019), Workneh (2014)
DEP	$\text{Customer deposit rate} = \frac{\text{Customer Deposit Balance}}{\text{Total assets}}$	+	Masood and Ansari (2016), Workneh (2014)
LOA	$\text{Customer loan rate} = \frac{\text{Customer Loan Balance}}{\text{Total assets}}$	–	Dreca (2013), Alajmi and Alqasem (2015), Masood and Ansari (2016), Pham and Nguyen (2017), Usman *et al.* (2019), Than and Nguyen (2015)
LIQ	$\text{Liquid asset ratio} = \frac{\text{Liquid assets}}{\text{Total assets}}$	+	Al-Tamimi and Obeidat (2013), El-Ansary and Hafez (2015), Vo *et al.* (2014), Keqa (2021), Aktas *et al.* (2015), Workneh (2014)
PROF	$\text{Return on equity} = \frac{\text{Net profit}}{\text{Average Equity}}$	+	Dreca (2013), Aktas *et al*. (2015)

Source: The authors' compilation

Decision No. 457/2005/QD-NHNN on CAR, which is issued by the State Bank of Vietnam, requires commercial banks to achieve at least 8%. Then, with lessons learned from

the crisis, which led to the prolonged recession and the collapse of many big banks in the world, combined with the practice of providing credit focusing on real estate and securities at commercial banks in Vietnam, the State Bank of Vietnam adjusted the minimum CAR to 9%, which is specified in Circular No. 13/2010/TT-NHNN. Effective from 01 January 2020, Circular No. 41/2016/TT-NHNN requires commercial banks to maintain a minimum level of 8%. Currently, according to Circular 23/2020/TT-NHNN, which is effective from 14 February 2021, the required ratio must be at least 9%. Therefore, joint-stock commercial banks in Vietnam do not only have to maintain and adjust the CAR in line with their strategies and financial goals set based on their characteristics and the general business environment, but also have to meet the regulations of the State Bank. This study is, therefore, more extensive than previous relevant empirical studies. It does not only test the model mentioned above but also identifies the abilities of the factors to explain the difference between the actual CARs of commercial banks and the minimum CAR required. The specific model is as follows:

$$DCAR_{i,t} = \beta_0 + \beta_1*SIZE_{i,t} + \beta_2*LEV_{i,t} + \beta_3*LLR_{i,t} + \beta_4*DEP_{i,t} + \beta_5*LOA_{i,t} + \beta_6*LIQ_{i,t} + \beta_7*PROF_{i,t} + \varepsilon_{i,t}.$$

The dependent variable of the supplementary model is DCAR, which is calculated by reducing the actual CAR by 8% or 9% depending on the year according to the regulations mentioned above. The calculation and the sign expectation of the independent variables are similar to those in the model with the dependent variable CAR.

4. Research results and discussion

4.1 Descriptive statistics

The results of descriptive statistics for the variables are summarized in Table 3 with balanced panel data and 264 observations for each of the variables.

Table 3. Descriptive statistics of variables

Variable	Mean	Max	Min	Standard deviation	Number of observations
CAR	0.1472	0.5492	0.0755	0.0618	264
DCAR	0.0581	0.4592	-0.0098	0.0622	264
SIZE	7.9399	9.1466	6.5236	0.5295	264
LEV	0.9001	0.9589	0.6764	0.0472	264
LLR	0.0129	0.0327	0.0051	0.0047	264
DEP	0.6219	0.8856	0.2667	0.1214	264
LOA	0.5393	0.8259	0.1942	0.1312	264
LIQ	0.1940	0.6104	0.0441	0.0936	264
PROF	0.1075	0.2920	-0.5633	0.0847	264

Source: The authors' calculation

According to Table 3, the average dependent variable CAR is 14.72%, which is higher than the minimum ratio prescribed by the Basel Committee and the State Bank of Vietnam. The lowest level, which is 7.55%, belongs to the Joint Stock Commercial Bank for Investment and Development of Vietnam in 2009. The highest level, which is 54.92%, is of the Vietcapital Commercial Joint Stock Bank in 2010. When comparing with the minimum CAR prescribed, DCAR is statistically shown to be 5.81% higher on average. About 45.92% max. 3 out of 264 observations show negative differences, but these are insignificant. The actual CAR is at most 0.98%, which is lower than the minimum CAR prescribed.

Regarding the independent variables in Table 3, SIZE shows the diversity of bank size. LEV confirms the appropriateness of the capital structure of commercial banks. LLR indicates that banks accept credit risks in lending to different extents. DEP shows that customers' deposits account for the largest proportion of total capital, which is consistent with the financial intermediary function as well as the specifics of the banking business. LOA shows that the asset structure of banks is focused on loans with the expectation of bringing in interest income. LIQ indicates the liquidity inequality of banks. PROF shows that banks ensure the ability to generate profit after tax for shareholders and create an important premise for capital accumulation and increase in a solid financial capacity.

4.2 Correlation matrix and variance inflation factor

The correlation coefficient matrix between variables and variance inflation factors (VIFs) are summarized in Table 4, including the correlation between the dependent variables CAR, DCAR, and the independent variables SIZE, LEV, LLR, DEP, LOA, LIQ, and PROF, and the correlation between independent variables.

According to Table 4, the correlation coefficients between CAR and DCAR and all the independent variables have statistical significance. The negative correlation is strongest with LEV and weakest with LLR. The only positive correlation is with LIQ. The results of this correlation analysis show that the volatility of CAR and the difference between the actual CAR and the minimum CAR required are inversely related to the fluctuations of bank size, financial leverage, customer deposits, customer loans, and profitability, but fluctuate in the same direction as bank liquidity.

Table 4. Correlation matrix and variance inflation factor

Variable	CAR	DCAR	SIZE	LEV	LLR	DEP	LOA	LIQ	PROF
SIZE	-0.6066***	-0.6163***	1.0000						
	(0.0000)	(0.0000)	-------						
LEV	-0.7865***	-0.7935***	0.7205***	1.0000					
	(0.0000)	(0.0000)	(0.0000)	-------					
LLR	-0.1483**	-0.1535**	0.2845***	0.2086***	1.0000				
	(0.0159)	(0.0125)	(0.0000)	(0.0006)	-------				
DEP	-0.3863***	-0.3920***	0.4128***	0.3239***	0.0709ns	1.0000			
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.2512)	-------			
LOA	-0.1741***	-0.1757***	0.2636***	0.0476ns	-0.1326**	0.6293***	1.0000		
	(0.0045)	(0.0042)	(0.0000)	(0.4414)	(0.0312)	(0.0000)	-------		
LIQ	0.1074*	0.1180*	-0.2190***	-0.0573ns	0.1118*	-0.5999***	-0.6081***	1.0000	
	(0.0815)	(0.0555)	(0.0003)	(0.3536)	(0.0697)	(0.0000)	(0.0000)	-------	
PROF	-0.2571***	-0.2483***	0.3705***	0.2260***	-0.0028ns	-0.0016ns	0.1596***	0.0052ns	1.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.9639)	(0.9793)	(0.0094)	(0.9335)	-------
VIF	2.8248	2.3280	1.1917	2.4044	2.2187	1.8812	1.2819		
PROF	0.1075	0.2920	-0.5633	0.0847	264				

Notes: *, **, and *** denote the level of significance at 10%, 5%, and 1%, respectively; ns denotes not significant.

Source: The authors' calculation

In addition, the correlation matrix also shows that the closest and strongest correlation among the group of independent variables is between SIZE and LEV. However, Gujarati (2008), Hair *et al.* (2006) argue that multicollinearity only becomes serious when the correlation coefficient is 0.8 or higher. The results in Table 4, which summarize the VIFs, show that all variables have the VIF values less than 10, which implies that there is no serious multicollinearity.

4.3 Regression analysis

The results of the regression and the tests of selecting estimation methods are summarized in Table 5.

Table 5. Regression results according to POLS, FEM, and REM

Variables/ Tests	Dependent variable CAR			Dependent variable DCAR		
	POLS	**FEM**	**REM**	**POLS**	**FEM**	**REM**
SIZE	0.0023 [0.3185]	0.0018 [0.1439]	0.0026 [0.3030]	0.0007 [0.0903]	-0.0061 [-0.4823]	-0.0003 [-0.0356]
LEV	-0.9625*** [-13.0348]	-1.0146*** [-10.8493]	-0.9859*** [-12.2509]	-0.9694*** [-13.2222]	-1.0192*** [-11.0060]	-0.9952*** [-12.4620]
LLR	0.0906 [0.1711]	0.3216 [0.5339]	0.2124 [0.3834]	0.0589 [0.1120]	0.2622 [0.4395]	0.1833 [0.3335]
DEP	-0.0758*** [-2.5988]	-0.0586 [-1.4645]	-0.0695** [-2.0892]	-0.0730** [-2.5217]	-0.0504 [-1.2728]	-0.0643* [-1.9490]
LOA	-0.0361 [-1.3904]	-0.0378 [-0.9989]	-0.0379 [-1.2534]	-0.0343 [-1.3315]	-0.0313 [-0.8360]	-0.0355 [-1.1808]
LIQ	-0.0439 [-1.3131]	-0.0487 [-1.1806]	-0.0485 [-1.3410]	-0.0349 [-1.0508]	-0.0389 [-0.9513]	-0.0383 [-1.0659]
PROF	-0.0628** [-2.0566]	-0.0609* [-1.7465]	-0.0627** [-1.9720]	-0.0533* [-1.7574]	-0.0534 [-1.5476]	-0.0530* [-1.6807]
C	1.0759*** [21.9708]	1.1146*** [13.9551]	1.0910*** [19.1994]	1.0012*** [20.5906]	1.0818*** [13.6785]	1.0263*** [18.1699]
R^2	0.6506	0.7074	0.6084	0.6598	0.7166	0.6198
Breusch-Pagan	7.4210 [0.0064]			8.0280 [0.0046]		
Redundant Fixed Effect		46.7895 [0.0024]			48.2413 [0.0016]	
Hausman			2.7965 [0.9032]			3.3953 [0.8462]

Notes: *, **, and *** denote the level of significance at 10%, 5%, and 1%, respectively; ns denotes not significant.

Source: The authors' calculation

According to Table 5, both of the dependent variables, CAR and DCAR, have Breusch-Pagan test results with a P-value of less than 5%. It is confirmed that REM is more suitable than POLS. The results of the redundant fixed effect test with a P-value of less than 5% also determine that FEM is more suitable than POLS while Hausman's test results with a P-value of greater than 5% conclude that REM is more suitable than FEM. We checked the autocorrelation and the heteroscedasticity. The results in Table 6 indicate that these problems exist in the model. Therefore, the GLS regression is used to overcome them. The R-squared values are 70.11% for the CAR and 79.56% for DCAR as shown in Table 7.

Table 6. Autocorrelation and heteroscedasticity

Tests	Prob. Chi-Square		Our findings
	CAR	DCAR	
Autocorrelation	0.0000 < 5%	0.0000 < 5%	Accepted
Heteroscedasticity	0.0000 < 5%	0.0000 < 5%	Accepted

Source: The authors' calculation

Table 7. Estimated results according to GLS

Variables	CAR	DCAR
SIZE	-0.0027 [-0.5915]	-0.0116** [-2.1327]
LEV	-0.7939*** [-13.1720]	-0.8140*** [-13.9000]
LLR	-0.0379 [-0.1327]	0.0416 [0.1457]
DEP	-0.0310* [-1.8635]	-0.0069 [-0.3661]
LOA	-0.0304* [-1.8913]	-0.0393* [-1.8411]
LIQ	-0.0353* [-1.7387]	-0.0534** [-2.5715]
PROF	-0.0985*** [-5.0753]	-0.0626*** [-3.0525]
C	0.9341*** [21.5553]	0.9248*** [18.9351]
R^2	0.7011	0.7956

Notes: *, **, and *** denote the level of significance at 10%, 5%, and 1%, respectively; ns denotes not significant.

Source: The authors' calculation

It is shown in Table 7 that in the case of CAR, five variables that ensure statistical significance are LEV, DEP, LOA, LIQ, and PROF. The regression results in this table also confirm that DCAR can be explained by the variables SIZE, LEV, LOA, LIQ, and PROF at the statistical significance levels of 1%, 5%, or 10%.

4.4 Discussion

Impact of financial leverage

According to the GLS results in Table 7, LEV has a regression coefficient of -0.7939 with a significance level of 1%. This finding shows that financial leverage has negative impacts on CARs of joint-stock commercial banks in Vietnam. This result is consistent with Aktas *et al.* (2015), who studied commercial banks in 10 countries in Southeast Europe. This finding suggests that when banks use more debt, they will face higher risks of capital insecurity. Indeed, when debt and the risks involved increase, banks will try to improve their lending opportunities and invest more in risky assets with the expectation of higher return for additional income since their equity and CARs are usually low. In addition, Table 7 also shows that LEV can explain the reverse trend of DCAR via the regression coefficient of -0.8140 with the significance level of 1%. This finding implies that when the level of debt used in a bank's capital structure is high, the CAR is less superior or even lower CAR compared to the minimum required.

Impact of customer loans

According to the GLS results in Table 7, LOA has a regression coefficient of -0.0304 with the statistical significance level of 10%. This finding indicates that expanding (or narrowing) customer loans will reduce (or increase) CAR. This finding is consistent with the expectations as well as the empirical research of Dreca (2013) and Than and Nguyen (2015). This can be attributed to the fact that commercial banks have to accept credit risks when making loans. They may be willing to lend more by reducing credit standards requirements, which increases risks for asset portfolios and leads to a decrease in CARs. At the same time, the regression coefficient of LOA and DCAR is -0.0393 with a significance level of 10%. This finding confirms that the increase in customer loans will reduce the positive difference between the actual CARs and the minimum ratio required. Moreover, excessive lending may lead to the lower level of actual CAR, which does not reach the minimum threshold set by the State Bank. Then, the safety level of banking business activity will be low.

Impact of liquidity

According to the GLS results in Table 7, LIQ has a regression coefficient of -0.0353 with a significance level of 10%. It shows that liquidity has a negative effect on CAR, which is contrary to the expectations and conclusions of Workneh (2014) and Aktas *et al.* (2015). The regression coefficient of LIQ is -0.0534 with a significance level of 5%. This evidence suggests that increasing liquidity reserves may lead to a smaller positive difference or even a negative one between the actual CAR level and the minimum level required by the State Bank. This reverse trend, which agrees with Shingjergji and Hyseni (2014), can be explained by the

trade-off between profit and risks in liquidity management. Banks can increase liquidity by holding more liquid assets as well as reducing investment in profitable assets. This strategy may lead to a decrease in income, poorer ability to raise capital from profits, or a significant increase in riskier investments because of their higher confidence in liquidity reserve. It may lead to a decrease in the bank's capital adequacy.

Impact of profitability

According to the GLS results in Table 7, PROF has a regression coefficient of -0.0985 with a significance level of 1%. This fact shows that profitability has a negative impact on CAR. This is contrary to the expectations and the empirical research of Dreca (2013) and Aktas *et al.* (2015). However, this result is consistent with the study of Bokhari *et al.* (2012) and Berger (1995). Moreover, PROF in relation to DCAR with a significance level of 1% has a regression coefficient of -0.0626. This finding means that profitability increasing may reduce the positive difference between the actual CAR and the minimum required by the State Bank, or make CAR lower than the required minimum level. Therefore, commercial banks often try to maximize the value of shareholders' assets by deciding to invest as much as possible in profitable assets with the capital accumulated from internal resources, such as retained earnings. Banks may be more inclined to riskier investments and loans, which leads to increased risks to the asset portfolio and, thus, a capital adequacy decrease.

Impact of customers' deposits

According to the GLS results in Table 7, DEP has a regression coefficient of -0.0311 with a statistical significance of 10%, which means that the volume of customer deposits has a negative impact on CARs of joint-stock commercial banks in Vietnam. This relationship is contrary to the expectations and empirical results of Workneh (2014). However, this result supports Dreca (2013), who anlyzed the same relationship among commercial banks in Bosnia. It can be explained that banks, as the financial intermediaries, should focus on mobilizing customers' deposits. If customers' deposits increase, banks increase risky asset item. While equity does not increase or increases slightly, the CAR will decrease. However, the relationship between DEP and DCAR does not guarantee statistical significance, which means that banks' decision to mobilize customers' deposits does not affect their compliance with the minimum CAR requirement of the State Bank.

Impact of bank size

SIZE does not guarantee statistical significance to explain CAR when it is inconsistent with the expectations. However, at 5% significance level, this variable is statistically significant and can be used to explain DCAR and the regression coefficient, which is at -0.0116. This result shows that banks certainly maintain a level of capital adequacy without being affected by the differences in bank size. However, the bank with larger size will have smaller positive difference. The negative difference between the actual CAR and the specified minimum is larger. This can be explained by the fact that banks of larger scales tend to establish riskier asset portfolios. Their CARs just meet the requirements of the State Bank of Vietnam on the

safety of the commercial bank system. Smaller commercial banks will give more priority to safety and CARs, which might be higher than the prescribed minimum.

Impact of loan loss reserve

LLR in a relationship with both CAR and DCAR does not guarantee statistical significance. This result indicates that risk provisions are not reliable to explain the level of capital adequacy in banks' business activities. This may be due to the fact that commercial banks can manage credit risks well and ensure the quality of loans. Provisions are mainly for technical purposes and adjusted entries in the accounting books.

5. Conclusion

According to the results estimated by the GLS method, the study summarizes banks' characteristics that are statistically significant in explaining CAR as well as the tendency to maintain CAR of joint-stock commercial banks compared to the minimum level required by the State Bank of Vietnam. These characteristics include financial leverage, customer deposits, customer loans, liquidity, and profitability. In addition, it is found that bank size and provision for credit risks do not guarantee statistical significance. These results suggest that banks maintain and adjust their CARs to ensure financial efficiency as well as to meet the requirements of the State Bank by choosing policies to attract deposits that are suitable and balanced with the demand for capital use. This strategy also helps harmoniously solve the trade-off between the cost of capital opportunities and the safety goal by deciding the liquidity reserve. In addition, it helps focus on the relationship between investment in profitable assets with capital generated from retained earnings determined by dividend policies. Furthermore, it is to ensure credit quality to be in line with loan growth objectives and maintain the correlation between equity the level of debt use.

Our findings are expected to provide empirical evidence and useful information for bank managers to make rational decisions in maintaining and adjusting their CARs in order to ensure financial performance and meet the regulations of the central bank. This study provides specific evidence for the State Bank of Vietnam to formulate policies to ensure the efficiency and stability of the banking system.

One limitation of this study is that the sample of this study does not include all commercial banks in Vietnam. In addition, the research model has not considered the macro factors or the moderation of the relevant legal system. Therefore, future studies may address these problems to have better results.

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