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Effects of macroeconomic indicators on capital adequacy ratio of joint stock commercial banks in Vietnam

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Abstract
Capital adequacy is an important standard, a measure of safety and soundness for banks and financial institutions. Determining capital adequacy is the bank's adjustment of capital levels so that it can absorb all unexpected losses arising in the future and ensure the safety of fixed assets. Maintaining the capital adequacy ratio at an appropriate level will help the bank both effectively use capital and maintain a safe operation. To measure the influence of macro indicators on capital adequacy, we use panel data of 28 commercial banks operating in Vietnam during the period 2007 to 2020. For the most reliable measurement results, the study used the generalized method of moments (GMM). The analysis results show that macroeconomic factors such as inflation, interest rates, GDP growth have opposite effects on CAR. Meanwhile, the VND/USD exchange rate has a positive impact on CAR. The results of this research will help managers have more scientific basis to come up with appropriate governance strategies for their banks.

Keywords: macroeconomic indicators, capital adequacy ratio, bank risk

Introduction

Capital adequacy is an important criterion, a measure of safety and soundness for banks and financial institutions (Kumar Aspal & Nazneen, 2014) [5, 15]. When the bank's capital is maintained at a safe level, it will ensure the smooth operation of the bank and be able to withstand shocks when the economy is adverse. Determining capital adequacy is the bank's adjustment of capital levels so that it can absorb all unexpected losses incurred in the future and ensure the safety of fixed assets (Abusharba *et al*., 2013; Kumar Aspal & Nazneen, 2014) [1, 5, 15]. When banks maintain capital at a safe level, banks can avoid failures and failures by absorbing losses (Abusharba *et al*., 2013; Kumar Aspal & Nazneen, 2014) [1, 5, 15]. To ensure capital adequacy to meet the requirements of continuous development in the banking industry, the Basel II Capital Accord in 2006 [6] aims to improve the safety, efficiency, soundness and competitiveness of the banking system. Currently, the application of the minimum capital adequacy ratio standard in Vietnam is applied at a minimum of 9% (SBV 2019). However, the maintenance of the minimum capital ratio at banks in recent years has not been consistent LE (2021) [16]. In which, some banks have capital adequacy ratio up to 15%, much higher than the current regulation (9%) (LE (2021) [16]. Maintaining a high capital adequacy ratio is also not good for the bank's performance (Phuong *et al*., 2019) [19]. It can be seen that maintaining the capital adequacy ratio at an appropriate level will help the bank both effectively use capital and maintain a safe operation. In order to have a basis for making scientific and practical recommendations in the matter of capital adequacy, we conducted a study on the influence of macroeconomic indicators on the capital adequacy ratio.

Research question

What are the macroeconomic factors that affect the car coefficient?
What is the magnitude and direction of the influence of these factors?

Literature review

Capital adequacy ratio

Capital Adequacy Ratio (CAR) is the basis used to measure the capital adequacy of a bank, it reflects the soundness, “health” of a bank to ensure that banks can withstand losses from operating losses (Bateni *et al*., 2014; Dang, 2011; Kumar Aspal & Nazneen, 2014) [5, 7, 15, 10]. Capital adequacy ratio shows the intrinsic strength of the bank to withstand losses in times of crisis, the higher the capital adequacy ratio, the greater the intrinsic strength of the bank, ensure the smooth operation of the bank, thereby protecting the interests of shareholders, investors and depositors (Kumar Aspal & Nazneen, 2014) [5, 15]. The Basel Committee recommends that banks maintain a minimum capital adequacy ratio to control the stability and performance of the financial system (Kumar Aspal & Nazneen, 2014) [5, 15]. The minimum capital adequacy ratio recommended by Basel is not less than 8% (Basel Committee on Banking Supervision, 2006) [6]. However, in some countries, this ratio is different due to the regulations of the central bank, the agency that regulates and supervises the national financial system of the host country. For example: Egypt's capital adequacy ratio is maintained at a minimum of 10% (El-Ansary & Hafez, 2015) [11]; in Vietnam, this ratio is regulated by the State Bank not lower than 9% (SBV, 2019) [21]; In India the capital adequacy ratio is also maintained at a minimum of 9% (Kumar Aspal & Nazneen, 2014) [5, 15].

Build models and hypotheses

Research on the capital adequacy of banks is an area that attracts a lot of attention from scholars. Shaddady & Moore (2015) [20] said that the capital adequacy ratio is influenced by macro factors such as economic growth, exchange rate. Meanwhile, Mili *et al*. (2017) [17] said that lending interest rate is an important factor affecting the capital adequacy ratio. Besides, ANSHU and Gakher (2019) [3] show that CPI, exchange rate and lending interest rate are factors affecting capital adequacy ratio, but do not record the impact of GDP. In Vietnam, Nu (2016) [18] said that macroeconomic factors only interest rate and CPI have a significant impact on capital adequacy ratio while economic growth (GDP), exchange rate (EXR) had not statistically significant effect.

Thus, it can be seen that the influence of macro factors on the capital adequacy ratio of banks is not consistent in the above studies.

We believe that the implementation of the study in different countries, at different times, should have different results. Based on the above studies, we propose a model to measure the influence of microeconomics on the capital adequacy ratio including: GDP, inflation, interest rates, exchange rates. In addition, we add a control variable which is bank size, some studies demonstrate that large banks have lower capital adequacy ratios than small banks because banks with large asset sizes have an advantage in meeting capital requirements from external sources and their portfolios (Wong *et al*., 2005; Kleff and Weber, 2003) [14, 26].

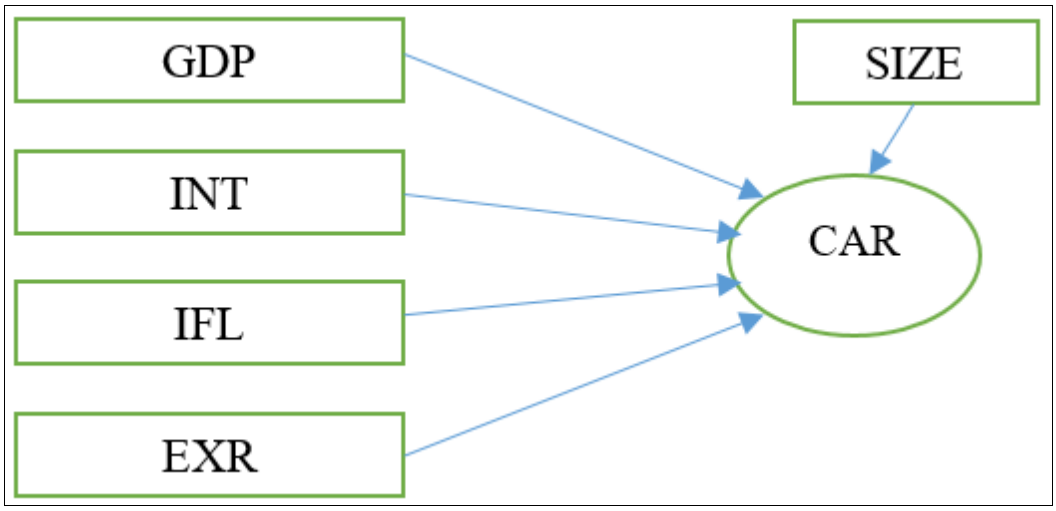

Fig 1: Research framework

Table 1: Identification of variables in the model

No	Name	Variable definition	Calculation formula
1	CAR	Capital adequacy ratio	(CAR) =(Tier 1 Capital+Tier 2 Capital)/ Risk Weighted Assets
2	INT	Interest rate	Real interest rate
3	IFL	Inflationary	Measured by consumer price index (CPI)
4	EXR	Exchange rate	EXR = VND/USD
5	GDP	Economic growth	% GDP
6	SIZE	Size of the bank	SIZE= Ln (Total assets)

Economic growth

Economic growth (GDP) is a macroeconomic indicator that measures the growth of domestically produced goods and services over a specific period of time. Economic growth is an important variable to explain CAR (Wong *et al*., 2005; Aktas *et al*., 2015 and Phuong *et al*., 2019) [2, 19, 26]. The research results of the above authors show that the economic growth rate has an inverse relationship with CAR. Asarkaya and Ozcan (2007) [4] conclude that banks can suffer losses due to possible risks in the context of recession so they will tend to hold more capital to reduce potential losses. Besides, Mili *et al* (2014) argue that, if a country has positive economic growth, banks may face less risk, conversely when economic growth is negative or low, this means that the probability of banks taking risks is higher, banks need to keep a high capital ratio to prevent future losses. Based on the above arguments, we hypothesize the following:

H1: Economic growth is negatively correlated with CAR

Inflationary

Inflation is an important macro indicator of the economy. Governments always want a moderate level of inflation for economic development. According to the research results of Nguyen (2021), the inflation rate is negatively correlated with CAR. Meanwhile, Ben Jabra, Mighri & Mansouri (2017) [8] added that increasing inflation reduces the real value of loans and increases insolvency, so risks to banks increase; Le (2018) believes that when inflation increases, businesses and individuals may have difficulty repaying loans. On this basis, we hypothesize the following:

H2: Inflation has a negative effect on capital adequacy ratio

Real interest rate

Some previous studies such as Ahlem *et al*., 2013; Mili *et al*. (2014) Phuong *et al* 2019[19] both show that interest rates have a negative impact on capital adequacy ratio. An increase in lending rates also reduces the ability of banks to lend, which is associated with a decrease in capital reserves (Mili *et al*. (2014). Phuong *et al* 2019 [19] added, rising

interest rates lead to an increase in risky assets, thereby reducing the capital reserve ratio. When interest rates rise, borrowing costs increase, making investments less profitable and assets riskier (Ahlem *et al*., 2013). On this basis, we hypothesize the following:

H3: Interest rate has a negative effect on capital adequacy ratio

Exchange rate

The exchange rate measures the value of a domestic currency against a foreign currency, when the domestic currency depreciates, the purchasing power of the domestic currency decreases, making imported goods more expensive, will increase production costs and indirectly increase the consumer price index, inflation may occur, this affects the reduction of capital adequacy ratio Le (2021). The exchange rate affects the investment decisions of foreign investors, when the exchange rate increases, foreign investors limit direct investment leading to a decrease in capital adequacy ratio (Phuong *et al*., 2019; Williams, 2011) [19, 24]. On this basis, we hypothesize the following:

H4: Exchange rate has a negative effect on capital adequacy ratio

Bank size

Bank size is a measure of a bank's total assets. Previous studies have shown that large-sized banks have high risk control ability, so they invest in high-risk assets (Aktas *et al*., 2015; Kumar Aspal & Nazneen, 2014; Usman *et al*., 2019) [2, 5, 15, 23]. Gropp and Heider (2007) [12] argue that larger banks hold more risky assets than small banks, so the CAR will be lower On this basis, we hypothesize the following:

H5: Bank size has a negative effect on capital adequacy ratio

Data and methods

To study the influence of macroeconomic indicators on the capital adequacy ratio of joint stock commercial banks in Vietnam, we use panel data of all joint stock commercial banks operating in Vietnam from 2007 to 2020. We remove the data for 2021 due to the covid pandemic raging this year, the blockade orders of the Vietnamese government caused the economy to stall. Data on exchange rates, interest rates, GDP, and inflation are collected from the World Bank (https://data.worldbank.org). Data on bank size is obtained from audited financial statements of banks. After the data is collected, it is sent for descriptive analysis and correlation analysis. Based on the proposed research model and data origin of the observed variables, the study uses the Generalized Method of Moments (GMM) for analysis. The Generalized Method of Moments has advantages in overcoming endogenous problems (Branas, Bucheli and Garcia, 2011; Wintoki, Link and Netter, 2012) [9, 25]. In the dynamic panel data model, the use of instrumental variables can consider whether the data of previous periods affect the present, improving the problem of autocorrelation and endogeneity and gives stability to the estimate. The analytical support tool is Stata 14 software.

Results and discussion

Descriptive statistics

Research data covers 28 banks within 14 years (2007 to 2020) corresponding to 392 observations, Table 2 details the mean, maximum, minimum and standard deviation of each variable. The average CAR of banks is 15.02%, with a standard deviation of 8.6, this index has a large difference between banks and between years, the largest CAR index belonged to Lien Viet in 2008 (70.43%). In addition, INF has the smallest value of -5.62%, this means that lending interest rates are lower than inflation, specifically in 2008 Vietnam's inflation was up to 23.12%, while the nominal interest rate is 17.5%.

Table 2: Descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
CAR	392	14.83	7.95	6.62	70.43
IFL	392	7.30	6.16	0.63	23.12
GDP	392	6.01	1.06	2.91	7.13
INT	392	2.94	3.58	(5.62)	7.32
EXR	392	20.46	2.37	16.11	23.21

Note: CAR is capital adequacy ratio; IFL is inflation; GDP is the economic growth rate; INT is the real interest rate; EXR is the exchange rate VND/USD

Correlation analysis and Multicollinearity

The correlation coefficient matrix reflects the correlation between the independent variables and the dependent variable and between the independent variables. Looking at the correlation of the independent variables with the dependent variable (CAR) shows that the GDP variable and the IFL variable are positively correlated with CAR, but the correlation of GDP with CAR is not significant. The remaining variables including INT, EXR and SIZE have a significant negative correlation with CAR.

In addition, the results of the correlation analysis in Table 3 also show that the variable INT has a strong negative relationship with INF (-0.95), so these two variables may have self-multicollinearity. To know for sure whether multicollinearity occurs, we use the variance magnification factor VIF. If VIF < 2, there is no multicollinearity.

Table 3: Correlation statistics

	CAR	IFL	GDP	INT	EXR	SIZE
CAR	1					
IFL	0.31**	1				
GDP	0.02	-0.0628	1			
INT	-0.30**	-0.95**	-0.10*	1		
EXR	-0.35**	-0.62**	-0.10*	0.62**	1	
SIZE	-0.58**	-0.35**	-0.0715	0.35**	0.53**	1

Note: ** is significant at <0.01, * is significant at <0.05, CAR is capital adequacy ratio; IFL is inflation; GDP is the economic growth rate; INT is the real interest rate; EXR is the exchange rate VND/USD

From the analysis results in Table 4, we can see that all the VIF values of the IFL and INT variables > 10, so it is certain that multicollinearity occurs, to overcome this problem, the study uses GMM regression.

Table 4: Multicollinearity Test

Variable	Variable VIF	1/VIF
IFL	19.75	0.05
INT	19.22	0.05
EXR	2.04	0.49
GDP	1.56	0.64
SIZE	1.41	0.71
Mean VIF	8.79	

Note: CAR is capital adequacy ratio; IFL is inflation; GDP is the economic growth rate; INT is the real interest rate; EXR is the exchange rate VND/USD

Regression analysis results

To examine the influence of macro factors on CAR, the study uses a model for GMM dynamic panel data to overcome the problems of endogeneity, autocorrelation, and multicollinearity and gives the stability of the estimation results. The results of the analysis are shown in Table 5.

Table 5: Results of Regression Analysis

Vaiable	Coef.	z	P>z	CI 95%	
IFL	-0.0042	-2.3800	0.017*	-0.0076	-0.0007
GDP	-0.0080	-2.8700	0.004**	-0.0135	-0.0025
INT	-0.0077	-2.6500	0.008**	-0.0135	-0.0020
EXR	0.0175	2.6300	0.009**	0.0044	0.0306
SIZE	-0.0905	-3.8100	<0.001**	-0.1370	-0.0440
_cons	2.7942	4.2100	<0.001**	1.4932	4.0951
Wald chi2(5)	221.29		<0.001**		
AR2 (check for autocorrelation)			0.194		
Hansen tests the limitations of the model			0.059		
Hansen test on using instrumental variables			0.059		

Note: ** is significant at <0.01, * is significant at <0.05, CAR is capital adequacy ratio; IFL is inflation; GDP is the economic growth rate; INT is the real interest rate; EXR is the exchange rate VND/USD

Check the fit of the model:

The analysis results show that Wald value = 221.29 and Prob value <0.001 so this model exists.

The AR2 test on autocorrelation gives a P>0.05 value, which means that the model does not occur autocorrelation

Hansen's test on the limitations of the model and the use of instrumental variables in the model both give p>0.05, so the model is not limited and the included instrumental variables are suitable.

Thus, through the above tests, the use of the GMM model is completely appropriate.

Statistical hypothesis testing:

The analysis results show that all 5 variables included in the model have p.value < 5%, so these variables have a significant influence on the change of CAR, in which:

The GDP variable has beta = -0.008, so this variable has a negative effect on CAR, specifically, when GDP increases by 1%, CAR will decrease by 0.008 units, equivalent to 0.8%;

Inflation variable (IFL) has beta = -0.0042, so this variable has a negative effect on CAR, specifically, when IFL increases by 1%, CAR will decrease by 0.0042 units, equivalent to 0.42%;

Interest rate variable (INT) has beta = -0.0077, so this variable has a negative effect on CAR, specifically, when INT increases by 1%, it will make CAR decrease by 0.0077 units, equivalent to 0.77%;

The exchange rate variable (EXR) has a beta coefficient of 0.0175, so this variable has a positive effect on CAR, specifically, when EXR increases by 1 unit, it will increase CAR by 0.0175 units, equivalent to 1.75%;

The bank's size variable (SIZE) has beta = -0.0905, so this variable has a negative effect on CAR, specifically, an increase in SIZE by 1 unit will make CAR decrease by 0.0905 units, equivalent to 9.05%.

Discussion

Inflation, In this study, inflation is a factor that has a negative effect on CAR, specifically, a 1% increase in inflation will cause CAR to decrease by 0.42%. This problem has been proved by a number of other studies such as: Nguyen (2021); Ben Jabra, Mighri & Mansouri (2017) [8]; Le (2021) [16]. According to Ben Jabra, Mighri & Mansouri (2017) [8], when inflation increases, it reduces the real value of the account, the risk to the bank increases, so the value of risky assets increases, thereby reducing CAR. We also agree with the comments of Ben Jabra, Mighri & Mansouri (2017) [8], in addition, we believe that when inflation increases, undistributed profits and provisions will decrease, reducing Tier 2 capital from which CAR reduce**.**

GDP, This variable has a negative effect on CAR, specifically when GDP increases by 1% will make CAR decrease by 0.8%, this is also found in the studies of Wong *et al*. (2005) [26], Aktas *et al* (2015) [2], Phuong *et al* (2019) [19]. We believe that when GDP increases, it also means that the economy is growing and the market is stable. The risks associated with risky assets will decrease, which causes the CAR of banks to decrease. Mili *et al* (2014) argue that, if a country has positive economic growth, banks may face less risk and they tend to reduce CAR to a minimum.

Real interest rates have a negative effect on CAR, specifically, when the real interest rate increases by 1%, CAR will decrease by 0.77%. negative relationship between interest rates and CAR was found by Ahlem *et al*. (2013); Mili *et al*. (2014) and Phuong *et al*. (2019) [19]. Phuong *et al*. (2019) [19] said that rising interest rates lead to an increase in risky assets, thereby reducing the minimum capital reserve ratio. Commenting on this issue, we believe that when the

real interest rate increases, the lending interest rate increases, which makes it more difficult for businesses to repay their loans, increased interest costs, and risky assets increase.

Exchange rate, In our study, the exchange rate has a positive effect on CAR, specifically when the VND/USD exchange rate increases by 1 unit (by 1000vnd/1USD), the CAR increases by 1.75%. Some previous studies such as Phuong *et al*. (2019) [19] and Williams (2011) [24] suggested that an increase in exchange rate reduces foreign investment leading to a decrease in capital adequacy ratio. However, we believe that when the VND depreciates against the USD, it will be a great advantage for exporters, which makes secured loans of these enterprises in banks less risky, thereby increasing the capital adequacy ratio.

Size, In our study, bank size has a negative relationship with CAR, this negative relationship has been found by most studies such as Aktas *et al*. (2015) [2]; Kumar Aspal & Nazneen (2014) [5, 15]; Usman *et al*. (2019) [23], the authors all believe that banks have a large scale, they invest in high-risk assets, which causes CAR to decrease. Commenting on this result in Vietnam, we think that the size of the bank represents the total assets of the bank, the larger the bank, the larger the amount of equity, the bank can guarantee the capital source when lending with high-risk assets. This can reduce the capital adequacy ratio to near regulatory levels. In addition, a large bank also means that there are more customers and a more stringent risk assessment system, so that the capital adequacy ratio does not need to be too high compared to the regulation (9%).

Conclusion

The capital adequacy ratio is one of the important criteria mentioned when evaluating the operation of commercial banks. From there, it can be seen the importance of this coefficient in evaluating the performance of banks. In today's trend of internationalization and market economy, commercial banks always face two big problems that are competitiveness and risks in business activities. Capital adequacy ratio is an important indicator to assess a bank's ability to face these two problems.

Our research results show that macroeconomic factors play an important role in determining the CAR coefficient. In adverse economic conditions such as rising inflation, an increase in interest rates will cause the capital adequacy ratio to decrease. However, in terms of economic stability and growth, a capital adequacy ratio that is not too high will bring more benefits to customers. In addition to increasing the exchange rate in favor of export rates, the CAR coefficient also increases. With the obtained results, this study has initially provided the bank managers with a high scientific basis, from which they can make the most appropriate policies.

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