The stability of Vietnamese commercial banks - Does liquidity creation matter?

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ABSTRACT

The study offers insights into whether liquidity creation, capital growth rate, and their interaction have affected the stability of Vietnamese commercial banks by employing the Bayesian method for a sample of 25 commercial banks during 2008 - 2022. Our empirical findings reveal that the more liquidity a bank creates and the higher the capital growth rate is, the more stable the bank is. Especially the results show that capital growth has a moderating role, as it allows banks to absorb potential loss due to liquidity risks in the course of liquidity creation. Moreover, other bank-specific factors, including the Capital Adequacy Ratio (CAR), Non-Performing Loan (NPL), Cost to Income Ratio (CIR), Net Interest income (NIM) ratio, Liquidity Ratio (LIR), Loan To Deposit ratio (LTD), and marco ecomomic factors including GDP growth and inflation are determinants of bank stability. The study suggests some implications for the State bank of Vietnam with regard to liquidity creation policies to maintain the stability of the Vietnamese banking sector.

1. Introduction

The contemporary theories of financial intermediation argue that commercial banks exist because they have crucial roles to play in liquidity creation and risk transformation (Bhattacharya & Thakor, 1993; Berger & Bouwman, 2009). In essence, banks create liquidity in the economy by converting illiquid deposits into liquid assets through their operations. Through the liquidity creation process, the banking system supports economic growth (Gupta & Kashiramka, 2020). Specifically, the Vietnamese banking system is the mainstay of the national economy due to the backward stock market (Le, 2019) as the banking system is contributing more than 60% - 80% of capital needed in the economy over the 2008 - 2022 timeframe. During this period, Vietnam reached an average economic growth rate of 5.8% annually. The driving force behind the maximization of bank liquidity creation is profitability enhancement and bank value increase (Berger & Bouwman, 2009; Duan & Niu, 2020), as illiquid assets provide banks with more income than liquid assets. However, liquidity creation may cause an adverse impact on bank stability stemming from the fact that banks finance illiquid assets with liquid liabilities (Fidrmuc et al., 2015). Once faced with external shocks, depositors may rush into banks to withdraw deposits while banks' funds are provided to borrowers with long-term commitments, which results in liquidity shortage and may lead to bank failure. Currently, the Vietnamese banking system's performance contains many potential risks due to the erosion of capital adequacy, the decline in asset quality, the rise in non-performing loans, involvement in real estate corporate bonds, and collateralized by off-plan property while the real estate market is illiquid. The characteristics of the Vietnamese commercial banking system are different from the banking sectors in developed countries (USA, Europe) and emerging markets (China, Middle East and North Africa). The dominance of state-owned commercial banks, the competition from foreign banks, and profit goals have the domestic banks lower lending standards while expanding credit and increasing the scale of liquidity creation, leading to higher risks (Vuong et al., 2023). Pham, Nguyen, et al. (2021) argued that liquidity creation is a increasing function with credit scale and confirm that liquidity creation gradually rose in the period 2012 - 2020. According to the draft report summarizing the implementation of the 10-year socio-economic development strategy over the period 2011 - 2020, formulating 10-year socio-economic development strategy for 2021 - 2030 at the 12th National Congress of the Communist Party of Vietnam XII (2021), bank stability was less sustainable compared to other countries in Southeast Asia region, and vulnerable to adverse sudden external shock, preventing sustainable stability of Vietnamese banking system (Tỉnh Ủy Lai Châu, n.d.). The research related to liquidity creation in the Vietnamese commercial banking system focuses on analyzing the relationship between bank capital and liquidity creation (Chu et al., 2021), exploring the impact of liquidity creation on performance (Vu et al., 2016) and the determinants of Vietnamese bank stability (Nguyen, 2021; Pham, Dao, et al., 2021) yet to examine the effect of liquidity creation. This article will provide empirical evidence of the relationship between liquidity creation and Vietnamese bank stability. This is the first new contribution of this study.

Although liquidity creation might have an adverse effect on bank stability, capital shall play the role of buffering and absorbing potential risks arising from liquidity creation (Repullo, 2004). Therefore, banks are motivated to strengthen their capital position intently to hedge against perceived risk exposure (Berger & Bouwman, 2009; Distinguin et al., 2013). Zheng et al. (2019) argued that a bank generating higher liquidity would face higher liquidity risk afterward; however, if the capital buffer is reinforced, it will help the bank absorb liquidity risk optimally. In other words, increasing capital may have a positive effect on liquidity creation without increasing bankruptcy risk. Therefore, ignoring the role of equity may lead to incomplete conclusions about the relationship between liquidity creation and bank stability. Zheng et al. (2019) revealed that creating liquidity positively affects the stability of US banks, which was moderated by an increase in equity. In India, an emerging economy, the banking system also faces liquidity shortages, especially for banks with low equity (Gupta & Kashiramka, 2020). The objective of this paper is to examine the impact of increasing capital and the moderating role of capital on the relationship between liquidity creation and bank stability by employing Bayesian regression whereas there has no evidence has been found in the case of Vietnamese banks, especially in the context that the banks are in the process of capital restructuring, aiming to meet capital adequacy requirements according to Basel II standards. The Bayesian method has many advantages over the frequency method, as it is easily accessed with different data characteristics, based on data set simulation. The results of posterior mean estimates can reveal both positive and negative effect probabilities rather than simply rejecting or accepting a hypothesis about the statistical significance of an effect (Nguyen et al., 2019). This is the second contribution of this study.

Following the introduction, the literature review is presented in Section 2. In Section 3, the data and methodology are illustrated. In Section 4, the regression results are provided. Section 5 is comprised of conclusions and policy implications.

2. Theoretical basis

The theoretical background that provides arguments for the adverse impact of liquidity creation on bank stability is the "High Liquidity Creation Hypothesis" (HLCH) developed by Fungacova et al. (2021) and the - cost hypothesis mentioned in the study by Tran et al. (2016).

The theoretical background of HLCH is a combination of the "Weak Fundamentals Hypothesis" (WFH) and the "Liquidity Shortage Hypothesis" (LSH). WFH and LSH provide the rationale behind bank fragility resulting in a bank failure. According to WFH, the financial fundamentals of the CAMELS framework becoming weak will allow the prediction of bank failure. Therefore, capital deterioration, liquidity decrease, loan quality degradation, and income reduction are early signals of an increase in a bank's probability of bankruptcy. While LSH argues that in a financial crisis, a bank's vulnerability stems from financing illiquid assets with liquid liabilities. Despite being a liquidity intermediary, banks are more vulnerable once depositors withdraw all deposits from the banks. As a result, the bank's capacity to meet depositors' withdrawals declines, bringing about liquidity shortage, bank instability, and the probability of bankruptcy increases. LSH indicates that bank failure arises from the risk of liabilities side, while WFH implies that the bank failure is caused by risk from the asset side of the balance sheet (Fungacova et al., 2021). However, in fact, both risks on each side of the balance sheets might interact and mutually affect together, leading to bank failure. "High Liquidity Creation Hypothesis" (HLCH) is a combination of two hypotheses, LSH and WFH explained that the bank's stability is determined by a comprehensive measure, namely, liquidity creation, which reflects a bank's overall ability of maturity transformation. According to HLCH, liquidity creation exposes banks to insolvency risk. For instance, when depositors have large sudden withdrawal demand, banks must dispose of illiquid assets at fire prices due to a shortage of liquid assets, leading to bankruptcy. Furthermore, Diamond and Rajan (2001) argued that maturity mismatching of long-term assets and deposits is prone to bank instability. In addition, Berger and Bouwman (2009) supposed that banks expand their liquidity creation by financing illiquid long-term assets instead of investing in short-term government bonds may lead banks to failure as long-term loans are riskier than short-term government securities. Likewise, the bankruptcy-cost hypothesis has shown that there was a trade-off between liquidity creation and stability. The higher the liquidity creation, the greater the illiquidity risk and this increases the likelihood of bank failure.

The empirical analysis showed that higher liquidity creation led to lower stability. Fungacova et al. (2021) found that higher liquidity creation would cause a greater probability of bank failure, confirming HLCH is true for Russian banks with the data spanning from the first quarter of 1999 to the fourth quarter of 2009 by employing the panel logit methodology. Specifically, when liquidity creation was from the 90th percentile of distribution above the liquidity creation of the whole banking system, the banks were more likely to fail than the average liquidity creators. Similarly, Vazquez and Federico (2015) implemented the probit regression method for a sample of 11,000 banks in the United States and Europe over the period from 2001 to 2009, the result showed that banks transforming maturity outrageously had a higher probability of bankruptcy afterward. In addition, they found that the smaller domestic banks engaged in excessive liquidity transformation the more susceptible they were exposed to failure, whereas larger foreign banks have gone bankrupt because the capital buffer is incommensurate with excessive risk-taking behavior.

On a contrary point of view, liquidity creation had a positive effect on bank stability for two reasons. Firstly, the capacity of liquidity creation represents the level of bank performance; therefore, banks are unable to manage their balance sheets and create liquidity had showed a sign of some emerging problems (Fungacova et al., 2021; Zheng et al., 2019). Secondly, those banks having low liquidity creation do not have sufficient short-term deposits, rely on volatile long-term funds primarily, and become less stable (Hahm et al., 2013). Javid et al. (2022) found a positive relationship between liquidity creation and bank stability in Pakistan, by employing the GMM estimation technique for a sample of 28 banks operating from 2006 to 2019.

In general, there are two arguments explaining the effect of liquidity creation on bank stability, including the HLCH hypothesis and the bankruptcy-cost hypothesis, providing arguments that liquidity creation has an adverse effect on bank stability, whereas the controversy suggested the reverse side. However, there was a study showing mixed results on the relationship between liquidity and bank stability. Gupta and Kashiramka (2020) examined the effect of liquidity creation on stability in the context of India, with a sample of 91 Indian commercial banks for the period 2007 - 2019. Liquidity creation affects bank stability positively for the whole sample, contrary to HCLH and bankruptcy-cost hypothesis. This is because liquidity creation in India was not higher than other banks in developed countries, and did not engage in risky activities, supported by capital buffer with the requirement of 5.5% Tier 1 capital on total assets. In addition, the findings showed that the relationship between liquidity creation and stability varied depending on bank size. For, liquidity creation negatively affected the stability of small and large banks, while it positively affected the stability of medium-sized banks.

In the context of a developing country, where the banking system creates less liquidity than its counterparts in developed countries, on the basis of the arguments supporting the positive effect of liquidity creation from previous studies, this study formulates the following hypothesis:

H1: There is a positive effect of liquidity creation on bank stability

In addition to examining the impact of liquidity creation on bank stability, there were some studies analyzing the interaction between liquidity creation and equity growth rate on bank stability to discover the moderating role of bank capital as it was considered as a buffer to absorb potential loss according to risk absorption hypothesis (Bhattacharya & Thakor, 1993; Repullo, 2004), allowing banks to monitor borrowers strictly (Acharya & Thakor, 2016). For this reason, a higher capital growth rate leads to greater liquidity creation without leading banks to instability. Zheng et al. (2019) argued that banks that create more liquidity would face higher liquidity risk afterward. However, in case the capital buffer was strengthened, it would enable banks to absorb risk and loss optimally. In other words, increasing bank capital would increase liquidity creation without enhancing liquidity risk, supporting stability. Zheng et al. (2019) examined the moderation role of bank capital on the relationship between liquidity creation and bankruptcy through the Z-score, on a sample of commercial banks in the US from QI & 2003 - QIV & 2014 by using OLS and 2SLS methods. The findings revealed that the interaction between liquidity creation and capital growth had a positive impact on bank stability. Notably, results were more evident for small banks. Since small banks have limited access to external funds, they had a strong incentive to hedge risk by holding more capital. In addition, the role of bank capital in this relationship is reported to be more pronounced during the financial crisis period. This showed that increasing capital was especially important to reduce liquidity risk when banks create liquidity amid crises. This is the background for this study to add a moderating variable, capital growth multiplied by liquidity creation, in the model to discover the role of capital on the effect of liquidity creation on Vietnamese bank stability. There have been some studies on the factors affecting bank stability, but the impact of liquidity creation has not been considered in the context of Vietnam. Therefore, this study formulates the following hypothesis:

H2: There is a positive effect of capital growth on bank stability

H3: The interaction between capital growth and liquidity creation has a positive effect on bank stability

This study points out differences compared to the previous. This is the first study to examine the role of liquidity creation and the interaction of capital growth and liquidity creation on the stability of commercial banks in Vietnam. Second, the study uses Bayesian methodology to imply some possible solutions.

3. Methodology

Mention the analytical methods/research models for the study. Data sources and sampling/data collection methods should be fully and accurately cited. Data on bank-specific factors were collected from the financial statements of 25 joint stock commercial banks, including Vietinbank, Vietcombank, BIDV, MB Bank, ACB, Sacombank, Techcombank, Saigonhanoi bank, Eximbank, Saigonbank, SCB, National Citizen bank, Kienlong bank, VP bank, VIB bank, HD bank, Seabank, PG bank, Tienphong bank, MSB, AB bank, Lienvietpost bank, NamA bank, OCB, Vietcapital bank; and macro data were extracted from the World Bank, from 2008 to 2022. The sample excludes non-bank credit institutions due to the limitations of data availability.

According to the theoretical background above and the empirical studies of Gupta and Kashiramka (2020), Zheng et al. (2019), the research model is a static multiple regression model with panel data to analyze the impact of liquidity creation, capital growth and the interaction between them on bank stability as follows:

$$Z - score_{it} = \beta_0 + \beta_1 LC_{it} + \beta_2 CAG_{it} + \beta_3 (LC\ x\ CAG)_{it} + \sum_{l=1}^{L} \gamma_{li,t} X_{li,t} + \sum_{k=1}^{K} \delta_k Z_{kt-1} + \varepsilon_{ij,t} \quad (1)$$

In equation (1), Z-score is a measurement of bank stability, liquidity creation is proxied by two alternative measurements including CatFat and CatNonFat. Therefore, the article has two models corresponding to each liquidity creation measurement. The $\beta_1, \beta_2, \beta_{3,}$ are coefficients of the main variables, $X_{i,t}$ are the vector of bank-specific control variables changing over time; γ, δ are the coefficients of the bank control specific variables, and macro variables respectively, $\varepsilon_{i,t}$ is the random error, *t* and *i* are time and banks respectively. β_1 and β_2 coefficients show the impact of liquidity creation and capital growth on bank stability, other factors being constant, β_3 is a coefficient stating the moderating role of bank capital growth on the effect of liquidity creation on bank stability.

In particular, two liquidity creation measurements CatFat and CatNonFat are calculated according to the formula developed by Berger and Bouwman (2009). First, balance sheet and off-balance sheet items are divided into three groups: liquid, semiliquid, and illiquid. Liabilities are classified based on the convenience, cost, and time that customers have to dispose of to withdraw bank deposits. Assets are classified based on the convenience, cost, and time the bank has to dispose of when liquidating assets to meet liquidity needs. According to that principle, all of the activities are classified based on category or maturity. Next, the weight of +1/2 is applied to liquid liabilities and illiquid assets. In contrast, the weight of -1/2 is applied to liquid assets, illiquid liabilities, and equity. The weight of 0 is applied to semiliquid assets and liabilities. The classification and weight allocation of off-balance sheet items are conducted with the same principles of on-balance sheet items. In case the activities are classified by category, the amount of liquidity created by the bank is calculated according to the formula:

CatFat (Liquidity creation from on-balance sheet and off-balance sheet activities) = + ½ x illiquid assets + ½ x liquid liabilities + ½ x illiquid commitments + 0 x semiliquid assets + 0 x x semiliquid liabilities + 0 x semiliquid commitments -½ x liquid assets -½ x illiquid liabilities -½ x equity -½ x liquid commitments -½ x liquid derivatives.

CatNonFat (Liquidity creation from on-balance sheet activities) = + ½ x illiquid assets + ½ x liquid liabilities + 0 x semiliquid assets + 0 x semiliquid liabilities -½ x liquid assets -½ x illiquid liabilities -½ x equitiy.

In addition, the research model adds control variables according to the CAMELS framework because they are used as early signals to assess the safety and soundness of Vietnamese commercial banks according to Circular No. 52 & 2018 & TT-NHNN effective from April 01, 2019. CAMELS capture intrinsic factors that determine the level of bank financial stability, including the Capital Adequacy Ratio (CAR), representing the role of capital capability in protecting banks against asset risks; Non-Performing Loan (NPL) represents asset quality; income & Cost Ratio (CIR) represents management efficiency; Net Interest income (NIM) ratio represents profitability; Liquidity Ratio (LIR) represents liquidity and Loan-To-Deposit ratio (LTD) represents sensitivity to market risk. Furthermore, the model adds real GDP growth and inflation rate under the existing macroeconomic environment in which the banks are involved, affecting bank stability. The definitions of the variables in the model are described in Table 1.

Table 1

Definition of Variables

Variable		Acronym	Measure	Predicted sign	Source
Dependent variable	Bank stability	Zscore	$Z - score = \frac{ROA + ETA}{\sigma(ROA)}$ where $\sigma(ROA)$ was calculated for the whole research period		Author's calculation from banks' financial statements
Independent variables	Capital growth rate	CAG	% change of bank capital	+	
	Liquidity creation	LC	CatFat/Total assets and CatNonFat/Total assets	+	
	Interaction between capital growth and liquidity creation		CAGxLC	+	
Control variables	Capital Adequacy Ratio	CAR	$\frac{\text{Capital}}{\text{Risk weighted assets}} \text{x100}$	+	
	Non-Performing Loan ratio	NPL	$\frac{\text{Non} - \text{performing loan}}{\text{Total loans}} \text{x100}$	-	
	Cost to income ratio	CIR	$\frac{\text{Total cost}}{\text{Total income}} \text{x100}$	+	
	Net interest margin	NIM	$\frac{\text{Interest income} - \text{Interest cost}}{\text{Total assets}} \text{x100}$	+	

Variable		Acronym	Measure	Predicted sign	Source
	Liquidity ratio	LIR	$\frac{\text{Cash + Deposits at financial institutions}}{\text{Total assets}}\text{x100}$	+	
	Loan To Deposit ratio	LTD	$\frac{\text{Total loans}}{\text{Total deposits}}\text{x100}$	-	
	Real GDP growth rate	GGDP	% Change of real GDP	+	WB
	Inflation rate	INF	% Change of consumer price index	-	

Source. Author's estimation

Table 2 presents descriptive statistics of the variables from the data set of 25 Vietnamese commercial banks from 2008 to 2022.

Table 2

Descriptive Statistics

Variable	Obs	Mean	Min	Max	Std. Dev.
ZSCORE	375	20.502	0.130	90.491	12.659
LC1	375	15.072	-34.781	143.847	20.016
LC2	375	6.797	-34.800	40.944	13.422
CAG	375	32.145	1.347	28.342	35.105
CAR	375	14.233	6.620	77.900	7.316
NPL	375	2.097	0.060	11.401	1.400
CIR	375	72.399	16.192	8,630.244	445.120
NIM	375	2.941	-0.754	8.170	1.244
LIR	375	0.202	0.045	0.610	0.105
LTD	375	90.394	23.509	251.981	24.228
GGDP	375	5.795	2.588	7.200	1.340
INF	375	7.015	0.6312	23.115	6.218

Source. Author's estimation

The average Z-score is 20.502. The highest Zscore is 90.491 (Maritime Bank in 2021); the lowest Z-score is 0.130 (Vietcapital Bank in 2016), and the standard deviation is 12.695. The average on-balance sheet liquidity creation/Total assets ratio is 6.797% with a standard deviation of 13.422%; the highest is 40.944% (Saigon Bank in 2013), and the lowest is -34.800% (Vietcapital Bank in 2011). The average on-balance and off-balance sheet liquidity creation/Total assets is 15.072%, the highest is 143.847% (Anbinh Bank in 2021), the lowest is -34.781% (Tienphong Bank in 2009), and the standard deviation is 20.061%. The remaining variables also have different mean and standard deviation values.

Most of the previous studies concentrating on determinants of bank stability were carried out by using the frequency statistical method. However, it is supposed that the results are no longer appropriate (Briggs et al., 2019). One of the crucial assumptions of frequency statistics is the repeatable process of generating observations, which is considered inappropriate in reality, whereas the Bayesian approach is not based on this assumption. In frequency statistics, the parameters are considered unknown and constant, which is inappropriate due to the change of the parameter over time. The coefficients in the Bayesian model are random parameters, the fluctuations of these coefficients will be affected by jamming factors and bank-specific variables. However, the fluctuations of the coefficients will decrease as the number of observations increases.

Since previous studies related to bank stability determinants were performed by frequency statistics, there is no information about the prior distribution of the variables in the model. To address this problem, we determined Gaussian standard distribution with different prior information as proposed by Block et al. (2011) and analysed Bayesian factors to select the simulation having the best prior information.

Table 3

Prior Information Simulation

Likelihood	$\boldsymbol{Zscore_{i,t}} \sim \mathbf{N}\ (\boldsymbol{\mu}, \boldsymbol{\sigma})$
Prior distribution of Model 1	
Simualtion 1.1	$\alpha_i \sim$ N $(0; 1)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0.01)$
Simualtion 1.2	$\alpha_i \sim$ N $(0; 10)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 1.3	$\alpha_i \sim$ N $(0; 100)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 1.4	$\alpha_i \sim$ N $(0; 1000)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 1.5	$\alpha_i \sim$ N $(0; 10000)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Prior distribution of Model 2	
Simualtion 2.1	$\alpha_i \sim$ N $(0; 1)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0.01)$
Simualtion 2.2	$\alpha_i \sim$ N $(0; 10)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 2.3	$\alpha_i \sim$ N $(0; 100)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 2.4	$\alpha_i \sim$ N $(0; 1000)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$
Simualtion 2.5	$\alpha_i \sim$ N $(0; 10000)$ $\sigma_1^2 \sim$ Invgamma $(0{,}01;\ 0{,}01)$

Source. Author’s estimation

The simulations in Table 3 present the decreasing levels of the prior information with Simulation 1.1 with Model 1 and 2.1 with Model 2, which have the strongest prior information, and Simulation 1.5 with model 1 and 2.5 with model 2 have the weakest prior information. Subsequently, Bayesian regression is conducted for the simulations, Bayesian factor analysis, and posterior Bayesian test afterward, as proposed by StataCorp LLC (2019). Bayesian factor analysis provides a ratio between the probability of a particular hypothesis (the prior information) and the probability of another hypothesis. Specifically, Bayesian inference provides average Log Bayes Factor, average Log Marginal Likelihood, and average Deviance Information Criterion. The posterior Bayesian test helps to compare the posterior probability of the simulations with different prior information. Accordingly, combining the research data with the proposed prior information allows us to choose the simulation with the highest posterior probability P(M|y).

4. Result and discussion

According to Bayesian factor analysis, the prior information simulation is chosen if it has the largest Log BF, Log ML average, minimum DIC mean, and the largest P(M|y). Tables 4 and 5 show that both models having the first simulation (simulation 1.1 and simulation 2.1) are superior to the other simulations. Hence, simulation 1.1 for model 1 and simulation 2.1 for model 2, which have prior information N (0,1), would be selected.

Table 4

Results of Bayes Factor Analysis. Effect of Liquidity Creation on Bank Stability (Liquidity Creation = CatFat/Total Assets)

	Chains	Avg DIC	Avg log (ML)	Log (BF)	P(M|y)
Simulation 1.1	3	2958.922	-1.50e+03	.	0.9999
Simulation 1.2	3	2955.760	-1.51e+03	-9.7993	0.0001
Simulation 1.3	3	2954.338	-1.52e+03	-20.0162	0
Simulation 1.4	3	2955.296	-1.53e+03	-32.8099	0
Simulation 1.5	3	2955.535	-1.55e+03	-46.5546	0

Source. Author’s estimation

Table 5

Results of Bayes Factor Analysis. Effect of Liquidity Creation on Bank Stability (Liquidity Creation = CatNonFat/Total Assets)

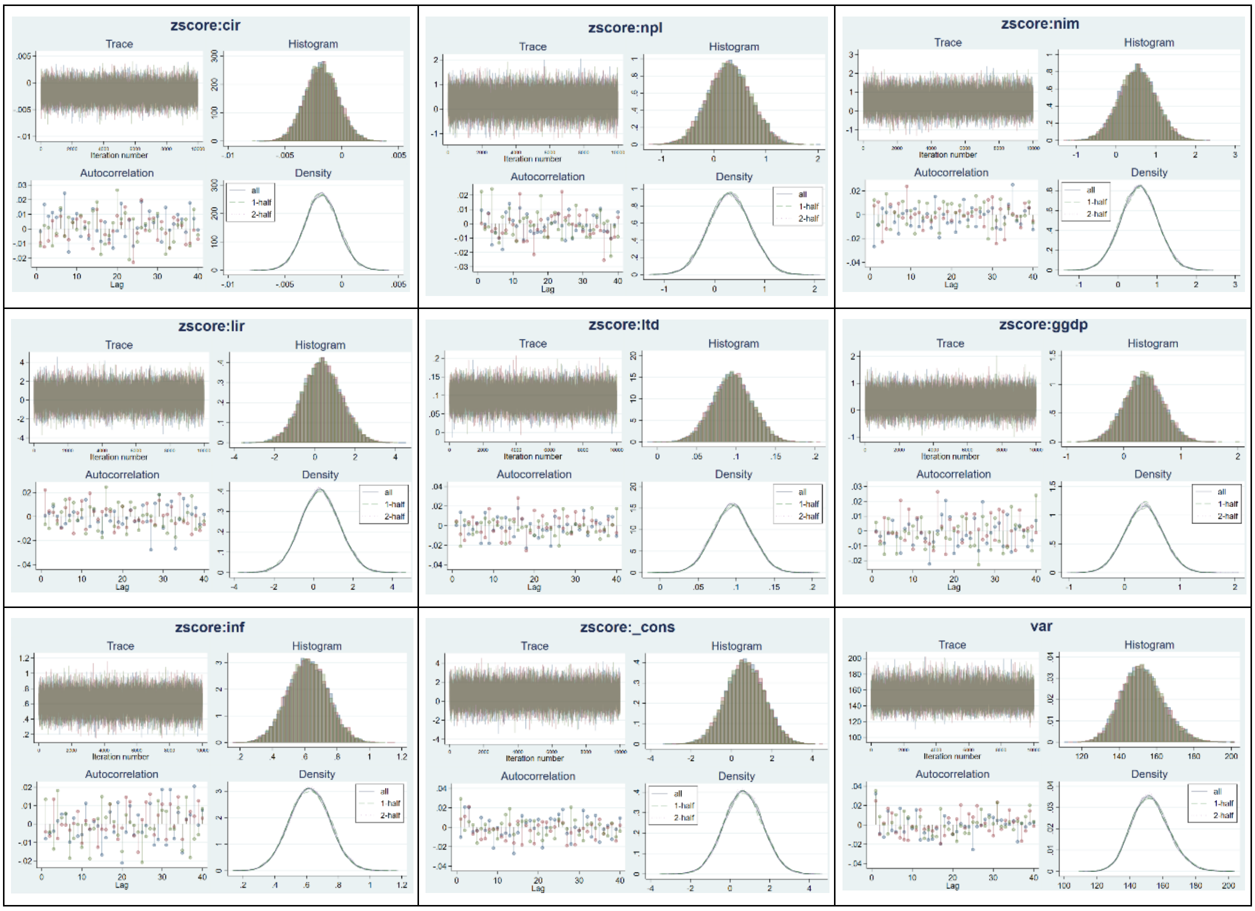
	Chains	Avg DIC	Avg log (ML)	Log (BF)	P(M|y)
Simulation 2.1	3	2964.099	-1.51e+03	.	0.9999
Simulation 2.2	3	2958.635	-1.52e+03	-8.8089	0.0001
Simulation 2.3	3	2954.430	-1.53e+03	-17.6235	0
Simulation 2.4	3	2954.636	-1.54e+03	-29.5184	0
Simulation 2.5	3	2954.711	-1.55e+03	-43.2319	0

Source. Author’s estimation

Figure 1 and Figure 2 show that all the graphs of the parameters in the model are reasonable, the trace plots and auto correlation plot present low autocorrelation; the density plots are uniform relatively and illustrate that the parameters are normally distributed. The autocorrelation coefficients fluctuate slightly and below 0.02, which is suitable with the distribution simulation density and reflects all lags within the effective limits.

Figure 1

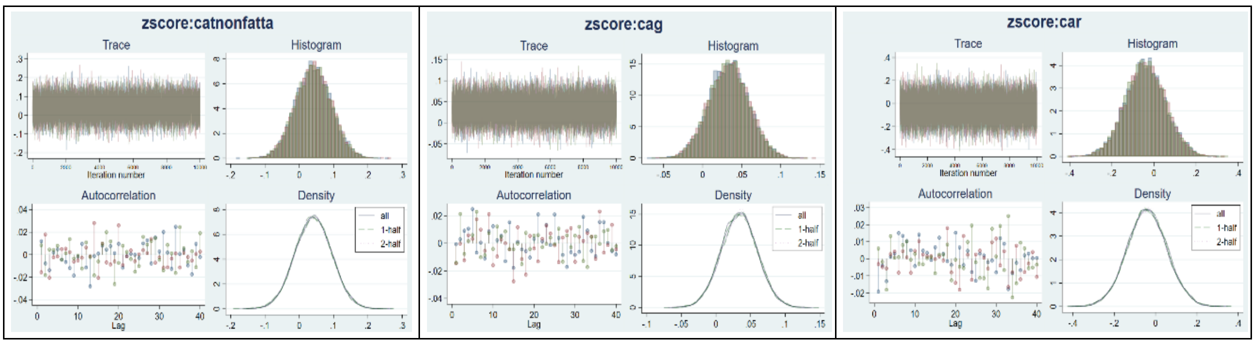
Convergence Diagnostic Graph. Effect of Liquidity Creation on Bank Stability (Liquidity Creation = CatFat/Total Assets)

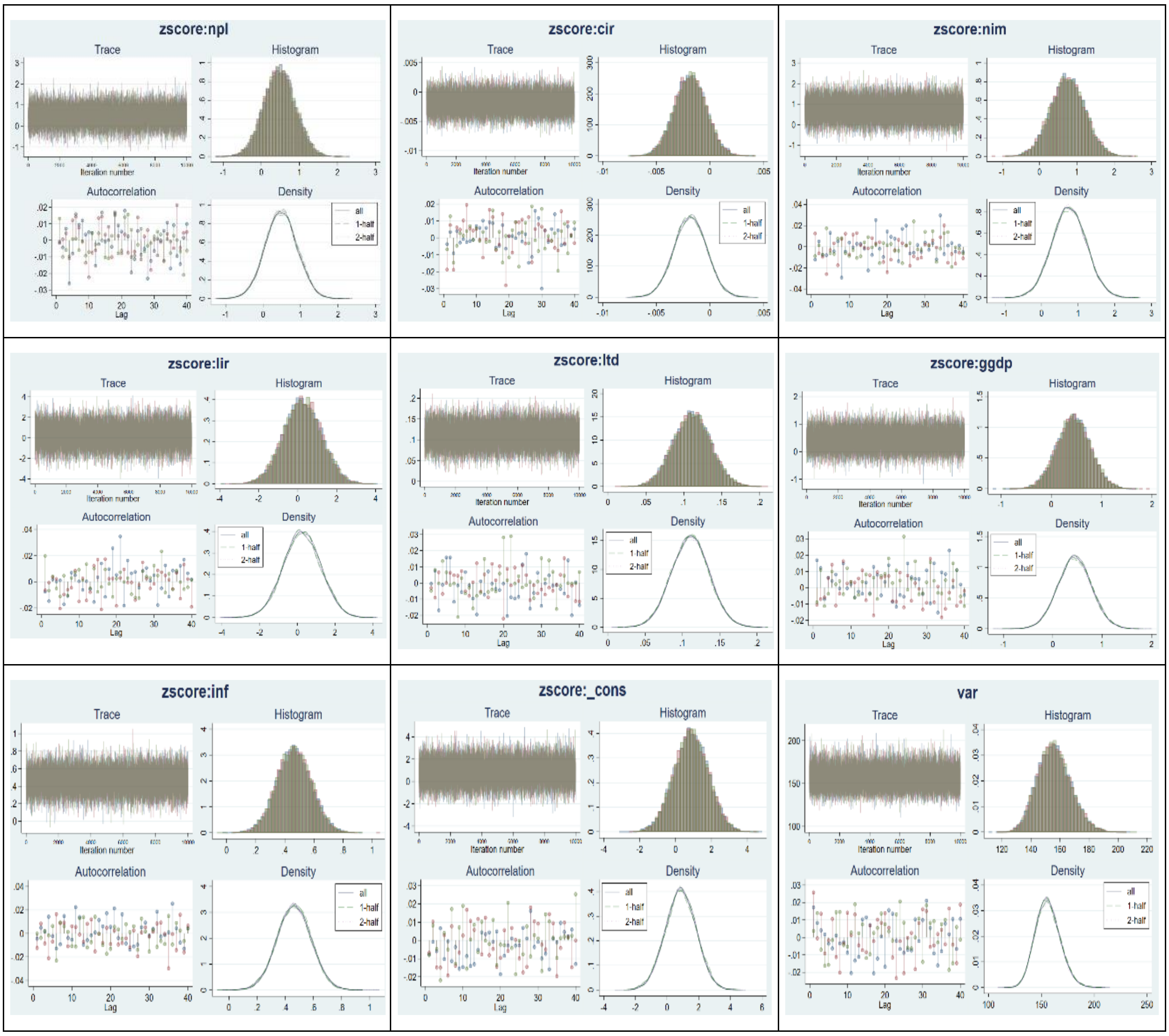


Source. Author's analysis results

Figure 2

Convergence Diagnostic Graph. Effect of Liquidity Creation on Bank Stability (Liquidity Creation = CatNonFat/Total Assets)





Source. Author's analysis results

Unlike the frequency statistics that only provide coefficients, the regression model using the Bayesian inference is simulated 10,000 times through the Metropolis-Hastings (MH) algorithm and provides mean, standard deviation of coefficient, and Monte-Carlo standard error. Metropolis-Hastings uses the Bayes theorem to get the posterior distribution of a complex distribution, from which sampling directly is difficult. Table 6 presents that the average acceptance rate is 1 and the smallest efficiency is 0.937 with model 1 and 0.9287 with model 2, which is far exceeding the allowable level of 0.01. Therefore, the research model meets the requirements. Flegal et al. (2008) argued that the smaller Monte-Carlo Standard Error (MCSE) of all parameters, the stronger the MCMC series. Specifically, if MCSE value is less than 6.5% of the standard deviation, MCMC series are acceptable; if MCSE value is less than 5% of the standard deviation, MCMC series is optimal. Furthermore, all the maximum Rc values of the coefficients are 1, which is not greater than 1.2, the level which Gelman and Rubin (1992), Brooks and Gelman (1998) suggested MCMC series meets the convergence requirements. The advantage of Bayes inference outweighing frequency statistics is that it can determine at which probability the liquidity creation enhances bank stability.

Table 6

Regression Results. Effect of Liquidity Creation on Bank Stability

	Liquidity creation = CatFat/Total assets			Liquidity creation = CatNonFat/Total assets		
Variables	**Mean**	**Std.dev.**	**MCSE**	**Std.dev.**	**MCSE**	**Mean**
LC	0.093063	0.060576	0.000351	0.045844	0.000265	-0.02102
CAG	0.027190	0.025991	0.000150	0.026195	0.000152	0.040589
LCxCAG	0.001376	0.002185	0.000013	0.001469	8.50E-06	0.004589
CAR	0.022675	0.098202	0.000567	0.096436	0.000560	0.005669
NPL	0.303812	0.417658	0.002411	0.413433	0.002391	0.438527
CIR	-0.002110	0.001539	8.90E-06	0.001518	8.80E-06	-0.002550
NIM	0.469215	0.463168	0.002674	0.472464	0.002762	0.680460
LIR	0.315345	0.991074	0.005722	0.99214	0.005811	0.235664
LTD	0.092636	0.025324	0.000147	0.025439	0.000147	0.104524
GGDP	0.408284	0.341265	0.001970	0.342020	0.001975	0.507472
INF	0.620692	0.120330	0.000695	0.124813	0.000726	0.459577
_cons	0.698757	0.973909	0.005623	0.974786	0.005628	0.905020
Var	152.4957	11.46104	0.068664	11.34529	0.06767	154.6503
Avg acceptance rate	1			1		
Avg efficiency: min	0.937			0.9287		
Max Gelman–Rubin Rc	1			1		

Note. The "Mean" column of Table 6 shows the probability of a positive or negative coefficient. The coefficients {ZSCORE: LC}, {ZSCORE:CAG}, {ZSCORE: LCxCAG}, {ZSCORE:CAR}, {ZSCORE :NPL}, {ZSCORE:CIR}, {ZSCORE:NIM}, {ZSCORE:LIR}, {ZSCORE:LTD}, {ZSCORE:GGDP}, {ZSCORE:INF} correspond to the variables LC, CAG, LCXCAG, CAR, NPL, CIR, NIM, LIR, LTD, GGDP and INF in the model
Source. Author's estimation

The results in Table 7 show the probability of the determinants affecting bank stability.

Table 7

Probability of Regression Coefficients

Probablity	**Mean**	**Std. dev.**	**MCSE**	**Mean**	**Std. dev.**	**MCSE**
	Liquidity creation = CatFat/Total assets			Liquidity creation = CatNonFat/Total assets		
{ZSCORE: LC} > 0	0.9793333	0.14227	0.0008214	0.6362	0.48110	0.0028268
{ZSCORE:CAG} > 0	0.8525333	0.35458	0.0020471	0.9419	0.23393	0.0013506
{ZSCORE: LCxCAG} > 0	0.8257333	0.37934	0.0022064	0.9824	0.13137	0.0007623
{ZSCORE: CAR} > 0	0.5954333	0.49081	0.0028337	0.5242	0.49943	0.0028835
{ZSCORE:NPL} > 0	0.7691	0.42141	0.0024465	0.8525	0.35460	0.0020564

Probablity	Mean	Std. dev.	MCSE	Mean	Std. dev.	MCSE
	Liquidity creation = CatFat/Total assets			**Liquidity creation = CatNonFat/Total assets**		
{ZSCORE: CIR} < 0	0.9171333	0.27568	0.0015917	0.9511	0.21566	0.0012565
{ZSCORE: NIM} > 0	0.8386333	0.36787	0.0021239	0.9301333	0.25492	0.0014788
{ZSCORE: LIR} > 0	0.6274667	0.48348	0.0028211	0.5914	0.49158	0.0028381
{ZSCORE: LTD} > 0	0.9997333	0.01633	0.0000943	0.9999667	0.00577	0.0000333
{ZSCORE: GGDP} > 0	0.8833667	0.32098	0.0018549	0.9316333	0.25238	0.0014571
{ZSCORE:INF} > 0	1	0.00000	0	0.9999667	0.00577	0.0000333

Source. Author's estimation

The coefficient corresponding to LC measured by CatFat & Total assets and CatNonFat & Total assets have a positive value are 97% and 63% respectively. This suggests that banks creating much more liquidity are more stable. The results are contrary to HLCH and the bankruptcy cost hypothesis. The findings confirm our speculating hypothesis that liquidity creation showed bank performance enhances bank stability, which is in line with Javid et al. (2022), Gupta and Kashiramka (2020), Zheng et al. (2019) and different from Vazquez and Federico (2015), Fungacova et al. (2021) who found that bank stability decreases as liquidity creation increases. The reason behind this positive impact may stem from the difference in the level of development of the banking system between developing countries and developed countries. It can be seen that the average ratio of liquidity creation (CatFat and CatNonFat to total assets) of Vietnamese commercial banks is about 15% and 6% respectively during 2008 - 2022, which is much lower than developed countries, such as the United States, having liquidity creation of 20% in 2003 (Berger & Bouwman, 2009); in Russia, it was more than 28% in 2007 (Fungacova et al., 2021); and in Western Europe it was 29% over 2004 - 2018 (Yeddou & Pourroy, 2020). In developed countries, massive liquidity creation increases liquidity risks and surge the likelihood of bank failures. Meanwhile, the findings for Vietnamese banking system represents the opposite trend. The more liquidity the banks create, the more stable the banks are. The liquidity creation at a lower level shows that Vietnamese commercial banks are less involved in activities that may cause excessive liquidity risks. These results are similar Indian banks, which created an average of 20.64% and 1.11% of CatFat and CatNonFat to total assets respectively during 2007 - 2019, while banks are required to achieve at least 5.5% common equity tier 1, supporting for bank stability. Similar to India, lower liquidity creation indicates that Vietnamese commercial banks are less likely to engage in risky activities which may expose banks to excessive liquidity risk, whereas commercial banks increase capital continuously through stock issuance and stock dividend policy as requested by the State Bank of Vietnam.

With 85% and 94% probability of occurrence, we find that capital growth enhances bank stability. Capital is supposed to be a buffer, supporting banks to absorb shocks that may reduce asset values (Distinguin et al., 2013; Repullo, 2004). Furthermore, capital growth supports banks to create more liquidity, expand lending and absorb adverse risks in these activities (Donaldson et al., 2018; Repullo, 2004). Consequently, the bank's overall risk will be minimized and bank stability is reinforced (Jabra, 2020). An interesting finding of the article is that the interaction between LC and CAG boosts bank stability. The probability that the coefficient corresponding to LCxCAG has positive values at 82% and 98%, indicating that the interaction between liquidity creation and capital growth has a positive impact on commercial bank stability, in line with the findings obtained by Zheng et al. (2019). Capital growth affects the relationship between liquidity creation and stability through sharing liquidity risk (Zheng et al., 2019). In recent times, Vietnamese commercial banks have consolidate their capital quality to meet the Basel II Capital Accord as required by the State Bank of Vietnam in Circular No. 41/2016/TT-NHNN dated December 30, 2016 (LawNet, n.d.). This ensures banks maintain sufficient capital to compensate for detrimental risks, enhance the resilience against disadventagous shocks, supporting the consolidation of financial stability in the process of creating and providing liquidity to the economy. Therefore, the possibility of failure would diminish (Distinguin et al., 2013; Repullo, 2004).

Other factors including CAR, NPL, NIM, LIR, LTD, GGDP and INF have positive effects on bank stability. CAR was found to have a positive effect on bank stability in many studies Jabra, (2020), Javid et al. (2022), Kiemo et al. (2019). The capital growth rate is an endogenous variable, showing the internal strength of the bank and its ability to compensate for bad debts and losses so that banks can operate smoothly even the risks occur in the process of credit and investment extension. The higher the capital growth rate, the stronger bank's financial autonomy. Better capitalized banks are charged a lower cost of funding. Therefore, they are safer compared to their counterparts with lower capital ratios. NIM is found to have a positive effect on stability. As profitability goes up, banks have more financial resources to cover unexpected losses. Regarding the exogenous macroeconomic factors, the inflation rate is found to have a positive and significant effect on bank stability. Loan-to-deposit ratio LTD increases lead to an increase in the stability of banks, in line with Rupeika-Apoga et al. (2018). In Vietnam, the bank needs to balance between input (mobilized capital) and output (loan balance), while the lending interest rate is always higher 3% - 4% than the interest rate of deposits. Then the banks could earn much profit, contributing to bank stability improvement. Especially, the results show that NPL also increases bank stability in Vietnam, which is different from previous studies (Kiemo et al., 2019). This is stem from the fact that the banks controlled NPL under 3%, the rate is acceptable by the State Bank of Vietnam. Furthermore, the banks could sell bad debts to Vietnam Asset Management Company since 2013 so that bank operation is stable. LIR has a positive impact on bank stability. The banks which have more liquid assets available for sale to meet withdrawals are less vulnerable to a shortage of liquidity conditions (Lai, 2002). In contrast, CIR has a negative effect on bank stability, as poor management and supervision increase bank costs, which results in bank instability (Cihak & Hesse, 2010).

With regards to macroeconomic variables, GGDP is found to have a positive association with bank stability, consistent with the studies of De-Ramon et al. (2018), Shim (2019), Jabra (2020). The results of this study show that the bank stability has followed a cyclical pattern. Rupeika-Apoga et al. (2018), Jabra (2020), and Pham, Dao et al. (2021) found a positive relationship between inflation and the stability of the banking sector since daily operations of banks are closely attached to interest rates which were adjusted in line with expected inflation; therefore, the impact of inflation on bank stability is positive. This is consistent with Perry (1992)'s argument that inflation would positively affect bank stability when it is predicted and included in the valuation process.

5. Conclusions & recommendations

Liquidity creation plays an important role in bank performance, however, it may generate a certain potential impact on bank stability, whereas capital rise shows a clear positive effect on the stability of the banking sector. On the basis of HLCL, bankruptcy-cost hypothesis, and counterarguments in addition to the risk absorption hypothesis, the article evaluates the impact of liquidity creation, and capital growth rate and discovers the moderating role of capital growth on the relationship between liquidity creation and stability of Vietnamese commercial banks during 2008 - 2022 through Bayesian method. The results reveal that liquidity creation, capital growth, and their interaction boost the stability of the banking system. In addition, other determinants including capital capability, management efficiency, profitability, asset quality, and sensitivity to market risk, also help to stabilize the bank's operations.

From the findings, some suggest that liquidity creation, capital growth, and their interaction positively contribute to bank stability. This suggests an incentive policy related to liquidity creation which has not been mentioned in the regulatory documents of the State Bank of Vietnam. It is necessary to include the calculation and disclosure of liquidity creation for evaluating the bank's performance, in addition to the capital adequacy ratio, and non-performing loan to analyse the bank's operation structure. This indicates that the policy requesting capital increase is still necessary for bank stability, especially in the context that Vietnamese depositors are extremely sensitive to negative information about banks holding many real estate corporate bonds, while their projects have been suspended from approval of authorities, causing concerning about contagion and domino effects. During the past years, commercial banks were put much pressure on the capital increase by the State Bank of Vietnam as it is not enough to secure CAR when applying Basel II standards. Stock dividend policy should be maintained by commercial banks and regulated strictly to consolidate capital strength.

With reference to limitation, the study is put in the context of single countries, banks are not broken down into different groups by bank size and threshold of liquidity, which is beneficial to bank stability. Future studies may aim to determine an optimal level of liquidity to strengthen the stability of banks with various levels of bank size and a larger sample.

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