“Bank liquidity sensitivity after the impact of the bank-run phenomenon: The moderating role of state ownership”

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BANK LIQUIDITY SENSITIVITY AFTER THE IMPACT OF THE BANK-RUN PHENOMENON: THE MODERATING ROLE OF STATE OWNERSHIP

Abstract

The article investigates the impact of commercial banks' liquidity sensitivity following the bank-run phenomenon. Using data from 25 Vietnamese commercial banks from 2010 to 2022, the Sys.GMM estimation results reveal that banks with more considerable equity capital and total assets exhibit higher liquidity sensitivity after a bank run. Additionally, larger banks are more likely to adopt liquidity management strategies that involve borrowing. The study also finds that banks with more substantial financial performance, higher loan-to-deposit ratios, and a more extensive spread between loan and deposit interest rates demonstrate lower liquidity sensitivity after experiencing a bank run, suggesting that these banks have more effective liquidity risk management strategies. Notably, for banks with a high proportion of state ownership, the liquidity sensitivity of all factors decreases following the bank-run event. The findings suggest several policy implications for bank managers regarding liquidity management and developing strategies to mitigate the effects of bank runs.

Keywords bank-run, liquidity sensitivity, large bank, liquidity management, state ownership, Vietnam

JEL Classification G21, G28, G30

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INTRODUCTION

In a globally integrated and rapidly developing economy, the banking system's stability plays a critical role in maintaining the trust of depositors and investors. The phenomenon of a bank-run, where depositors, fearing insolvency, rush to withdraw their funds within a short period, can severely undermine financial stability. This situation affects the liquidity of individual banks and can lead to broader systemic risks, destabilizing the financial sector as a whole. The recent global economic crises have underscored the significance of such phenomena and prompted a re-examination of the mechanisms safeguarding the banking system's stability.

At a global level, countries have increasingly sought to understand how various banking systems react to liquidity crises, particularly those triggered by bank runs. While numerous studies have examined the impact of bank runs on banking operations, assessing the liquidity sensitivity of banks post-bank runs remains an area of relatively limited research. Additionally, the role of state ownership in banks has become a critical factor in determining the extent of the effects of bank runs on banking liquidity and financial stability.

In Vietnam, the banking sector has undergone significant reforms in recent years, with a marked increase in the presence of state-owned

banks. This shift raises essential questions about how state ownership influences a bank's ability to withstand liquidity shocks and its response to bank-run phenomena. While Vietnam has seen substantial economic growth, its banking system has faced challenges related to non-performing loans and liquidity risks. The state's involvement in the banking sector may play a moderating role in how banks handle liquidity crises and manage depositor confidence during periods of financial distress.

1. LITERATURE REVIEW

Every commercial bank needs to maintain appropriate levels of liquidity. Banks must have enough financial resources to promptly meet customers' deposit withdrawal needs and disburse credits when committed or due. The lack of liquidity exposes banks to liquidity risks. Liquidity risk will mostly appear when customers tend to withdraw their deposits in bulk quickly, demonstrating the phenomenon of bank runs.

The concept of "mass withdrawals of customer deposits" or "bank runs" was mentioned early in the studies by Bryant (1980), Diamond and Dybvig (1983). According to Diamond and Dybvig (1983), bank runs are a common feature of financial crises and play an important role in monetary history. During a crisis, a bank run is a phenomenon in which customers predict that a bank will go bankrupt, so they simultaneously withdraw their deposits from that bank. Bryant (1980) and Diamond and Dybvig (1983) believe that the phenomenon of bank runs comes from customers' "self-prediction of information". These studies argue that once a financial crisis occurs, customers consistently predict that the bank will go bankrupt, so they tend to withdraw their deposits from the bank. When customers withdraw too much of their deposits, the bank will no longer have enough liquidity, forcing it to sell its liquid assets at a loss to meet customer needs. Thinking on the rule of "first come, first serve" (FCFS), fearing that the bank will not have enough money to meet your withdrawal needs, you should quickly go to the bank to withdraw money as soon as possible. This problem can lead to customers simultaneously "running away" from the bank quickly.

Freixas and Rochet (2008) define a bank run as a situation in which depositors observe large sums of money being withdrawn from their bank, fear bankruptcy, and then react by withdrawing deposits. Banks are hurt by premature withdrawals that can lead to bankruptcy due to loss of liquidity. Banks mobilize highly liquid debt in deposit contracts but invest in other illiquid assets in the form of loans. A banking panic occurs when depositors at other banks in a region or country try to withdraw their money simultaneously.

Freixas and Rochet (2008) explain the phenomenon of a "bank run," which means that when customers learn bad news about the bank and fear it will go bankrupt, they withdraw their deposits immediately in response to bad news. That bad news is usually news about a decline in the value of a bank's assets or information about a large amount of that bank's deposits being withdrawn. Withdrawing money over the bank's expectations can cause negative impacts on the bank's liquidity, possibly leading to bankruptcy. Not only that, it can also cause systemic impacts on the entire banking system, leading to a banking crisis (bank panic).

Bank sensitivity is the degree to which a commercial bank can withstand and be affected by potential events or situations, such as mass withdrawals from customers. If a bank is highly sensitive, meaning it is easily affected by loss of customer confidence or adverse financial system events, it can pose liquidity and stability risks. A bank's sensitivity can depend on many factors, such as liquidity, scale of operations, margin ratio, customer confidence, and government support (Hayes, 2022). According to Vodová and Stavárek (2017), a bank's sensitivity to mass withdrawals of customers is said to be the bank's ability to withstand sudden bank runs.

Bank runs are often considered costly and detrimental to the banking industry and the entire economy, so most economists, especially bank managers, try to have strategies to prevent bank runs. One of those solutions is effective liquidity risk management. Sufficient bank liquidity in

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a liquidity buffer can reduce the pressure on asset sales when a bank run occurs. Such buffers enhance the ability of banks to absorb external shocks.

To date, there has not been much research on the use of secondary data from financial statements to assess bank sensitivity to the bank-run phenomenon (Vodová & Stavárek, 2015). Vodová and Stavárek (2015, 2017) are pioneer authors in studying banks' liquidity sensitivity to the phenomenon of bank direct runs. Vodová and Stavárek (2017) argue that when managing liquidity, banks should prepare for unexpected situations, primarily the phenomenon of mass withdrawals of depositors. Using secondary data from financial statements of commercial banks in Visegrad countries, Vodová and Stavárek (2017) studied the factors that affect banks' sensitivity to bank runs. Research results of Vodová and Stavárek (2017) have shown that the sensitivity of commercial banks to the bank run phenomenon is determined mainly by the bank's liquidity (linked to lending activities, bank financial operations and capital mobilization activities) along with profits (for banks in Czech and Slokivia) and capital structure (for banks in Poland), the size of the bank (for banks in Hungary) and unemployment rate.

Because there are few direct studies on Bank-run sensitivity, studies on bank liquidity are pretty abundant. Vodová (2013) researched liquidity in Visegrad countries and showed that the ratio of equity to total assets, lending interest rates and profit margins impact liquidity similarly. On the contrary, the size of the bank and the difference between loan and deposit interest rates have a negative impact on liquidity. Since then, Vodová (2013) believes that capital structure and profits affect bank liquidity in Czech countries. The ratio of liquid assets decreased in 2000–2009 because banks promoted lending activities. For banks in Hungary, the ratio of liquid assets is influenced by capital structure factors, size and profitability. For banks in Poland, the financial crisis had a substantial impact on the liquidity of banks in this country due to factors such as capital structure and bank size. Finally, for Slovakia countries, banks' liquidity is affected by lending interest rates, capital structure, profitability, and unemployment rate.

Al-Harbi (2017) studied the factors affecting the liquidity of OIC countries with a sample of 686 banks for 19 years. The results show that the ratio of equity to total assets, foreign ownership, credit risk, inflation rate, monetary policy, and deposit insurance have a negative impact on liquidity. On the contrary, efficiency, bank size, off-balance sheet activities, market share, and centralized accounts positively impact liquidity for banks. In Pakistan sector, Ahmad and Rasool (2017) studied banks' liquidity with a data sample of 34 commercial banks over ten years. Research results show that the ratio of equity to total assets and GDP have the same impact on liquidity. On the contrary, non-performing loan ratios and bank size negatively impact banks' liquidity. The relationship between capital and liquidity creation of a bank also depends on the size of the bank. For small banks, capital has a negative impact on liquidity creation, while this impact is in the same direction for large banks. Similar results are obtained in the study by Diriba and Berhe (2022). Diriba and Berhe (2022) also show that bank size and interest rates positively and negatively impact bank liquidity in Ethiopia. Asset quality factors, economic growth rate, and credit growth rate negatively impact liquidity. Profits and unemployment rates have the same impact.

Abdelaziz et al. (2020) studied the relationship between credit risk, liquidity risk and profitability in the MENA region from 2004 to 2015. The study results showed that profitability is negatively sensitive to the impact of liquidity risk and credit risk. The results show whether the impact of these two risks individually or simultaneously negatively impacts profitability. Mdaghri and Oubdi (2022) also have a study on the liquidity of banks in MENA countries. The study used data from 153 banks from 2008 to 2017. Research results show that the ratio of equity to total assets and gross savings has a negative impact on liquidity creation. On the contrary, the return on total assets z-score coefficient positively impacts bank liquidity formation in MENA banks.

Ahamed (2021) studied the bank liquidity risk in Bangladesh and suggested that bank size and inflation have opposite effects on liquidity risk. On the contrary, equity to total assets, return on equity, economic growth rate, domestic credit, and

the ratio of outstanding loans to total assets have the same impact on liquidity risk at banks in this country. Addo and Bensghir (2021) studied liquidity risk in Islamic banks in the UAE countries. Research results show that return on total assets and non-performing loans have a negative impact on liquidity risk. On the contrary, bank size, return on equity, liquidity gap, and CAR coefficient positively impact liquidity risk. Nguyen (2021) researched the factors affecting the liquidity of commercial banks in Vietnam from 2009 to 2019 through a research sample of 22 commercial banks. The author concludes that the ratio of equity to total assets, the scale of banking operations, the ratio of SMEs to customer turnover, the inflation index and money supply negatively impact liquidity. On the contrary, the factors of return on equity and economic growth rate have the same impact on liquidity.

Regarding the state's role, some studies suggest that State ownership is essential in mobilizing capital and creating liquidity (Fungáčová & Weill, 2012; Kusi et al., 2022). Specifically, a study by Fungáčová and Weill (2012), using a sample of banks in Russia, found that state-controlled banks create more liquidity than private banks. Similarly, Kusi et al. (2022) research on forms of liquidity ownership in the Ghanaian market probability shows that local and state-owned banks are more likely to create more liquidity compared to their foreign and privately owned bank counterparts, and they have a lower facing liquidity risk. Studies argue that state-owned banks have an oriental role in the economy and are large in scale, which helps them gain customer trust in mobilizing funding and borrowing in the financial market. Therefore, banks with state ownership create good liquidity and are less likely to encounter liquidity risks.

This study aims to analyze the impact of bank runs on bank liquidity while also examining the moderating role of state ownership in this relationship and provides deeper insights into how banks can effectively respond to liquidity crises and propose policies that may contribute to enhanced financial stability.

Based on the reviewed studies, the author develops the research model in the following section.

2. RESEARCH METHODOLOGY AND MODEL

The article uses the OLS least squares regression method. OLS regression requires conditions such as the model's residuals having a normal distribution, no multicollinearity, homogenous variance, autocorrelation, and no collinearity. When the model violates the phenomenon of heteroskedasticity and is autocorrelated and not endogenous, then the FGLS method is appropriate. When the model violates the phenomenon of heteroskedasticity and/or is autocorrelated, and there is endogeneity, then the GMM method is appropriate.

The article's research data are specific financial indicators collected from audited financial statements of 25 commercial banks in Vietnam for ten years, from 2010–2022. Macro indicators are collected from the World Bank and IMF. The results obtained are balanced panel data, 325 observations.

The article inherits the research model of Vodová and Stavárek (2017), choosing the dependent variable ΔLAR, liquidity sensitivity after the Bank-run effect. Independent variables include a group of bank-specific variables, including equity size, total asset size, financial efficiency, and outstanding loans on deposits. The macro variables include economic growth rate, inflation, unemployment and the difference between loan interest rates and deposit interest rates. The independent variables used follow studies on bank liquidity, such as those by Addou and Bensghir (2021), Ahamed (2021), and Al-Harbi (2017). Specific models are as follows:

$$\begin{aligned}\Delta LAR_{it} &= \beta_0 + \beta_1 CAP_{it} + \beta_2 SIZE_{it} \\ &+ \beta_3 ROA_{it} + \beta_4 LODE_{it} + \beta_5 GDP_t \\ &+ \beta_6 INF_t + \beta_7 UNE_t + \beta_8 IRM_t + \mu_{it}.\end{aligned} \quad (1)$$

The *CAP* variable is calculated as equity divided by a bank's total assets; the natural logarithm of the book value of total bank assets measures the bank size (*SIZE*) variable; the *ROA* variable is measured by profit after tax divided by the bank's average total assets; the *LODE* variable is measured by the ratio of outstanding loans to total customer deposits. the *GDP* variable is the agency economic growth rate; the *INF* variable is the inflation rate; the *UNE* variable is the unemployment rate; and

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the *IRM* variable is the difference between loan interest rate and average deposit interest rate (*IRM*).

Measuring a bank's sensitivity to bank run (ΔLAR), Vodová and Stavárek (2017) argue from the LAR coefficient.

$$LAR = \frac{Liquid\ assets}{Total\ assets}. \quad (2)$$

According to Vodová and Stavárek (2017), the LAR coefficient represents a bank's ability to absorb a liquidity shock. The higher the LAR coefficient, the higher the bank's ability to absorb a liquidity shock and vice versa. To calculate the LAR coefficient under the impact of the bank run, Vodová and Stavárek (2017) subtract a% of customer deposits from liquid assets, which is the proportion of money that customers withdraw due to the effect of the bank run. When depositors flee at one or more banks, the Government agency managing the bank in the host country will intervene to cut off the chain effect, the Domino effect, of withdrawal. Because otherwise, the entire banking system faces the risk of collapse. The remaining liquid assets after a bank run occurs will be used by banks to respond to actions related to mass withdrawals of customers in the future. Therefore, the Bank-run liquidity ratio (LARs) is calculated as follows:

$$LAR_S = \frac{Liquid\ assets - a\% \cdot deposits}{Total\ assets - a\% \cdot deposits}. \quad (3)$$

From (2) and (3), calculate the difference ΔLAR as follows:

$$\Delta LAR = \left| \frac{LAR_S - LAR}{LAR} \right|. \quad (4)$$

Δ*LAR* indicates the change in the ratio of liquid assets after being affected by a bank run at a% compared to the initial ratio of liquid assets. Therefore, ΔLAR represents the bank's sensitivity to bank runs. The higher the bank's sensitivity to the mass run phenomenon, the more vulnerable the bank is to the negative effects of the bank run.

Regarding the bank-run phenomenon, there are many focused studies such as those by Vodová and Stavárek (2017) in Visegrad countries, Vodová and Stavárek (2015) in the Czech Republic and Slovakia, Negrilă (2010) in Romania, and Komárková et al. (2010) in the Czech Republic. In each study for a country, the bank run rate of a% is different. Specifically, in the study by Vodová and Stavárek (2015, 2017), the bank run rate in Visegrad, the Czech Republic and Slovakia was simulated at 20% of customer deposits. Negrilă (2010) simulates a level of 20% for individual customer deposits and 10% for institutional customer deposits in the Romanian banking market. Komárková et al. (2010) assumed that the phenomenon of bank runs in the Czech Republic was at 11% of total customer deposits. Based on the above studies, the article assumes the bank runs at 20% of total customer deposits for the Vietnamese banking market. The ratio of 20% of customer deposits implies that when the Bank-run phenomenon occurs, about 20% of customer deposits will be withdrawn. At that time, the State Bank will intervene to stop the phenomenon. This action prevents a banking crisis from occurring if the bank run continues. With such an assumption, LAR in the research model is calculated with a% = 20% of customer deposits. This coefficient represents the difference between the liquid asset ratio before and after the customer's bank-run phenomenon occurs. It also represents the risk-bearing ability of commercial banks against future liquidity risks.

3. RESEARCH RESULTS AND DISCUSSION

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std.	Min	Max
Independent variable					
Δ*LAR*	325	0.89843	0.69482	0.04655	4.41564
Dependent variable					
CAP	325	0.09616	0.05984	0.04061	0.90771
SIZE	325	18.6367	1.18981	15.9227	21.4749
ROA	325	0.00884	0.00768	–0.05511	0.04728
LODE	325	0.89386	0.29037	0	4.83592
IRM	325	0.02354	0.00323	0.02000	0.03200
GDP	325	0.06100	0.01582	0.02600	0.08000
INF	325	0.05309	0.04597	0.00631	0.18677
UNE	325	0.02946	0.00732	0.01900	0.04400

Table 1 shows that the variable Δ*LAR* represents the bank's liquidity sensitivity after the impact of the bank run, with an average value of 0.8984 and a standard deviation of 0.6948. The most sig-

nificant value of this variable reached 4.41564 at Saigon Bank (SSB) in 2011. The smallest value reached 0.0465 at Saigon Thuong Tin Bank (STB) in 2017.

The article uses the OLS least squares method, so first, it will test 5 hypotheses of OLS regression, including normal distribution, multicollinearity, heteroskedasticity, autocorrelation, and endogeneity, from which to choose the appropriate estimation method.

Table 2 presents the results of the model's pairwise correlation matrix between variables. Suppose the correlation coefficient between two variables is greater than the value 0.8. In that case, it can be said that those two variables have vital signs of linearity with each other and often quickly cause multicollinearity. Table 2 shows that the correlation coefficients all have absolute values less than 0.8. In addition, testing the variance magnification factor VIF is all less than 10, allowing the article to conclude that the variables have a small level of collinearity, not causing a bias effect on the regression results.

One of the conditions of OLS regression is normal distribution. The results of testing the normal distribution (see Figure 1) show that the variables and

Table 2. Correlation matrix and multicollinearity test

Variable	ΔLAR	CAP	SIZE	ROA	LODE	GDP	INF	UNE	IRM	VIF test
ΔLAR	1.0000	–	–	–	–	–	–	–	–	–
CAP	–0.0465	1.0000	–	–	–	–	–	–	–	1.26
SIZE	0.1903***	–0.2905***	1.0000	–	–	–	–	–	–	1.43
ROA	–0.0601	0.2468***	0.2262***	1.0000	–	–	–	–	–	1.28
LODE	–0.0435	0.0548	0.1545***	0.2104***	1.0000	–	–	–	–	1.11
GDP	0.0316	–0.1040*	–0.0705	–0.0514	0.0187	1.0000	–	–	–	1.91
INF	–0.3258***	0.1236**	–0.2891***	0.0817	0.0050	0.0391	1.0000	–	–	1.16
UNE	–0.0643	0.0856	0.2539***	0.1767***	0.1555***	–0.4821*	–0.0982***	1.0000	–	1.64
IRM	–0.0941**	0.1054*	0.1019*	0.1718***	0.1382**	–0.5767*	–0.1535***	0.2797***	1.0000	1.46
Mean										1.41

Note: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

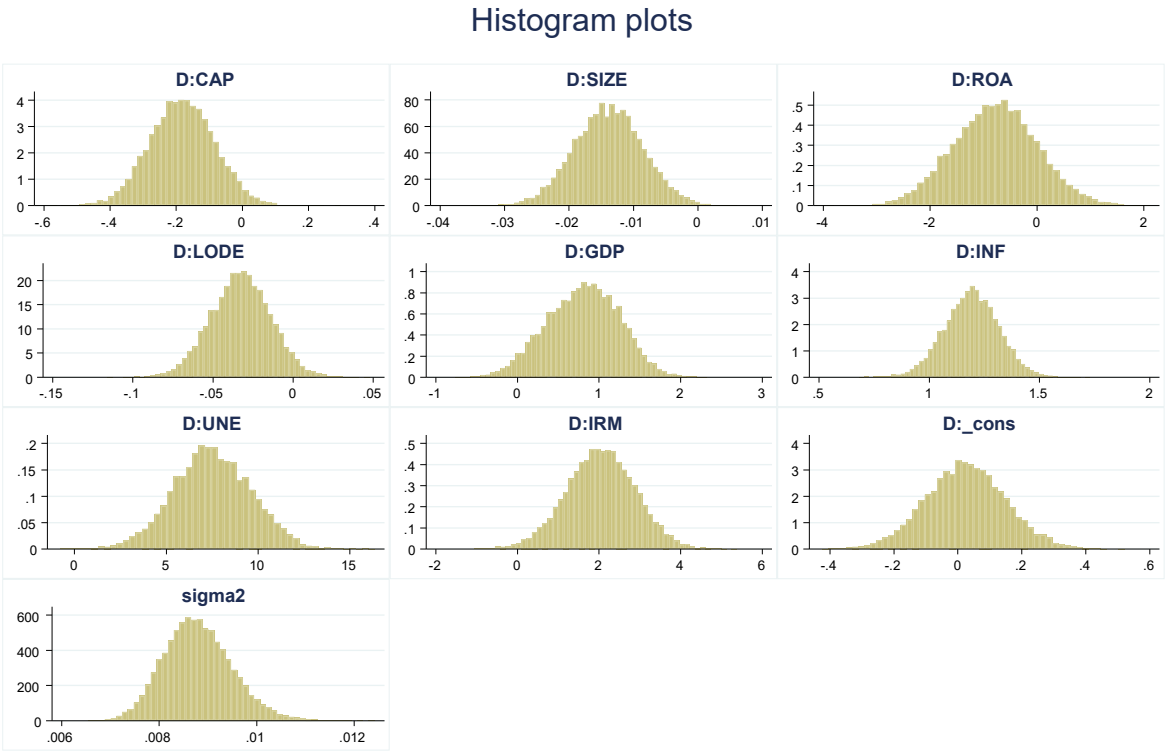

Figure 1. Testing normal distribution

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Table 3. Model selection test, heteroskedasticity test, and autocorrelation test

Dependent var. ΔLAR	OLS	FEM	REM	FGLS
CAP	0.8690	1.3071**	1.2712**	0.5782*
	[1.29]	[2.29]	[2.28]	[1.90]
SIZE	0.1045***	0.0989	0.1048*	0.1062***
	[2.88]	[1.18]	[1.67]	[4.12]
ROA	–3.4921	–4.8853	–4.8217	–0.3534
	[–0.66]	[–1.04]	[–1.05]	[–0.13]
LODE	–0.0381	–0.0450	–0.0453	–0.1075**
	[–0.29]	[–0.39]	[–0.41]	[–2.05]
IRM	–39.8925***	–39.6790***	–39.7238***	–25.1067***
	[–2.80]	[–3.58]	[–3.61]	[–4.25]
GDP	–4.9082	–4.6807*	–4.7233*	–4.45192***
	[–1.57]	[–1.91]	[–1.94]	[–3.60]
INF	–4.8093***	–4.8926***	–4.8504***	–2.4849***
	[–5.73]	[–5.78]	[–6.44]	[–5.67]
UNE	–13.2757**	–12.9159**	–13.1462***	–7.1112**
	[–2.25]	[–2.36]	[–2.61]	[–2.28]
_cons	0.8292	0.8715	0.7806	0.0164
	[0.99]	[0.58]	[0.67]	[0.03]
F-test	Prob > F = 0.0000		FEM is suitable	
Hausman test	Prob > chi2 = 0.0410 < 5%		FEM is suitable	
Wald test	H0: sigma(i)^2 = sigma^2 for all i Prob > chibar2 = 0.0000 < 5%: Reject H0			
Wooldridge test	H0: no first-order autocorrelation Prob > F = 0.0000 < 5%: Reject H0			

Note: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

residuals of the model are approximately normally distributed.

Appropriate model selection tests include F-test: a choice between OLS and FEM, Hausman test: a choice between FEM and REM; both tests show that the FEM test is appropriate. Then, the article tests for heteroskedasticity and tests for first-order autocorrelation. With the Wald test, it is concluded that the model has heteroskedasticity. The Wooldridge test concluded that the model had first-order autocorrelation. From this result, the

Table 4. Test of endogenous variables

Variable	Wu-Hausman test	Conclusion
CAP	p = 0.801 > 5%	Accept hypothesis H_0. The *CAP* variable is an exogenous variable
SIZE	p = 0.000 < 5%	Accept hypothesis H_1. The *SIZE* variable is an endogenous variable
ROA	p = 0.575 > 5%	Accept hypothesis H_0. The *ROA* variable is an exogenous variable
LODE	p = 0.557 > 5%	Accept hypothesis H_0. The *LODE* variable is an exogenous variable
IRM	p = 0.236 > 5%	Accept hypothesis H_0. The *IRM* variable is an exogenous variable
GDP	p = 0.537 > 5%	Accept hypothesis H_0. The *GDP* variable is an exogenous variable
INF	p = 0.101 > 5%	Accept hypothesis H_0. The *INF* variable is an exogenous variable
UNE	p = 0.763 > 5%	Accept hypothesis H_0. The *UNE* variable is an exogenous variable

Note: H_0: Exogenous variables; H_1: Endogenous variables.

FGLS method was used to handle violations of heteroskedasticity and autocorrelation.

A final hypothesis of OLS regression is to test the endogeneity of the model. The results of testing endogenous variables for each variable presented in Table 4 show that all variables are exogenous except for the variable *SIZE*, which is endogenous. The article handles the phenomenon of endogeneity using the Sys.GMM method.

The results of testing Table 4 show that the *SIZE* variable is an endogenous variable in the model. The article uses the SysGMM estimation method to handle the endogenous phenomenon of the model. The tests show that the estimated coefficient SysGMM is unbiased and reliable. Specifically, in Table 5, the AR2 test, Sargan test, and Hansen test are greater than 10%; the number of instruments is smaller than the number of groups, all showing that the instrumental variable is appropriate; the estimated coefficient SysGMM is reliable.

Table 5. SysGMM estimation results

ΔLAR	Coefficient	t
L.ΔLAR	0.3910***	4.71
CAP	3.6268**	2.26
SIZE	0.2564**	2.44
ROA	–18.7123**	–2.6
LODE	–0.3039**	–2.41
IRM	–35.6340*	–2.35
GDP	–3.8240***	–2.92
INF	–0.9605	–1.05
UNE	–10.4282*	–1.85
_cons	–2.7029	–1.31
Number of instrumental variables	24	
Number of groups	25	
AR2 test	0.479	
Sargan test	0.149	
Hansen test	0.237	

Note: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Table 5 shows that the *CAP* variable positively impacts ΔLAR and is statistically significant at the 5% level. The estimated results are entirely similar to the research results of Vodová and Stavárek (2017) in Poland, Munteanu (2012), Lei and Song (2013), Vodavá (2013, 2015), and Berger and Bouwman (2009). The results imply that banks with low equity capital are often concerned with liquidity risk management and hold more liquid assets than banks with high equity capital (Vodová, 2013). According to Rose and Hudgins (2008), small banks often apply asset liquidity management by increasing their holdings of highly liquid assets. This liquidity management strategy is considered less risky than asset liquidity management. Therefore, banks with low equity capital are less liquidity-sensitive after the bank-run effect.

The bank's size (*SIZE*) positively impacts ΔLAR and is statistically significant at the 5% level. This result shows that large banks are more sensitive to liquidity after a bank run than small banks. The results agree with liquidity studies such as Diriba and Berhe (2022), and Berrospde (2012). As implied by the "too big to fail" theory, large banks are often relatively passive in managing liquidity risks and rely on government help (Gregoriou, 2009). In addition, once banks hold a lot of liquid assets, they tend to use them mainly to seek profits instead of increasing liquidity protection for potential risks, which is the cause of increased risk for their asset portfolio (Berrospide, 2019). Therefore, when faced with a crisis of mass withdrawals from customers, larger banks will have more difficulty refunding deposits when customers withdraw cash than smaller banks because they manage based on borrowed liquidity, which calls for the bank to purchase or borrow from the money market to cover all of its liquidity needs. Large banks usually prefer a liability management strategy because of the advantages of scale and reputation in the market, which large banks expect to access liquid capital sources efficiently and quickly in the money market (Rose & Hudgins, 2008).

Research results show that the *ROA* variable has a negative effect on ΔLAR and is statistically significant at the 5% level. The results show that banks with good financial performance are less sensitive to liquidity under the impact of bank runs than banks with low financial performance. This result is similar to the results of studies by Vodová and Stavárek (2015, 2017) in Slovakia and is consistent with liquidity theory. Empirical studies show a negative impact on liquidity, implying that a high ROA means a bank has good financial stability, which will help the bank absorb risks better and be less sensitive when faced with the phenomenon of customers withdrawing deposits in bulk.

The ratio of outstanding loans to customer deposits LODE has a negative impact on ΔLAR at the

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5% significance level. This result shows that banks with a higher ratio of outstanding loans to customer deposits often have lower sensitivity to the Bank-run phenomenon. This result coincides with the research results of Vodová and Stavárek (2015, 2017). The higher this LODE, the larger the bank's loan balance is compared to customer deposits. This indicates that the bank is pursuing the goal of increasing profits, increasing financial capacity to absorb risks better, and being less sensitive to risk.

The difference between lending interest rates and IRM deposit interest rates has a negative impact on ΔLAR at the 10% significance level. That means the higher the difference between lending and deposit interest rates, the lower the sensitivity of commercial banks to the Bank-run effect. The research results are similar to the study by Vodová and Stavárek (2017) and the study of liquidity by Vodová (2013). Banks are currency businesses with most of their profits coming from the difference in lending interest rates and deposit interest rates. Therefore, the more significant the interest rate difference, the more profitable the bank will be, leading to increased financial stability. Therefore, when faced with the Bank-run effect, the sensitivity of those commercial banks will be lower.

GDP economic growth rate has an inverse impact on ΔLAR at the 1% significance level. This result means that when the economy is in a period of solid growth, the sensitivity of commercial banks to the Bank-run effect will be lower. This result is similar to the results of research on liquidity by Vodová (2013) in Visegrad countries, Pham (2017), and Diriba and Berhe (2022). During an economic cycle, commercial banks often increase their loans when the economy is growing. Commercial banks must increase their level of liquid assets to ensure risks from loans. Therefore, during this period, the sensitivity of Vietnamese commercial banks to the Bank-run effect is often lower. In addition, during periods of economic recession, commercial banks believe that the demand for money needed by customers will decrease, reducing their precautions against crises related to massive cash withdrawals.

Research shows that rising inflation will limit banks' liquidity sensitivity to bank runs. However, the regression coefficient of the INF variable is not statistically significant, so the paper has no basis for the conclusion.

Research results show that the UNE unemployment rate has a negative impact on ΔLAR. This result means that when the unemployment rate increases, the sensitivity of commercial banks to the Bank-run effect will be lower. The results of liquidity studies by Munteanu (2012) and Diriba and Berhe (2022) support the research results. The unemployment rate represents the economy's demand for loans and money

Table 6. State ownership interaction results

ΔLAR	(1)	(2)	(3)	(4)
L.ΔLAR	0.2047	0.4361***	0.2872**	0.4428***
	[1.71]	[4.80]	[2.34]	[5.03]
CAP	8.9413***	6.9071**	7.1883***	6.3662**
	[4.59]	[2.68]	[2.83]	[2.65]
SIZE	0.6264***	0.4272***	0.6059***	0.3863**
	[4.19]	[2.82]	[3.61]	[2.63]
ROA	–43.8891***	–29.4042**	–35.7017***	–26.6245**
	[–3.90]	[–2.78]	[–3.46]	[–2.72]
LODE	–0.4822*	–0.4684**	–0.6432**	–0.4157**
	[–1.81]	[–2.56]	[–2.58]	[–2.53]
IRM	–16.2137	–43.0625**	–37.9281**	–42.8248**
	[–0.96]	[–2.53]	[–2.31]	[–2.53]
GDP	–2.7815*	–3.8488**	–2.5449	–3.8501**
	[–1.71]	[–2.37]	[–1.66]	[–2.45]
INF	0.269	–0.443	–0.6	–0.368
	[0.24]	[–0.47]	[–0.55]	[–0.40]
UNE	–20.6203***	–12.6671**	–12.0025*	–12.0459*
	[–3.53]	[–2.10]	[–2.01]	[–2.02]

Table 6 (cont.). State ownership interaction results

ΔLAR	(1)	(2)	(3)	(4)
CAP*STATE	–7.1487***	–	–	–
	[–3.02]	–	–	–
SIZE*STATE	–	–0.0319***	–	–
	–	[–4.46]	–	–
ROA · STATE	–	–	–56.1902***	–
	–	–	[–4.56]	–
LODE · STATE	–	–	–	–0.6124***
	–	–	–	[–4.04]
_cons	–9.7272***	–5.6773*	–8.9207***	–4.9775*
	[–3.43]	[–1.90]	[–2.82]	[–1.71]
N	250	250	250	250
AR2	0.440	0.512	0.407	0.512
Sargan	0.203	0.484	0.470	0.371
Hansen	0.208	0.190	0.299	0.196
Number of instrumental	25	25	25	25
Number of groups	25	25	25	25

Note: *significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

(Vodová & Stavárek, 2017). The higher the unemployment rate, the more unemployed people need to withdraw cash to cover their living expenses. Commercial banks will enhance liquidity assurance under the significant withdrawal needs of unemployed people, thereby reducing the sensitivity of commercial banks to situations of massive withdrawals from customers.

The interaction results of State ownership with factors such as CAP, SIZE, ROA, and LODE presented in Table 6 show that State ownership weakens the positive impact of capital and size on sensitivity liquidity after a bank-run (the variables CAP · STATE and SIZE · STATE have negative regression coefficients and are statistically significant at the 1% level). Banks with high state ownership are often trusted and have excellent reputations among customers, so these banks can quickly mobilize abundant and stable deposits from other economic sectors at low mobilization costs. For these reasons, the liquidity sensitivity of capital and size with high State ownership banks decreased after the impact of the bank-run phenomenon. Similarly, the interaction variables ROA · STATE, and LODE · STATE all have negative and statistically significant coefficients, showing that state ownership has strengthened the negative impact of ROA, and LODE on LAR. The results imply that the level of liquidity sensitivity after the effects of the bank-run phenomenon of the factors ROA, and LODE decreases when the state ownership ratio increases. In general, state ownership interaction results show that the state's role in the ownership structure helps banks reduce liquidity sensitivity levels after the impact of bank runs.

CONCLUSION

The article aims to examine the effect of commercial banks' liquidity sensitivity in the aftermath of a bank-run phenomenon. Using data from 25 Vietnamese commercial banks from 2010 to 2022, the Sys.GMM estimation results show: Firstly, the size of equity and total assets are factors that increase a bank's liquidity sensitivity to a bank run. Secondly, financial efficiency, loan-to-deposit ratio, difference between loan interest rates and deposit interest rates are factors that limit a bank's liquidity sensitivity to a bank run. Thirdly, macro factors such as economic growth and rising unemployment rate are factors that reduce banks' liquidity sensitivity to a bank run. Lastly, interestingly, the role of ownership in the ownership structure is a factor that reduces the liquidity sensitivity levels of CAP, SIZE, ROA, and LODE after the impact of the bank-run phenomenon.

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From the research results, some recommendations are implied for bank administrators to focus on liquidity risk management, reducing a bank's liquidity sensitivity to the bank run phenomenon. Specifically, administrators must maintain appropriate liquid assets and comply with regulations on liquidity safety of the Government agency managing banks. In addition, large-scale banks should not be subjective or negligent in liquidity management and need to develop response scenarios when there is a phenomenon of bank run. Government agencies managing banks must strengthen the inspection and supervision of bank liquidity, ensuring banks comply with liquidity regulations. In particular, the Government agency managing banks needs to intervene promptly and effectively when there is a phenomenon of bank run to minimize damage to the economy and quickly stabilize the national financial system.

AUTHOR CONTRIBUTIONS

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Formal analysis: Nam Hai Pham.
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