THE POWER OF SCALE MODERATES FACTORS AFFECTING LIQUIDITY RISK: EVIDENCE FROM AN EMERGING ECONOMY

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Abstract: ***The article examines the impact of factors affecting liquidity risk, explicitly exploring how bank size moderates this relationship. Employing SGMM regression on panel data encompassing 25 Vietnamese commercial banks from 2010 to 2022, the analysis reveals that bank size, credit risk, and reliance on external funding sources elevate liquidity risk levels. Conversely, equity, profitability, and liquid assets mitigate liquidity risks for banks. Notably, the moderation effect of scale demonstrates that bank size plays a crucial role in liquidity risk management, exerting a substantial influence on other factors. The effect of scale overwhelms the impact of profits, capital, credit risk, and external financing on liquidity risk and strengthens the power of liquid assets to reduce liquidity risk. These findings suggest implementing management policies to curb liquidity risks in the bank's operational endeavours.***

• Keywords: *moderate; bank size; liquidity risk; Vietnam.*

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1. Introduction

Customer deposits constitute a significant portion of a bank's total asset. When a bank cannot fulfil its debt obligations as they come due or meet its debt obligations at a cost higher than the market average, it faces liquidity risk (Joel, 2015). The danger lies in the fact that when liquidity risk materializes, it can likely lead the bank to bankruptcy and create a crisis within the banking sector. Realities from the global financial crisis of 2007-2009, the Euro area crisis, and the recent banking crisis in the United States have highlighted the importance of liquidity in financial markets and the banking sector. These events serve as a stark reminder to banks with inadequate liquidity that they must revise their policies to become more adept at minimizing or evading the risk of bankruptcy during similar crises. Regulatory bodies in various countries have introduced numerous banking management regulations to mitigate liquidity risk damaging depositors, the state, and society. In line with this spirit, the Basel Committee on Banking Supervision introduced Basel III, a set of enhanced regulations on liquidity management designed to guide banks to prioritize liquidity risk management because a liquidity shortfall at a single bank can trigger systemic repercussions. In extreme scenarios, a collective surge in liquidity demand can trigger bank runs by depositors, posing a systemic collapse risk (Diamond & Dybvig, 1983). Research by Aiyar (2012) underscores the severe impact of liquidity risk on bank viability.

Numerous factors contribute to liquidity risk, encompassing bank-specific elements like total asset size, capital, credit quality, deposits, and industry-related factors such as industry size and banking concentration. Additionally, macroeconomic factors like economic growth, inflation, and money supply play a role. Various studies, including those by Leykun (2016), Zaghdoudi & Hakimi (2017), and Mohammad et al. (2020), delve into the level and direction of influence exerted by these factors on liquidity risk. Among these factors, scale is considered pivotal. Rose (2008) notes that banks tailor their liquidity management strategies according to their scale, with larger banks often favour borrowing-based approaches while smaller banks opt for asset liquidity management. This article contributes to the ongoing research on liquidity risk factors by investigating how bank size moderates the impact of these factors on liquidity risk. Drawing on data from an emerging economy like Vietnam, the study reveals that bank size profoundly influences the effects of capital, credit risk, profits, liquid assets, and external financing on liquidity risk.

2. Literature review

The academic literature has conducted many studies examining liquidity factors. Goddard et al. (2009)

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argue that larger bank size will reduce bank liquidity. Large-scale banks often tend to be more adventurous, boldly accepting investments in profitable assets with high risk and the expectation of increasing profits. Venture investment leads to potential risks, especially banks' liquidity risk. However, the study of Akhtar et al. (2011) had the opposite result, showing that bank size positively correlates with creating liquidity, implying that the larger the bank's total assets, the more liquidity and reduced liquidity risk. Like this argument, Mugenyah's (2015) study of liquidity in Kenyan banks found that bank size negatively influences liquidity risk. The more significant the asset scale, the more competitive advantages the bank has in the market that reduce liquidity risk. Zaghdoudi & Hakimi (2017) used data from 10 Tunisian banks observed between 1990 and 2015 to study the determinants of liquidity risk. The estimation results show that the size of Tunisian banks has a negative and significant impact on liquidity risk. Large banks face less liquidity risk than small banks. The larger the scale of banks, the better their liquidity position and the lower their liquidity risk (Ahamed, 2021). Another line of argument is the study of Jedidia et al. (2015), which studied the determinants of Islamic banks' liquidity risk in MENA and Southeast Asian countries from 2004 to 2012. This study argued that bank size probably does not matter because Islamic banks, large and small, face difficulty managing liquidity risks.

Between profits and liquidity, Berger's (1995) research shows that banks with low profits will focus on investing in high-risk portfolios to improve profits. They have the motivation to reduce the proportion of liquid assets, increase the proportion of earning assets and accept high liquidity risks. Meanwhile, banks with high profits will focus on safety and limit excessive credit growth, enhancing more liquid assets (Bunda & Desquilbet, 2008). The bank's equity is guaranteed to build customer trust, promote Public Confidence, provide Funds for Growth, and give a Cushion Against the Risk of Failure. Vodová's (2011) study identifies the determinants of liquidity of commercial banks in the Czech Republic from 2001 to 2009, showing that bank liquidity increased with higher capital adequacy. Mugenyah (2015) examined the factors determining liquidity risk for 43 commercial banks in Kenya from 2010 to 2014. The regression analysis results show that the capital adequacy ratio positively impacts liquidity. Leykun's (2016) study on the determinants of liquidity risk of commercial banks in Ethiopia provided analytical results showing that capital adequacy ratio, loan scale and mobilization negatively affect liquidity risk. These variables are considered the most critical factors determining the liquidity position of commercial banks. Studies argue that if banks maintain stable equity capital, that guarantees the bank's liquidity, and a decline in equity capital can cause a lack of liquidity and lead to failure. In addition to factors demonstrating financial capacity, loan scale greatly influences liquidity. If banks focus a lot on lending and seeking profits, they are ready to lower credit conditions when they expand the loan scale. The significant credit growth leads to encountering more bad customers, thereby increasing credit risk. In addition, excessive lending expansion, taking off all mobilized sources, causes a liquidity shortage. Some studies have recommended that banks have measures to balance mobilization, credit, and profit goals (Goddard et al., 2009; Plochan, 2007; Goodhart, 2008).

The macroeconomic environment has a significant impact on bank liquidity. Lucchetta (2007) analyzes how interest rates affect banks' risk-taking and liquidity-holding decisions in European countries. The financial crisis on the liquidity of commercial banks in Latin American and Caribbean countries suggests that cyclical downturns will reduce banks' expected demand for transaction funds and thus lead to reduced liquidity (Moore, 2009). On the contrary, in a booming economy, the demand for loans from individuals and businesses increases. Banks expand their credit scale to increase their opportunities to seek profits, which will cause them to face liquidity problems (Al-Homaidi, 2019; Gautam, 2016; Vodova, 2011). A study by Sheefeni & Nyambe (2016) on the macroeconomic determinants of commercial bank liquidity in Namibia found a negative relationship between inflation and liquidity, while the relationship between gross domestic product and liquidity is positive. Results imply that economic development increases the mobilization capacity of banks to provide capital for the needs of the financial market (Naoaj, 2023). On the contrary, high inflation causes banks to reduce rates of return in terms of money and asset holdings. Inflation causes a redistribution of income that favours borrowers and disadvantages lenders. Inflationary pressures make banks limit credit and hold more liquid assets, reducing the bank's liquidity risk (Zaghdoudi & Hakimi, 2017; Tan & Kong, 2018; Ahamed, 2021).

Empirical studies show that bank-specific and macro factors affect bank liquidity, but studies have not considered the impact of scale on this relationship. The research results presented below show exciting things about the regulation of scale. Bank size can change the influence of profits,

capital, credit risk, and external funding sources on liquidity risk.

3. Research models

First, the article examines internal and external factors affecting bank liquidity using equation (1). The next step is to perform the role of scale as a moderate variable in the relationship of factors with liquidity using equation (2).

$$FGAP_{it} = \lambda_0 + \lambda_1 SIZE_{it} + \lambda_2 ROE_{it} + \lambda_3 CAP_{it} + \lambda_4 LTR_{it} + \lambda_5 LAR_{it} + \lambda_6 EFD_{it} + \lambda_7 GDP_t + \lambda_8 INF_t + e_{it} \quad (1)$$

$$FGAP_{it} = \beta_0 + \beta_1 SIZE_{it} + \beta_2 ROE_{it} + \beta_3 CAP_{it} + \beta_4 LTR_{it} + \beta_5 LAR_{it} + \beta_6 EFD_{it} + \beta_7 SIZE*ROE_{it} + \beta_8 SIZE*CAP_{it} + \beta_9 SIZE*LTR_{it} + \beta_{10} SIZE*LAR_{it} + \beta_{11} SIZE*EFD_{it} + \beta_{12} GDP_t + \beta_{13} INF_t + \varepsilon_{it} \quad (2)$$

The dependent variable is the funding gap (FGAP), representing the bank's liquidity, measured by the difference between outstanding credit and deposits. Banks with wide funding gaps represent high liquidity risks and vice versa. Independent variables include bank size (SIZE), return on equity (ROE), equity size (CAP), and loan size (LTR) representing credit risk, high liquidity asset (LAR), and external funding source (EFD). The model uses macroeconomic growth (GDP) and inflation (INF) as control variables.

4. Research hypotheses

Based on previous studies, the article makes the following hypotheses.

Hypothesis H1: Bank size (SIZE) has a positive impact on liquidity risk.

Hypothesis H2: Profitability (ROA) has a negative impact on liquidity risk.

Hypothesis H3: The effect of capital (ROE) on liquidity risk is positive

Hypothesis H4: Credit size (LTR), representing credit risk, positively impacts liquidity risk.

Hypothesis H5: A high liquidity assets ratio (LAR) is negatively related to liquidity risk.

Hypothesis H6: External financing (EFD) is positively related to liquidity risk.

5. Data sources and descriptive statistics

Data was collected from audited financial statements of 25 Vietnamese commercial banks from 2010 to 2022. The data obtained is strongly balanced panel data, with 300 observations. The statistical description table (Table 1) shows the mean, standard deviation, minimum, and maximum values of the equation (1) variables. Specifically, the liquidity gap (FGAP) has an average value of -0.0827, showing that the average level of loans is higher than deposits. The Mean of FGAP assesses that the banking system is generally in a state of liquidity shortage and high liquidity risk. However, the maximum value is 0.5450, and the minimum value is -0.3856, showing that some banks have pretty high liquidity and some banks have a significant liquidity shortage, so there is a need to regulate their liquidity. For bank size (SIZE variable), the average value is 18.7065, the smallest value is 16.5136, and the maximum value is 21.4749, showing that the number of small-sized banks is more than that of large-sized banks.

Table 1. Statistical description of variables

Variables	Obs	Mean	Standard deviation	Minimum	Maximum
FGAP	300	-0.0827	0.1190	-0.3856	0.5450
SIZE	300	18.7065	1.1697	16.5136	21.4749
ROE	300	0.0955	0.0862	-0.8200	0.2682
CAP	300	0.0946	0.0598	0.0406	0.9077
LTR	300	0.5649	0.1224	0.1448	0.7880
LAR	300	0.0100	0.0088	0.0025	0.0846
EFD	300	0.6418	0.6649	0.0000	4.2489
GDP	300	0.0589	0.0154	0.0258	0.0802
INF	300	0.0509	0.0447	0.0063	0.1868

6. OLS regression pretests

The article tests Variance Inflation Factors (VIF), correlation matrix and normal distribution to control multicollinearity and normal distribution of residuals, ensuring that model regression results are unbiased and reliable. The variance inflation factor has functions to measure the correlation and strength of the correlation between variables in the model. Last row belowTable 2 presents the results of the largest VIF being 1.51 (SIZE) and the smallest being 1.02 (GDP), with the mean of 1.21 being less than 10; these values indicate that multicollinearity does not occur in the model (1).

Table 2. Correlation matrix

Biến	FGAP	SIZE	ROE	CAP	LTR	LAR	EFD	GDP	INF
FGAP	1								
SIZE	0.1822***	1							
ROE	0.2830***	0.4862***	1						
CAP	0.0668	-0.2402***	-0.1004	1					
LTR	0.5046***	0.3589***	0.2923***	-0.0048*	1				
LAR	-0.0291	0.0148*	0.0526*	0.0422	-0.0541	1			
EFD	0.0387*	0.0658*	0.0281**	-0.1819***	-0.3064***	-0.1078*	1		
GDP	-0.0788*	-0.0414	-0.0419	0.0455*	-0.0698*	0.0119	-0.0019	1	
INF	0.2156***	0.1175*	0.2006***	-0.0201*	0.0967	-0.0346	-0.0886*	0.0832*	1
VIF	(Mean 1.21)	1.51	1.39	1.10	1.37	1.03	1.21	1.02	1.07

*Note: *,**,***: indicate the statistical significance at 10%, 5% and 1%.*

The correlation coefficient is a statistical measure of the strength of the relationship between two variables. The correlation matrix results (Table 2) show that the correlation between pairs of variables in

the model (1) is relatively low. The highest is 0.5046, lower than the allowed level of 0.8. Thus, the level of pairwise correlation does not seriously affect the regression results.

7. SGMM estimation

The author uses the System Generalized Method of Moments (SGMM) to control and handle the phenomenon of variance, autocorrelation and endogenous variables of the model. The SGMM estimation results (Table 3) are unbiased and stable by the AR(2) test, Hansen test, and Sagan test; all have P-values> 10%, and the number of instrumental is less than or equal to the number of groups. Therefore, the following discussion based on the estimation results presented in Table 3 is reliable.

Table 3. SGMM estimation results

Dependent Var.: FGAP	(1) Model 1	(2) SIZE*ROE	(3) SIZE*CAP	(4) SIZE*LTR	(5) SIZE*LAR	(6) SIZE*EFD
L.FGAP	0.5447***	0.3533**	0.1069	0.4183***	0.3617***	0.4951***
	(0.000)	(0.013)	(0.555)	(0.000)	(0.001)	(0.002)
SIZE	0.0534**	-0.0497	0.1654***	0.1912**	0.1494***	0.0196
	(0.017)	(0.133)	(0.002)	(0.013)	(0.000)	(0.013)
ROE	-0.7159**	-12.1478***	-0.7874*	-0.0860	-0.1077***	-0.1491
	(0.054)	(0.002)	(0.096)	(0.662)	(0.563)	(0.588)
CAP	0.1896	0.0609	-18.0443**	-0.2330	0.0881	-0.1954*
	(0.366)	(0.807)	(0.020)	(0.339)	(0.753)	(0.072)
LTR	1.1163 ***	0.6995***	0.9952***	5.4887**	0.6038***	0.3870**
	(0.000)	(0.001)	(0.000)	(0.014)	(0.004)	(0.024)
LAR	-8.7515**	-7.6154*	-11.5872*	-7.3743**	-12.5606***	-5.0544*
	(0.036)	(0.056)	(0.055)	(0.034)	(0.006)	(0.061)
EFD	0.1922***	0.0903***	0.1558***	0.0952***	0.1113**	1.0326**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.027)
GDP	-0.3340	-0.3437	-0.8371*	-0.0791	-0.5597*	-0.4536*
	(0.140)	(0.253)	(0.056)	(0.654)	(0.088)	(0.003)
INF	0.5312***	0.5852***	0.6399***	0.4347***	0.2426*	0.1528**
	(0.004)	(0.001)	(0.002)	(0.003)	(0.070)	(0.049)
SIZE*ROE		0.6258***				
		(0.002)				
SIZE*CAP			0.8732**			
			(0.019)			
SIZE*LTR				-0.2586**		
				(0.025)		
SIZE*LAR					-11.2834***	
					(0.005)	
SIZE*EFD						0.0570**
						(0.024)
_cons	-1. 6641***	-0.4755	-3.8271***	-3.9938***	-3.2643***	-0.5660
	(0.000)	(0.530)	(0.001)	(0.008)	(0.000)	(0.442)
Number of observations	275	275	275	275	275	275
Number of instruments	23	22	22	23	23	23
Number of groups	25	25	25	25	25	25
AR(2) test	0.981	0.459	0.652	0.889	0.847	0.713
Sagan test	0.730	0.610	0.726	0.324	0.322	0.303
Hansen test	0.625	0.494	0.703	0.193	0.553	0.739

*Note: *,**,***: indicate the statistical significance at 10%, 5% and 1%.*

Bank size effect on liquidity risk

The estimated model results indicate that bank scale has a statistically significant positive impact on liquidity risk at a 5% significance level. With this outcome, the alternative hypothesis (H1) is accepted. The research findings suggest that as the scale of a bank increases, its liquidity decreases. Larger banks tend to expand lending activities to enhance profit-seeking opportunities by concentrating resources on profitable assets. Leveraging their reputation and scale advantage, they borrow when liquidity needs arise, widening the liquidity gap and consequently increasing liquidity risk.

Bank size moderates effect of financial performance on liquidity risk

The estimation results in Table 3, column 1, reveal an inverse relationship between profitability (ROE variable) and liquidity risk. The implication is that banks with higher profits serve as internal liquidity providers, thereby reducing liquidity risk. Furthermore, the results in Table 3, column 2, regarding the variable *SIZE**ROE demonstrate statistical significance, indicating that bank size moderates the impact of financial efficiency on liquidity risk. The positive coefficient of the SIZE**ROE* variable suggests that the effect of scale amplifies the positive effect of economic efficiency, resulting in a simultaneous positive impact of the SIZE*ROE variable. This finding indicates that although banks rely on retained profits to mitigate liquidity risk, the strategic choice of leverage-based liquidity management holds greater significance.

Bank size moderates effect of bank equity on liquidity risk

The research model results indicate that the scale of equity capital has an inverse impact on bank liquidity risk, aligning with hypothesis H3. A larger equity capital scale reflects the bank's financial capacity, serving as the basis for banks to enhance their reputation in external capital mobilization, promptly offsetting liquidity when necessary, thus reducing liquidity risk. However, the variable *SIZE**CAP demonstrates statistical significance, evidencing the moderating effect of bank scale on the strength of the impact of capital on liquidity risk. Once again, the positive interaction term of SIZE**CAP* demonstrates the more substantial impact of scale on liquidity risk than capital alone. It also reinforces the strength of liquidity strategy relying on borrowing, holding fewer liquid assets, concentrating resources on income-generating assets, and accepting higher liquidity risk.

Bank size moderates effect of credit scale on liquidity risk

The research findings reveal that the scale of credit (LTR variable) has an inverse impact on bank

liquidity risk with a statistically significant level of 1%, yielding a positive regression coefficient, thus supporting hypothesis H4. A bank with a large credit scale experiences heightened credit risk, consequently escalating liquidity risk, indicating a strong influence of credit risk on liquidity risk. Banks pursuing profit goals increase their credit scale since lending activities constitute a primary income source. However, expanding lending exposes banks to the risk of encountering bad borrowers with poor repayment capabilities, elevating credit and liquidity risks. The interaction variable LTR*SIZE reflects the moderating effect of scale on the relationship between credit risk and liquidity risk, displaying a negative regression coefficient with a statistically significant level of 1%. The interaction variable results indicate that larger banks mitigate the spill-over effect of credit risk on liquidity risk. Leveraging their substantial scale, these banks establish a solid financial foundation to reduce the likelihood of liquidity risk as they expand their lending scale. In practice, it's observed that larger banks, when increasing their lending scale, allocate more financial resources to lending rather than focusing on liquid assets. Bank liquidity primarily relies on borrowing from the market, and with large scale, banks efficiently pursue this liquidity management strategy.

Bank size moderates effect of liquidity asset on liquidity risk

The research model results indicate that liquidity assets (LAR variable) have an inverse impact on FGAP, demonstrating that when banks hold more liquid assets, the bank's liquidity risk decreases, aligning with hypothesis H5. However, the interaction variable SIZE*LAR results are negative and statistically significant, revealing an intriguing implication. It suggests that larger banks are more likely to face higher liquidity risk than smaller ones. However, when large banks implement liquidity management policies by increasing reserves of highly liquid assets, the bank's liquidity risk is likely to decrease. Cash and cash equivalents, deposits at central banks, are always considered the most liquid assets, ensuring the bank's financial strength for payment commitments. However, liquidity assets and profitability are two factors that trade-off against each other. Holding too many liquid assets may force the bank to reduce income-generating assets, depleting resources for profit-seeking business operations and thus diminishing financial efficiency.

Bank size moderates effect of external funding on liquidity risk

The research model's results indicate that external borrowing has a positive impact on bank liquidity risk, with a statistically significant level of 5% and a regression coefficient of 1.0326. This finding is consistent with hypothesis H6. However, the interaction variable SIZE*EFD exhibits statistical significance, revealing the moderating effect of bank size on the influence of external funding dependence (EFD) on liquidity risk. The positive coefficient of the SIZE*EFD variable suggests that larger banks face higher liquidity risk when they rely more on external funding sources.

8. Conclusion and recommendations

Using the SGMM estimation method on data from 25 commercial banks from 2010 to 2022, the article assesses the regulatory role of scale on liquidity risk factors. The estimation results indicate that factors increasing liquidity risk include bank scale, credit risk, and external funding sources, while capital, profitability, and liquidity assets help banks mitigate liquidity risk. Intriguing implications emerge when employing scale as a moderator variable in the relationship between capital, credit risk, profitability, liquidity assets, external funding sources, and liquidity risk.

Firstly, although profitability reduces a bank's exposure to liquidity risk, the magnifying effect of scale on liquidity risk remains more significant than the impact of profitability. *Secondly,* while capital provides a buffer against failure risk, bank scale predominates the influence of capital on liquidity risk. *Thirdly,* the bank scale can alleviate the pressure of credit risk on liquidity risk. *Fourthly,* as larger banks bolster investments in liquid assets, they face fewer liquidity risks. *Fifthly,* reliance on external funding sources increases the likelihood of liquidity risk emergence for banks, with more severe liquidity risks observed in larger banks.

Based on these findings, the author recommends that commercial banks enhance scale by augmenting equity capital, retaining profits, or merging to leverage scale advantages, thus improving competitiveness and minimizing liquidity risk.

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