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Impact of Geographical Diversification on Bank Liquidity: Empirical Evidence from Vietnamese Commercial Banks

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Abstract

This study investigates the effects of geographical diversification on liquidity within Vietnamese commercial banks from 2008 to 2023. Using panel data regression methods, including fixed-effects regressions to measure the relationship between bank liquidity, geographical diversification, and control variables, the generalized method of moments (GMM) to address endogeneity issues, and quantile regression to assess whether this interaction differs across different quantiles of bank liquidity, we present empirical evidence regarding the relationship between bank liquidity and geographical diversification. These findings indicate that geographical diversification reduces bank liquidity, as banks expanding into various locations complicate liquidity management due to differing economic conditions and regulations. Furthermore, inefficiencies in monitoring and resource allocation among geographically dispersed branches may intensify liquidity limitations, necessitating the adoption of strong risk management measures by banks. Nonetheless, for banks that have an abundance of liquidity, much of the adverse effect is ameliorated compared to those with less liquidity, suggesting that banks experiencing low liquidity would find it more difficult to manage liquidity across branches that are spread over a wide area. The study provides important practical implications for bank management and policymaking, including (i) developing stricter risk management strategies when expanding bank branch networks to maintain stable liquidity and (ii) establishing appropriate supervisory frameworks to mitigate liquidity risks arising from geographical diversification.

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1. Introduction

In the context of international integration and rapid economic development, Vietnam's commercial banking system plays a crucial role in promoting growth and ensuring stability in the financial sector. Following the 2008 financial crisis, the significance of liquidity has become a primary concern in discussions about financial stability. Liquidity, which refers to the capacity to fulfill short-term financial obligations, is essential for the continuous operation of commercial institutions. A significant number of previous scholars have investigated both bank-specific indicators and macroeconomic variables that affect bank liquidity. The factors include bank size (Bonner, van Lelyveld, & Zymek, 2015; Roman & Sargu, 2015), bank profitability (Rauch, Steffen, Hackethal, & Tyrell, 2010; Roman & Sargu, 2015), the capital-to-total assets ratio (Berger & Bouwman, 2009; Vodova, 2013), the cost-to-income ratio (Bourke, 1989), GDP growth (Trenca, Petria, & Corovei, 2015; Vodova, 2013)

and inflation (Moussa, 2015; Vodova, 2013). The expansion of a bank is significantly influenced by the maintenance of adequate liquidity, which is essential for promoting trust among clients and stakeholders, as well as for preventing financial crises. The geographic diversification strategies employed by Vietnamese commercial banks present various concerns related to their effects on liquidity.

Geographic diversification indicates a strategic approach aimed at expanding commercial activities across several locations. This approach reduces concentration risk while also leveraging emerging opportunities. In Vietnam, this trend is becoming more prominent as numerous commercial banks are broadening their branch networks both domestically and internationally, as shown by Vietinbank's establishment of a branch in Germany. The primary objectives are to broaden opportunities in the market, reduce concentration risk, and enhance operational efficiency. However, this strategy has challenges, particularly in managing liquidity across locations with differing economic situations, regulatory frameworks, and infrastructure. Banks must adapt their liquidity management strategies to address diverse risks, such as exchange rate volatility, inflation, and macroeconomic influences that may impact cash flows and total liquidity.

Despite its considerable significance, there are certain research gaps that this study aims to fill. Initially, studies on the effects of geographical diversification on bank liquidity in the context of Vietnam remain limited. The Vietnamese banking system is experiencing rapid expansion and structural transformation, leading to a thorough examination of the impact of geographical diversification on liquidity to accommodate the country's different regulatory framework, business conditions, and financial infrastructure, as international study findings are not directly applicable. Furthermore, considering that Vietnamese commercial banks are facing macroeconomic volatility and the implementation of international liquidity management standards such as the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), a country-specific analysis will facilitate the integration of theory and practice. Secondly, most of the prior research has neglected the timeframe from 2008 to 2023. Assessing the influence of geographical diversification on liquidity during this period is essential, since it includes substantial changes in Vietnam's banking system, such as post-financial crisis recovery, regulatory changes, and the global expansion of commercial banks. This study will provide updated evidence to help policymakers and bank managers in dealing with the changing financial environment, thus ensuring liquidity stability and sustainable development.

Consequently, examining the impact of geographic diversification on commercial bank liquidity from 2008 to 2023 is both a critical need and an approach to enhance operational efficiency and promote the sustainable development of Vietnam's financial system. Besides the introduction, the rest of the paper is structured as follows: Section 2 presents the theoretical foundation of geographic diversification and a review of studies on its impact on bank liquidity; Section 3 highlights the research methodology applied; Section 4 summarizes key findings and results of the study. Finally, conclusions and policy implications are discussed in Section 5.

2. Literature Review

2.1. Geographical Diversification

Chandler (1990) argued that diversification represents a strategy that allows a business to leverage the required scale and scope for achieving swift growth in the modern age. Nachum (2004) highlighted that diversification plays a vital role in boosting a company's operational efficiency and fostering growth. Geographical diversification stands out as an important strategy for businesses among the different options available (Subramaniam & Wasiuzzaman, 2019). Geographical diversification, often referred to as related diversification, involves a company broadening its operations across various locations, regions, or countries to tap into different markets (Wasiuzzaman, 2020). Geographical diversification refers to a type of corporate diversification in which a business expands its operations into various locations, markets, or countries. This approach enables companies to take advantage of growth opportunities and improve operational efficiency by utilizing their size and range to achieve quick expansion in today's world.

Expanding into different geographical areas can bring advantages as well as difficulties for companies. From a resource-based viewpoint, a firm that operates in various locations can effectively distribute its resources across different countries, industries, and markets. Numerous countries offer chances for companies to leverage their strengths, allowing them to reach economies of scale and enhance their operational efficiency (Mishra & Akbar, 2007). Martin and Sayrak (2003) pointed out that these competitive advantages enable businesses to create internal capital markets, which allow firms within a diversified group to share resources instead of depending on imperfect external capital markets. When businesses use their own resources, they can reduce transaction costs and build management skills and specialized knowledge, which turn into valuable intangible assets (Lins & Servaes, 2002). Conversely, Chen and Yu (2012) highlighted that firms with geographic diversification encounter difficulties in coordinating their operations, experience heightened information asymmetry, and deal with misaligned incentives across various business units. Agency theory, as explored by Kali and Sarkar (2011) suggests that companies might engage in diversification not solely for the purpose of creating value, but also driven by motives related to "empire-building." When agency conflicts arise within a company, it can lead managers and controlling shareholders to pursue diversification that serves their own interests instead of focusing on what benefits all shareholders collectively. This indicates that diversification may occasionally be sought for personal benefits instead of focusing on creating value for shareholders (Phung & Mishra, 2016).

Additionally, diversification comes with its own set of costs and benefits, and in certain situations, the costs involved might surpass the benefits, resulting in adverse effects of geographical diversification (Wasiuzzaman, 2020).

2.2. Bank liquidity

Valla, Saes-Escorbiac, and Tiesset (2006) stated that liquidity is the ability of a financial institution to meet its financial obligations as they come due. This includes managing customer withdrawals, fulfilling payment commitments, and participating in short-term asset transactions. The role of liquidity is critical in assuring the financial stability of a bank's operations. Furthermore, Diamond and Dybvig (1983) developed a theoretical framework that demonstrates the significance of liquidity in banking, emphasizing its role in protecting banks from short-term liquidity risks. They also proposed that a bank could face a liquidity crisis if customers or investors were to lose confidence and simultaneously demand withdrawals or liquidate assets, leading to a situation where the bank does not possess sufficient cash to meet these obligations. Similarly, Ivashina and Scharfstein (2010) contended that liquidity should not merely be viewed as a "fallback" option in times of crisis; rather, it is instrumental in influencing a bank's operational efficiency and strategic decisions. Financial institutions typically maintain an important amount of cash reserves and readily accessible assets to ensure they possess stable liquidity. Acharya, Shin, and Yorulmazer (2011) emphasized the importance of bank liquidity, referred to as funding liquidity, from the perspective of economic entities such as corporations, banks, or individuals, underscoring its critical role in financial stability and risk management.

2.3. Impact of Geographical Diversification on Bank Liquidity

Research findings have shown that spreading operations across various regions can enhance bank liquidity by offering more consistent cash flow and sources of capital. Wasiuzzaman (2020) indicated that geographic diversification enables a company to reduce its dependence on external capital markets. This approach promotes the establishment of internal capital markets and allows the maintenance of substantial cash reserves, thereby positioning the firm to capitalize on investment opportunities. This additionally lowers transaction costs and enhances liquidity. Furthermore, organizations can manage their working capital more efficiently, reducing unnecessary excess liquidity while simultaneously enhancing their overall liquidity in the process. Acharya, Hasan, and Saunders (2006) conducted a study that revealed banks with loan portfolios spread across various geographic regions are likely to experience more stable cash flows during times of market turbulence. When a region encounters economic challenges, the revenue from other areas can act as a cushion, helping to balance out the losses or drops in profitability in the struggling regions. In a similar vein, Goetz, Laeven, and Levine (2016) pointed out how the differing economic cycles in various regions help reduce cash flow volatility for banks. Because different regions can face varying economic conditions and cycles, a decline in one area can be offset by growth or stability in another, helping to maintain a more stable cash flow for banks.

Thus, geographical diversification enables banks to sustain stable cash flows due to the asynchrony of economic cycles across different regions. When one region experiences a downturn, others can offset the losses, thereby increasing bank liquidity (Acharya et al., 2006; Goetz et al., 2016; Wasiuzzaman, 2020). Based on this, the research hypothesis is proposed as follows:

H_{1a}: Geographical diversification has a positive impact on bank liquidity.

Conversely, various studies indicate that geographical diversification could heighten liquidity risk for banks. Managing, operating, and controlling branches in various regions can create financial strain for banks, especially in tough economic times. According to Berger and Udell (2006), banks that are expanding into new regions usually face difficulties arising from information asymmetries, with a largely incomplete picture of the financial standing and credit risks of customers in these areas. This could result in adverse credit allocation and a subsequent increase in liquidity risk as the recovery of nonperforming loans becomes more difficult. In the same vein, Mian (2006) pointed out that geographical diversification might increase transaction costs, especially in markets with low transparency and high credit risk. As banks expand into new areas, they might face difficulties in managing cash flow and recovering debts. This situation can increase the possibility of experiencing liquidity shortages, particularly if robust risk management strategies are not implemented. A notable risk that banks face when they venture into new regions is information asymmetry (Froot & Stein, 1998). In international or emerging markets, banks often encounter difficulties related to a lack of adequate information concerning financial conditions, economic factors, and customer credit behaviours. The prediction and assessment of credit risk have become progressively more complex due to the disparities in legal frameworks, banking practices, and financial markets. Lack of adequate information may lead to suboptimal lending decisions, heightened credit risk, and adverse effects on the liquidity of financial institutions.

Thus, geographical diversification increases operational risks and information asymmetry risks, particularly in new regions with low transparency. This can result in inaccurate credit decisions, difficulties in debt recovery, and heightened liquidity risks (Berger & Udell, 2006; Froot & Stein, 1998; Mian, 2006). Based on this, the authors propose the alternative hypothesis as follows:

H_{1b}: Geographical diversification has a negative impact on bank liquidity.

3. Research Methodology

3.1. Research Data

The study utilizes an unbalanced panel dataset of 27 Vietnamese commercial banks from 2008 to 2023, comprising 324 firm-year observations. The 2008 Global Financial Crisis brought significant challenges to the financial system. By 2023, the COVID-19 pandemic and global geopolitical issues had impacted Vietnam's banking sector as well. Many important and minor events from 2008 to 2023 show how Vietnamese commercial banks adjusted to these changes. After joining the WTO, Vietnam became more integrated into the global economy, leading to expanded branch networks and changes in liquidity management. The restructuring policies from 2011 to 2015, along with the push for digitalization, have influenced how banks approach their geographical diversification strategies.

Data were collected from the FiinPro database. Additionally, Stata 17 software was employed to conduct quantitative analyses on the relationship between geographical diversification and the liquidity of Vietnamese commercial banks. We winsorized the variables at 1st and 99th percentiles to remove the effects of outliers in our data.

3.2. Variable Constructions

3.2.1. Geographical Diversification

Many scholars have proposed various methods for measuring geographical diversification. Wasiuzzaman (2020) applies revenue-based methods to measure geographical diversification using the following formula:

$$\text{Geographical Diversification} = 1 - \sum(sales\ by\ branch\ /total\ sales)^2$$

The study by Brammer, Pavelin, and Porter (2006) measures geographical diversification based on the total number of branches a firm operates. According to this approach, a firm with more branches is considered to have a higher level of geographical diversification. Measuring geographical diversification using the total number of branches per year may be superior to revenue-based methods, as it provides greater stability and is less affected by revenue fluctuations over time. Therefore, this study adopts the branch count method, using the total number of domestic and foreign branches of banks, to measure the geographical diversification of each bank annually.

3.2.2. Bank Liquidity

Additionally, numerous scholars have proposed various methods for measuring bank liquidity. One widely used approach is measuring liquidity through the amount of available cash in the bank, where a higher cash reserve indicates greater liquidity (Wasiuzzaman, 2020). Furthermore, Ivashina and Scharfstein (2010) propose the following formula to measure a bank's funding liquidity.

$$\text{Loan-to-Deposit Ratio} = \frac{Total\ Loans}{Total\ Deposits}$$

The Loan-to-Deposit Ratio (LTD) measures the relationship between a bank's loans and deposits and is a key indicator of bank liquidity (Ivashina & Scharfstein, 2010). A high LTD ratio indicates that the bank is utilizing most of its deposits for lending, which can increase liquidity risk and reduce overall liquidity (Ivashina & Scharfstein, 2010). This study adopts the LTD ratio as a measure of bank liquidity, as it reflects the extent to which a bank's mobilized funds are used for lending, thereby assessing the bank's ability to meet customer withdrawal demands.

3.2.3. Control Variables

The control variables in the model are measured as follows: LNSIZE is the natural logarithm of a bank's total assets, reflecting the bank's size (Roman & Sargu, 2015). ROA is calculated as the ratio of net profit to total assets, representing the bank's profitability (Roman & Sargu, 2015). EA is the ratio of equity to total assets, indicating the bank's capital adequacy (Berger & Bouwman, 2009). CIR is measured as the ratio of operating expenses to total operating income, reflecting the bank's cost efficiency (Bourke, 1989). GDP represents the GDP growth rate, indicating the country's economic growth during a given period (Trenca et al., 2015). Finally, CPI is measured by the growth rate of the Consumer Price Index (CPI), representing the inflation rate and changes in the general price level of goods and services in the economy (Moussa, 2015).

3.3. Research Models

To conduct the quantitative analysis of geographical diversification and liquidity in Vietnamese commercial banks, after reviewing the studies of previous scholars, the study proposes the following equation. The detailed measurement of variables is presented in Table 1.

$$LTD_{i,t} = \beta_0 + \beta_1 LNGDI_{i,t} + \beta_2 LNSIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 EA_{i,t} + \beta_5 CIR_{i,t} + \beta_6 GDP_{i,t} + \beta_7 CPI_{i,t} + \varepsilon_{i,t} \quad (1)$$

In Equation 1, the dependent variable is the loan-to-deposit ratio of banks. The test variable is the natural logarithm of the number of domestic and foreign branches of banks. Control variables are defined in Table 1. We apply different model specifications including pooled OLS (POLS), fixed effect model (FEM), and random effect model (REM) as they are widely used in panel data analysis, allowing for the control of individual effects and assessing the impact of independent variables on bank liquidity. The Generalized Method of Moments

(GMM) is employed to address endogeneity issues and ensure the consistency of estimations. The Method of Moments Quantile Regression (MMQR) is applied to analyze the relationship between geographical diversification and bank performance at different levels of liquidity, helping to detect asymmetries and provide more accurate results compared to traditional OLS regression. After conducting regression analysis, along with tests to select the appropriate model and check for model deficiencies, we make necessary adjustments and corrections to enhance the predictive accuracy of the models.

Table 1. Variables descriptions.

Variable's name	Variable's acronym	Measurement
Dependent variable		
Bank liquidity	LTD	LTD = $\frac{Total\ Loans}{Total\ Deposits}$
Independent variables		
Geographical diversification	LNGDI	Ln (Number of domestic and foreign branches of bank)
Bank size	LNSIZE	LNSIZE = Ln (Total assets)
Return on assets	ROA	ROA = $\frac{Net\ Income}{Total\ Assets}$
Equity to total assets ratio	EA	EA = $\frac{Equity}{Total\ Assets}$
Cost to income ratio	CIR	CIR = $\frac{Total\ Operating\ Cost}{Total\ Income}$
Gross domestic products	GDP	Annual growth rate of gross domestic product (GDP) (Collected from the database of the general statistics office)
Inflation	CPI	Annual growth rate of the consumer price index (CPI) (Collected from the database of the general statistics office)

4. Research Results

4.1. Descriptive Statistics

The results of the study's descriptive statistical analysis are presented in Table 2. Specifically, the LNGDI index measuring the level of geographical diversification ranges from 4.2195 to 6.9985, with a standard deviation of 0.7796. The average value of LNGDI is 5.3543. Meanwhile, LTD has an average value of 0.8005, ranging from 0.5207 to 1.0777, with a standard deviation of 0.1469.

Table 2. Descriptive statistics.

Variables	Obs.	Mean	Std. dev.	Min.	Max.
LTD	324	0.801	0.147	0.521	1.078
LNGDI	324	5.354	0.777	4.220	6.999
LNSIZE	324	32.664	1.096	30.693	34.723
ROA	324	0.010	0.006	0.001	0.023
EA	324	0.087	0.031	0.051	0.162
CIR	324	0.497	1.136	0.301	0.783
GDP	324	5.771	1.477	2.580	8.020
CPI	324	4.642	4.116	0.190	18.130

High correlation between variables can cause multicollinearity, affecting the effectiveness of the estimator. According to Kennedy (2008), correlation is strong when the absolute coefficient exceeds 0.8 or 0.9, and Anderson, Williams, and Cochran (1996) suggest that multicollinearity occurs when the coefficient is above 0.7. The results of Table 3 show that no pair of variables has a linear correlation coefficient exceeding 0.9, suggesting that the data does not encounter multicollinearity and the level of correlation between variables is within the acceptable limits, positively affecting the selection and testing of the model.

Table 3. Correlation matrix.

Variables	LTD	LNGDI	LNSIZE	ROA	EA	CIR	GDP	CPI
LTD	1.000							
LNGDI	0.400	1.000						
LNSIZE	0.390	0.567	1.000					
ROA	0.377	0.136	0.334	1.000				
EA	0.183	-0.377	-0.397	0.360	1.000			
CIR	-0.349	-0.341	-0.527	-0.758	-0.111	1.000		
GDP	-0.063	-0.003	-0.053	-0.098	-0.049	0.154	1.000	
CPI	-0.111	-0.023	-0.154	0.099	0.061	0.073	0.207	1.000

4.2. Empirical Model Results

Table 4 reports the findings of the baseline regression models of bank liquidity on geographical diversification. The results in Table 4 show that the coefficient of the LNGDI variable is positive at 0.169 in the FEM model and statistically significant at the 1% level, indicating that geographic diversification negatively impacts the liquidity of Vietnamese commercial banks. Specifically, the results in holding other variables unchanged at their sample mean, when geographic diversification increases by 1%, bank liquidity decreases by 0.169 units. This finding aligns with the studies of Berger and Udell (2006), Mian (2006), and Froot and Stein (1998). The negative impact of geographic diversification on the liquidity of Vietnamese commercial banks during the 2008–2023 period possibly stems from various factors, particularly increased operational costs, information asymmetry, and credit risks in newly expanded areas. Vietnam's banking system faced huge capital outflows, faced liquidity pressures due to diminishing demand for foreign currency, and faced an upsurge in non-performing loans (NPLs) against export businesses post-2008 global financial crisis. In retaliation, a number of commercial banks opted for expansion plans, targeting new customers, especially in rural and remote areas, where financial services were still in the infant stage. However, this method was fraught with difficulties for banks, especially regarding the huge amount that would be required to invest in infrastructure, technology, and personnel to maintain branch activities. With these risks on new branches tending to erode their liquidity as well, they invariably had to invest their considerable resources to set these branches up.

Many local banks, such as Agribank, the Bank for Investment and Development of Vietnam (BIDV), and VietinBank in Vietnam, have made great efforts to expand their branch networks into remote areas in order to improve financial inclusion. However, this expansion increases transaction costs and complicates risk management. Financial reports from Agribank show that some branches located in the northern mountainous and Central Highlands regions are operationally inefficient. This lack of efficiency is due to limited transaction volumes, resulting in revenue that is less than cost coverage. Agribank is noted to have the largest branch network in Vietnam, fulfilling important roles for agricultural credit; however, it also suffers from liquidity constraints due to high ratios of non-performing loans in some estates.

In addition, economic differences and varying levels of financial literacy from one region to another have now accentuated the risks associated with credit. Most banks have their branches in remote areas, facing problems with debt collection as customers have no verifiable sources of income or even collateral. This situation has given rise to non-performing loans, which reduce bank funds. An example is BIDV's and Vietin Bank's tremendous growth in the volume of non-performing loans at remote branches, which adversely affects the overall liquidity of banking systems.

Managing operations in remote branches presents significant challenges. The difficulties arising from geographic distance prevent the effective monitoring of activities, consequently increasing the risks related to fraud and violations of credit processes. Consequently, banks are required to make substantial investments in risk management systems and internal controls, which in turn increases operational costs. Transaction cost theory posits that geographic expansion notably elevates customer acquisition expenses, necessitates greater efforts in relationship building, and requires adherence to local regulatory frameworks. In Vietnam, the legal requirements for financial activities vary by province, necessitating that banks maintain teams of legal experts to manage administrative procedures and ensure adherence to regulations. Moreover, financial institutions that are broadening their networks need to tackle the issue of the efficiency of infrastructure investment. The implementation of ATMs, POS devices, and digital banking services in remote regions necessitates significant initial investments, yet the uptake of financial services continues to be minimal. For instance, certain banks have launched digital banking services in mountainous provinces; however, they face challenges as local residents still favor cash transactions, which complicates efforts to generate adequate revenue to cover investment expenses.

Pham and Nguyen (2023) also highlighted the issue of endogeneity frequently occurring in panel data regressions, which can distort model estimates. To address this issue, this study employs the generalized method of moments (GMM). The GMM model results, presented in Table 5, further reinforce the study's key findings.

Table 4. Geographical diversification and bank liquidity – Baseline regression results.

Model	POLS	FEM	REM	FEM robust
Variables				
LNGDI	0.075***	0.169***	0.103***	0.169***
	(0.010)	(0.024)	(0.015)	(0.030)
LNSIZE	0.052***	0.057***	0.041***	0.057**
	(0.010)	(0.014)	(0.013)	(0.022)
ROA	7.712***	11.273***	10.372***	11.273***
	(1.894)	(1.790)	(1.762)	(2.880)
EA	1.365***	1.755***	1.679***	1.755***
	(0.281)	(0.262)	(0.258)	(0.422)
CIR	0.376***	0.323***	0.261***	0.323**
	(0.057)	(0.082)	(0.080)	(0.126)
GDP	-0.006*	-0.007*	-0.007*	-0.004*
	(0.006)	(0.005)	(0.005)	(0.003)
CPI	-0.005***	-0.005***	-0.003**	-0.005*
	(0.002)	(0.002)	(0.002)	(0.003)
Constant	0.414**	-0.002***	-0.946**	-1.544**
	(0.412)	(0.002)	(0.435)	(0.681)
R-square	0.909	0.984	0.956	0.984
Prob > F	0.000	0.000	0.000	0.000

Note: Robust standard errors are in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. All financial variables are winsorized at 1% level on the top and bottom of the distribution.

Table 5. GMM model results.

Model	GMM
Number of instruments	18
Number of groups	26
Variables	
LNGDI	0.442***
	(0.156)
LNSIZE	0.020*
	(0.037)
ROA	14.750***
	(5.450)
EA	1.044**
	(0.487)
CIR	1.011***
	(0.289)
GDP	-0.004*
	(0.004)
CPI	-0.003*
	(0.004)
Constant	-1.367*
	(1.291)
Sargan test of overid. Restrictions	
Prob > chi2	0.993
Hansen test of overid. Restrictions	
Prob > chi2	0.942

Note: Robust standard errors are in parentheses. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively. All financial variables are winsorized at 1% level on the top and bottom of the distribution.

Table 6. Model testing results.

Hausman test selects REM and FEM	
Chi-sq. statistic	26.91
P-value	0.0003
Modified Wald test for heteroskedasticity	
Chi-sq. statistic	459.82
P-value	0.000
Wooldridge test for autocorrelation	
Chi-sq. statistic	27.470
P-value	0.000

Next, we conducted the Hausman test to determine if FEM or REM is the more appropriate model for testing the relation between geographical diversification and bank liquidity using our sample data. The results presented in Table 6 indicate that the FEM model is the moret appropriate. However, issues of heteroskedasticity and autocorrelation were detected. To address these issues, we applied a robust standard error model, and the results, recorded in Table 4, confirm that the signs of the coefficients remain unchanged.

4.3. Percentile Regression Results

To further explore how geographic diversification affects the liquidity of Vietnamese commercial banks, we conduct a quantile regression method over time (MMQR). This method evaluates how the relationship between geographic diversification and bank performance varies across different levels of bank liquidity. The results in Table 7 present the controlled quantile regression model for the same variables as the baseline regression model. The findings indicate that the effect of geographic diversification on bank liquidity is consistent in sign and gradually decreases in magnitude as the quantile level increases. This suggests that geographic expansion consistently exerts a negative impact on bank liquidity, regardless of whether a bank has low or high liquidity. However, for banks with higher liquidity, the negative effect is significantly less pronounced compared to those with lower liquidity. This implies that banks with lower liquidity are more vulnerable to the adverse effects of geographic diversification, potentially due to challenges in managing liquidity across dispersed branches. In contrast, banks with higher liquidity, benefiting from better risk management capabilities, are less affected by geographic expansion.

Table 7. Quantile regression results.

	LTD	LTD	LTD	LTD	LTD
	Q10th	**Q30th**	**Q50th**	**Q70th**	**Q90th**
LNGDI	0.110***	0.101***	0.084***	0.070***	0.053***
	(0.017)	(0.014)	(0.012)	(0.010)	(0.031)

Note: Robust standard errors are in parentheses. *** indicate significance at the 1%, levels, respectively. All financial variables are winsorized at 1% level on the top and bottom of the distribution.

5. Conclusion and Policy Implications

In this study, an unbalanced panel dataset on 27 commercial banks in Vietnam is used from the period between 2008 and 2023. Consequently, the study shows through proper quantitative analysis techniques that geographical diversification negatively affects liquidity in banks. Establishing a branch network increases operational costs, liquidity risk, increases asymmetry of information, and provides greater exposure to the credit risks of newly established branches. This is important for banks with low liquidity and will ultimately result in reduced liquidity at the entire bank level. The findings from quantile regression indicate that this negative effect is maintained uniformly across the quantiles. However, the intensity decreases for banks with higher liquidity. This means banks with lower liquidity are more affected by geographical diversification because the difficulty lies in effective liquidity management across their widely spread branches. On the contrary, banks with smaller liquidity usually encounter relatively lesser effects, quite possibly because of their much superior risk management capabilities. Furthermore, the research underlined the significance of size, profitability, equity ratio towards total assets, and cost-to-income ratio as important factors to enhance liquidity conditions.

This study employs an unbalanced panel dataset that includes 27 Vietnamese commercial banks over the years between 2008 and 2023. Thus, through proper quantitative analysis techniques, the study shows that geographical diversification reduces liquidity in banks. The creation of branch networks not only increases operational costs; it also increases the risk of cash flow mismatch, heightens the degree of information asymmetry, and raises credit risk concerning deposits, as most are in newly established branches. It is very important for banks with low liquidity, which ultimately reduces the overall liquidity of banks. Quantile regression results reveal that this adverse effect is consistently evident across all quantiles but becomes less severe as liquidity increases. This shows that banks with lower liquidity might suffer adverse effects to a larger extent due to the challenges faced in better liquidity management across their widely spread branches. On the other hand, banks holding liquidity tend to be less impacted, possibly because of better risk management. Furthermore, the research underlined the significance of size, profitability, equity ratio towards total assets, and cost-to-income ratio as important factors to enhance liquidity conditions.

These research findings have far-reaching consequences for the State Bank of Vietnam and Vietnamese commercial banks in the formulation of branch expansion strategies. The State Bank should craft an adequate risk-control policy to ensure that the geographical spread of Vietnamese commercial banks is not at the expense of the stability of the financial system. Furthermore, it is crucial to outline regulations regarding liquidity and capital support, especially for banks facing low liquidity, which might actually help alleviate the risks of expansion.

In carrying out geographical expansion initiatives, Vietnamese commercial banks must carefully weigh their positions in liquidity and risk management. Financial establishments that face low levels of liquidity must concentrate on improving their liquidity management and implementing cost control measures before embarking on geographical diversification so as not to create possible financial imbalances in new markets;

meanwhile, banks with high liquidity should then be able to employ their superior risk management capabilities for gradual expansion without jeopardizing their operational efficiencies.

In conjunction with these approaches, the strong application of liquidity management should also be supplemented by the introduction of regulatory caps on exchange rates and interest rates so that banks' resilience in times of economic disturbance is duly fortified. This will not only uphold domestic liquidity stability; it will also protect the sustainability of the entire Vietnamese banking system under conditions of global economic integration.

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