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Does Bank Liquidity Risk Lead to Bank's Operational Efficiency? A Study in Vietnam

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Abstract

Purpose: This paper studies the factors affecting liquidity risk and examines the impact of liquidity risk on the operational efficiency of commercial banks in Vietnam in the period from 2010 to 2020.

Design/methodology/approach: By using the concept of the commercial loan theory, efficient structure theory, market power theory, and trade theory, this paper first applies the pooled multi-variable regression method to analyze the impact of liquidity risk on the operational efficiency of banks in Vietnam in the period 2010 - 2020 on Stata software. We then use the fixed-effects and random-effects models to look at differences between cross-objects in analyzing the impact of factors on liquidity risk. Finally, we employ the feasible general least

squares method to eliminate errors due to each bank's time, characteristics and handle the problem of autocorrelation and multicollinearity.

Findings: We find that the bank's liquidity risk measured by the difference between credit and mobilized capital on total assets, credit to mobilized capital, and equity to total assets ratio is mainly influenced by banks' both internal and macro variables but internal variables are more important. At the same time, the performance of Vietnamese commercial banks is presented by using return on total assets, return on equity, and net profit margin. We also find that rising income from interest increases liquidity risk. If there is an unexpected shock, the bank will fall into a liquidity shortage and increase liquidity risk.

Originality/value: All our findings are original and new in the literature.

Implications: Our findings suggest that banks with growth in credit activities tend to increase liquidity risk. If there is an unexpected shock, the bank will fall into a liquidity shortage and increase liquidity risk. In general, if the risk of rising inflation is forecasted, Government will impose policies to control the money supply and inflation and require commercial banks to control liquidity and ensure banking activities strictly. In addition, we find that liquidity risk could have the opposite effect. All the above findings are our contributions to the literature. Our findings are useful in making recommendations for banks in creating strategies to improve operational efficiency towards the sustainable development of banks.

JEL classifications: G21, G30, G32, G33

Keywords: liquidity risk, commercial banks, Vietnam, total assets, Credit to mobilized capital, Equity to total assets ratio, Return on Total Assets, Return on Equity, Net Profit Margin

Introduction

Vietnam joined the World Trade Organization (WTO) on November 1, 2007, and signed the Trans-Pacific Partnership (TPP), which has been brought many economic development opportunities. However, on the other hand, this has been accompanied by significant challenges when many domestic economic sectors and fields are subject to intense competition from foreign enterprises. Banking is one of the sensitive economic sectors and has a considerable influence on the country's development to keep up with economic market

changes in the globalization trend. In addition, the financial system is dominated mainly by banks (Diamond and Dybvig, 1983). For commercial banks, liquidity risk management is, in general, considered a determining factor for the bank's financial strength (Duttweiler, 2011). The relationship between liquidity risk and performance has been known for a long time through the theoretical approach of both market power theory and structure-efficiency theory. According to Bank for International Settlements (2013), the financial crisis at the end of 2007 has once again shown the importance of liquidity risk and liquidity risk management in the banking industry. In addition, after the financial crisis, the Basel Committee on Banking Supervision (BCBS) issued the Basel III Agreement to promote coordination, supervision, and risk management in the banking sector. Basel III was born with strict regulations to improve the quality and quantity of banks' capital and tighten liquidity requirements to better prevent and respond to financial crises without State bank support.

Thus, improving liquidity to avoid liquidity risk is extremely important for banks. This factor is one of the most critical financial factors because it could be affecting the breakdown of the whole banking system. Recently, there have been many studies on the relationship between liquidity and performance of commercial banks, see, for example, Bourke (1989), Poposka and Trpkoski (2013), Goddard, Molyneux, and Wilson (2004), Kosmidou et al. (2005), Wasiuzzaman and Tarmizi (2010), Arif and Anees (2012), Shen et al. (2009), and Lee and Kim (2013). Most studies show that improving liquidity will help commercial banks avoid unexpected risks in liquidity and ensure both operational efficiency and sustainable development for banks. To extend the findings in the literature, this paper find that the bank's liquidity risk measured by the difference between credit and mobilized capital on total assets, credit to mobilized capital, and equity to total assets ratio is mainly influenced by banks' both internal and macro variables but internal variables are more important.

However, most studies often analyze individual banks or bank groups listed on the exchange stock. They often focus on accounting data factors such as bad debt ratio. Still, They do not consider financial ratios such as ratio of credit extension to mobilized capital, lending capacity index, ratio equity to total assets. At the same time, performance metrics often use return on assets (ROA) and return on equity (ROE), and several studies use net profit margin ratio (NIM). These ratios are some of the very important factors in analyzing the banking system. We extend the study in the existing literature by finding that the performance of Vietnamese commercial banks is presented by using return on total assets, return on equity, and net profit margin.

The nature of banking activities is inherently risky. If the risk is not well controlled, then it will also reduce the bank's profitability in one way or another. Thus, in this study, we combine several pieces of independent research on the factors affecting the bank's liquidity risk and its impact on the bank's operating performance. With a research scope of 32/37 operating in Vietnam (excluding banks with a young age because too much missing data will affect the results) for 11 years from 2010 to 2020. Our study helps to clarify which factors affect liquidity risk and how liquidity risk has affected the performance of Vietnamese banks. We find that rising income from interest increases liquidity risk, suggesting that banks with growth in credit activities tend to increase liquidity risk. If there is an unexpected shock, the bank will fall into a liquidity shortage and increase liquidity risk. In general, if the risk of rising inflation is forecasted, Government will impose policies to control the money supply and inflation and require commercial banks to control liquidity and ensure banking activities strictly. In addition, we find that liquidity risk could have the opposite effect. From there, we propose some recommendations to help improve the company's operational efficiency in the future.

Theoretical Basis

Commercial Loan Theory

According to Commercial Loan Theory, commercial banks should receive short-term loans from the central bank when they issue short-term self-liquidating productive loans, assuring commercial banks obtain some degrees of liquidity and the entire economy accurs some degrees of money supply. To do so, the central bank discounts some approved loans to erase or increase bank reserves. Banks are able to get more funds by getting the central bank's rediscounting bills when more trades in the economy and business is growing. On the other hand, there will be less rediscounting bills, bank reserves, bank credit, and money supply will shrink when there is less trade in the economy and business slows down.

Wilson et al. (2010) argue that when the financial market is not highly developed, lending is the biggest asset for banks. So, to maintain liquidity, banks are required to hold more funds and other loans. In the condition that the banks' sources are primarily short-term, commercial loans to finance short-term assets of enterprises to ensure the suitability of the term is the best method to provide liquidity.

Efficient Structure (ES) Theory

According to ES theory, building product prices that are not suitable for consumers will reduce consumption, production surplus and may encourage mergers. The theory also explains that banks can make more profits than other banks thanks to the size of the bank,

which can reduce costs or by applying good policies. This theory implies that the relationship between market structure and company performance is determined by company performance, or in other words, the company performance creates the market structure. Therefore, the increase in profitability of banks is an indirect result of improving banking governance efficiency, and banks achieve higher profits because they operate more efficiently (Olweny et al., 2011). Accordingly, maximizing profits by good management of production costs will bring better operational efficiency to banks.

Market Power Theory (MP)

Market power (MP) theory has two main approaches: Relative market power (RMP) theory and Structure Conduct-Performance (SCP) theory. SCP theory emphasizes that only banks with lower deposit rates and higher lending rates have an advantage in imperfect competition in markets. The Theory of Relative Market Power (RMP) is known when being converted from SCP in the studies of Demsetz (1973), Peltzman (1977), and Brozen (1982). The RMP theory indicates that banks with significant market shares and featured products will have many advantages and can use their market power to profit enormously. Banks will effectively gain big profits by operating thanks to the big market share (Gillian et al., 1984). Therefore, the scale can increase the efficiency of banks and bank profits.

Thus, the Market Power (MP) theory shows that the bank's profitability is a function of the market factor. In contrast, the structure theory (ES) holds that internal factors like internal efficiency and political decisions have impacts on the effectiveness of the bank (Hương & Nga, 2018). Many studies have relied on these two theories to introduce valuable variables for the bank's profitability measurement model. The majority acknowledges that bank profitability is a function according to internal and external factors (Olweny et al., 2011).

Trade (Trade-Off) Theory

The principle of risk and profit exchange states that the higher the risk of an investment, the greater the return that the investor expects, and vice versa. If the returns are not attractive enough, investors are willing to ignore investments. And they are likely to make great returns but high-risk returns to choose another investment that has a lower return but is less risky to ensure its operations' safety, certainty, and stability. Thus, the risk of an investment and the expected profit is a favorable relationship.

According to Miller et al. (1990), monetary managers' capital guarantee requirements force banks to keep liquidity beyond their optimal levels, forcing banks to exceed their optimal internal liquidity levels. In times of crisis, the liquidity and profitability of banks are

in a positive relationship, or banks try to increase liquidity to improve their profits (Osborne et al., 2012). Therefore, profitability and liquidity in the short term have some relationships which could be positive or negative, depending on whether the bank is in a position that is higher or lower than the optimal liquidity levels.

Definition of Liquidity, Liquidity Risk, and Causes

Liquidity definition

In terms of assets, liquidity shows the ability of assets to convert to cash quickly at a low cost and vice versa. An asset is highly liquid if it simultaneously satisfies two characteristics, including a trading market, having a relatively stable price that is not affected by the amount and time of transactions (Rose, 2001).

From a business perspective, liquidity is the amount of cash and cash equivalents that a business holds. If used at the level of banking governance, the bank's ability to promptly and fully meet financial obligations arising in the course of business activities such as deposit payment, lending, payment, and other financial services (Tiến, 2012). According to Basel (2008), a bank's liquidity is its ability to increase its assets and meet its debt obligations as they come time without un-due losses. According to Duttweiler (2009), liquidity represents the ability to fulfill all payment obligations and when they come due – to the maximum extent and in a specified currency. Since it is cash, liquidity is only related to cash flows. Failure to fulfill payment obligations will lead to insolvency.

Liquidity risk definition

Basel Committee (2008), Liquidity risk occurs when a financial institution does not have enough capital to meet the bank requirement without affecting its daily business operations. It also has no impact on the financial situation.

According to Duttweiler (2009), liquidity risk appears when a bank cannot guarantee its solvency at a particular time or has to mobilize capital sources at a high cost to meet its liquidity needs. Liquidity is a bank's ability to promptly and fully meet financial obligations arising from business activities such as deposit payment, lending, payment, and other transactions. In other financial transactions, when the liquidity shortage persists, it will lead to liquidity risk. The mismatch of terms has resulted in liquidity risk for the banks (Diamond et al., 2001). Banks will face a liquidity shock if they do not manage their liquidity risk, sell off their accumulated liquidity and reduce lending to the economy. The Basel Committee has also classified liquidity risk into two categories: capital and market. Liquidity risk increases the likelihood of market disruptions and liquidity shocks for banks, leading to a prolonged decline in market liquidity, which severely affects domestic economic growth.

Causes of liquidity risk

According to Rose (2001), liquidity risk comes from the following reasons: First, banks raise large amounts of deposits and short-term reserves from individuals, businesses, and other lending institutions and then convert them into long lines of credit to borrowers. Second, the bank's sensitivity to changes in interest rates. At the same time, borrowers tend to have increased access to credit that bank provides because interest rates are lower than capital sources outside the market. Changes in interest rates affect both depositor demand and borrowing demand, and both have a tremendous impact on the bank's liquidity position. Third, the unreasonable customer structure is also the cause affecting the bank's liquidity. When banks only focus on mobilizing individual customers or large companies, there will be liquidity risk for banks when these customers fail to repay loans on time or withdraw money unexpectedly. Fourth, the bank's liquidity management strategy is inappropriate and ineffective.

Some other reasons can lead to liquidity risk for banks as abnormal fluctuations of the economy, change in payment policy of the central bank, etc. Doing this leads to liquidity risk in the operations of banks.

Operational Efficiency of Commercial Banks

According to Peter S. Rose (2001), in essence, commercial banks can be considered a business group and operate to maximize profits with the allowable level of risk. Many studies have shown that the performance of banks is measured through the profitability of banks (Khalid et al., 2019; Ndoka et al., 2016; Arif and Anees, 2012). Ponce (2011) said that profitability shows a bank's ability to lend to generate profits and maintain the continuity of banking activities.

Previous Studies and Hypotheses

Previous Studies

To consider the relationship between liquidity risk and bank performance, many studies worldwide have been conducted and concluded that this relationship is quite complex. Several studies that found negatives in this relationship, such as Chen et al. (2001) regarding banks in Japan from 1993 to 1999, found that funding had the opposite effect on operational performance. Ndoka et al. (2016) studied 16 commercial banks in Albania between 2005 and 2015, finding liquidity risk negatively impacting operational efficiency (ROA). Bassey and Moses (2015) studied the trade-off between liquidity risk and the profits of 15 private banks

in Nigeria with data from 2010-2012, which showed the opposite impact between liquidity risk and Nigerian bank profits. Nevertheless, the author also uses the Return on Assets Index (ROA) to represent the bank's return factor. In addition, to demonstrate a negative relationship, Kutsienyo's (2011) study used the general least squares (GLS) estimation techniques on the databases of 26 commercial banks in Ghana between 2000 and 2009 for analysis. The study found that liquidity (including five variables of banking control (bank size, liquidity, equity/total assets, resource/total assets, operating cost), macro variables (unemployment rate, inflation rate, GDP growth rate, banking industry concentration) had the opposite effect with the return of banks (ROA).

Several other studies have shown positive correlations between liquidity risk and performance representation variables. Bourke (1989) discovered positive relationships between liquidity risk and bank profits in 12 European, North America, and Australian countries. In addition, Kosmidou et al. (2005) found that liquidity risk positively affected ROA by looking at factors that influenced the effectiveness of banking in Greece between 1990 and 2002, including 23 banks. The authors show that banks with low liquidity also have low ROA. This is also consistent with the earlier conclusions of (Bourke, 1989). With positive results, Poposka and Trpkoski (2013) studied the factors that worked for Macedonian bank during Q4, 2001 - Q3, 2012. The study also used a return on assets ratio (ROA) and a return on equity ratio (ROE) to represent operational efficiency. The study results showed that liquidity and capital are factors affecting bank profits, in which the positive correlation between liquidity and bank profitability is strong. Siaw (2013) studied liquidity risk’s impact on bank profits in Ghana (Africa). The author uses funding gaps (FGAPR) to measure liquidity risk. The study concluded that bank size, non-deposit assets, changes in inflation positively impact and have statistical implications on liquidity risk. Historical research also shows a positive relationship between liquidity risk and bank profits measured in ROA and ROE. Then, the bank needs to have a funding diversification strategy to reduce liquidity risk.

In addition, some domestic studies such as Nga's research (2018) found the dummy variable factors liquidity risk, bank size, liquidity asset quality, equity on total assets, credit risk, net interest income, GDP growth, money supply, inflation, financial crisis all have implications and affect liquidity risk, case studies in Southeast Asian countries. The study found that liquidity risk had the same impact on the operating activities of banks, in the case of Southeast Asian countries and Vietnam. In addition, the study results also showed the scale of the opposite impact on operational efficiency in Vietnam's case while the non-linear impact in the case of Southeast Asian countries. The financial crisis factor has an effect on the banking board in the case of Southeast Asian countries. Research by (Nguyen & Nguyen,

2012) on the performance of banks in Vietnam and Southeast Asia found two factors that have a negative impact on banking performance: the safety level of capital and market interest rates. Meanwhile, the quality of assets, the quality of cost management have the same impact.

However, some studies have found no relationship between liquidity risk and operational efficiency. Anbar and Alper (2011) consider the factors that influenced the bank's business (ROA, ROE) in Turkey between 2002 and 2010 or Anbar and Alper (2011) studied the factors influencing the Turkish bank's business (2002-2010), DeYoung and Jang (2016) tested the liquidity management ability of commercial banks in the U.S. if it is in compliance with the Basel 3 (of the period 1992-2012). However, all of these show no correlation between liquidity risk and bank profits.

In conclusion, the authors said that the relationship between liquidity risk and operational efficiency is quite complex, whether it impacts or not, impact in the same direction or opposite direction depends on the variable measuring liquidity risk and more specifically the model used for research includes what type of variables representing liquidity risk. In summary of the studies, the authors found gaps in the study's space and time. In addition, before reviewing the liquidity risk relationship, the paper will first review the factors affecting liquidity risk to have a more comprehensive assessment of this relationship of banks in Vietnam. This gives better implications for active commercial banks as well as relevant fiscal policy suggestions.

Develop Research Hypotheses

Research hypotheses about factors that affect liquidity risk.

Bank size and square bank size ($SIZE^2$).

Bank size is usually measured by the natural logarithm of total bank assets (Williams,2014; Bonfim and Kim, 2014; Delécha et al., 2012; Ferrouhi and Lahadiri, 2014; Lucchetta, 2007; Vodova, 2011) or logarithm of the market value of equity (Haq and Heaney, 2012). In theory, banks with significant total assets would have low liquidity risk because they are backed by the interbank market and the last lender. However, from the debate over "Too big to fail" in developed and developing countries (Kaufman, 2014), an essential relationship between bank size and risk has been pointed out. The reliance on backing the big banks increases leverage, increases lending rates, and invests in large projects that increase bad debts and risks. Vodova (2011) and Shen et al. (2009) found that bank size and liquidity risk have a nonlinear and U-shaped relationship. Small banks will often hold a high liquidity structure while the larger

banks show a poorer liquidity structure, increasing liquidity risk. From there, the authors hypothesize as follows:

H_1: The size of the bank has a non-linear relationship and the relationship is in the form of a U shape with banking risk.

Liquidity asset quality.

Banks with a better quality of liquid assets will handle liquidity risk well. As evidenced by Vietnam's bank liquidity crisis from 2008 and the impact of the 2011-2012 crisis, it again shows the critical role of liquidity management. Previous studies using a formula for assessing the quality of liquid assets through the Liquidity Reserve Ratio/Total Credit Balance (Bunda and Desquilbet, 2008; Delécha et al., 2012; Lucchetta, 2007 and Vodova, 2011), Liquid Assets/Total Short-Term Mobilized Capital (Bunda and Desquilbet, 2008; Cucinelli, 2013; Delécha et al., 2012 and Vodova, 2011) all showed opposite results. Theoretically, the higher the bank's liquid assets, the higher the liquidity structure, the lower the liquidity risk. Besides that, Liquid Assets / Total Assets (Bonfim and Kim, 2014; Bunda and Desquilbet, 2008; Delécha et al., 2012; Lucchetta, 2007; Munteanu, 2012; Vodova, 2011) provides the opposite result. In this study, the authors selected three variables to represent the quality of liquid assets: cash holding ratio (CASH), Ratio of liquid assets to short-term capital mobilized (LADS), and the ratio of liquid assets to total credit debt (LLR). Drawing from previous studies, the authors expect a reverse relationship between the quality of liquid assets and liquidity risk.

H_2: The quantity of liquid assets has a reverse relationship with liquidity risk

Net interest income (NIM).

The net interest income ratio is a percentage difference between interest income and the bank's interest expenses payable, indicating how much the banks benefit from the interest rate difference between mobilization and credit investment. Research by Delécha et al., 2012; Munteanu (2012); Bonfim and Kim (2014) concluded that the higher the interest income banks earn, the higher the liquidity risk. In the same view, Lee et al. (2014) showed that banks with increased interest rate activity, overall risks, and specific risks tend to increase during economic instability or crisis periods. Meanwhile, Lee et al. (2014) in Asia indicates that the more banks increase interest income, the lower the bank risk.

H_3: Net interest income has a positive relationship with liquidity risk

Macro factor.

The economy's growth is usually measured by the annual GDP growth rate (GDPG), and the bank's liquidity also has particular sensitivities and fluctuations in the economy. Williams' (2014) study of banks in Asia found higher GDP growth increases risk. In addition, inflation often accompanies high nominal interest rates and can lead to unfavorable fluctuations for the banking system. In addition, the money supply indicator shows the liquidity of the economy. If this indicator has a high growth rate, it can increase liquidity risk (Yurdakul, 2014b), the local currency's devaluation. Another study (Ferrouhi and Lahadiri, 2014; Munteanu, 2012; Cucinelli, 2013; Bunda and Desquilbet, 2008) shows the correlation between GDP growth and bank liquidity risk. The authors expect the exact correlation of macro factors with liquidity risk.

H_4: GDP growth rate has a positive relationship with liquidity risk
H_5: Inflation is positive related to liquidity risk
H_6: Money supply has a positive impact on liquidity risk

Shocks during the Study Period: Economic Crisis, COVID-19 (RISK).

During operations, market shocks will affect almost all sectors, including banking. Maintaining the appropriate liquidity ratio in banking operations is extremely important if there is a crisis/ epidemic. When there is a liquidity crisis, banks need to borrow from the market at a higher rate, and this causes a decline in banks' earnings. Research by Bunda and Desquilbet (2008), Bunda and Desquilbet, 2008; Delécha et al., 2012; Lucchetta, 2007; Munteanu, 2012; Shen et al., 2009; Skully and Perera, 2012; Vodova, 2011, Ferrouhi and Lahadiri, 2014 showed that banks faced a higher risk of liquidity risk during the financial crisis. In addition, COVID-19 has had a significant impact on the bank's savings rate (the bank's primary source of mobilization) and the payment on time of customer's loans.

H_7: Market shock has a positive relationship with liquidity risk

Research hypotheses on liquidity risk factors affecting the BOARD.

Funding Gap (FGAP).

The funding gap is calculated by the difference in outstanding loans and mobilization on total assets. Research by Shen et al. (2009) suggests that banks with higher liquidity asset

structures can receive lower interest income than banks with lower liquidity asset structures. If the market gives deposits with competitive costs, banks storing more liquid assets will be negatively affected by marginal interest income. Therefore, it is expected that liquidity risk will impact the bank's operational efficiency in the same direction. Based on theory and practice, the authors propose the hypothesis.

$H_{8:}$ The funding gap (FGAP) has a positive relationship with the Bank's performance.

Credit-to-capital ratio (LDR).

LDR (Loan to Deposit) is the ratio calculated by taking the loan's balance to the customer to divide by the bank's raised capital. The LDR is one of the key indicators used to estimate the safety of banks. If the LDR is high, the bank will be highly profitable, but there are many trade-offs, such as higher liquidity risk. Credit is the bank's main profitable asset but is significantly less flexible compared to other assets. Banks with increasing LDR can reduce the risk of sudden withdrawals of deposits of individuals and businesses. Khalid et al. (2019) used this indicator to assess liquidity risk affecting the performance of banks and negative impact results. Therefore, the authors can expect LDR to be negatively correlated with operational efficiency.

$H_{9:}$ The ratio of credit to mobilized capital has a negative impact on operational efficiency.

Equity-to-assets ratio (ETA).

With abundant capital, it will be easier for banks to change policies and products in line with market changes, increasing the bank's efficiency. In addition, with significant capital sources, banks also timely avoid unexpected liquidity risk, helping banks be more stable in their operations. The study results by Khalid et al. (2019) suggest that ETA positively impacts ROA. Research by Siaw (2013) has shown that the equity to assets ratio impacts in the same direction as the bank performance. The authors expect the mark of the variable "equity to assets ratio" to be positively correlated with the performance of Vietnam's commercial banks.

$H_{10:}$ The ratio of own assets to total assets has a positive impact on operational efficiency.

Cash Status Index (CASH).

The bank holds high liquid assets that will help the bank to avoid possible unexpected liquidity risks and avoid the bank's shortfalls in meeting the liquidity needs. The results of a study by Mohammad et al. (2014) show that the cash to total assets ratio positively affects bank performance, which means that banks holding large enough cash will be highly profitable. Mustafa (2009) also shows the ratio of liquid assets to total assets with a co-variable relationship with a return on total assets (ROA). Therefore, the authors can expect the cash index variable to be positively correlated with the performance of Vietnam's commercial banks.

H_{11}: The cash status index has a positive impact on operational efficiency.

Bank size and square bank size ($SIZE^2$).

The size of the bank is calculated by the logarithm of the total assets, which is one of the main characteristics of the bank. Increasing size can increase bank profits. (Anbar and Alper, 2011) found a one-way relationship between size and profitability. However, scaling beyond a certain point can lead to ineffective scaling increases because of bureaucracy. Several studies found the opposite correlation (Sufian and Chong, 2008). Thus, the relationship between the size and the bank performance may be nonlinear in a U shape or unidentified. To assess the nonlinear relationship between the size of the bank and the board of directors, the authors use the square bank's size, calculated by the logarithm of the total assets. Non-linear relationships are defined when the scale positively impacts and the bank size square negatively influences the efficiency of the bank performance. Several studies have used the measurement method and found nonlinear correlations (Lee and Kim, 2013; Shen et al., 2009). The economic theory explains this by size. Profits increase by scale to some point the efficiency decreases and reduce profits. Some studies have found no relationship between size and profitability (Almumani, 2013; Athanasoglou et al., 2005; Goddard et al., 2004; Sufian and Chong, 2008). On that basis, the topic raises the hypothesis.

H_{12}: Bank size in a U-shape nonlinear relationship with operational efficiency.

Quality of liquid assets.

Liquid assets/total outstanding credit (LLR) and Liquid Assets/Capital Mobilized (LADS) represented the study's quality measurement of liquid assets. Shen et al. (2009) found a reverse correlation between liquidity and banking performance. AlJafari and Alchami (2014) also found a reverse correlation between liquidity and banking performance. Meanwhile

(Ayaydin and Karakaya, 2014) argue that this relationship does not make sense. Based on the results of previous research, theory, and practice, the authors hypothesize:

$H_{13:}$ Liquid assets / Outstanding loans (LLR) have a negative relationship with operational efficiency.

$H_{14:}$ Liquid assets/ Mobilized Capital (LADS) is negatively-correlated with operational efficiency.

Deposit-to-Asset Ratio (DEP).

The Deposit-to-Asset ratio is the indicator of the stability of cash to assess the profitability of banks. Arif and Anees (2012) and Dezfouli et al. (2014) find that the ratio of customer deposits to total assets is used to make control variables. Based on the results of previous studies, the authors expect:

$H_{15:}$ The ratio of Deposit-to-Asset (DEP) is negatively-correlated with operational efficiency.

Growth rate (GDPG).

Economic growth is often measured by GDP growth. Economic growth also partly impacts bank profits because banks tend to lower interest rates during the growth period. This will make the demand for loans higher, and then the banks will charge more for their services and interest. Some previous studies such as Goddard et al., 2004; Kosmidou et al., 2005; Lee and Kim, 2013; Shen et al., 2009 indicate GDP growth has a positive impact on bank performance. On that basis, the topic hypothesizes:

$H_{16:}$ GDP growth rate has a positive impact on operational efficiency.

Inflation rate (INF).

The inflation rate is measured based on the rate of change in the country's CPI year by year. Ferrouhi's research (2014) shows that inflation has a direct and indirect impact on bank performance. Direct impact through the bank having to pay for inputs such as labor and equipment when prices increase. With unpredictable inflation, costs can rise rapidly, and profits will fall. The bank lends for longer than the deposit period, inflation fluctuates and impacts the bank performance (Shen et al., 2009, Athanasoglou et al., 2005 and Shen et al.,

2009). Several studies (Anbar and Alper, 2011) found no link between inflation and profitability. The authors expect the inflation rate to have a positive impact on the bank's performance.

H_{17}: Inflation has a positive relationship with operational efficiency.

Economic shocks include: Economic Crisis (2011-2013) and COVID-19 (RISK).

The topic is included in the financial crisis (RISK) model to assess the other impact of liquidity risks on the performance of banks in the case of banks in Vietnam when there are economic crisis factors and COVID-19.

Data, Variables, and Methodology

Data and Variables

The study uses secondary data collected from the financial statements of 32 out of 37 banks in Vietnam, from 2010 to 2020) on stock exchanges including, HOSE, HNX, UpCom, OTC. The authors removed banks that did not have sufficient data, which affected the results of the study. In addition, macro data such as GDPG, inflation, money supply are collected from data published by the General Statistics Office over the years, from the SBV and WorldBank. Risks such as the economic crisis (2011-2012) and COVID-19 in 2020 are also noted based on the actual situation of the economy.

Dependent variable.

To measure the performance of commercial banks, the study uses the measurement method according to the indicators reflecting profitability, specifically as follows:

Return on assets (ROA) is one of the indicators reflecting the profitability of banks. Many studies have used ROA to measure the performance of commercial banks such as (Ali Sulieman Alshatti, 2015; Samuel Siaw, 2013; Mohammad Hossein Khadem Dezfouli et al., 2014; M. Saifullah Khalid et al., 2019; Almekhlafi et al., 2016; Omer Allagabo Omer Mustafa, 2009). This ratio reflects the ratio of return on total assets. ROA measures asset use efficiency, showing how much profit after tax for a dollar of assets. ROA is a crucial parameter of management efficiency and demonstrates the effectiveness of a bank's lending or investment policy.

The formula for calculating this ratio is:

$$\text{ROA} = \frac{\text{Return}}{\text{Total assets}} * 100\% .$$

Besides, the return on equity (ROE) is also used quite commonly in analyzing bank performance. ROE measures the efficiency of capital use, showing how much profit after tax for each dollar of equity invested. ROE is also used in many studies to measure the performance of commercial banks (Ali Sulieman Alshatti, 2015; Samuel Siaw, 2013; Mohammad Hossein Khadem Dezfouli et al., 2014; M. Saifullah Khalid et al., 2014).

This rate is calculated using the formula

$$\text{ROE} = \frac{\text{Return}}{\text{Equity}} * 100\% .$$

In addition, to measure the profit from investment activities of financial enterprises and banks, banks also focus on the net profit margin (NIM) to evaluate, analyze, and make the right investment decisions. NIM is the percentage difference between interest income and interest expense payable by Samuel Siaw (2013). This coefficient shows how much banks enjoy the difference in interest rates between deposit and credit investment activities. An increase in NIM shows that banks are managing their assets well and vice versa.

This ratio is calculated by the formula:

$$NIM = \frac{\text{Interest income} - \text{interest expense}}{\text{Total assets}} * 100\% .$$

Independent variable.

Cash status index variable (CASH).

The bank holds high liquid assets to help the bank meet the bank's liquidity needs (Mustafa, 2009). The cash status index is calculated according to the formula:

$$\text{Cash} = \frac{\text{Cash + Deposits in State bank + Deposit in Financial institution}}{\text{Total Asset}} .$$

Variable credit-to-capital mobilization ratio (LDR).

The LDR is one of the key indicators used to assess the safety of banks. LDR demonstrates the bank's ability to mobilize itself to use lending. According to Khalid et al. (2019). The bank's LDR ratio is calculated according to the formula:

$$\text{LDR} = \frac{\text{Loan Capital}}{\text{Mobilized Capital}} .$$

Funding gap variable (FGAP).

In the banking business, assets will be financed by deposits which are primarily current deposits that can be withdrawn from the bank at any time, creating a liquidity gap, thereby creating liquidity risk for banks (Arif and Nauman Anees, 2012). Saunders and Cornett (2006) proposed using the financing gap concept to measure liquidity risk. In this study, the authors incorporate funding gap ratios used by previous researchers (Lucchetta 2007; Bunda and

Desquilbet, 2008; Saunders and Cornett, 2006; Shen et al., 2009; Ferrouhi, 2014) and liquidity ratios to measure liquidity risk in the banking business. Financial gap metrics:

$$\text{FGAP} = \frac{\text{Credit balance – mobilized capital}}{\text{Total assets}} .$$

The funding gap (FGAP) represents a warning sign of a bank's future liquidity risk. When a bank has a larger ratio of outstanding loans to total assets, then the bank will reduce liquidity reserves, leading to increased liquidity risk. Moreover, when banks extend credit, credit risk will rise, increasing liquidity risk. Thus, when a bank has a more significant financial gap, it will force the bank to reduce cash reserves and reduce liquid assets or borrow additional money in the money market, leading to liquidity risk of the banks will increase and vice versa.

Equity-to-Total Asset Ratio (ETA).

With abundant capital, it will be easier for banks to change policies and products in line with market changes, increasing banks' efficiency. The higher the ETA index ensures solvency, the lower the bank's liquidity risk (Hoang, 2011). Equity is the cushion, the last line of defense to fend off the various risks of the bank. The ratio of equity to total capital is calculated according to the formula:

$$\text{ETA} = \frac{\text{Equity}}{\text{Total assets}} .$$

Control Variable.

Variable customer deposit-to-asset ratio (DEP).

The ratio of customer deposits is the indicator of the cash stability to assess the profitability of banks. According to studies Arif and Anees (2012) and Dezfouli et al. (2014), the ratio of customer deposits to total assets is used to make control variables. The percentage of customer deposits to total assets is calculated according to the formula:

$$\text{ETA} = \frac{\text{Deposit}}{\text{Total assets}} .$$

Bank size variable (SIZE).

The size of a bank, calculated in the logarithm of the bank's total assets, contributes to the bank's level of liquidity because it affects its ability to raise capital from various sources and the costs associated with it. Many studies (Siaw, 2013; Dezfouli et al., 2014 and Shen et al., 2009) have brought the size of the bank variable to assess the impact of liquidity risk on the bank performance. From the debate on “Too big to fail” in developed and developing countries (Kaufman, 2014), an essential relationship between bank size and bank risk has

been pointed out. The larger the banks are less motivated to hold cash because of venture capital activity or rely on government intervention in the event of liquidity shortages. The support from the "Too big to fail" perspective has somewhat increased the risk of the bank. Bank size and square bank size are calculated according to the formula:

$$\text{SIZE} = \text{Log (Total Assets)},$$

$$\text{SIZE}^2 = [\text{Log (Total Assets)}]^2.$$

Liquidity asset quality.

Liquid assets typically include cash, bonds, interbank deposits, and short-term securities on the market (Goddard et al., 2004). In this study, the authors selected two variables Of Liquid Assets/ Total Credit Balance (LLR) and Liquidity Assets/ Short-Term Mobilized Capital (LADS), representing the quality of liquid assets. Studies have used the LLR variable by Shen et al. (2009); Ferrouhi (2014); Anbar and Alper (2011); Ayaydin and Karakaya (2014). Meanwhile, the LADS variable was applied by Almumani (2013), Ayaydin and Karakaya (2014), Ferrouhi (2014), Anbar and Alper (2011) to their research.

Two variables are calculated according to the following formula:

$$\text{LLR} = \frac{\text{Liquid assets}}{\text{Outstanding loans}}.$$

$$\text{LADS} = \frac{\text{Liquidity Assets}}{\text{Mobilized Capital}}.$$

GDP growth rate variable (GDPG).

Economic growth is the consumption indicator to measure a country's economic development. When the economy is in recession, businesses are underperforming, and this affects the ability to repay debts and reduces the efficiency of banks and vice versa when the economy grows, contributing to increasing the bank performance (Hương & Nga, 2018). Studies by Goddard and his colleagues (2004), Shen et al. (2009), and Chen et al. (2001) gave similar results. Economic growth is calculated according to the formula:

$$\text{GDPG} = \frac{GDP_n - GDP_{n-1}}{GDP_{n-1}}.$$

Inflation variable (INF).

One of the external factors that affect the liquidity of the bank is inflation. When the economy is in a period of inflation, banks will give less credit, so the higher the inflation rate, the lower the bank performance (Hoang, 2016). Hương & Nga, 2018; Dezfouli et al., 2014; Mustafa, 2009; Almekhlafi et al., 2016) also showed the co-variable relationship between inflation and bank performance.

Money supply growth variable (M2).

Money supply growth rate strongly influences inflation and economic performance and the tightening or loosening policies. The money supply growth rate (MSG) defined as

Money supply growth rate (MSG) = $\frac{MS_n - MS_{n-1}}{MS_{n-1}}$.

is calculated from the percentage of money supply gap between years**.**

Dummy variable.

Market Shock variable: Economic Crisis and COVID-19 variable (RISK)

We assign a value of 1 to both an economic crisis and COVID-19 pandemic, and 0 otherwise. The crisis and COVID -19 pandemic have many influences on both the stock market and firms' profits. The economic crisis leads to more difficulties and challenges for businesses. Maudos (2017) indicated that the crisis in mid-2007 adversely affected profits and risks in the European companies.

Methodology

The paper uses a multi-variable regression method to analyze the impact of liquidity risk on the operational efficiency of banks in Vietnam in the period 2010 - 2020 on Stata software. The authors use the table data of 32 banks and remove banks that do not fully meet the balance sheet data. In theory, the table data structure is combined from a cross-section and a time-series data component. Combining the two data components has many advantages in analysis, especially when it comes to observing and analyzing the changes of study groups over time and analyzing differences between groups of subjects participating in the study. However, table data regression will encounter several problems such as multicollinearity, autocorrelation, and heteroskedasticity. The study will use Pooled OLS, FEM, REM models that will, in turn, address these issues. Finally, use the general least squares (GLS) method to eliminate errors due to each bank's time, characteristics and handle endogenous problems.

` **Classic regression model pooled OLS with table data.**

Many studies worldwide and Vietnam use cross-data and apply a minor perverted regression method (OLS) to determine the relationship between dependent and independent variables. This method is heavily used in estimating the linear relationship between variables because of its reliability. Previous studies used the traditional Pooled OLS regression model to study liquidity risk and performance as Kosmidou et al. (2005); Poposka and Trpkoski (2013); Ndoka et al. (2017); Bassey and Moses (2015), Arif and Anees (2012), etc. However, the OLS cross-data estimate is too tightly bound in space and time–constant coefficients, resulting in unsuitable modeling under real-world conditions. Petria et al. (2015) study of the

relationship between capital and banking business performance in the Eurozone between 2004 and 2011 combined with REM, FEM.

Fixed effects model (FEM) and random effects model (REM).

The fixed-effects model is concerned with the individual differences that affect the model, so there will be no similar phenomenon in the model. The use of fixed factors to analyze the effects of the model is considered too similar to an OLS model that uses a fake variable, in which the variable plays as fixed factors. This method reduces the degree of freedom of the model, especially when the number of fake variables is considerable. The randomized effects model considers the differences of the objects analyzed over time impacting the model, so the similarity is a potential problem in this model that needs to be addressed. Because table data overcome the downsides of cross-data, it will be used in this study in combination with two estimated models: the Fixed Effects Model and the Random Effects Model. These two models can look at differences between cross-objects in analyzing the impact of factors on liquidity risk.

F test to select the model: F test to select the model between the Pooled Regression model and the Fixed Effect Model. The assumption is as follows:

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = ... = \alpha_n = 0$.

H_1: $\alpha_j \neq 0$ (j =1,…, n) .

If $\beta \geq \alpha$, accept H_0, choose the Pooled Regression model.

If $\beta < \alpha$, reject H_0, choose the Fixed Effect model.

Hausman test to select the model After estimating, conducting the Hausman test to choose between the fixed effects model and the random-effects model. The assumption is as follows:

H_0: The estimates of FEM and REM are not different.

H_1: Estimates of FEM and REM are different.

If the p-value < 0.05, reject $H_{0.}$ At that time, REM was not reasonable, it is recommended to use FEM. Breusch Pagar test to choose between POOLED and REM models. αi test is a random variable to choose between pooled regression (POOLED) and random effect model (REM). The assumption is as follows:

H_0: Var $(\alpha_i) = 0$ for all i=1, …., n.

H_1: Var $(\alpha_i) \neq 0$ there exists i=1,…,n.

If $\beta \geq \alpha$, accept $H_{0,}$ α_i is not a random quantity, choose the Pooled Regression model. If $\beta < \alpha$, reject $H_{0,}$ α_i is a random variable, select the Random Effect model.

General regression model with table data.

The documentation of array data will mainly lead to the overcoming of model defects. These problems are all solved through robust models or general regression models, including the general least squares (GLS) and the feasible general least squares (FGLS) models. This method assumes the errors of random distribution data measurements. Gauss-Markov's therapy demonstrates that the results obtained from the minimum squared process and data measurement error are not necessarily followed.

Research Model

Model of study of factors affecting liquidity risk.

Based on the objectives set by the study, the authors gave model 1 as follows:

$$\text{LIQUIDITY RISK}_{it} = \beta_0 + \beta_1 CASH_{it} + \beta_2 SIZE_{it} + \beta_3 SIZE^2_{it} + \beta_4 LADS_{it} + \beta_5 LLR_{it} + \beta_6 NIM_{it} + \beta_7 GDPG_{it} + \beta_8 INF_{it} + \beta_9 M2_{it} + \beta_{10} RISK_{it} + \varepsilon_{it}, \quad i=1,\ldots,n,\ t=1,\ldots,T \quad (1)$$

in which β_0 is the block coefficient, $CASH_{it}$ is the cash status index, $SIZE_{it}$ denotes the size of the bank, $LADS_{it}$ represents the ratio of liquid assets to short-term capital mobilized, LLR_{it} is the ratio of liquid assets to total credit debt, NIM_{it} is the net interest income, $GDPG_{it}$ denotes economic growth, INF_{it} is the fluctuation of inflation, $M2_{it}$ denotes the money supply, $RISK_{it}$ represents the risk shock including Economic Crisis (2011-2012) and CoViD-19 (2020), and ε_{it} is the error term. All variables have been defined in Section 4.1.

Study model affecting performance.

To complement the model in Equation (1), we also propose the following model based on the theory and applications studied by Siaw (2013), Dezfouli et al. (2014), Khalid et al. (2019), and others:

$$PERFORMANCE_{it} = \beta_0 + \beta_1 CASH_{it} + \beta_2 FGAP_{it} + \beta_3 LDR_{it} + \beta_4 ETA_{it} + \beta_5 SIZE_{it} + \beta_6 SIZE^2_{it} + \beta_7 LLR_{it} + \beta_8 DEP_{it} + \beta_9 GDPG_{it} + \beta_9 INF_{it} + \beta_9 M2_{it} + \beta_9 RISK_{it} + \varepsilon_{it}, \quad (2)$$

in which β_0 is the block coefficient, $CASH_{it}$, $SIZE_{it}$, LLR_{it}, $GDPG_{it}$, INF_{it}, $M2_{it}$, $RISK_{it}$ have been defined in Equation (1), β_0 is block coefficient, ε_{it} is the error term for the i bank and year t. All variables have been defined in Section 4.1.

Emprical Analyhsis

Description Statistics

Descriptive statistical analysis involves examining the characteristics of variables. Descriptive statistics help to get an overview of research data and measures that reflect the overall study objects. Considering the values calculated from the statistical description helps us quickly assess the degree of change and the uniformity of the data in the variables collected in the experimental study. Thereby, it is possible to detect deviations in the sample size. Statistical results will indicate the range of values, averages, and standard deviations of variables used in the study of independent variables, control variables, and dependent variables.

From Table 1, the figures show the dependant variable depends on the performance of the business represented by ROA with the highest level of 4.7% and the lowest is 5.5%; ROE (yield on equity) has the highest value of 27%, while the lowest value is - 82%, the average value of ROE is 8.9% with a standard deviation of 8.1% and the highest value of interest income on total bank income (NIM) reached 8.8%. In comparison, the lowest value was -1.9%, the average value of NIM was 2.8%, with a standard deviation of 1.32%. Thereby, the bank performance in the sample is quite different, especially the ROE variable. The operational efficiency indicators are relatively lower with the banking industry average as of December 31, 2020. According to the state bank's December 31, 2020 report, the average ROA of the banking industry reached 0.7%, ROE was 9.09%, and NIM was around 3.5% - 4.2%. The cash ratio of the bank accounted for about 18.8% of the bank's total assets, in which there was still a bank with this ratio at 4.5% belonged to STB bank in 2017, but in 2011 SSB bank had a huge cash ratio of 61.04%. The bank's equity capital ratio is relatively low, about 9.6% of the bank's total assets ranging from 2.62% to 37.59%, with a risk of 4.79% on average.

The most significant cash holding ratio variable (highly liquid value) value is 61%, and the lowest is 4.5% at an average of 18.6%. It shows that banks with little cash reserves still hide many risks (the overall standard deviation is 10%). The ratio of the difference between mobilization and lending is quite large. The lowest rate is - 66.24%, the highest is 2.66%, the average is -28.37%, the risk level is 13.14%, banks often lend more than the mobilized capital. In addition, the highest lending-to-mobilized capital (LDR) ratio exceeded 100% (precisely 104.4%) along with a risk of 15.7%, once again demonstrating the bank's use of resources for the bank beyond mobilization resources. The last variable related to liquidity risk is that the highest equity capital ratio (ETA) is 37.59% of total assets. The lowest is 2.6%, corresponding to the average of 9.5% of banks, indicating that most of the bank's operating funds come from mobilization.

The size-related interpretation variables represent the bank size with a peak of 15.19. As low as 12.92, an average of 14.05, the volatility compared to the average value of 0.5, indicating a not-so-large disparity in the size of the banks in the sample over the years. In addition, the lowest value ratio of liquid asset quality (LADS) at 4.9% and the highest of 93% provides evidence of a significant disparity in the proportion of liquid assets to total assets raised by banks. The important macro-related variables are INF and M2 that had significant differences between the lowest and highest levels during the study period. The risk levels of the two variables are 4.8% and 6.8%, respectively.

Table 1: Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min	Max
ROA	341	0.0083669	0.0077492	-0.0551175	0.0475236
ROE	341	0.0896724	0.0818089	-0.8200213	0.2712203
NIM	341	0.0287915	0.0132802	-0.0190394	0.088359
CASH	341	0.1861528	0.1006054	0.0450184	0.610376
FGAP	341	-0.283667	0.1314132	-0.6623533	0.0266024
LDR	341	0.675628	0.1576599	0.1874026	1.044057
ETA	341	0.0956228	0.0476203	0.0262139	0.3758971
SIZE	341	14.0494	0.502641	12.91516	15.19538
SIZE^2	341	197.6375	14.17698	166.8013	230.8996
LLR	341	0.4013678	0.3584196	0.0700221	3.194972
LADS	341	0.2276515	0.1299968	0.0498387	0.9302582
DEP	341	0.6488871	0.140519	0.0471902	0.8958942
GDPG	341	0.0598273	0.0116213	0.0291	0.0708
INF	341	0.0582273	0.0479833	0.0063	0.1858
M2	341	0.1506455	0.068136	0.044	0.333

Note: readers may refer to Section 4.1 for the definitions of the variables.

Table 2 shows the frequency of the binary variable RISK=1 during the crisis of 2012–2013 and the COVID-19 pandemic of 2020, and zero otherwise. The crisis and the COVID-19 epidemic have had an impact on Vietnam's economy. The binary variable for the study's risk periods contains 93 frequencies of 1 and 248 frequencies of 0.

Table 2: Statistics describing binary risk variable

RISK	Freq.	Percent	Total
0	248	72.73	72.73
1	93	27.27	100
Total	341	100	

Note: readers may refer to Section 4.1 for the definition of RISK.

Correlation Coefficient Analysis

From Table 3 (see the appendix), the correlation between independent variables to dependent variables (liquidity risk) is relatively high. The pairs, namely LADS and CASH (0.96) LLR and CASH (0.87), LDR and FGAP, SIZE and $SIZE^2$ (0.99), all are higher than 0.8. This might cause multicollinearity between independent variables in the model. The remaining pairs have a low correlation. To verify that the authors check the multicollinearity, only SIZE, $SIZE^2$, CASH, LADS are subject to the multicollinearity. The rest are less than five, so no multicollinearity occurs with these variables. With VIF testing, multicollinearity has occurred for the model.

Similarly, the authors also examined the correlation between independent and dependent variables as the Bank's operational efficiency. Table 4 (see the appendix) presents the correlations between independent variables in the model of the impact of liquidity risk on the bank performance. The correlation coefficients between the variables were used to test the possibility of multicollinearity between other variables in the model. The correlation coefficient matrix table for the remaining independent variables is correlated but insignificant. The correlation coefficient r is relatively small. Most of the remaining r values are below 0.8 except for the pairs of ROA and ROE variables (0.81), LADS and CASH (0.96), GAP and LDR (0.97), SIZE and $SIZE^2$, and the LLR and LADS pairs (0.84) that have the multicollinearity in the model. However, the multicollinearity processing does not depend on the high or low correlation coefficient but depends on the consequence of multicollinearity at the model. The impact of multicollinearity causes the regression coefficient to change the direction and cause deviation in the regression result. The paper rechecks the multicollinearity using the variance inflation factor VIF. According to the VIF coefficient

results, multicollinearity in SIZE, $SIZE^2$, LADS, CASH, LDR, and GAP variables led to a substantial VIF average. The remaining variables have a VIF value ranging from 1.3 to 7.2.

However, according to Goldberger, "When a study has a multicollinearity problem, it is necessary to see if this problem remains convincing and the "small sample size problem" is replaced by the "multicollinearity problem". He suggests deciding how small the number of n observations is before determining whether they have a small sample size problem. They choose how high the value of R^2 is in an auxiliary regression function before saying that multicollinearity is serious. Therefore, the authors continue to use these variables for the model.

Regression Analysis

Result of factors affecting liquidity risk.

Consider the factors that influence the Bank's liquidity risk based on the multivariate regression of OLS, FEM, and REM models. The OLS model assumes no difference in liquidity risk between the banks involved in the study, and the risk does not change over time. In addition, the authors use the FEM model to remove unobserved variables, non-measurable and unchanging factors over time, and REM models to check the impact of the unobserved factors and factors that change over time to liquidity risk. To choose the suitable model, the authors conducted the F and Hausman tests. Both resulted in Prob > F being less than 5% (95% statistically significant). Since then, the FEM model has been best suited to estimate the model of factors affecting banks' liquidity risk in Vietnam.

In addition, to check if the model had any defects, the authors used additional Modified Wald (test of whether heteroskedasticity exists) and Wooldridge (check the model if it has the autocorrelation). The results of the two tests both give a P_Value value of less than 5%. This suggests that the model exists in both defects, which are heteroskedasticity and autocorrelation. Thus, the authors used the GLS model to repair the disadvantages and have the same results as Table 5 (see the appendix).

Cash holding (CASH) is inversely correlated with liquidity risk at a meaningful 1%. When the bank has a large cash ratio, it will relieve the pressure on liquidity risk. This was demonstrated by Bonfim and Kim's research (2014), Bunda and Desquilbet (2008); Delécha et al. (2012), Lucchetta (2007), Munteanu (2012), Vodova (2011), and others.

Bank size (SIZE) has a negative value with liquidity risk factors (FGAP, LDR, and ETA) at a meaningful level of 1%, confirming that bank size is vital in limiting liquidity risk. In fact, in Vietnam, most banks often rely on the interbank market or liquidity support from the last lender (State Bank) to ensure liquidity for the whole system. The results are consistent with

the results of the study of Delécha et al. (2012), Lucchetta (2007), Vodova (2011), Trenca et al. (2015), Ferrouhi and Lahadiri (2014), Bonfim and Kim (2014), and Horvàth et al. (2012). Besides turning SIZE and $SIZE^2$ change direction from negative to positive and vice versa. This shows that the size of the bank affects liquidity risk in a non-linear and U-shaped form. In general, the large scale might not reduce liquidity risk, and vice versa. The small scale will increase liquidity risk. From the debate on "Too big to fail" in developing and developed countries (Kaufman, 2014), an important relationship between bank size and banking risk has been pointed out. Since most large-sized banks are less motivated to hold liquidity because of venture capital or rely on government intervention in liquidity shortages, the "Too big to fail" view partly increased the bank's risk. This result is consistent with the hypothesis and is similar to previous studies (Vodova, 2011; Shen et al., 2009; Aspachs et al., 2005).

Turning liquid assets across total short-term capital raised (LADS) is positively correlated with a liquidity risk at 99% statistically significant. This means that using too much short-term funding for liquidity will enhance the bank's risks. The results are contrary to previous studies by Delécha et al. (2012), Lucchetta (2007), Vodova (2011), Trenca et al. (2015), Ferrouhi and Lahadiri (2014), Bonfim and Kim (2014), and Horandth et al. (2012). In addition, the following liquidity quality variable is the liquidity-to-credit balance (LLR) ratio that has a reverse relationship with most liquidity risk representation variables at a meaningful 1%. The larger the liquid asset, the lower the bank's liquidity risk. This result has also been demonstrated by Delécha et al. (2012); Lucchetta (2007); Vodova (2011), Trenca et al. (2015), Ferrouhi and Lahadiri (2014), Bonfim and Kim (2014); Hor and et al., (2012).

Net interest income (NIM) is a positive value and statistical significance at 1%, confirming that net interest income plays a vital role in controlling liquidity risk. The operation of traditional banks is mainly from lending activities, so when banks have high net interest income, this increases credit risk. If there are unexpected shocks, the bank will fall into liquidity shortage and increase liquidity risk. This is consistent with the commercial theory that banking is always a high risk because commercial lending is very risky, increasing liquidity risk. In terms of impact marks, this result is entirely in line with the authors' original expectations and is similar to previous studies such as Delécha et al. (2012), Munteanu (2012), and Trenca et al. (2015). This conclusion implies that lending activity increases interest income, and this will increase liquidity risk (Demirguc-Kunt and Huizinga, 1999).

For the macroeconomic variable group, the study found a reverse correlation between GDP growth and liquidity risk (ETA) at a statistical significance 5% level but not enough basis to prove the relationship between FGAP and LDR with GDPG. This result is consistent with previous research such as (Dinger, 2009; Vodova, 2011). Indeed, the economy is

growing well and creating development production and consumption opportunities, contributing to promoting business activities of enterprises to improve and increase, thereby positively impacting the bank's credit quality. However, it should also be noted that the more the growth, the more sensitive bank assets will be to market volatility. In other words, the more the bank's market risk increases as GDP growth increases, which impacts banking liquidity risk (Williams, 2014).

Inflation (INF): Similar to GDPG, the results show a reverse correlation between inflation and liquidity risk (ETA) INF with a statistical significance level of 1%. There is no basis for concluding the relationship between the FGAP and the LDR. The implication is that higher inflation makes it easier for customers to repay debts. It reduces the actual value of loans, controls liquidity risk, and high inflation reduces unemployment like Phillips' curve. Experience of the Crisis of 2011 - 2012 showed that inflation had eroded the value of the currency, affecting the production and business activities of the economy, thereby adversely affecting the credit quality and liquidity status of commercial banks in countries around the world in general. In general, the relationship between inflation and liquidity risk depends on the liquidity risk variable.

Money supply growth (M2), this study found the M2 money supply had an opposite effect on liquidity risk, namely, FGAP at a significant level of 5%. Increasing money supply is often accompanied by economic growth goals with low-interest rate policies to support businesses to access reinvested credit for production and business activities.

Crisis and COVID-19 (RISK) do not make statistical sense, which is not sufficiently conclusive about liquidity risk. However, the fact that through the recent financial crises leading to sudden withdrawals at a bank due to investor panic and refinancing and increased discount rates in the interbank market increased liquidity risk.

Result of factors affecting performance.

To assess the impact of liquidity risk on the performance of banks' business, the study used different estimated models to test ROA, ROE, and NIM. Each model was estimated in OLS, REM, FEM, and GLS. Liquidity risk is carried out with three scales of Credit Difference and Mobilization (FGAP), Credit-to-Capital Mobilization Ratio (LDR), Equity-to-Total Asset Ratio (ETA). First of all, the model is statistically significant because the p-value values (Prob > F) of the model are minimal (Prob > F = 0.0000). The R^2 index is pretty good at 62.7%, and the highest is 76.1%. (refer to Table 6 in the appendix), the above estimates can be used to analyze the impact of liquidity risk on the operational efficiency of banks in Vietnam in the period from 2010 to 2020. Next, the authors use the Hausman test to select the

appropriate analysis model. The results found that the FEM model was suitable for ROA and ROE, and the REM model was in line with NIM. After testing Modified Wald and Wooldridge, both models resulted in similar phenomena and variable dialects.

However, the Modified Wald and Wooldridge inspections have P-value < 0.05, specifically with ROA, ROE, and NIM both have Prob > chi^2 = 0.0000 in the Modified Wald test, and there is Prob > F in the Wooldridge test. The authors overcome the disadvantages of the two models with the GLS model and the final analysis results based on the GLS method regression results. The results of the analysis of the impact of liquidity on the bank performance (10) are as follows:

Liquidity risk: The parameter of the liquidity risk variable (FGAP and ETA) is a positive value and statistically significant at 1%. This result confirms the importance of liquidity risk to the banks' performance and the impact in the same direction as the bank performance (ROE, NIM). Banks use the capital raised to finance loans by businesses and consumers to finance investment and consumption. Still, the majority of resources used by banks are often tied to liabilities in the form of deposit interest payments and potential risk charges in short-term mobilization activities such as short-term deposits and short-term investments. This result is consistent with the previous study as the risk and profit exchange hypothesis (Ferrouhi, 2014; Lucchetta, 2007; Bunda and Desquilbet, 2008; Shen et al. 2009). This implies that as banks increase capital, leverage levels, and risks are lower, banks' efficiency tends to increase. This study is in line with the theory of market power, capital increase that demonstrates the strength and position of the bank in the financial markets. However, LDR has a strong relationship with ROA and ROE at a significance level of 1%. This result coincides with the results of Khalid et al. (2019).

The Cash ratio (CASH) has the same impact as the bank performance at 99% statistically significant. This means that banks hold assets with high liquidity, liquidity risk will be low, profits are controlled during periods of a liquidity shock. The results were also demonstrated by Mustafa (2009.

Bank's size (SIZE) has a positive value. It is statistically significant at 1%, affirming the importance of the size of the bank in the contribution of the bank performance and plays a role in increasing the bank performance. When the size of the bank increases, it helps to improve the bank performance because it creates conditions to reduce the risks that occur to the bank. This result is in line with the theory of market power. Banks with an increasing size will bring benefits that can increase bank profits. This result is entirely consistent with the results of Anbar and Alper (2011); Sufian and Chong (2008).

However, $SIZE^2$ changes direction from positive to negative and has statistical significance at 1%. This implies that the impact of bank size variables on liquidity risk is nonlinear and a U-shaped graph. It does not always increase the SNS as the economic theory does. The bank's business contains many risks and many uncontrollable factors, so the bank's size will increase the board of directors. Still, when the size of the bank rises beyond a certain threshold, it will have the impact of reducing the bank performance. Initially, increasing the size of the effects on the bank performance, but increasing the size to a certain point can lead to inefficiency because of the bureaucracy. A larger scale could allow banks to diversify, venture capital, or rely on government intervention in cases of liquidity shortfalls, rising costs, and an impact on bank profits.

The ratio of liquid assets to short-term capital mobilized (LADS) has a negative impact on NIM at a level of 1% but not significantly. This shows that the bank spending too many resources on highly liquid assets will limit the implementation of lending and investment activities to earn more profit.

The results also found a negative correlation between **asset quality variables (LLR)** and bank performance (ROA, ROE, NIM) at a statistical significance level of 1%, which is similar to expectations and previous research (Shen et al., 2009). It shows that if the bank holds a high ratio of liquid assets, it will increase the profitability ratio. Still, at some point, due to the increase in a credit balance, this increases the risk for the bank because of the rise in costs, the efficiency of banking activities tends to decrease. The study results show that bank profits are derived from reputation and business opportunities and a large part of the profit from the term-risk management of assets. Suppose banks usually reserve liquid assets at optimal levels to ensure business operations in case of shocks. In that case, the bank performance is controlled. Still, if banks reserve liquid assets beyond the optimal level, it will reduce the bank performance because the cost increases faster than revenue.

The customer deposit to total asset ratio (DEP) is positively correlated with NIM with a 99% statistically significant, but there is insufficient evidence to prove a relationship with ROE. The more capital raised by credit institutions usually comes from customer deposits. The higher this rate shows that the larger the mobilization from customers, the more generous the bank's operational funding, the greater the bank's efficiency will be. This has been demonstrated from previous studies such as Arif and Anees (2012), Dezfouli et al. (2014)).

GDP growth rate (GDPG): in the same direction as the bank performance (NIM) at a statistical significance level of 1% but not enough basis to conclude the relationship with ROE. This result is similar to previous studies such as Shen et al. (2009), Anbar and Alper (2011); Ferrouhi (2014); Ayaydin and Karakaya (2014). This may explain that economic

growth has a positive impact on portfolios, increasing the value of assets and cash flows of banks, resulting in higher returns. Conversely, an economic downturn often leads to a decline in the ability to repay borrowers' debts, contributing to increased credit risk, which affects bank profits.

Money Supply Factor (M2): Research results show that the money supply is correlated in the same direction as profit with ROE at a significant level of 1% but not enough basis to evaluate NIM. Dietrich and Wanzenried (2014) explained that the increased money supply showed that monetary policy was expanded, which will create conditions for banks to turn around credit, businesses have access to capital, thereby contributing to increasing bank performance.

Inflation (INF): found the exact correlation between inflation and the bank performance (ROE, NIM) at a significant level of 1%. This result is similar to previous studies (Athanasoglou et al., 2005 and Shen et al., 2009). Dietrich and Wanzenried (2014) showed that higher inflation makes the bank's interest differences higher when inflation is low.

In addition, the parameters of the risk variable from the financial crisis in the period 2012-2013 and the impact of the COVID-19 pandemic in 2020 (RISK) are positive values and statistically significant at 1%, indicating that the financial crisis factor has an impact on NIM but is not statistically significant with ROE and has the same impact on the bank performance.

Concluding Remarks and Discussions

This paper studies the factors affecting liquidity risk and examines the impact of liquidity risk on the operational efficiency of 32 banks in Vietnam in the period from 2010 to 2020. We first find that, in general, factors affecting the bank's liquidity risk come from the bank's intrinsic and macro factors. We also find that rising income from interest increases liquidity risk, suggesting that banks with growth in credit activities tend to increase liquidity risk. If there is an unexpected shock, the bank will fall into a liquidity shortage and increase liquidity risk. In general, if the risk of rising inflation is forecasted, Government will impose policies to control the money supply and inflation and require commercial banks to control liquidity and ensure banking activities strictly. There is not enough evidence to assess the risk of dummy variables in influencing liquidity risk. Total loans on total assets have the same impact on the bank performance with variables measuring ROA, ROE, and NIM. In addition, we find that liquidity risk could have the opposite effect.

Policy Suggestions

The results from our quantitative analysis have several important implications. First, after the impact of the economic crisis of 2011-2012, along with the process of restructuring the banking system and enhancing market discipline in countries, the bank's liquidity risk is controlled, but many factors affecting both the stability and sustainability of the bank performance have not been resolved. The results of the study model at 32 banks in Vietnam highlighted the impact of bank size, asset structure, capital, income from interest, GDP growth, money supply, inflation impact on liquidity risk, and the impact of liquidity risk on bank performance in the period of 2010-2020. The capital increase needs a suitable roadmap for each bank because each bank will have its equity threshold capital structure. Banking governance needs to adjust its credit policy and manage liquidity risk on time to reduce the costs caused by liquidity shocks. The central bank needs to take suitable measures to maintain risk management for the commercial bank and the national financial system.

In addition, our findings imply that the commercial banks should continue to do well in managing the liquidity risk, reassuring liquidity when there are unfavorable rumors affecting depositors, preparing immediate plans in case commercial banks face liquidity risk. The Central Bank needs to have the necessary mechanisms and policies to improve the level of liquidity management in commercial banks.

Moreover, our findings for the size of the banking impacting nonlinear banks in the form of nonlinear and U-shaped graphs imply that increasing the scale of the bank does not always affect the bank's performance. Commercial banks must be very cautious in increasing the size because expanding the bank's size to a certain point can lead to inefficiency because of the bureaucracy. A larger-scale could allow banks to diversify, venture capital, or rely on government intervention in cases of liquidity shortages, rising costs, and a negative impact on bank profits. Commercial banks need to develop strategies to increase the scale to ensure the safety of banking operations, especially in controlling the cost of capital. Our findings that banking activities are cyclical implies that in macroeconomic stability, banks need to accept a reasonable level of inflation to stabilize the banking system and improve the banking performance. The recommended policy is to control liquidity risk and improve the bank performance in Vietnam. Commercial banks need to be aware that increasing competition through accessible credit provision will only reduce credit quality and affect the bank's ability to operate safely in the long run. Periodically, banks need to re-evaluate efforts to establish and maintain relationships with owners, supporting the diversification of capital sources, especially raising capital from shareholders.

Our findings also imply that building solid relationships with key capital suppliers will provide a liquidity buffer when the commercial bank faces liquidity difficulties and forms an integral part of liquidity management policy. Nevertheless, good handling of bad debts and improving credit quality gradually sustainably handle bad debts, limiting increased bad debts to open up capital flows, ensuring banking safety, promoting credit growth, and actively supporting capital for the economy. The Bank needs to be transparent in information, research, and apply the standards set by Basel III to maintain customer's reliability towards the bank itself in particular and the banking system in general.

Limitations of the Study and Future Research

There are some limitations to our study. First, when analyzing the bank performance, our study only uses ROA, ROE, and NIM ratios collected from financial statements. Secondly, space and time are only within Vietnam, and the 11-year period is not too long to have a very good assessment. Thirdly, the quantitative analysis in our paper only measures liquidity risk and analyzes the impact on bank performance but does not control or swap liquidity risk. Moreover, the liquidity risk management process has not been set. Therefore, there is not enough practical basis for proposing solutions to control and manage banking risks and improve bank performance efficiency. Fourthly, the paper mainly studies the one-way impact of liquidity risk on bank performance but has not examined the two-way relationship between liquidity risk and bank performance. The authors expect further studies to implement and overcome the above-mentioned limitations of this study. This paper studies the factors affecting liquidity risk and examines the impact of liquidity risk on the operational efficiency of banks in Vietnam. Academics and practitioners could apply our approach to study other banking issues, see, for example, Adjei-Frimpong, et al. (2013), Chan, et al. (2014), Obrimah and Ebere (2015), Anis and Rashid (2017), Esmaeil, et al. (2020), Suu, et al. (2020), Tran (2020), Pho, et al. (2021), Abbas, et al. (2021), Nhan, et al. (2021), and many others. Academics and practitioners could also apply our approach to study other issues in risk and efficiency, see, for example, Gasbarro, et al. (2012), Alghalith, et al. (2016), Lu, et al. (2018), Nguyen and Vo (2019), Vo, et al. (2019), Nguyen, et al. (2021), and many others.

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Appendix

Table 3: Matrix correlates with the dependent variable as liquidity risk

	CASH	FGAP	LDR	ETA	SIZE	$SIZE^2$	LADS	LLR	NIM	GDPG	INF	M2	RISK
CASH	1.0000												
FGAP	-0.5040**	1.0000											
LDR	-0.5336**	0.9709**	1.0000										
ETA	0.2070**	0.2010**	0.1010	1.0000									
SIZE	-0.2506**	0.1593**	0.2490**	-0.6527**	1.0000								
$SIZE^2$	-0.2522**	0.1683**	0.2581**	-0.6448**	0.9998**	1.0000							
LADS	0.9696**	-0.3983**	-0.4633**	0.3306**	-0.3103**	-0.3103**	1.0000						
LLR	0.8762**	-0.6426**	-0.6813**	0.1138*	-0.2453**	-0.2480**	0.8486**	1.0000					
NIM	-0.0387	0.4089**	0.3865**	0.3754**	-0.0418	-0.0383	-0.0004	-0.1390*	1.0000				
GDPG	-0.0384	-0.0321	0.0028	-0.0257	-0.0532	-0.0536	-0.0334	-0.0394	-0.0541	1.0000			
INF	0.3435**	-0.0493	-0.1007	0.2208**	-0.2585**	-0.2563**	0.4277**	.3949**	0.1613**	-0.0994*	1.0000		
M2	0.1066	-0.0031	0.0050	0.0830	-0.1462**	-0.1443**	0.1511**	0.0688	-0.0688	0.2905**	0.0276	1.0000	
RISK	0.1829**	0.0679	0.0182	0.1068*	-0.0438	-0.0425	0.2221**	0.2122**	0.1823**	-0.7244**	0.5774**	-0.2383**	1.0000

Notes: ** and * Correlation is significant at the 0.01 and 0.05 levels, respectively, (2-tailed). Readers may refer to Section 4.1 for the definitions of the variables.

Table 4: Matrix correlates with the dependent variable as bank performance

	ROA	ROE	NIM	CASH	FGAP	LDR	ETA	SIZE	$SIZE^2$	LLR	LADS	DEP	GDPG	INF	M2	RISK
ROA	1.0000															
ROE	0.8168**	1.0000														
NIM	0.6306**	0.4817**	0.1613													
CASH	0.2093**	0.0954	-0.0387	1.0000												
FGAP	0.2791**	0.2405**	0.4089**	-0.5040**	1.0000											
LDR	0.2303**	.2453**	0.3865**	-0.5336**	0.9709**	1.0000										
ETA	0.4449**	-0.0536	0.3754**	0.2070**	0.2010**	0.1010	1.0000									
SIZE	-0.0090	0.3384**	-0.0418	-0.2506**	0.1593**	0.2490**	-0.6527**	1.0000								
$SIZE^2$	-0.0072	0.3375**	-0.0383	-0.2522**	0.1683**	0.2581**	-0.6448**	0.9998**	1.0000							
LLR	-0.0067	-0.1249*	-0.1390*	0.8762**	-0.6426**	-0.6813**	0.1138 *	-0.2453**	-0.2480**	1.0000						
LADS	0.2673**	0.0962	-0.0004	0.9696**	-0.3983**	-0.4633**	0.3306**	-0.3103**	-0.3103**	0.8486**	1.0000					
DEP	-0.0950	0.0414	0.0427	-0.3189**	0.1293*	0.2135**	-0.2479**	0.3703**	0.3706**	-0.4074**	-0.4274**	1.0000				
GDPG	-0.0229	0.0004	-0.0541	-0.0384	-0.0321	0.0028	-0.0257	-0.0532	-0.0536	-0.0394	-0.0334	-0.0419	1.0000			
INF	0.1429**	0.0239	0.1613**	0.3435**	-0.0493	-0.1007	0.2208 **	-0.2585**	-0.2563**	0.3949**	0.4277**	-0.5648**	-0.0994	1.0000		
M2	0.1085*	0.0813	-0.0688	0.1066	-0.0031	0.0050	0.0830	-0.1462**	-0.1443**	0.0688**	0.1511	-0.2381**	0.2905**	0.0276	1.0000	
RISK	0.1077*	0.0403	0.1823**	0.1829**	0.1829	0.0182	0.1068*	-0.0438	-0.0425	0.2122**	0.2221**	-0.2303**	-0.7244**	0.5774**	-0.2383**	1.0000

Notes: ** and * Correlation is significant at the 0.01 and 0.05 levels, respectively, (2-tailed). Readers may refer to Section 4.1 for the definitions of the variables.

Table 5: Regression results of factors affecting bank liquidity risk in Vietnam

Variables	FGAP				LDR				ETA			
	OLS	FEM	REM	GLS	OLS	FEM	REM	GLS	OLS	FEM	REM	GLS
CASH	-1.303***	-2.115***	-1.770***	-1.411***	-0.486**	-1.528***	-1.065***	-0.664***	-0.537***	-0.430***	-0.441***	-0.199***
	[-6.49]	[-9.50]	[-8.38]	[-9.22]	[-2.01]	[-5.56]	[-4.15]	[-3.77]	[-8.04]	[-7.26]	[-7.55]	[-4.23]
SIZE	-2.724***	-0.587	-1.328***	-2.485***	-3.877***	-0.963	-2.119***	-3.827***	-1.172***	-1.513***	-1.470***	-1.366***
	[-6.87]	[-1.08]	[-2.74]	[-6.04]	[-8.12]	[-1.43]	[-3.62]	[-7.43]	[-8.89]	[-10.42]	[-10.61]	[-10.57]
$SIZE^2$	0.0976***	0.0259	0.0495***	0.0893***	0.139***	0.0401*	0.0783***	0.137***	0.0397***	0.0508***	0.0497***	0.0463***
	[6.96]	[1.33]	[2.88]	[6.17]	[8.24]	[1.67]	[3.77]	[7.57]	[8.50]	[9.83]	[10.09]	[10.14]
LADS	1.203***	1.593***	1.432***	1.142***	0.610***	1.158***	0.920***	0.606***	0.521***	0.340***	0.360***	0.194***
	[8.09]	[10.35]	[9.57]	[9.67]	[3.40]	[6.10]	[5.05]	[4.83]	[10.53]	[8.31]	[8.82]	[5.19]
LLR	-0.257***	-0.166***	-0.200***	-0.169***	-0.335***	-0.229***	-0.271***	-0.244***	-0.0124	-0.00392	-0.00437	-0.0151***
	[-10.39]	[-6.86]	[-8.28]	[-7.18]	[-11.22]	[-7.64]	[-9.21]	[-8.39]	[-1.51]	[-0.61]	[-0.67]	[-2.63]
NIM	2.189***	1.995***	2.169***	1.778***	2.488***	2.607***	2.658***	1.863***	0.999***	0.952***	0.975***	0.683***
	[6.76]	[4.77]	[5.66]	[4.97]	[6.38]	[5.05]	[5.73]	[4.32]	[9.28]	[8.55]	[9.03]	[7.75]
GDPG	1.182*	0.626	0.967*	0.0632	1.821**	1.184*	1.567**	0.555	-0.269	-0.196	-0.233*	-0.168**
	[1.94]	[1.26]	[1.88]	[0.22]	[2.48]	[1.93]	[2.48]	[1.50]	[-1.33]	[-1.48]	[-1.72]	[-2.11]
INF	-0.21	0.139	-0.135	-0.086	-0.102	0.202	-0.0557	0.0487	-0.150***	-0.147***	-0.124***	-0.0730***
	[-1.52]	[0.98]	[-1.05]	[-1.10]	[-0.61]	[1.15]	[-0.36]	[0.50]	[-3.25]	[-3.88]	[-3.50]	[-3.19]
M2	0.00689	0.121**	0.0504	-0.00203	0.0884	0.205***	0.131*	0.0506	-0.0561***	-0.0519***	-0.0470***	-0.0214**
	[0.11]	[2.22]	[0.92]	[-0.06]	[1.15]	[3.05]	[1.95]	[1.19]	[-2.64]	[-3.59]	[-3.22]	[-2.21]
RISK	0.0607***	0.0352**	0.0522***	0.00931	0.0710***	0.0431**	0.0614***	0.0115	-0.00568	0.00000687	-0.00232	-0.0017
	[3.10]	[2.13]	[3.11]	[1.05]	[3.01]	[2.11]	[2.99]	[1.01]	[-0.87]	[0.00]	[-0.52]	[-0.70]
_cons	18.63***	2.807	8.542**	17.01***	27.49***	6.2	14.87***	27.27***	8.714***	11.31***	10.94***	10.14***

	[6.66]	[0.73]	[2.50]	[5.83]	[8.16]	[1.31]	[3.60]	[7.47]	[9.36]	[11.10]	[11.22]	[11.08]
R-sq	0.697	0.661			0.694	0.627			0.745	0.761		
	F 10, 330) = 75.89	F (10,300) = 58.42	Wald chi2 = 606.70	Wald chi2 = 650.48	F (10, 330) = 75.00	F (10,300) = 50.35	Wald chi2 = 557.36	Wald chi2= 599.11	F (10, 330) = 96.18	F (10,300) = 95.68	Wald chi2(10) = 979.65	Wald chi2 = 668.18
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

Note: ***, **, and * indicate statistical significance levels of 1%, 5%, 10%, respectively. Readers may refer to Section 4.1 for the definitions of the variables.

Table 6: Results of regression of liquidity risk factors affecting the bank performance in Vietnam

Variables	ROA				ROE				NIM			
	OLS	FEM	REM	GLS	OLS	FEM	REM	GLS	OLS	FEM	REM	GLS
CASH	0.121***	0.0937***	0.114***	0.0445***	1.395***	1.185***	1.314***	0.574***	0.172***	0.110***	0.122***	0.0697***
	[5.79]	[4.21]	[5.36]	[3.21]	[5.63]	[4.36]	[5.21]	[3.29]	[4.13]	[3.06]	[3.54]	[2.99]
FGAP	0.0481***	0.0270**	0.0429***	0.0387***	0.517***	0.315**	0.448***	0.423***	0.0584**	-0.00193	0.00708	0.0233*
	[3.60]	[2.06]	[3.29]	[4.92]	[3.25]	[1.97]	[2.89]	[4.09]	[2.19]	[-0.09]	[0.34]	[1.65]
LDR	-0.0318***	-0.0251**	-0.0313***	-0.0294***	-0.348***	-0.272**	-0.329***	-0.288***	-0.0112	0.0201	0.016	0.0000927
	[-2.85]	[-2.38]	[-2.92]	[-4.53]	[-2.62]	[-2.11]	[-2.58]	[-3.44]	[-0.50]	[1.18]	[0.96]	[0.01]
ETA	0.137***	0.159***	0.143***	0.118***	0.497***	0.714***	0.552***	0.444***	0.184***	0.184***	0.183***	0.120***
	[12.64]	[10.43]	[10.89]	[12.30]	[3.84]	[3.83]	[3.54]	[3.52]	[8.47]	[7.48]	[8.03]	[6.93]
SIZE	0.212***	0.148***	0.176***	0.173***	1.745***	1.032*	1.342***	1.328***	0.250***	0.163**	0.174**	0.150***
	[6.24]	[3.09]	[4.25]	[5.83]	[4.32]	[1.76]	[2.73]	[3.30]	[3.69]	[2.11]	[2.42]	[2.68]
$SIZE^2$	-0.00717***	-0.00445***	-0.00578***	-0.00579***	-0.0583***	-0.029	-0.0431**	-0.0437***	-0.00861***	-0.00531*	-0.00579**	-0.00517***
	[-5.98]	[-2.64]	[-3.97]	[-5.58]	[-4.09]	[-1.41]	[-2.49]	[-3.09]	[-3.59]	[-1.95]	[-2.29]	[-2.64]
LLR	-0.0124***	-0.0151***	-0.0142***	-0.00779***	-0.188***	-0.226***	-0.214***	-0.0760**	0.00066	-0.00415	-0.00379	-0.00479**

	[-5.77]	[-7.45]	[-6.87]	[-3.41]	[-7.33]	[-9.15]	[-8.73]	[-2.42]	[0.15]	[-1.27]	[-1.18]	[-2.05]
LADS	-0.0572***	-0.0401**	-0.0515***	-0.00883	-0.564***	-0.371*	-0.461**	-0.18	-0.136***	-0.0911***	-0.0980***	-0.0538***
	[-3.50]	[-2.49]	[-3.22]	[-0.78]	[-2.91]	[-1.88]	[-2.43]	[-1.21]	[-4.17]	[-3.51]	[-3.87]	[-2.85]
DEP	-0.00535*	-0.00733*	-0.00742**	-0.00384*	-0.0697*	-0.0522	-0.0696*	-0.018	0.00637	-0.00197	-0.000632	0.00551
	[-1.78]	[-1.95]	[-2.16]	[-1.74]	[-1.96]	[-1.14]	[-1.71]	[-0.62]	[1.06]	[-0.33]	[-0.11]	[1.17]
GDPG	0.0344	0.00314	0.03	0.0331*	0.374	0.13	0.354	0.415*	0.137	0.136**	0.142**	0.181***
	[0.77]	[0.08]	[0.76]	[1.88]	[0.71]	[0.28]	[0.75]	[1.78]	[1.54]	[2.22]	[2.35]	[5.35]
INF	0.0241**	0.0667***	0.0320***	0.0158***	0.267**	0.657***	0.346***	0.236***	0.0582***	0.0636***	0.0562***	0.0359***
	[2.27]	[5.66]	[3.08]	[2.94]	[2.12]	[4.57]	[2.80]	[3.34]	[2.75]	[3.35]	[3.24]	[3.53]
M2	0.0164***	0.0253***	0.0176***	0.0105***	0.167***	0.241***	0.175***	0.116***	0.00151	0.00112	-0.00052	-0.00263
	[3.40]	[5.70]	[4.00]	[4.80]	[2.92]	[4.45]	[3.36]	[4.01]	[0.16]	[0.16]	[-0.08]	[-0.63]
RISK	0.000535	-0.00138	0.00021	0.000426	0.00363	-0.0131	0.00115	0.0019	0.00405	0.00473**	0.00498**	0.00690***
	[0.37]	[-1.09]	[0.16]	[0.80]	[0.21]	[-0.85]	[0.08]	[0.27]	[1.42]	[2.32]	[2.50]	[6.70]
_cons	-1.536***	-1.194***	-1.307***	-1.256***	-12.65***	-8.562**	-10.04***	-9.728***	-1.800***	-1.254**	-1.308**	-1.071***
	[-6.31]	[-3.47]	[-4.41]	[-5.94]	[-4.37]	[-2.04]	[-2.85]	[-3.39]	[-3.71]	[-2.27]	[-2.54]	[-2.68]
R-sq	0.55	0.524			0.43	0.427			0.39	0.424		
	F (13, 327) = 30.75	F (13,297) = 25.11	Wald chi2 = 314.21	Wald chi2= 397.68	F (13, 327) =18.94	F (13,297) = 17.01	Wald chi2= 219.75	Wald chi2 = 156.49	F (13, 327) = 16.0	F (13,297) = 16.85	Wald chi2 = 231.67	Wald chi2 = 297.58
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

Note: ***, **, and * indicate statistical significance levels of 1%, 5%, 10%, respectively. Readers may refer to Section 4.1 for the definitions of the variables.