

Vu, Thanh Huu

Article

Liquidity coverage ratio and profitability: an inverted U-shaped pattern

Cogent Economics & Finance

Provided in Cooperation with:

Taylor & Francis Group

Suggested Citation: Vu, Thanh Huu (2024) : Liquidity coverage ratio and profitability: an inverted U-shaped pattern, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-17,
<https://doi.org/10.1080/23322039.2024.2426532>

This Version is available at:

<https://hdl.handle.net/10419/321663>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

Liquidity coverage ratio and profitability: an inverted U-shaped pattern

Thanh Huu Vu

To cite this article: Thanh Huu Vu (2024) Liquidity coverage ratio and profitability: an inverted U-shaped pattern, Cogent Economics & Finance, 12:1, 2426532, DOI: [10.1080/23322039.2024.2426532](https://doi.org/10.1080/23322039.2024.2426532)

To link to this article: <https://doi.org/10.1080/23322039.2024.2426532>



© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 10 Nov 2024.



[Submit your article to this journal](#)



Article views: 1588



[View related articles](#)



[View Crossmark data](#)



Citing articles: 1 [View citing articles](#)

Liquidity coverage ratio and profitability: an inverted U-shaped pattern

Thanh Huu Vu 

Department of Finance and Banking, Ho Chi Minh City Open University, Ho Chi Minh City, Vietnam

ABSTRACT

The aim of this paper is to investigate the relationship between the Liquidity Coverage Ratio (LCR) and profitability in the banking sector of Vietnam, focusing on determining how LCR impacts profitability while identifying the optimal level of LCR that balances liquidity management and profitability. The study uses a sample of 20 banks from Q1 2015 to Q4 2022. Profitability is measured through Return on Assets (ROA) and Net Interest Margin (NIM). Employing a system GMM estimator to explore the quadratic effect of LCR on profitability, the results demonstrate an inverted U-shaped relationship. Initially, increases in LCR enhance profitability, reflecting better liquidity management. However, beyond optimal points (approximately 5.89 for ROA and 7.47 for NIM), further increases in LCR lead to diminishing returns, indicating that excessively high liquidity buffers impose opportunity costs and reduce profitability. These findings underscore the importance of balancing liquidity and profitability in banking operations. This study is novel in its use of the system GMM estimator to investigate the quadratic relationship between LCR and profitability in the Vietnamese banking sector, offering new insights into how banks can optimize liquidity management to enhance profitability. Unlike previous studies, this paper identifies specific optimal LCR thresholds for ROA and NIM, providing actionable benchmarks for banking operations.

IMPACT STATEMENT

This study contributes valuable insights into the relationship between the Liquidity Coverage Ratio (LCR) and profitability within the Vietnamese banking sector. By identifying a specific optimal LCR threshold for Vietnamese banks, the research offers actionable benchmarks that enable financial institutions to balance liquidity and profitability more effectively. These findings underscore an inverted U-shaped relationship between LCR and profitability, wherein initial increases in LCR enhance bank performance through better liquidity management. However, profitability diminishes as LCR exceeds optimal levels, highlighting the potential opportunity costs associated with maintaining excessive liquidity. This study's application of a dynamic two-step Generalized Method of Moments (GMM) estimator further provides a rigorous and robust analysis, addressing endogeneity concerns often present in banking studies. Ultimately, these insights equip Vietnamese banks and regulatory bodies with practical tools to enhance financial stability and operational efficiency in a dynamic economic landscape.

ARTICLE HISTORY

Received 13 August 2024
Revised 21 October 2024
Accepted 3 November 2024

KEYWORDS:

Liquidity coverage ratio; profitability; quadratic effect; inverted U-shaped pattern; fixed effects model; generalized method of moments

JEL CLASSIFICATION CODES

G01; G21; G28

SUBJECTS

Finance; Business, Management and Accounting; Economics

Introduction

During the onset of the 2007 financial crisis, even with sufficient capital, numerous banks were unable to manage their liquidity prudently (BCBS, 2013). During that period, prudently managing the process of acquiring short-term debts to fund longer-term loans was a productive and useful activity that formed the core of the contemporary financial system. The practice of using short-term debts to fund longer-

CONTACT Thanh Huu Vu  thanh.vh@ou.edu.vn  Department of Finance and Banking, Ho Chi Minh City Open University, 35 – 37 Ho Hao Hon Street, District 1, Ho Chi Minh City, Vietnam

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/23322039.2024.2426532>

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

term loans, commonly referred to as maturity mismatch, poses significant liquidity and profitability challenges for banks. In this scenario, banks borrow funds on a short-term basis (such as overnight or within a few months) and then use these funds to issue longer-term loans to borrowers (such as mortgages or corporate loans). While this strategy can lead to higher profitability due to the interest rate spread (the difference between the short-term borrowing costs and the long-term loan rates), it also exposes banks to liquidity risks. Banks face failure when this short-term funding vanishes (Hartlage, 2012). The crisis highlighted the need to effectively manage liquidity for the banking industry (BCBS, 2013). After this crisis, the Basel Committee for Banking Supervision adopted two minimum financing liquidity rules in December 2010. These standards serve two complementary goals. The primary goal is to ensure a bank has enough high-quality liquid assets to survive a one-month stress scenario. The second goal is to incentivize banks to gradually adopt more reliable funding sources over time to boost resilience. In order to achieve the initial and subsequent objectives, the Committee devised the Net Stable Funding Ratio (NSFR) and the LCR, respectively (BCBS, 2013). The LCR, introduced under Basel III regulations, is a key liquidity measure that ensures banks maintain a sufficient stock of high-quality liquid assets (HQLA) to cover their total net cash outflows over a 30-day stress period. This ratio is designed to improve banks' short-term resilience to liquidity shocks by requiring them to hold liquid assets that can be quickly converted into cash to meet obligations. Hence, the LCR requires banks to maintain an adequate stock of HQLA. These assets refer to those that can be easily and quickly converted into cash with little to no loss of value, even during times of financial stress (BCBS, 2013). Additionally, the LCR is based on forecasted net cash outflows, which represent the estimated cash outflows a bank expects to encounter over a 30-day stress period, minus any inflows that are expected to be realized during the same time frame (BCBS, 2013). This measure helps banks prepare for sudden liquidity demands by requiring them to hold sufficient HQLA to cover these forecasted outflows. According to the BCBS (2013), the LCR should be a fundamental component of the supervisory methodology used to assess liquidity risk.

Banking institutions incur an opportunity cost by retaining liquid assets (Bordeleau & Graham, 2010) like cash, treasury securities, and government securities due to their typically low returns. Without regulation, it is logical to anticipate that banks will maintain liquid assets to optimize profitability. The nexus between liquidity roles and profitability within the banking sector has constituted the core of extensive scholarly investigation (Golubeva et al., 2019). Sidhu et al. (2022) further comment that banks need to maintain a sufficient level of liquidity to sustain operations while still allowing for profitability. This means that banks should achieve a balance between liquidity and profitability. Excessive liquidity and insufficient liquidity are two financial issues that can erode the profitability of banks (Kong et al., 2019).

Although there has been extensive empirical research on the connection between bank liquidity and profitability, there is still a lack of agreement or consensus on this matter (Golubeva et al., 2019).

From a theoretical perspective, signaling theory could explain the positive relationship between bank capital and profitability, according to Berger (1995b). Lu (2021) also notes that the LCR indicates a bank's liquidity, which includes high-quality liquid assets and forecasted net cash outflows. As a result, a bank's LCR reassures partners that they have enough cash and liquid assets to meet client payment requests and emergency capital needs. Thus, fundraising, lending, and service partners are likely to remain or increase their cooperation with the bank, helping it increase profitability. Besides the signaling theory, there are other methods of argumentation that can explain the relationship between two variables. Bordeleau and Graham (2010) argue that liquidity has a quadratic non-linear relationship with profitability, using Berger (1995b)'s 'expected bankruptcy cost hypothesis' and the formula for 'illiquidity risk' proposed by Morris and Shin (2009).

From an empirical standpoint, many studies record contradictory results regarding the impact of the LCR on profitability. For instance, studies by Ibrahim (2017) and Mashamba (2018) discover a positive correlation between LCR and profitability. In contrast, studies by Banerjee and Mio (2018) and Sidhu et al. (2022) find a negative impact.

In addition to the issue just mentioned, measuring the LCR in empirical research is also a topic of interest. In many countries, including Vietnam, reporting LCR is not mandatory; therefore, researchers have sought ways to estimate LCR from financial report data. Polizzi et al. (2020) acknowledged that it is not possible to calculate LCR accurately based on financial reports alone, but they suggest the ratio of liquid assets to total assets as a proxy for LCR. Similarly, Chiaramonte and Casu (2017) recommend the

ratio of liquid assets to deposits and short-term funding as an alternative proxy for the LCR. Lu (2021) uses annual financial reports to estimate the LCR for Morgan Bank and compares it with the official LCR reported by Morgan Bank. The results show that the estimated LCR and the officially reported LCR differed by 16%. Hong et al. (2014) measure LCR approximately based on the quarterly reports' data. However, this calculation method might not yield an accurate approximation of the LCR.

This study is conducted to address two issues: first, to calculate LCR approximately, and second, to explore and evaluate the relationship between LCR and profitability in the context of the banking system in Vietnam. Addressing the endogeneity problems inherent in dynamic panel data models, particularly those involving lagged dependent variables, is critical. The use of the two-step Generalized Method of Moments (GMM) estimator, as developed by Arellano and Bond (1991), is instrumental in mitigating these issues. This study employs the dynamic two-step system GMM panel estimator to explore the relationship between LCR and profitability, using ROA and NIM as dependent variables. By leveraging this robust methodological framework, the study aims to provide more reliable insights into how liquidity management impacts bank profitability in Vietnam's banking sector from Q1 2015 to Q4 2022.

This research contributes to the existing literature by validating the hypothesis that the relationship between LCR and profitability follows an inverted U-shaped pattern, where initial increases in LCR enhance profitability, but excessive liquidity coverage beyond an optimal point leads to diminishing returns. This study's findings underscore the importance of achieving an optimal balance in liquidity management to maximize bank profitability.

The remainder of this paper is structured as follows: Section 2 presents a review of the relevant literature on the relationship between the Liquidity Coverage Ratio (LCR) and profitability. Section 3 describes the research methods, including data sources, variable definitions, and the econometric model employed. Section 4 provides the empirical results and a detailed discussion of the findings. Section 5 concludes the paper by summarizing the key insights, highlighting practical implications, and suggesting directions for future research.

Literature review

Liquidity and liquidity coverage ratio

The second primary component of the Basel III rule is the liquidity position of a bank. Bank liquidity is the capacity of a financial organization to fulfill its financial responsibilities without experiencing unacceptable losses (BCBS, 2008). Tirole (2011) classifies bank liquidity into two types: funding and market liquidity.

Funding liquidity is commonly defined as the portion of the balance sheet that represents liabilities. The bank has the option to issue several types of securities, such as new wholesale deposits, long-term bonds, straight equity, preferred stocks, or other similar financial instruments. By doing so, it diminishes the value or impact of its current investors. Market liquidity refers to the assets side of the balance sheet. The bank has the potential to generate cash that exceeds the yield accruing from assets listed on its balance sheet. In agreement with Tirole (2011), Roy et al. (2019) also acknowledge that liquidity involves the bank's capacity to promptly convert assets into cash or its access to funding. Tirole (2011) finds that funding and market liquidity tend to be positively correlated.

Following the financial crisis that originated in the United States in 2007, resulting in the collapse of numerous banking institutions, the examination of bank liquidity has gained substantial importance. This crisis caused considerable disruption in financial markets and heightened the demand for stricter financial system regulation. In response, BCBS (2010) bolstered its liquidity framework by introducing two standards for managing liquidity risk: the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR standard mandates that banks maintain an adequate level of high-quality liquid assets to withstand a severe stress scenario over one month, whereas the NSFR standard requires banks to fund their operations with more stable sources of funding. The LCR is a metric of asset liquidity, defined as the ratio of high-quality liquid assets to the total net cash outflows expected over the next 30 days under conditions of severe liquidity stress. BCBS (2019) defines a liquid asset as one that can easily and promptly convert into cash without significant value loss. The NSFR is a measure that calculates the proportion of available stable financing (ASF) to required stable funding (RSF). The LCR

standard tries to augment the liquidity reserves of individual banks, while the NSFR standard intends to fortify the stability of their funding.

This study specifically examines the LCR and its effect on profitability, rather than focusing on the NSFR. The LCR mitigates liquidity risk by augmenting bank investments in high-grade liquid assets, whereas the NSFR aims to mitigate financing risk resulting from the discrepancy between assets and obligations (King, 2013). After Basel 2013, it is recommended to continuously utilize the LCR to effectively oversee and manage liquidity risk.

Liquidity coverage ratio and profitability

From a theoretical perspective, Berger (1995b) argues that signaling theory, as proposed by Spence (1973), could provide a reasonable explanation for the positive link between bank capital and profitability. The concept of signaling refers to the act of conveying information from a signaler to a receiver. This idea is grounded in the principles of asymmetric information theory. It posits that important stakeholders seek accurate and vital information to minimize the negative effects of information asymmetry. Once partners have obtained the required information, they will proceed to take actions that align with the information. Banks employ diverse methods to communicate with their partners, particularly when conveying messages pertaining to the foundational principles of bank governance as outlined by BCBS (2012).

Liquidity coverage is also considered one of the essential pillars of bank governance. By increasing liquidity, banks provide valuable information to their partners. Lu (2021) further highlights that the Liquidity Coverage Ratio (LCR) offers insight into a bank's liquidity status, particularly in terms of expected net cash outflows and the quantity of high-quality liquid assets. Consequently, information from a bank's LCR instills confidence in partners that they have sufficient cash and liquid assets to easily meet immediate payment demands from customers, as well as capital needs in emergency situations. As a result, partners involved in fundraising, lending, and service provision are likely to continue or even increase their cooperation with the bank, thereby facilitating the bank's ability to enhance profitability.

In addition to signal theory, there are other arguments to explain the relationship between two variables. Notably, the reasoning by Bordeleau and Graham (2010) stands out. The authors put together Berger (1995b)'s 'expected bankruptcy cost hypothesis' and Morris and Shin (2009)'s 'illiquidity risk formula' to show that liquidity has a quadratic relationship with profitability. This means that as a bank's liquidity ratio increases, it helps reduce costs and simultaneously lowers bankruptcy risk (applying the expected bankruptcy cost hypothesis and the 'illiquidity risk' formula). However, holding liquid assets comes with a downside. It imposes an opportunity cost on the bank because these assets have a lower return compared to other assets. As a result, this hurts profitability. This study supports the idea that keeping liquid assets is a disadvantage for the bank because they have a poor return compared to other assets. This ultimately hurts profitability. For the first point, the study finds that the 'expected bankruptcy cost hypothesis' applies to the relationship between capital and profitability. Berger (1995b) concludes that increasing capital lowers the uninsured debt rate, resulting in increasing profits. This indicates that Berger (1995b) does not use the expected bankruptcy cost hypothesis for liquid assets. Nevertheless, the second argument put out by Morris and Shin (2009) refers to holding high liquidity assets as synonymous with holding less-earning assets.

Many empirical studies investigate the relationship between bank liquidity and profitability. However, the results from empirical studies are mixed. Some research shows a positive impact of liquidity on profitability, as seen in studies by Islam and Nishiyama (2016), Bourke (1989), and Waleed et al. (2016). Several studies have utilized the LCR as a metric to assess liquidity, such as Mashamba (2018) and Veeramoothoo and Hammoudeh (2022), also found similar conclusions. In contrast, research on banks in emerging markets finds that LCR, representing a measure of liquidity, negatively impacts profitability. For instance, one study found that higher LCR leads to reduced NIM due to a narrower interest spread, which ultimately affects overall profitability negatively (Supriadi, 2016). Similarly, a study by Sidhu et al. (2022) on Indian banks observes that LCR reduces banks' NIMs. Additionally, it is noted that higher LCR is associated with an increase in Non-Performing Assets, which further negatively impacts profitability (Sidhu et al., 2022).

In addition, Abbas et al. (2019) discovered that liquidity negatively impacts the profitability of large commercial banks in the USA, whereas it positively affects the profitability of commercial banks in developed Asian countries during the post-crisis period. The study by Morris and Shin (2009), using the ratio of realizable cash to short-term liabilities to measure liquidity, confirms the nonlinear relationship between liquidity and profitability. Specifically, as a bank's liquidity increases, its profitability increases. However, when a bank holds too many liquid assets, profitability decreases.

The literature review of this study indicates that, despite an abundance of research on the relationship between liquidity and profitability of banks, no theory can definitively establish the precise direction of the effect of liquidity on profitability. Additionally, results from empirical investigations have been mixed. These two variables may have a positive, negative, or nonlinear relationship. To be precise, research employing LCR as a metric for assessing liquidity has yielded results indicating either a favorable or unfavorable influence of LCR on profitability; however, no studies have yet investigated nonlinear associations.

Building on signal theory, Lu (2021)'s arguments, and the mixed empirical results mentioned above, this study concludes that holding more liquid assets helps banks send valuable signals about their liquidity capabilities to relevant parties. Consequently, collaborations between the bank and its partners engaged in lending, service provision, and fundraising are probable to persist or potentially expand, thus bolstering the bank's capacity to augment profitability. Nevertheless, excessive holding of liquid assets results in an opportunity cost for the bank due to their comparatively low return in comparison to other assets, consequently impacting profitability adversely (Morris & Shin, 2009). Therefore, this research proposes the following hypothesis:

H1: *There is a quadratic (inverted U-shaped) relationship between the Liquidity Coverage Ratio (LCR) and bank profitability. Initially, increases in LCR improve profitability, but after reaching an optimal point, further increases in LCR reduce profitability.*

Research methods and data sources

Measurement

Bank profitability

The term 'bank profitability' pertains to a bank's capacity to sustain its profit margin on an annual basis (Menicucci & Paolucci, 2016). Profitability serves as an indicator of the operational management of banks in the context of their operating environment (García-Herrero et al., 2009). Indeed, it is imperative that the profitability of banks reflects not only their competitive strategies, efficiency, and risk management capabilities but also the caliber of their management and shareholders' conduct (García-Herrero et al., 2009). Menicucci and Paolucci (2016) state that the profitability performance of banks is one of the most crucial performance indicators for investors and a measure of the management's success.

Bank profitability is proxied in many ways in the empirical literature. To capture bank profits, some common metrics often applied in empirical studies include ROA, ROE, NIM, and NPM (Net Profit Margin). Like Lee and Hsieh (2013), Menicucci and Paolucci (2016), and Bikker and Vervliet (2018), our research focuses on the aforementioned variables and does not encompass all dimensions of profitability. To begin, the ROA, which has been established as a benchmark for assessing the profitability of banks in scholarly works (García-Herrero et al., 2009; Klein & Weill, 2018), is utilized. Accounting scholars emphasize ROA as a crucial factor for assessing the profitability of banks (Golubeva et al., 2019; Rose, 2010). Similar to García-Herrero et al. (2009), this research considers ROA to be a more suitable metric than ROE in the context of Vietnam due to the abnormally low level of bank equity. Another metric is the NIM, which quantifies the earnings generated from interest-related activities (Berger, 1995b). Bank efficacy and investment success are both indicators of the NIM ratio (Menicucci & Paolucci, 2016). Certain scholars, including García-Herrero et al. (2009) and Tan et al. (2017) employ the metrics mentioned above as a means of quantifying profitability.

LCR measurement

BASEL III and Vietnam regulations. *BASEL III regulations.* BCBS (2010) introduced the LCR, which was subsequently revised by BCBS (2013). The LCR expands upon conventional liquidity 'coverage ratio'

approaches that financial institutions employ internally to evaluate their vulnerability to contingent liquidity events. The LCR consists of two elements: the stock of HQLA and total net cash outflows. The LCR is computed as follows:

$$LCR = \frac{\text{Stock of HQLA}}{\text{Total net cash outflows over the next 30 calendar days}} \quad (1)$$

(Source: BCBS (2013)).

The LCR's numerator is represented by the 'stock of HQLA'. Financial institutions are required to maintain an inventory of unencumbered HQLA sufficient to withstand the aggregate net cash outflows (as delineated below) that occur during a 30-day period under the specified stress scenario. Assets are classified as HQLA if they are capable of being converted into cash without significant depreciation or difficulty. The stock may incorporate two distinct classifications of assets: Level 1 and Level 2 assets. The inclusion of 'Level 1' assets is not restricted, whereas the proportion of 'Level 2' assets in the stock is limited to 40% (Table A1 in Appendix A provides a summary of the categories and weights utilized in the HQLA calculations, as reported by BCBS (2013)). The LCR denominator is total net cash outflows. In the stress scenario for the next 30 days, it is the predicted cash outflows minus the expected cash inflows. A summary of cash inflows and outflows, by the Basel III regulation, is presented in Table A2 and Table A3 of Appendix A.

Vietnam regulations. Recognizing the role of LCR, the Vietnam State Bank (SBV) issued Circular No.22/2019/TT-NHNN, which refers to the regulations and methods of determination related to LCR. The Circular, which establishes safety ratios and limits for banks and foreign bank branches, mandates a 30-day liquidity coverage ratio that is comparable to the LCR. That Circular and Basel III differ in several aspects, most notably regarding the computation of currency inflows and outflows, where all the components of the cash flow in and out are 100% weighted. Table A4, Table A5, and Table A6 of Appendix A detail the components of HQLA, cash outflows, and cash inflows as specified in this circular, respectively.

LCR proxies. Since the bank's LCR is not widely applied and has not been publicly disclosed, some authors, such as Polizzi et al. (2020), compute the ratio of liquid assets to total assets as a proxy for the LCR. Chiaramonte and Casu (2017) consider a proxy of the LCR estimated as liquid assets to deposits and short-term funding. Golubeva et al. (2019) utilize two alternative measures: the Loans to Deposits (LTD) ratio and the Financing Gap to Total Assets (FGR) ratio, where the financing gap is defined as the difference between loans and deposits.

Although these proxies are simple to calculate, they have two disadvantages: first, they calculate by year, and second, they do not use the components that make up the LCR. Consequently, the calculation's results will differ from the LCR. Therefore, identifying methods for estimating LCR through financial statements will yield more accurate results, as the financial report includes the components that comprise the LCR.

LCR approximation. Some authors, such as Hong et al. (2014), Lu (2021), and Heuver and Berndsen (2022), approximately estimate LCR using annual financial statements. In my viewpoint, using financial statements to estimate LCR would be better than using representative variables. Some authors such as Lu (2021) and Heuver and Berndsen (2022) estimate LCR through the quarterly financial report, while Hong et al. (2014) estimated it by using the quarterly financial report. Because quarterly financial reports provide information closer to the monthly financial report, calculating the LCR using quarterly data can provide more accurate results than using annual reports. The study will follow BCBS (2013)'s guidelines, adjust to Vietnam's Circular No. 22/2019/TT-NHNN, and then apply the LCR calculation formula based on the quarterly financial report. The study proposes five steps for estimating LCR, which are as follows:

Step one: Identify the components of HQLA and determine their respective weights. This study utilizes the components and weighting of HQLA under Circular No.22/2019/TT-NHNN issued by SBV (see Table A4 of Appendix A).

Step two: Identify the components and the weighting of the components that make up the cash outflows. This study utilizes the components and weighting of HQLA under Circular No.22/2019/TT-NHNN issued by SBV (see Table A4 of Appendix A).

Step three: Estimate the HQLA over a quarter. This study will calculate the average of each component then the HQLA is calculated as follows:

$$HQLA_{proxy} = \sum_{i=1}^7 \left(\frac{A_{C_i} + A_{P_i}}{2} \right) \quad (2)$$

where $HQLA_{proxy}$ is a proxy of HQLA, i is the i th asset of the seven asset categories to be collected according to the SBV's instructions (see Table A4 of Appendix A). Further, A_{P_i} and A_{C_i} represent total assets for the previous quarter and current quarter, respectively.

$HQLA_{proxy}$ can also be considered an approximate estimate of the high liquidity assets in 30 days.

Step four: Estimate total net cash outflows. The quarterly call report data, however, only reports information about cash flow within three months. Therefore, it is necessary to extrapolate the cash flow for one month. Assuming the cash flow is evenly distributed, the amount of cash flow within one month equals one-third of the amount of cash flow within three months.

$$NetCash_{proxy} = \frac{outflows_Q - \text{Min}(inflows_Q; 75\% \text{ of } outflows_Q)}{3} \quad (3)$$

where $NetCash$ is a proxy of total net cash outflows over the next 30 calendar days. Further, $outflows_Q$ and $inflows_Q$ represent quarterly cash outflows and inflows as per Circular No.22/2019/TT-NHNN issued by SBV (see Table A4 of Appendix A).

Step five: Estimate the proxy of LCR:

$$LCR_{proxy} = \frac{HQLA_{proxy}}{NetCash_{proxy}} \quad (4)$$

LCR_{proxy} is an estimation of asset liquidity that represents the ratio of high-quality liquid assets to the total net cash outflows expected during the next 30 calendar days.

Control variables

Bank size. Whether bank size increases profitability is one of the most critical inquiries in the literature (Menicucci & Paolucci, 2016). The role of size as a determinant of bank profitability has been the subject of many previous studies, and empirical research has provided numerous examples of this association. Nevertheless, the relationship between the size of a bank and its profitability produces conflicting results. A substantial positive correlation between size and profitability has been documented in previous research conducted by Saeed (2014), Menicucci and Paolucci (2016), Adelopo et al. (2018), Saif-Alyousfi (2022), and Radovanov et al. (2023). Nevertheless, Gržeta et al. (2023) demonstrate the diverse impact of size on profitability. The effect is beneficial for large and medium-sized banks but detrimental for small banks.

The size of a bank is typically assessed by its total assets or deposits. This paper determines the size of a bank by the logarithm of its total assets. This is regarded as a determining factor in profitability.

Bank capital. The capital ratio serves as a crucial metric for evaluating the sufficiency of a bank's capital and gauges the overall stability of the bank by measuring its level of capitalization. Thus, the equity to total assets ratio also referred to as the capital ratio, is considered a crucial measure of capital strength (Golin & Delhaise, 2013). Besides, Kanga et al. (2020) and Saif-Alyousfi (2022) highlight that bank profitability is determined by bank capital. The signaling and bankruptcy cost hypotheses proposed by Berger (1995a) are major explanations for the positive impact of capital on profitability. The empirical research consistently shows that capital is positively correlated with profitability (Ayaydin & Karakaya, 2014; Berger, 1995a; Berger & Bouwman, 2013; Saif-Alyousfi, 2022).

Expenses management. The total cost of a bank can be separated into operating costs and other expenses (including taxes, depreciation, etc.). The ratio of these expenses to total assets is expected to

be negatively related to profitability (Athanasoglou et al., 2008; Mathuva, 2009), since improved management of these expenses will increase efficiency and therefore raise profits.

Income diversification. There is tension in the empirical literature regarding the advantages of diversification (Sanya & Wolfe, 2011). According to Sanya and Wolfe (2011), several studies discover that diversification has a positive effect on bank stability, whereas others find evidence that suggests the opposite. To assess the extent of revenue diversification, this study calculates the Herfindahl-Hirschman Index (HHI_{Income}) for each bank, considering the level of diversification between the two primary sources of income as follows:

$$HHI_{Income} = \left(\frac{NET - IN}{NET - OP} \right)^2 + \left(\frac{NON - IN}{NET - OP} \right)^2 \quad (5)$$

where NET-IN denotes net-interest income, NON-IN represents non-interest income, and NEP-OP is net-operating revenue. Further, NET-OP is the total of NET-IN and NON-IN.

Credit risk. The profitability of financial institutions is significantly influenced by credit risk, which is the potential for loss as a result of a borrower's failure to repay a loan or satisfy contractual obligations. This relationship has been the subject of numerous studies in a variety of banking sectors and regions, which have offered valuable insights into the ways in which credit risk affects profitability. For instance, De Leon (2020) indicates that the profitability of 20 ASEAN banks is adversely affected by credit risk. In order to evaluate credit risk, this investigation implements the loan-loss provisions to loans ratio (LPR).

GDP growth. GDP growth has been found to have a varied impact on bank profitability depending on the region and other factors. Studies such as those on Chinese banks indicate that GDP growth can negatively affect bank profitability, due to factors such as competition and market inefficiencies (Tan & Floros, 2012). In contrast, research on banks in Turkey that GDP growth positively impacts return on assets (ROA) and return on equity (ROE), highlighting that stronger economic growth boosts profitability in the banking sector (Doğan & Yildiz, 2023). Additionally, Bonaccorsi di Patti and Palazzo (2020) highlight that the relationship between GDP growth and profitability can vary depending on specific bank characteristics, like the size of their loan portfolios.

Market structure. The structure of the market profoundly influences bank profitability. According to the structure-conduct-performance (SCP) and relative market power (RMP) theories, Mirzaei et al. (2013) argue that an increase in market share leads to improved profitability. A common variable that controls market structure is the Herfindahl-Hirschman Index (HHI) (Khan et al., 2016). It measures the level of concentration in a market by summing the squares of the market shares of all firms in the industry.

$$HHI_{Market} = \sum_{i=1}^n S_i^2 \quad (6)$$

where n is the total number of banks in the market and S_i represents the market share of bank i , expressed as the percentage of the bank i 's assets relative to the total assets of n banks.

Estimation framework

The primary goal of this study is to examine how bank liquidity impacts profitability, as measured by ROA and NIM. One major challenge in this estimation is the issue of endogeneity, which refers to the possibility that banks with higher profitability may have an advantage in increasing their equity by retaining earnings, as highlighted by García-Herrero et al. (2009). By relaxing the assumption of perfect capital markets, it becomes possible for an increase in capital to result in higher projected earnings (Tan et al., 2017). In addition, they have the option to allocate a higher budget towards advertising initiatives and expand their operations, thereby impacting their overall profitability. Alternatively, the causal relationship could be reversed, where banks that are more lucrative may choose to employ additional staff, thus diminishing their operating efficiency (García-Herrero et al., 2009). Also, bank profits tend to stay

the same over time, which could mean that there are barriers to market competition, a lack of information, or a high risk of regional or macroeconomic shocks (Athanasoglou et al., 2008). Another significant issue is the presence of unobserved heterogeneity across banks (Tan et al., 2017), for example, differences in corporate governance and the case of state-owned banks.

Applying fixed effects or random effects models to estimate dynamic panel data models can solve the problem of unobserved heterogeneity. However, they cannot tackle the endogeneity problem primarily, due to the presence of a lagged dependent variable. In dynamic panel data models, the lagged dependent variable is included as a regressor. This creates endogeneity problems because the lagged dependent variable is likely correlated with the error term.

To address these challenges, this study employs the two-step Generalized Method of Moments (GMM) system estimator developed by Arellano and Bond (1991). This method is particularly suitable for dynamic panel models and helps to eliminate unobserved heterogeneity and address endogeneity. The model is specified as follows:

$$Y_{it} = \hat{\beta}_0 + \hat{\alpha}Y_{it-1} + \sum_{k=1}^n \hat{\beta}_k X_{k,it} + u_i + e_{it} \quad (6)$$

here, Y_{it} represents the ROA and NIM. Y_{it-1} is the lagged dependent variable. i and t denote the individual bank and time dimension of the panel respectively. $X_{k,it}$ refers the $k \times 1$ vectors of explanatory variables. The unobserved heterogeneity (the unobserved bank-specific effect) and error term are captured by u_i and e_{it} .

Equation (6) indicates that the explanatory variables may have possible endogeneity. To address this, equation (6) needs to be differentiated to obtain equation (7). This transformation, based on dynamic panel analysis, aims to remove bank-specific effects. The initial difference equation is defined as:

$$Y_{it} - Y_{it-1} = \hat{\alpha}(Y_{it-1} - Y_{it-2}) + \sum_{k=1}^n \hat{\beta}_k (X_{k,it} - X_{k,it-1}) + e_{it} - e_{it-1} \quad (7)$$

Equation (7) can be rewritten as:

$$\Delta Y_{it} = \hat{\alpha} \Delta Y_{it-1} + \sum_{k=1}^n \hat{\beta}_k \Delta X_{k,it} + \Delta e_{it} \quad (8)$$

where Δ denotes the difference between periods t and $t-1$.

After first-differencing, the lagged dependent variable ΔY_{it-1} is still endogenous. This is addressed by the Arellano-Bond estimator, which uses lagged levels of the dependent variable and potentially other exogenous variables as instruments for the differenced equation. The Arellano-Bond estimator employs the system Generalized Method of Moments (GMM) to estimate the parameters of the dynamic panel model. GMM is a flexible estimation technique that constructs moment conditions based on the instruments. The moment conditions in the Arellano-Bond estimator are:

$$E[z_{it} \Delta e_{it}] = 0 \quad (9)$$

where z_{it} are the instruments. This paper employs the dynamic two-step system GMM panel estimator of Arellano and Bond (1991), which is validated through several diagnostic tests, such as the Arellano-Bond test, Sargan test, Hansen test, and Difference-in-Hansen tests.

Data

The dataset includes data from 20 publicly traded banks on the Vietnam stock exchange, covering the period from the first quarter of 2015 to the fourth quarter of 2022. Due to the lingering impact of the global financial crisis in 2008 and Vietnam's financial difficulties in 2012, it was not possible to gather data on the banking sector before 2014. Furthermore, Vietnamese commercial banks' CAR index has been fully available since 2014. The data is gathered from the State Securities Commission of Vietnam (SSC) database and form a highly balanced panel data sample. Table C1 in Appendix C provides a comprehensive list of the banks included in the analysis.

Results and discussion

Descriptive statistics

The descriptive statistics, panel stationarity tests, and trends of all variables are described in [Tables 1](#) and [2](#).

[Table 1](#) presents the descriptive statistics for all variables employed in the econometric model. This table also presents the findings from the Levin–Lin–Chu unit-root test for panel data, which assesses a data series for the presence of a unit root. The test results show that the adjusted t-statistics for all variables are negative and below the critical value, supporting the rejection of the null hypothesis of non-stationarity, which indicates that the data is stationary across the variables.

[Table 2](#) demonstrates the trends of the variables from 2015 to 2022. During these periods, the bank's ROA experiences remarkable growth. During the period from 2015 to 2017, there is a slight increase in the ROA from 0.0064 to 0.0084, suggesting a positive development in the bank's financial performance. Between 2017 and 2022, ROA continues to rise sharply, from 0.84% to 1.63%. This significant increase may indicate a notable improvement in banks' financial performance in a challenging and unpredictable business environment.

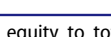
During this period, NIM in the period from 2015 to 2017 remains relatively stable, with little variation ranging from 3.15% to 3.16%. The rest of the time, there is a notable change in the NIM, with an increase from 3.16% to 3.82%.

ROE is employed in robustness check. The trend of the Return on Equity (ROE) from 2015 to 2022 shows initial growth, peaking in 2018 at 0.1421, followed by a gradual decline in subsequent years. After

Table 1. Descriptive statistics and panel stationarity tests.

Variables	Mean	Min	25%	50%	75%	Max	Std	Unit-root test
ROA	0.0110	0.0002	0.0056	0.0082	0.0145	0.0248	0.0070	−3.45(0.012)
NIM	0.0339	0.0199	0.0254	0.0313	0.0349	0.0785	0.0130	−2.67(0.042)
ROE	0.0933	0.0211	0.0341	0.0533	0.0879	0.1421	0.0212	−3.92(0.004)
LCR	5.7716	1.0281	4.5636	5.4842	6.7095	12.0291	2.6740	−4.11(0.002)
CAP	0.0807	0.0476	0.0640	0.0803	0.0940	0.1336	0.0223	−3.78(0.008)
CR	0.0142	0.0111	0.0120	0.0134	0.0160	0.0211	0.0029	−2.85(0.032)
CIR	0.4758	0.3325	0.3859	0.4777	0.5358	0.8227	0.1262	−4.09(0.001)
HHI _{Income}	0.6844	0.5798	0.6515	0.6662	0.7263	0.8373	0.0748	−3.95(0.003)
GDP	0.0587	−0.0602	0.0542	0.0656	0.0699	0.1367	0.0297	−4.14(0.001)
HHI _{Market}	0.1879	0.1124	0.13240	0.16320	0.22650	0.3224	0.0924	−3.42(0.013)

Table 2. Trends of variables from 2015 to 2022.

Year	2015	2016	2017	2018	2019	2020	2021	2022	Trends	Average
ROA	0.0064	0.0062	0.0084	0.0113	0.0119	0.013	0.0148	0.0163		0.01104
NIM	0.0315	0.031	0.0316	0.0327	0.0337	0.0352	0.0374	0.0383		0.03394
ROE	0.0732	0.0845	0.0664	0.1421	0.1202	0.1127	0.0743	0.0734		0.09335
LCR	4.104	4.5018	5.0448	5.4195	6.3795	6.7528	6.6134	7.3572		5.77163
CAP	0.0813	0.0755	0.0708	0.0754	0.0786	0.0849	0.0863	0.0928		0.08070
CR	0.0136	0.013	0.013	0.0135	0.0136	0.0135	0.0151	0.0184		0.01421
CIR	0.5375	0.5489	0.51	0.5159	0.465	0.4204	0.3777	0.4311		0.47581
HHI _{Income}	0.7769	0.7193	0.6721	0.6533	0.6602	0.6443	0.6513	0.698		0.68443
GDP	0.066	0.063	0.0649	0.0714	0.0696	0.028	0.0262	0.0801		0.05874
HHI _{Market}	0.3224	0.2382	0.2096	0.1734	0.1554	0.1472	0.1226	0.1343		0.1879

Note. ROA: return on assets; NIM: net interest margin; ROE: return on equity; LCR: liquidity coverage ratio; CAP: equity to total assets; CR: credit loss provision ratio; CIR: cost to income ratio; HHI_{Income}: income diversification; GDP: gross domestic production Growth; HHI_{Market}: market structure.

reaching its highest point, ROE steadily decreased, ending at 0.0734 in 2022, indicating a downward trend after the peak in 2018.

The bank's LCR exhibits consistent growth in this period, indicating a notable enhancement in its capacity to fulfill its liquidity requirements. During this period, the LCR experienced a significant increase, nearly doubling from its initial level of 4.1040 to 7.3572. This increase indicates that banks have made significant efforts to improve their ability to ensure liquidity and reduce the potential for liquidity risk in recent years. The efforts of banking regulators and supervisors in Vietnam to promote liquidity policies and regulations may also contribute to the ongoing enhancement of the LCR. Table B1 in Appendix B illustrates the descriptive statistics over quarters of all the variables.

Empirical results

To consider how LCR affects profitability in Vietnamese banks, I estimate the GMM system equations. After the Hausman test, the FE model is used as a benchmark model for robustness checks.

Table 3 displays the estimations considering the current level of LCR and LCR² as the key explaining variables. The first two columns provide panel FE estimations, and the remaining two illustrate system GMM estimations.

When comparing the regression results across the Fixed Effects (FE) and System GMM models, several key points stand out. For ROA, the lagged ROA is significant at the 10% level in the FE model (0.249) and at the 5% level in the System GMM model (0.369), indicating stronger persistence in profitability when endogeneity is addressed. The LCR has a positive and significant effect at the 5% level in the System GMM model (0.00412), while it is positive but not significant in the FE model (0.00241). The LCR squared term (LCR²) shows significantly negative in both models, indicating diminishing returns. For NIM, the lagged NIM is significant at the 5% level in the System GMM model (0.322) but not significant in the FE model (0.232). The LCR positively affects NIM and is significant at the 5% level in the System GMM model (0.00568), whereas it is positive but not significant in the FE model (0.00173). The squared term of LCR (LCR²) is negative and significant in both models at the 10% level, implying diminishing returns at higher liquidity levels. Aside from that, the difference in LCR² coefficients between FE and system GMM estimation is not significant. Bank capital (CAP) has a significant positive impact on ROA in both models, underscoring its role in

Table 3. Estimation results.

Variables	FE		Sys.GMM	
	ROA (1)	NIM (2)	ROA (3)	NIM (4)
ROA(-1)	0.249 (0.102)		0.369(0.050)	
NIM(-1)		0.232 (0.145)		0.322 (0.034)
LCR	0.00241 (0.111)	0.00173 (0.136)	0.00412 (0.032)	0.00568 (0.057)
LCR ²	-0.00033 (0.073)	-0.00034 (0.081)	-0.00035 (0.034)	-0.00038 (0.072)
SIZE	-0.01251(0.023)	-0.00143 (0.120)	-0.01574 (0.023)	0.00041 (0.128)
CAP	0.13822 (0.017)	-0.05720 (0.033)	0.14652 (0.003)	-0.06132 (0.024)
CR	-0.13442 (0.341)	0.16889 (0.068)	-0.14523 (0.263)	0.18785 (0.019)
CIR	-0.00565 (0.038)	-0.15524 (0.268)	-0.00549 (0.057)	-0.16324 (0.232)
HHI _{Income}	-0.00252 (0.071)	-0.01144 (0.201)	-0.00256 (0.070)	-0.01032 (0.206)
GDP	0.00346 (0.211)	0.00446 (0.211)	0.00268 (0.213)	0.00372 (0.311)
HHI _{Market}	0.00210 (0.312)	0.00535 (0.062)	0.00247 (0.301)	0.00498 (0.069)
R ²	0.51	0.38		
Arellano Bond test:				
AR(1)			-2.81 (0.006)	-2.43 (0.0173)
AR(2)			-0.87 (0.386)	-0.42 (0.675)
Overidentification restrictions Hansen test			28.57 (0.687)	36.12 (0.324)
Difference-in-Hansen tests of exogeneity of instrument subsets:				
GMM instruments for levels			11.04 (0.136)	9.15 (0.241)
IV instruments			3.12 (0.148)	0.59 (0.482)
Number of banks		20		
Number of periods		32		
Number of observations		640		

Note. ROA: return on assets; NIM: net interest margin; LCR: liquidity coverage ratio; CAP : equity to total assets; CR: credit loss provision ratio; CIR: cost to income ratio; SIZE: logarithm of total assets; HHI_{Income}: income diversification; GDP: gross domestic production Growth, HHI_{Market} : market structure. These empirical results are based on a strongly balanced sample. *p*-value in parentheses

profitability, whereas its effect on NIM is negative. Credit risk (CR) positively and significantly affects NIM in both models, indicating risk premium pricing. Besides, market structure (HHI_{Market}) also has a favorable impact on NIM which suggests that a concentrated market will assist banks become more profitable. Other control variables like bank size (SIZE), expense management (CIR), income diversification (HHI), and gross domestic production growth (GDP) remain largely insignificant across models. Diagnostic tests, including the Hansen test and Arellano-Bond test, support the validity and robustness of the system GMM estimations, providing more reliable results, more significant and stronger effects by addressing potential endogeneity issues.

The diagnostic tests for the system GMM estimation of the NIM and ROA models indicate robust instrument validity and model specification. The Arellano-Bond tests reveal significant first-order autocorrelation (NIM: $z = -2.43$, $p = 0.0173$; ROA: $z = -2.81$, $p = 0.006$) but no significant second-order autocorrelation (NIM: $z = -0.42$, $p = 0.675$; ROA: $z = -0.87$, $p = 0.386$), supporting the validity of the instruments. The Hansen test for overidentifying restrictions confirms the overall validity of the instruments (NIM: $\chi^2(33) = 36.12$, $p = 0.324$; ROA: $\chi^2(33) = 28.57$, $p = 0.687$). Additionally, the Difference-in-Hansen tests affirm the exogeneity of both GMM instruments for levels and IV instruments across both models. Collectively, these results indicate the appropriateness of the instruments used and the correct specification of the models.

Examining the impact of LCR on profitability

To display the effect of the LCR and its squared term (LCR^2) on ROA and NIM, excluding other variables, the simplified equations are:

$$\begin{aligned} ROA_{it} &= 0.00412LCR_{it} - 0.00035LCR_{it}^2 + e_{it} \\ NIM_{it} &= 0.00568LCR_{it} - 0.00038LCR_{it}^2 + e_{it} \end{aligned}$$

The regression results support the hypothesis (H1) of an inverted U-shaped relationship between LCR and profitability. This is evident from the positive and significant linear coefficients (0.00412 for ROA and 0.00568 for NIM) and the negative coefficients for the squared LCR term (-0.00035 for ROA and -0.00038 for NIM).

The positive linear term indicates that initially, increases in LCR enhance profitability metrics such as ROA and NIM. This can be attributed to better liquidity management, which reduces the risk of financial distress and enhances operational efficiency, leading to improved bank performance. My findings are in line with Bourke (1989), Waleed et al. (2016), Mashamba (2018), or Veeramoothoo and Hammoudeh (2022). However, the negative coefficients of the squared LCR term (-0.00035 for ROA and -0.00038 for NIM) indicate diminishing returns, meaning that while higher LCR improves performance up to a point, further increases beyond this point reduce profitability. This finding aligns with several previous studies, including Supriadi (2016) or Sidhu et al. (2022).

The optimal LCR levels identified (approximately 5.89 for ROA and 7.47 for NIM) represent the peak points of the inverted U-shape, where profitability is maximized. Beyond these levels, the marginal benefits of additional liquidity coverage decrease, supporting the hypothesized inverted U-shaped relationship. This finding is consistent with the theory proposed by Bordeleau and Graham (2010), who highlighted the opportunity cost of holding excessive liquid assets, leading to lower returns on investment.

Despite these similarities, my findings deviate from these key empirical studies when confirming the inverted U-shape relationship between LCR and Profitability. The deviations from other research stem from differences in market conditions, regulatory environments, and econometric techniques, all of which influence the specific relationship between LCR and profitability.

- **Different Market Conditions:** my study focuses on Vietnamese banks, while studies like those by Sidhu et al. (2022) and Supriadi (2016) focused on different emerging markets (India and Indonesia, respectively). Differences in banking regulations, market structures, and economic conditions can influence the relationship between LCR and profitability.
- **Regulatory Environment:** Vietnam's regulatory framework, particularly with the adoption of Basel III LCR standards, may differ in enforcement or compliance compared to other countries. This could

lead to varying impacts on banks' profitability as they adjust to liquidity requirements at different rates.

- Model Specifications: my use of a two-step Generalized Method of Moments (GMM) estimator, which addresses endogeneity concerns, may provide more robust results compared to other studies that did not employ similar methodologies. This could explain the quadratic relationship found in your study, which other studies may have overlooked due to methodological differences.

Figure 1 below visualizes the inverted U-shaped relationship between LCR and profitability.

Robustness checks

To test the robustness of the relationship between the liquidity coverage ratio (LCR) and bank profitability, additional regressions are conducted. Unless otherwise specified, this research exclusively uses System Generalized Method of Moments (GMM) panel regressions in these tests, as they are the most relevant for addressing endogeneity issues and generating robust standard errors.

Initially, the study verifies the robustness of our profitability measure by re-estimating the main specification using the banks' ROE. While ROA is a comprehensive measure of bank profitability that reflects the risks borne by both shareholders and creditors, ROE specifically indicates the return on the capital invested by shareholders. The estimation results are presented in Table 4, where our primary findings remain consistent. Notably, this research observes a quadratic impact of the LCR on ROE.

Subsequently, the research employs a substitute measure for the LCR. Chiamonte and Casu (2017) use liquid assets to represent deposits and short-term funding (LiqA) as a measure of the LCR, while Golubeva et al. (2019) employ loans to deposits (LTD) as a proxy for LCR. In lieu of LTD, the study uses LiqA as a substitute indicator. This is because LiqA represents liquid assets, whereas LTD does not encompass them. The results presented in Table 4 reveal a significant positive effect of LiqA on profitability, whereas no quadratic effect is observed.

Summary

This study examines the relationship between the LCR and profitability, specifically measured by ROA and NIM, for banks listed in Vietnam from Q1 2015 to Q4 2022. The results confirm an inverted U-

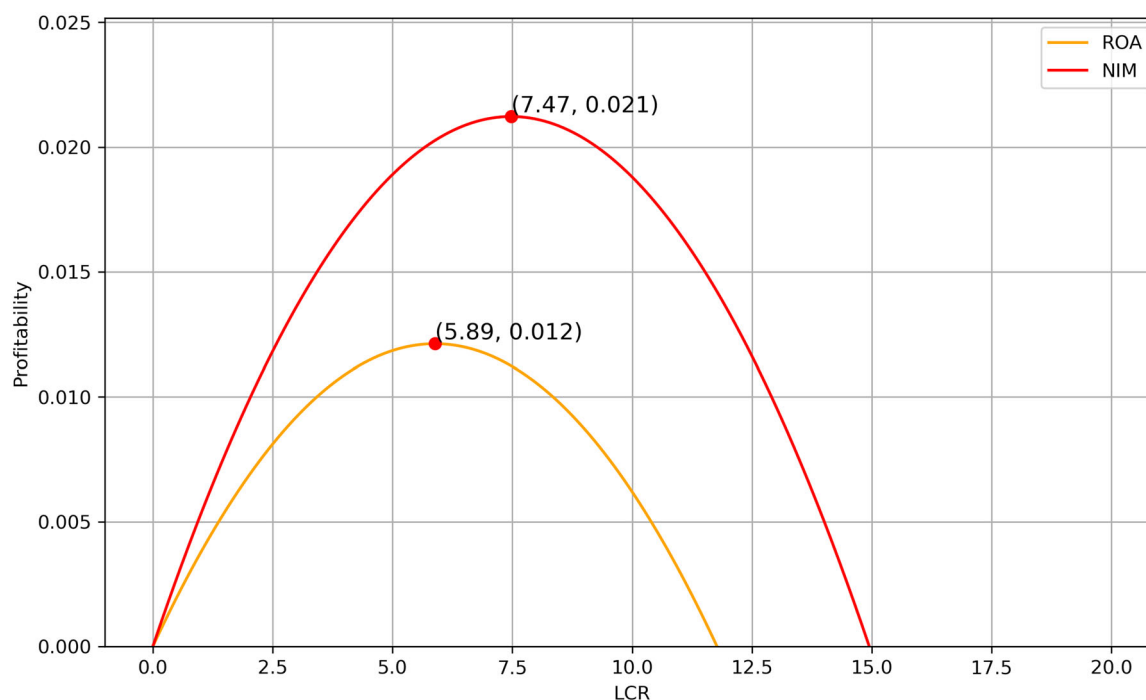


Figure 1. Inverted U-shaped relationship between LCR and profitability.

Table 4. Robustness check results.

Variables	Sys.GMM		
	ROA	NIM	ROE
ROA(-1)	0.254(0.051)		
NIM(-1)		0.319 (0.037)	
ROE(-1)			0.262(0.061)
LiqA	0.00562 (0.018)	0.00488 (0.064)	
LiqA ²	-0.00015 (0.116)	-0.00029 (0.144)	
LCR			0.00642 (0.053)
LCR ²			-0.00051 (0.061)
SIZE	-0.01022 (0.126)	0.00041 (0.116)	0.00128 (0.072)
CAP	0.14667 (0.002)	-0.06164 (0.021)	-0.0642 (0.034)
CR	-0.13372 (0.272)	0.17222 (0.028)	0.1748 (0.014)
CIR	-0.00562 (0.051)	-0.16732 (0.332)	-0.1441 (0.201)
HHI _{Income}	-0.00274 (0.064)	-0.01332 (0.200)	-0.02421 (0.078)
GDP	0.00198 (0.323)	0.00361 (0.345)	0.00472 (0.253)
HHI _{Market}	0.00241 (0.287)	0.00548 (0.052)	0.00211 (0.0322)
Arellano Bond test:			
AR.(1)	-2.92 (0.0045)	-1.97 (0.052)	-1.99 (0.050)
AR.(2)	-0.26 (0.795)	-0.28 (0.780)	-0.32 (0.749)
Overidentification restrictions Hansen test	40.12 (0.169)	38.66 (0.242)	33.12 (0.291)

Note. LiqA: liquid assets to represent deposits and short-term funding. *p*-value in parentheses.

shaped relationship, indicating that initial increases in LCR enhance profitability up to an optimal point (approximately 5.89 for ROA and 7.47 for NIM). Beyond these levels, further increases in LCR lead to diminishing returns, suggesting that while adequate liquidity is crucial for stability, excessive liquidity imposes opportunity costs and reduces profitability. These findings underscore the importance of balancing liquidity and profitability to optimize bank performance.

Recommendations and practical solutions for optimal liquidity management

While this paper has extensively analyzed the relationship between the LCR and profitability metrics such as ROA and NIM, it is crucial to provide actionable insights for achieving optimal liquidity management. The following are several guidelines and potential solutions that can help banks balance liquidity requirements with profitability:

- i. **Dynamic liquidity buffer management:** Banks should adopt a dynamic approach to managing their liquidity buffers, adjusting their holdings of high-quality liquid assets (HQLA) in response to changing market conditions. By periodically reassessing their liquidity needs based on stress testing and market developments, banks can avoid holding excess liquidity that could reduce profitability due to opportunity costs. Maintaining liquidity levels close to the optimal points identified in this study—around 5.89 for ROA and 7.47 for NIM - ensures that banks are prepared for liquidity shocks without sacrificing profitability.
- ii. **Diversified funding sources:** To reduce the dependency on short-term funding, banks should diversify their funding sources. This could include a mix of long-term debt, stable deposits, and other funding instruments that provide greater stability. By maintaining a balanced funding structure, banks can reduce the risk associated with maturity mismatches, ensuring that they can meet long-term loan commitments without jeopardizing their liquidity.
- iii. **Implementing liquidity risk management tools:** Banks should adopt advanced liquidity risk management tools, such as early warning systems and liquidity stress tests, to monitor potential liquidity shortfalls. These tools can help banks identify liquidity risks well in advance, enabling them to take corrective actions such as adjusting their asset mix or borrowing strategies before liquidity issues arise. The integration of real-time data analytics into liquidity management could also enhance banks' responsiveness to market changes.
- iv. **Alignment with regulatory requirements:** Considering the Basel III framework, banks should continuously monitor their compliance with LCR and NSFR requirements, ensuring that they are well-positioned to meet regulatory standards while optimizing their operational efficiency. Regular internal

reviews of liquidity ratios, combined with dialogue with regulators, can help banks remain compliant and profitable.

Limitations and further research

This study must acknowledge several limitations. First, it should be noted that the sample size is limited to 15 banks listed in Vietnam, which could potentially limit the applicability of the findings to other banking sectors or regions. Second, the proxies used to estimate LCR may not fully capture banks' actual liquidity positions due to a lack of detailed LCR data. Third, the study period (2015–2022) may not adequately reflect long-term trends or the impacts of economic cycles and regulatory changes. Lastly, the analysis focuses on ROA and NIM as measures of profitability, potentially overlooking other important aspects of bank performance.

To address these limitations, future research could expand the sample to include more banks from various regions and banking systems to increase the generalizability of the findings. Developing more precise and comprehensive LCR measures could improve the accuracy of liquidity assessments. Longitudinal studies spanning longer periods and taking into account economic cycles and regulatory changes would provide a more robust understanding of the LCR-profitability relationship. Additionally, exploring other dimensions of bank performance, such as risk-adjusted returns, could offer a more comprehensive view of liquidity management's impact. Finally, qualitative research involving interviews with bank managers and regulators could provide deeper insights into the practical implications and challenges of implementing optimal liquidity strategies.

Acknowledgments

The author thanks all lecturers and managers of the Ho Chi Minh Open University, Ho Chi Minh City, Vietnam.

Disclosure statement

No potential conflict of interest was reported by the author(s). The analysis and conclusions drawn are based solely on the data and methodologies applied, with no external influences impacting the integrity of the study.

This study was conducted as part of my academic responsibilities at the Department of Finance and Banking, Ho Chi Minh City Open University and all necessary approvals and ethical guidelines were adhered to during the research process.

Funding

No funding was received.

About the author

Thanh Huu Vu has main research interests are in banking finance, corporate finance, and econometrics finance.

ORCID

Thanh Huu Vu  <http://orcid.org/0000-0003-2306-2565>

Data availability statement

Data is taken from the HOCHIMINH STOCK EXCHANGE (HOSE): <https://www.hsx.vn/Modules/Listed/Web/SectorDetail?id=89f71512-503a-4aae-885b-873b835a82b9&rid=200379459>

I agree to make available data and materials supporting the results or analyses in this paper (according to the attached file).

References

- Abbas, F., Iqbal, S., & Aziz, B. (2019). The impact of bank capital, bank liquidity and credit risk on profitability in post-crisis period: A comparative study of US and Asia. *Cogent Economics & Finance*, 7(1), 1605683. <https://doi.org/10.1080/23322039.2019.1605683>
- Adelopo, I., Lloydking, R., & Tauringana, V. (2018). Determinants of bank profitability before, during, and after the financial crisis. *International Journal of Managerial Finance*, 14(4), 378–398. <https://doi.org/10.1108/IJMF-07-2017-0148>
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277–297. <https://doi.org/10.2307/2297968>
- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money*, 18(2), 121–136. <https://doi.org/10.1016/j.intfin.2006.07.001>
- Ayaydin, H., & Karakaya, A. (2014). The effect of bank capital on profitability and risk in Turkish banking. *International Journal of Business and Social Science*, 5(1), 252–271.
- Banerjee, R. N., & Mio, H. (2018). The impact of liquidity regulation on banks. *Journal of Financial Intermediation*, 35, 30–44. <https://doi.org/10.1016/j.jfi.2017.05.008>
- BCBS. (2008). *Principles for Sound Liquidity Risk Management and Supervision*. <https://www.bis.org/publ/bcbs144.pdf>
- BCBS. (2010). *Basel III: International framework for liquidity risk measurement, standards and monitoring*. Bank for International Settlements Basel.
- BCBS. (2012). *Principles for sound liquidity risk management and supervision (September 2008) Basel committee on banking supervision*.
- BCBS. (2013). *The liquidity coverage ratio and liquidity risk monitoring tools. Bank for International Settlements*.
- BCBS. (2019). *Liquidity coverage ratio - LCR30. Basel committee on banking supervision*.
- Berger, A. N. (1995a). The profit-structure relationship in banking—tests of market-power and efficient-structure hypotheses. *Journal of Money, Credit and Banking*, 27(2), 404–431. <https://doi.org/10.2307/2077876>
- Berger, A. N. (1995b). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, 27(2), 432–456. <https://doi.org/10.2307/2077877>
- Berger, A. N., & Bouwman, C. H. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109(1), 146–176. <https://doi.org/10.1016/j.jfineco.2013.02.008>
- Bikker, J. A., & Vervliet, T. M. (2018). Bank profitability and risk-taking under low interest rates. *International Journal of Finance & Economics*, 23(1), 3–18. <https://doi.org/10.1002/ijfe.1595>
- Bonaccorsi di Patti, E., & Palazzo, F. (2020). Bank profitability and macroeconomic conditions: Are business models different? *Economic Notes*, 49(2), e12155. <https://doi.org/10.1111/ecno.12155>
- Bordeleau, É., & Graham, C. (2010). *The impact of liquidity on bank profitability*.
- Bourke, P. (1989). Concentration and other determinants of bank profitability in Europe, North America and Australia. *Journal of Banking & Finance*, 13(1), 65–79. [https://doi.org/10.1016/0378-4266\(89\)90020-4](https://doi.org/10.1016/0378-4266(89)90020-4)
- Chiaromonte, L., & Casu, B. (2017). Capital and liquidity ratios and financial distress. Evidence from the European banking industry. *The British Accounting Review*, 49(2), 138–161. <https://doi.org/10.1016/j.bar.2016.04.001>
- De Leon, M. (2020). The impact of credit risk and macroeconomic factors on profitability: The case of the ASEAN banks. *Banks and Bank Systems*, 15(1), 21–29.
- Doğan, M., & Yildiz, F. (2023). Testing the factors that determine the profitability of banks with a dynamic approach: Evidence from Turkey. *Journal of Central Banking Theory and Practice*, 12(1), 225–248. <https://doi.org/10.2478/jcbtp-2023-0010>
- García-Herrero, A., Gavilá, S., & Santabábara, D. (2009). What explains the low profitability of Chinese banks? *Journal of Banking & Finance*, 33(11), 2080–2092. <https://doi.org/10.1016/j.jbankfin.2009.05.005>
- Golin, J., & Delhaise, P. (2013). *The bank credit analysis handbook: a guide for analysts, bankers and investors*. John Wiley & Sons.
- Golubeva, O., Duljic, M., & Keminen, R. (2019). The impact of liquidity risk on bank profitability: some empirical evidence from the European banks following the introduction of Basel III regulations. *Journal of Accounting and Management Information Systems*, 18(4), 455–485. <https://doi.org/10.24818/jamis.2019.04001>
- Gržeta, I., Žiković, S., & Tomas Žiković, I. (2023). Size matters: Analyzing bank profitability and efficiency under the Basel III framework. *Financial Innovation*, 9(1), 43. <https://doi.org/10.1186/s40854-022-00412-y>
- Hartlage, A. W. (2012). The Basel III liquidity coverage ratio and financial stability. *Michigan Law Review*, 111, 453–483.
- Heuver, R. A., & Berndsen, R. J. (2022). Liquidity coverage ratio in a payment network: Uncovering contagion paths. *Latin American Journal of Central Banking*, 3(1), 100046. <https://doi.org/10.1016/j.latcb.2022.100046>
- Hong, H., Huang, J.-Z., & Wu, D. (2014). The information content of Basel III liquidity risk measures. *Journal of Financial Stability*, 15, 91–111. <https://doi.org/10.1016/j.jfs.2014.09.003>
- Ibrahim, S. S. (2017). The impacts of liquidity on profitability in banking sectors of Iraq: A Case of Iraqi Commercial Banks. *International Journal of Finance & Banking Studies* (2147-4486), 6(1), 113–121. <https://doi.org/10.20525/ijfbs.v6i1.650>

- Islam, M. S., & Nishiyama, S.-I. (2016). The determinants of bank net interest margins: A panel evidence from South Asian countries. *Research in International Business and Finance*, 37, 501–514. <https://doi.org/10.1016/j.ribaf.2016.01.024>
- Kanga, D., Murinde, V., & Soumaré, I. (2020). Capital, risk and profitability of WAEMU banks: Does bank ownership matter? *Journal of Banking & Finance*, 114, 105814. <https://doi.org/10.1016/j.jbankfin.2020.105814>
- Khan, H. H., Ahmad, R. B., & Gee, C. S. (2016). Market structure, financial dependence and industrial growth: Evidence from the banking industry in emerging Asian economies. *PLOS One*, 11(8), e0160452. <https://doi.org/10.1371/journal.pone.0160452>
- King, M. R. (2013). The Basel III net stable funding ratio and bank net interest margins. *Journal of Banking & Finance*, 37(11), 4144–4156. <https://doi.org/10.1016/j.jbankfin.2013.07.017>
- Klein, P.-O., & Weill, L. (2018). Bank profitability and economic growth.
- Kong, Y., Musah, M., & Antwi, S. K. (2019). Liquidity-profitability trade-off: A panel study of listed non-financial firms in Ghana. *International Journal of Trend in Scientific Research and Development*, 3(4), 1086–1099. <https://doi.org/10.31142/ijtsrd25068>
- Lee, C.-C., & Hsieh, M.-F. (2013). The impact of bank capital on profitability and risk in Asian banking. *Journal of International Money and Finance*, 32, 251–281. <https://doi.org/10.1016/j.jimonfin.2012.04.013>
- Lu, Y. (2021). *The influence of liquidity information on liquidity holdings in the banking system*. The University of Chicago].
- Mashamba, T. (2018). The effects of Basel III liquidity regulations on banks' profitability. *Journal of Governance and Regulation*, 7(2), 34–48. https://doi.org/10.22495/jgr_v7_i2_p4
- Mathuva, D. M. (2009). Capital adequacy, cost income ratio and the performance of commercial banks: The Kenyan Scenario. *The International Journal of Applied Economics and Finance*, 3(2), 35–47. <https://doi.org/10.3923/ijae.2009.35.47>
- Menicucci, E., & Paolucci, G. (2016). The determinants of bank profitability: Empirical evidence from European banking sector. *Journal of Financial Reporting and Accounting*, 14(1), 86–115. <https://doi.org/10.1108/JFRA-05-2015-0060>
- Mirzaei, A., Moore, T., & Liu, G. (2013). Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies. *Journal of Banking & Finance*, 37(8), 2920–2937. <https://doi.org/10.1016/j.jbankfin.2013.04.031>
- Morris, S., & Shin, H. S. (2009). *Illiquidity component of credit risk*.
- Polizzi, S., Scannella, E., & Suárez, N. (2020). The role of capital and liquidity in bank lending: Are banks safer? *Global Policy*, 11(S1), 28–38. <https://doi.org/10.1111/1758-5899.12750>
- Radovanov, B., Milenković, N., Kalaš, B., & Horvat, A. M. (2023). Do the same determinants affect banks' profitability and liquidity? Evidence from West Balkan Countries using a panel data regression analysis. *Mathematics*, 11(19), 4072. <https://doi.org/10.3390/math11194072>
- Rose, P. S. (2010). Bank management & financial services.
- Roy, S., Misra, A. K., Padhan, P. C., & Rahman, M. R. (2019). Interrelationship among liquidity, regulatory capital and profitability-A study on Indian banks. *Cogent Economics & Finance*, 7(1), 1664845. <https://doi.org/10.1080/23322039.2019.1664845>
- Saeed, M. S. (2014). Bank-related, industry-related and macroeconomic factors affecting bank profitability: A case of the United Kingdom. *Research Journal of Finance and Accounting*, 5(2), 42–50.
- Saif-Alyousfi, A. Y. (2022). Determinants of bank profitability: Evidence from 47 Asian countries. *Journal of Economic Studies*, 49(1), 44–60. <https://doi.org/10.1108/JES-05-2020-0215>
- Sanya, S., & Wolfe, S. (2011). Can banks in emerging economies benefit from revenue diversification? *Journal of Financial Services Research*, 40(1-2), 79–101. <https://doi.org/10.1007/s10693-010-0098-z>
- Sidhu, A. V., Rastogi, S., Gupte, R., & Bhimavarapu, V. M. (2022). Impact of liquidity coverage ratio on performance of select Indian banks. *Journal of Risk and Financial Management*, 15(5), 226. <https://doi.org/10.3390/jrfm15050226>
- Spence, M. (1973). Job market signaling. *Uncertainty in economics*. (pp. 281–306). Academic Press.
- Supriadi, M. D. (2016). The effect of liquidity coverage ratio to profitability at OCBC NISP Bank. *Journal of Management and Collaboration*, 3(5), 54–75.
- Tan, Y., & Floros, C. (2012). Bank profitability and GDP growth in China: A note. *Journal of Chinese Economic and Business Studies*, 10(3), 267–273. <https://doi.org/10.1080/14765284.2012.703541>
- Tan, Y., Floros, C., & Anchor, J. (2017). The profitability of Chinese banks: impacts of risk, competition and efficiency. *Review of Accounting and Finance*, 16(1), 86–105. <https://doi.org/10.1108/RAF-05-2015-0072>
- Tirole, J. (2011). Illiquidity and all its friends. *Journal of Economic Literature*, 49(2), 287–325. <https://doi.org/10.1257/jel.49.2.287>
- Veeramoothoo, S., & Hammoudeh, S. (2022). Impact of Basel III liquidity regulations on US Bank performance in different conditional profitability spectrums. *The North American Journal of Economics and Finance*, 63, 101826. <https://doi.org/10.1016/j.najef.2022.101826>
- Waleed, A., Pasha, A., & Akhtar, A. (2016). Exploring the impact of liquidity on profitability: Evidence from banking sector of Pakistan. *Journal of Internet Banking and Commerce*, 21(3), 21–32.