Evaluation of Asset and Liability Management Strategies on Financial Stability in Indonesian Listed Banks: Moderating Effects of Bank Characteristics

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Abstract
This research investigates how the Liquidity Coverage Ratio (LCR) influences the financial stability of banks listed on the Indonesian stock exchange, considering the moderating roles of Net Interest Margin (NIM), Capital Adequacy Ratio (CAR), bank size, and asset growth. This study utilizes secondary data from the annual reports of 27 conventional banks listed on the Indonesia Stock Exchange, covering the period 2020–2024, this research employs a quantitative causal-comparative approach with multiple linear regression and robust standard errors in STATA. Financial stability is measured using the Z-Score, while LCR represents short-term liquidity. The results indicate that the direct effect of LCR on financial stability is significant but negative, suggesting that excessive liquidity may reduce profitability and weaken stability. However, when moderated by CAR, bank size, and asset growth, LCR positively and significantly influences financial stability, highlighting the importance of internal bank characteristics in enhancing resilience. In contrast, NIM does not significantly strengthen the effect of LCR on stability, implying that profitability alone may not optimize the impact of liquidity. Overall, the study demonstrates that the effectiveness of liquidity in maintaining bank stability depends on the bank's internal conditions, including capital adequacy, size, and asset growth, while the role of profitability remains limited. These findings provide insights for bank managers and regulators on the strategic management of liquidity and internal resources to support sustainable financial stability, particularly in post pandemic conditions and under global economic uncertainties.

INTRODUCTION

The banking industry significantly contributes to the advancement of sustainable economic growth in Indonesia. Banks function as financial intermediaries, collecting funds from the public and redistributing them back to society through various financing activities. Indonesia's economy has attracted the attention of investors in making investment decisions. In addition to assessing the financial stability of individual banks, investors also evaluate the overall stability of the national economywhich can be seen through the expansion of the national Gross Domestic Product (GDP).

Table 1. GDP Growth Indonesia

GDP Growth	2019	2020	2021	2022	2023	2024
Indonesia	5,02	-2,07	3,70	5,31	5,05	5,03

Based on data released by the World Bank, as shown in Table 1 above, Indonesia's economic growth experienced a slowdown in 2020–2021 due to the COVID-19 pandemic. Up to 2024, GDP growth has continued to decelerate, prompting financial institutions to take a more active role in supporting Indonesia's economic growth to ensure sustained development. Being one of the main pillars supporting financial stability, the banking industry serves a vital role in safeguarding Indonesia's economic resilience. The year 2020 marked the peak of economic pressure caused by the COVID-19 pandemic, and in the following years, the banking industry has faced various policy challenges related to the post-pandemic recovery period. In addition, the persistence of global economic uncertainty—particularly the

geopolitical tensions in the Middle East and conflicts in several Eastern European countries—has added further pressure. Another major challenge is the rapid advancement of technology, which significantly affects the financial stability of banks and, consequently, the stability of the national economy.

To maintain financial stability, banks must implement well-managed financial strategies. Asset and Liability Management (ALM) serves as a strategic framework employed by banks to manage the structure, maturity, and the risks linked to assets and liabilities to achieve an optimal balance with profitability, liquidity, and solvency (Saunders & Cornett, 2022). Within the retail banking sector, ALM is closely linked to interest rate risk caused by the imbalance between loans (assets) and deposits (liabilities). Banks that adopt adaptive ALM strategies and utilize digitalized treasury systems are better able to sustain financial stability even under conditions of high market volatility. An effective ALM framework is a key element in ensuring the liquidity and solvency of banks (Englisch, Krabichler, Müller, & Schwarz, 2023). Therefore, evaluating ALM strategies is essential to assess the extent to which banks can maintain a balance between risk and financial performance.

In recent years, The Liquidity Coverage Ratio (LCR) has emerged as a central regulatory measure aimed at improving liquidity resilience and maintaining the stability of the banking sector. This ratio is a key component of the Basel III framework, introduced in the aftermath of the 2008 global financial crisis, with the goal of guaranteeing ensuring banks maintain an adequate stock of HQLA to cover net cash outflows within 30 days during financial stress.

Conceptually, the Liquidity Coverage Ratio (LCR) measures a bank's ability to maintain short-term liquidity. A higher LCR value indicates a greater capacity of the bank to withstand potential liquidity risks, thereby strengthening public confidence and the overall stability of the financial system. In Indonesia, the implementation of the LCR is regulated under OJK Regulation No. 42/POJK.03/2015 concerning the Obligation to Fulfill the Liquidity Coverage Ratio Requirement, which mandates all commercial banks to maintain a minimum LCR of 100% (OJK, 2015).

Nevertheless, the effectiveness of LCR implementation often varies across banks, depending on their asset and liability management strategies, capital structure, and prevailing financial market conditions. Several studies have indicated that an excessively high LCR may signal excess liquidity, which can negatively impact profitability, whereas an overly low LCR increases liquidity risk and the potential for financial instability. Therefore, maintaining an optimal balance in managing the LCR is essential to ensure sustainable financial performance.

In this context, research on the effect of the Liquidity Coverage Ratio (LCR) on financial stability becomes highly relevant, especially in relation to bank-specific factors like Capital adequacy (CAR) alongside net interest margin (NIM), bank size, and asset growth. These four variables are presumed to either strengthen or weaken the relationship between LCR and a bank's financial stability. Therefore, a comprehensive understanding of the role of LCR as a liquidity indicator and its relationship with financial stability through these moderating factors is essential to strengthen the resilience of the country's banking system, especially during the post-pandemic period and amid global monetary policy shifts between 2020 and 2024.

Several previous studies have analyzed the factors influencing banking stability; however, most have focused on profitability or credit risk rather than the strategic aspects of Asset and Liability Management (ALM) (Muhardini, Sasongko, Soedarmono, & B, 2023). Furthermore, many studies have combined all commercial banks without distinguishing those that are publicly listed, even though publicly listed banks possess distinct characteristics in terms of governance, transparency, and market discipline. Accordingly, limited research has addressed the impact of asset and liability management strategies on the financial stability of publicly listed banks in Indonesia. The research examines the relationship between the Liquidity Coverage Ratio (LCR) and financial stability, as well as the moderating effect of factors specific to banks, such as Net Interest Margin (NIM), Capital Adequacy Ratio (CAR), Bank Size, and Asset Growth regarding the relationship between LCR and financial stability.

Asset and Liability Management (ALM)

ALM is a management strategy aimed at controlling a bank's assets and liabilities to mitigate liquidity, market, and credit risks. The primary focus of ALM is to maintain sufficient liquidity to meet short-term obligations, manage profitability by ensuring that returns from assets are adequate to cover the costs of liabilities, and structure an optimal asset–liability portfolio to minimize risk and enhance financial stability (Hafeez, Li, Kabir, & A, 2022). Furthermore, other studies emphasize that ALM is a crucial

strategy in managing a bank's financial risks particularly liquidity, credit, and interest rate risks with the objective of minimizing risk while maximizing profitability. Through a quantitative approach, research has shown that the effectiveness of ALM is significantly influenced by corporate governance characteristics, particularly regarding the composition and oversight of the board of directors (Davis-adesegha, 2025).

ALM has become a critical focus that is inseparable from financial management and strategic planning aimed at enhancing a bank's financial stability. Other studies regard ALM as a primary tool for managing interest rate risk and liquidity risk in banking operations. An effective ALM strategy must take into account institutional characteristics such as the type of bank, country context, and regulatory framework since differences in these characteristics lead to variations in the strategies that should be implemented (Lysiak, Masiuk, Chynchyk, Yudina, & Olshanskiy, 2022).

Bank Financial Stability

The Z-Score indicator is used to assess the financial stability of banks, which reflects the risk of bank insolvency. A higher Z-Score indicates a lower probability of failure. Multiple factors impact the financial stability of a bank. The first is liquidity (LCR), reflecting the bank's capacity to fulfill short-term liquidity requirements. The second factor is capital adequacy (CAR/KPPM), which reflects the bank's capacity to absorb losses and financial shocks. The third factor is profitability (NIM), which represents how effectively the bank can derive returns from its assets. The final factors bank size and asset growth help determine diversification capacity and operational risk (Sysoyeva, 2020). Other studies suggest that bank stability is strongly influenced by the effectiveness of capital, asset, and liability management, which aligns with the concept of Asset and Liability Management (ALM) (Dewi & Saraswati, 2024). Minsky (2015) argues that financial systems inherently move from stability toward fragility because periods of prosperity often encourage increasingly risky behavior, higher leverage, and eventually lead to crises. Banks that pursue aggressive credit expansion or high-risk asset growth may heighten their vulnerability to shocks (Minsky, 2015). This study links asset–liability management (ALM) and internal bank variables—such as CAR, NIM, and LDR as key components of control mechanisms to mitigate such vulnerabilities.

Liquidity and LCR

The Liquidity Coverage Ratio (LCR) is a liquidity ratio that measures a bank's ability to meet short-term cash needs using high-quality liquid assets. Previous studies have shown that LCR positively affects bank stability when supported by adequate capital and healthy asset growth. However, excessive liquidity may reduce profitability, thereby negatively impacting the Z-Score (Benlaria & Mouna, 2025). Theoretically, LCR is an essential factor in maintaining short-term bank liquidity. Numerous studies show that banks meeting the minimum LCR requirement often face a reduction in Net Interest Margin (NIM) as a result of tighter interest spreads, although the relationship with Return on Assets (ROA) is not statistically significant (Sidhu, Rastogi, Gupte, & Bhimavarapu, 2022).Other research reveals that large banks with deteriorating LCRs can trigger liquidity contagion effects liquidity shortfalls in other banks. Although this phenomenon is more systemic than individual, The study highlights the significance of LCR as a means to evaluate liquidity and its influence regarding the stability of the entire financial system (Heuver & Berndsen, 2022).These findings support the present study's premise that the LCR significantly influences financial stability. Other literature studies evaluate whether the introduction of the Liquidity Coverage Ratio (LCR) leads to better liquidity risk management, as well as its implications for banks' business models and its influence on capital and other regulations. The implementation of LCR helps improve liquidity risk management in many banks, although there are implementation challenges and variations across banks. This indicates that LCR, as a liquidity regulation, affects internal bank behavior (Tammenga & Haarman, 2020).

Bank Characteristics as Moderating Variables

Theoretically, bank characteristics are reflected in indicators that represent a bank's overall performance. In this study, bank characteristics are represented by Net Interest Margin (NIM), Capital Adequacy Ratio (CAR), Bank Size, and Asset Growth. This classification is based on previous research that examined the effects of financial inclusion and bank characteristics (bank size, CAR, and NPL) on the stability of Indonesian banking from 2009 to 2019. The findings indicated that bank characteristics,

specifically NPL and bank size, had a negative effect on stability, whereas CAR had a positive influence (Rosalina & Wahyuningsih, 2023). From a theoretical perspective, Capital Adequacy Ratio (CAR) indicates that well-capitalized banks are better able to utilize liquidity to enhance financial resilience. Profitability (NIM) reflects the return on assets, which influences how effectively liquidity contributes to stability. Bank Size (lnAset) suggests that larger banks are generally more capable of optimizing liquidity through portfolio diversification. Lastly, Asset Growth (lnAG) implies that healthy asset expansion strengthens the effect of liquidity on bank stability (Farag, Ali, Mutai, Luqman, & Mahmoud, 2025). In addition, according to Yensu (2021), internal factors such as bank size, interest cover, and Earnings per share (EPS) significantly influence bank stability as measured by the Z-Score. This study indicates that bank stability is influenced not only by macroeconomic conditions but also by internal bank characteristics and governance (Yensu, Yusif, Tetteh, Asumadu, & Atuilik, 2021).

Conceptual Framework

A qualitative research method is applied in this study, which includes six variables. The dependent variable is represented by Financial Stability (Y), while the independent variable is Liquidity Coverage Ratio (LCR) (X). Additionally, there are four moderating variables, namely Net Interest Margin (NIM) (Z1), Capital Adequacy Ratio (CAR) (Z2), Bank Size (Z3), and Asset Growth (Z4). Referring to the variables and conceptual framework depicted in Figure 1, five hypotheses are formulated and tested in this study:

H1: LCR has a positive effect on financial stability.
H2: LCR has a positive effect on financial stability when moderated by NIM.
H3: LCR has a positive effect on financial stability when moderated by CAR.
H4: LCR has a positive effect on financial stability when moderated by Bank Size.
H5: LCR has a positive effect on financial stability when moderated by Asset Growth.

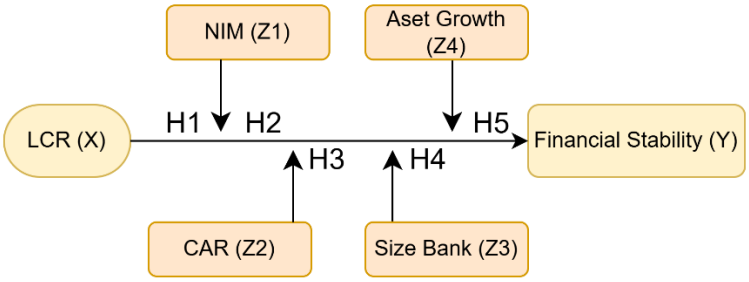

Figure I. Conceptual Framework

METHODS

A quantitative methodology is employed in this study, based on secondary data extracted from financial statements of banking institutions from 2020 to 2024. A causal-comparative (explanatory) approach is also applied, since this study seeks to investigate the impact of the independent variables on the Z-Score and to analyze the moderating effect pertaining to the Liquidity Coverage Ratio (LCR).

The population in this study consists of conventional banks in Indonesia listed on the Indonesia Stock Exchange (IDX) during the period 2020–2024. The sampling method used is purposive sampling with specific criteria, namely banks that have complete financial statements from 2020 to 2024, including data on LCR, total assets, total liabilities, total equity, ROA, NIM, and CAR. Out of thirty-three (33) conventional banks in Indonesia listed on the IDX, only twenty-seven (27) met the sampling criteria.

Based on the conceptual framework, this study comprises six main constructs, in which the Asset and Liability Management (X) variable consists of NIM (X1), CAR (X2), Total Assets (X3), and Asset Growth (X4), with LCR (X5) serving as the moderating variable and Financial Stability (Y) measured using the Z-Score.

Table 2. Variable and Indicator

Variable	Code	Indicator
Financial Stability (Dependent Variable)	Y	It assesses a bank's financial stability, with higher Z-Scores indicating greater stability. The Z-Score is computed as follows:

Variable	Code	Indicator
		$Z = \frac{ROA + (Equity/Total\ Assets)}{\sigma(ROA)}$
lnLCR (Independent Variable)	X	Short-term bank liquidity, a liquidity ratio used to cover liquidity needs over a 30-day period.
NIM (Moderating Variable)	Z1	Net Interest Margin
CAR (Moderating Variable)	Z2	Capital adequacy, which reflects the bank's ability to cover credit and operational risks.
Total Aset (Moderating Variable)	Z3	Obtained using lnAssets to represent the scale of the bank.
Aset Growth (Moderating Variable)	Z4	Obtained using lnAG to indicate the bank's year-to-year growth.

Data were collected from the annual reports published by banking institutions for the period 2020–2024, officially published on the respective banks' websites and have been verified for validity. The data analysis method begins with descriptive analysis, assessing the average, standard deviation, highest, and lowest values of all variables. Following this, classical assumption testing is carried out, including checks for normality, multicollinearity, and heteroskedasticity. Multiple linear regression analysis is then carried out to explain the direct impact of each independent variable on the dependent variable. Subsequently, significance testing of coefficients and interpretation of moderating effects are performed. Interpretation of the moderating effects is conducted to assess whether the independent variable LCR (X) shows a significant change in its relationship with Y after being moderated by the variables NIM, CAR, Bank Size, and Asset Growth. Data processing is carried out using the STATA software, chosen for its suitability in analyzing models with large panel data, the use of robust standard errors, and its flexibility in conducting moderation analysis.

RESULTS AND DISCUSSION

A. Result

The results of data processing using STATA software show that, based on the classical assumption tests, multicollinearity exists due to the interaction among variables; however, the regression coefficients remain interpretable as significant. The Breusch–Pagan test indicates heteroskedasticity in the model ($p < 0.001$). Therefore, the regression analysis was performed using robust standard errors, ensuring that the t-tests and p-values for the coefficients remain valid. The Shapiro Wilk test results reveal that the model's residuals are not normally distributed ($p < 0.001$). Nevertheless, because the regression uses robust standard errors, the significance of the coefficients can still be validly interpreted. After completing the classical assumption tests, the next step is model determination. As indicated by the Chow test results in STATA, the test generated a significance value of 0.0206. Following the standards of the Chow test, if the significance value is greater than 0.05, H_0 is accepted; however, since $0.0206 < 0.05$, H_0 is rejected and H_1 is accepted, indicating that the Fixed Effect Model (FEM) is more appropriate. Subsequently, The Hausman test was performed to assess whether the Random Effect Mode (REM) is more suitable than the FEM. The result shows Prob > Chi^2 = 0.6897, and since $0.6897 > 0.05$, H_0 is accepted, meaning indicating that the Random Effect Model is preferable to use than the Fixed Effect Model.

Table 3. R -Square

Variabels	Prob > F	R-Squared
(Y) Financial Stability	0.0000	0.6573

Source: The data were processed using STATA, 2025

According to the results in Table 3, the overall F-test achieves significance at the 5% level, showing that the independent variables (LCR, NIM, CAR, Bank Size, and Asset Growthcollectively exert a significant influence on financial stability. In addition, 65.73% of the variation in banks' financial

stability is accounted for by LCR, NIM, CAR, bank size, asset growth, and the moderating effects included in the model.

Table 4. Hypotesis Test Result

Hypothesis	Path	Effect Size	p-Value	Decision
H1	lnLCR → Z-Score	-3.917	0.001	Rejected
H2	lnLCR × NIM → Z-Score	-0.276	0.060	Rejected
H3	lnLCR × CAR → Z-Score	0.021	0.002	Accepted
H4	lnLCR × lnAset → Z-Score	0.235	0.003	Accepted
H5	lnLCR × lnAG → Z-Score	0.045	0.020	Accepted

Source: The data were processed using STATA, 2025

B. Discussion

This study consists of nine hypotheses, in which five hypotheses investigate the direct impact of the independent variables on the dependent variable, whereas four hypotheses focus on analyzing their effects on the dependent variable after being moderated by the LCR variable.

Bank liquidity measured by the Liquidity Coverage Ratio (LCR) has a positive effect on financial stability (Z-Score).

The results of the multiple regression analysis using the random effect model show a coefficient of -3.917 with a p-value of 0.001, indicating that bank liquidity significantly affects financial stability, but the direction of the relationship is negative. This means that lower liquidity increases financial stability. This finding differs from the theoretical expectation and the proposed hypothesis, which stated that bank liquidity should have a positive effect on financial stability; therefore, the first hypothesis is rejected. Previous studies have found that liquidity positively affects bank stability, although its impact may vary depending on market conditions and monetary policy (García & Suárez, 2025). This study does not include monetary policy as a variable. Fundamentally, this negative relationship may occur because excessively high liquidity indicates an accumulation of low-return liquid assets, which can reduce profitability and, in turn, negatively impact the financial stability of banks.

The effect of the Liquidity Coverage Ratio (LCR) on financial stability (Z-Score) moderated by Net Interest Margin (NIM)

The sixth hypothesis examines whether LCR's effect on financial stability is moderated by Net Interest Margin (NIM). The test results display a coefficient of -0.276 along with a p-value of 0.060, indicating that the effect of LCR on financial stability after being moderated by NIM becomes insignificant, thus the second hypothesis is rejected. Previous studies found that income diversification can enhance bank stability, implying that better NIM management could help strengthen financial stability (Farag et al., 2025). However, the findings of this study differ profitability (NIM) does not significantly reinforce the effect of LCR on bank stability. This may occur because high liquidity does not necessarily coincide with a high interest margin. According to the literature, high liquidity (such as LCR) and high profitability (such as NIM) do not always simultaneously enhance bank stability (García & Suárez, 2025). This suggests that NIM does not necessarily strengthen the positive effect of LCR on financial stability.

The effect of the Liquidity Coverage Ratio (LCR) on financial stability (Z-Score) moderated by Capital Adequacy Ratio (CAR)

The test results show a coefficient of 0.021 along with a p-value of 0.002. These results indicate that the impact of LCR on financial stability, when moderated by CAR, is positive and significant, which is consistent with existing theory. This demonstrates that the moderating effect is significant. Liquidity is more effective in enhancing stability when a bank has adequate capital, as the combination of liquidity and capital adequacy strengthens the bank's financial resilience. These findings align with previous

research showing that capital adequacy ratios consistently improve bank stability by increasing the capacity to absorb shocks (Benlaria & Mouna, 2025). Additionally, other studies have indicated that capital positively affects bank stability, although the impact may vary depending on market conditions and monetary policy (García & Suárez, 2025).

The effect of the Liquidity Coverage Ratio (LCR) on financial stability (Z-Score) moderated by Bank Size (lnAset)

The test results show a coefficient of 0.235 with a p-value of 0.003, indicating that the fourth hypothesis is accepted. This confirms that LCR has a positive effect on financial stability when moderated by bank size. In principle, larger banks are not necessarily more stable due to complex risk management and greater credit exposure, which can reduce the Z-Score. Previous studies have found that bank size negatively affects the Z-Score, suggesting that larger banks may face challenges in managing more complex risks (Sysoyeva, 2020). However, in this study, bank size acts as a moderating factor, allowing the independent variable LCR to have a positive effect on financial stability. This implies that larger banks can leverage their liquidity more effectively to enhance stability, for example, through portfolio diversification and risk-adjustment capabilities, which aligns with existing theory.

The effect of the Liquidity Coverage Ratio (LCR) on financial stability (Z-Score) moderated by Bank Asset Growth (lnAG)

The fifth hypothesis states that the effect of LCR on financial stability is positively influenced when moderated by bank asset growth. The test results show a coefficient of 0.045 with a p-value of 0.020, confirming that the fifth hypothesis is accepted. This indicates that LCR has a meaningful positive relationship with financial stability once moderated by bank asset growth. Healthy asset growth strengthens the effect of liquidity on stability, meaning that banks whose assets grow while maintaining liquidity tend to be more resilient to financial shocks. Previous research has highlighted that asset growth is an important factor in assessing a bank's health and its ability to handle risk (Hafeez et al., 2022).

CONCLUSIONS AND SUGGESTIONS

A. Conclusion

Based on the results of the study on the nine proposed hypotheses, the following conclusions are derived:

1. The direct effect of the independent variables on financial stability (Z-Score) shows that only LCR has a significant negative effect, indicating that the direct influence of LCR does not necessarily enhance bank stability, as LCR is a short-term liquidity ratio.
2. Different results are obtained when the independent variables are moderated by other factors. In this case, LCR has a positive and significant effect on financial stability when moderated by CAR, bank size, and asset growth, whereas after moderation, the effect of NIM becomes negative.
3. The moderation of internal variables reflecting the bank's capacity (capital, size, and asset growth) tends to strengthen the effect of LCR on bank financial stability. In contrast, the profitability variable (NIM) does not always reinforce the effect of LCR, because high liquidity can reduce returns if not managed optimally.
4. Overall, the research demonstrates the effectiveness of liquidity on bank financial stability largely depends on internal bank conditions, such as capital, size, and asset growth, while the impact of individual variables like LCR, CAR, and bank size may differ from classical theoretical expectations.

B. Suggestion

1. For future research, macroeconomic variables or monetary policy could be included to assess how market conditions influence the relationship between liquidity, capital, and bank stability.
2. Conducting studies with long-term data to test the dynamics of the impact of liquidity and asset growth on financial stability.
3. Analyzing banks with different characteristics (Books I to IV) to investigate variations in ALM strategies and their effects on stability.

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