Exploring the Determinants of Liquidity of Private Commercial Banks in Bangladesh: Moderating Effect of Bank Age

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Citation: Hoque, M. A., Akter, R., & Begum, F. (2025). Exploring the Determinants of Liquidity of Private Commercial Banks in Bangladesh: Moderating Effect of Bank Age. *Finance & Economics Review 7(1),* 13-24. https://doi.org/10.38157/fer.v7i1.655.

Research Article

Abstract

Purpose: *The main objective of this study is to explore the critical bank-specific determinants of the liquidity of private commercial banks in Bangladesh.*

Methods: *This research examined the financial statements of twenty private commercial banks in Bangladesh over thirteen years (2010–2022). Various statistical tests and analyses, including the F-test, Breusch and Pagan LM Test, Modified Wald Test, Pesaran CD Test, Wooldridge Test, and Feasible GLS Model, were employed to evaluate the panel data.*

Results: *The regression results showed that the net interest margin, capital adequacy, financial leverage, credit quality, operating efficiency, and bank age are statistically significant variables influencing the liquidity of private commercial banks in Bangladesh. The study also indicates that a bank`s age moderates the impact of financial leverage, credit quality, and operating efficiency on liquidity.*

Implications: *The study's theoretical implications deepen understanding of factors influencing bank liquidity, integrating bank age as a moderating variable. As far as the practice is concerned, it assists policymakers and bank managers in enhancing liquidity management techniques, guaranteeing financial stability, and promoting resilience within the banking industry.*

Originality: *This study distinguishes itself by examining the moderating effect of bank age on liquidity determinants in private commercial banks in Bangladesh, a facet seldom explored in prior studies.*

Keywords: Bank-specific factors, Liquidity, Bank age, Private commercial banks, Bangladesh.

1. Introduction

The ability of banks to satisfy their financial obligations and support economic activities is contingent upon liquidity, which is a critical component of financial intermediation. The stability of the broader financial system and the stability of institutions are contingent upon their capacity to preserve liquidity. This entails the equilibrium of assets and liabilities to prevent liquidity shortages that could result in economic distress. Certain factors, including the size of the bank, the type and characteristics of banking, and the bank's involvement with complex operations, become critical when banks strive to achieve the optimal level of liquidity. It evaluates the bank's capacity to identify easily accessible currency, short-term creditworthy instruments, sovereign bills, and other assets that can be promptly converted into cash (Baros et al., 2023). Consequently, liquidity risk is a consequence of the fundamental function of banks, which is to convert short-term deposits into long-term loans at maturity. Consequently, to fulfill depositor obligations and

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ultimately optimize their profitability, banks must maintain an appropriate level of liquidity. The bank must limit risk exposure factors, implement synchronized regulation to prepare liquidity, adhere to a rigid decisional structure, and develop an appropriate financing strategy to control liquidity risk (Van Greuning & Brandanovic, 2020).

The banking system is vital for economic growth and development in developing economies with less developed alternative financial markets. Banks facilitate the redistribution of capital, essential for financing investments and promoting economic development, by mobilizing savings and channeling them into productive investments. This process is critical for developing economies, as the banking sector is frequently the primary financial intermediary due to the delayed development of non-banking financial markets. The role of banks in economic development is rooted in their capacity to attract deposits and provide loans, which supports both structural economic changes and the real sector (Mhadhbi et al., 2020). Furthermore, Manasseh et al. (2021) emphasize the significance of liquidity in promoting economic development, asserting that financial intermediation, measured by bank deposits, credits, and reserves, has demonstrated a positive correlation with economic growth. In Bangladesh, private commercial banks have been instrumental in the country's economic development since the 1980s, establishing this relationship (Tasneem & Ahmad, 2024). Banks must, therefore, meticulously organize their liquidity positions; otherwise, their credibility and repute may be compromised. Banks' stability and profitability are contingent upon maintaining an optimal level of liquidity, which enables them to fulfill their obligations and promote economic growth. Nevertheless, effective liquidity management can optimize the loan-to-deposit ratio, increasing institutions' profitability (Olofin et al., 2024).

Moreover, a bank's profitability, stability, and liquidity can be substantially influenced by age, with the effects being observed in varying degrees across various banking systems and contexts. Their larger asset bases can affect the capacity of older banks to manage liquidity effectively, as well as their more extensive networks and more established reputations. In the context of Indian commercial banks, it was discovered that bank age had a detrimental effect on liquidity risk. This suggests that elder banks may be able to manage liquidity more effectively due to their established practices and accumulated experience (Antony, 2023). Moreover, the relationship between financial performance and bank age in the Chinese banking sector was linear for listed banks and U-shaped for unlisted banks, which can indirectly impact liquidity. This suggests that the influence of bank age on liquidity may not be consistent across various categories of banks (Işık & Ersoy, 2022). However, the factors that influence liquidity in private banks, mainly the function of bank age, remain underexplored in the Bangladeshi context. This lacuna in the literature indicates a need for further research into the potential impact of organizational characteristics, such as bank age, on liquidity dynamics. Consequently, this research introduces a novel perspective by focusing on the age of the bank as a moderating factor, thereby contributing to the limited literature in this field. The study endeavors to offer actionable insights to enhance liquidity strategies among private banks in Bangladesh by addressing this underexplored issue.

2. Literature Review

Bank liquidity is influenced by various bank-specific and macroeconomic factors, which play crucial roles in maintaining financial stability and supporting economic growth. In Ethiopia, internal factors such as lagged liquidity values and deposits positively impact bank liquidity. In contrast, capital adequacy, bank size, interest rate margin, and real GDP growth rate have a negative impact. This suggests that bank-specific factors, which management can control, are crucial for improving liquidity (Belay, 2024). In India, deposits and capital positively influence bank liquidity, highlighting the importance of maintaining a strong deposit base and capital position (Kasana, 2024). In addition, Yitayaw (2021) asserts that internal factors mainly affect bank liquidity. The lagged values of liquidity and deposits have a statistically significant positive impact on the liquidity of commercial banks. On the other hand, capital adequacy, bank size, interest rate margin, and real GDP growth rate affect the liquidity of commercial banks in Ethiopia. He concluded that

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it is possible to improve the bank's liquidity by paying more attention to bank-specific factors, as management controls them. Moreover, Al Homaidi et al. (2019) found that, of the bank-specific variables, net interest margin ratio, assets quality ratio, return on equity ratio, and bank size had a significant negative impact on LQD, while capital adequacy ratio, deposits ratio, operation efficiency ratio, and return on assets ratio had a significant positive impact. The results showed that interest and currency rates significantly impact LQD regarding macroeconomic parameters. The study suggested that bankers think about asset quality in a way that enhances the efficiency of their institutions.

In addition, the research conducted by Khan et al. (2023) highlighted how crucial it is to implement stringent recovery measures and liquidity constraints in order to improve the resilience and overall performance of commercial banks. The central bank must regularly monitor crucial factors that substantially impact enterprises' liquidity in Pakistan to reduce the possibility of bank runs and liquidity degradation. Financial instability and stress on liquidity could arise if these problems are not resolved quickly. It is suggested that bank capital protects against liquidity problems since they frequently occur before a company fails. Moreover, Badarin et al. (2024) demonstrated how the financing-to-deposit ratio, inflation, economic expansion, and return on assets positively affect Islamic banks' liquidity risks. The study also found that the liquidity problems related to Islamic banks were unaffected by non-performing financing, capital sufficiency, operational performance, or scale. In order to create banking liquidity risk management policies, this article offered guidelines for the processes and systems for managing liquidity risk in Islamic banks. It is concluded that an ideal financing-to-deposit ratio must be established in order to protect Islamic banks from liquidity risks.

Several researchers in Bangladesh also sought to investigate the effects of firm-specific and macroeconomic variables on bank liquidity. According to Islam and Nasreen (2018), large banks in Bangladesh keep considerably more liquid assets than small commercial banks. Banks with high-risk exposure and engagement in off-balance-sheet operations must hold less liquidity. Liquid assets are favorably influenced by a bank's profitability, deposits, and age. A greater GDP growth rate is also said to lower bank liquidity. Moreover, Ahamed (2021) investigated the influence of internal and external factors on the liquidity risk of Bangladeshi commercial banks. A negative relationship exists between the size of a bank's assets and its liquidity risk. It indicates that, if bank's asset size increases, it typically holds more long-term or illiquid assets, which can reduce its ability to quickly meet short-term obligations, increasing its liquidity risk. The association between liquidity risks and return on equity and capital adequacy ratios is positive but negligible. Regarding macroeconomic issues, inflation exacerbates liquidity worries, but GDP and domestic credit positively influence it. In addition, Kajola et al. (2019) examined the factors influencing Nigeria's liquidity management. They suggested that, while establishing the appropriate liquidity management approach, bank management should consider both bank-specific (size and profitability) and macroeconomic (GDP growth and inflation rate) aspects. Even if numerous variables have a positive or negative association, the study reveals that banks must carefully analyze the elements to avoid a future liquidity crisis.

Furthermore, Khanam and Hasan (2021) discovered that inflation has a negligible impact on liquidity in Bangladesh. Islam et al. (2021) demonstrated, in contrast, that there is a considerable positive correlation between inflation and bank liquidity. Additionally, Ahamed (2021) investigated how micro- and macroeconomic factors affected the liquidity risk of Bangladeshi commercial banks and found that the volume of a bank's assets hurt that bank's liquidity risk. Regarding macroeconomic issues, inflation exacerbates concerns about liquidity, although GDP and domestic credit favorably impact them. In addition, other studies in this field did not consider several significant factors that affect banks' liquidity. Khanam and Hasan (2021) and Islam et al. (2021) did not consider the net interest margin, capital adequacy, financial leverage, credit quality, operating efficiency, and bank age determinants of bank liquidity in Bangladesh. Even though Tasnova (2022) views monetary policy as a determining factor, the author disregards capital

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adequacy, financial leverage, credit quality, operating efficiency, etc.

Moreover, although liquidity is one of the significant issues for the smooth operations of banks, there is still a scarcity of literature in this field. A few studies that empirically illustrate the impact of microeconomic and macroeconomic variables on banks' liquidity are available in the literature. That is why researchers are motivated to research in this field. In addition, Bank age serves as a pertinent moderating variable in this study due to its potential to influence the relationship between bank-specific factors and liquidity outcomes. Prior research often neglects the temporal dimension of bank operations, overlooking how the age of a bank might interact with other determinants to shape liquidity dynamics. By including bank age as a moderating variable, this study addresses this gap in the literature, recognizing that the impact of factors like capital adequacy, financial leverage, credit quality, and operating efficiency on liquidity may vary depending on the maturity and experience of the bank. Thus, by exploring the moderating effect of bank age, this study aims to provide a more nuanced understanding of the complex interplay between bank-specific factors and liquidity within the context of private commercial banks in Bangladesh.

3. Research Framework

Figure 1 depicts the conceptual framework defining the multiple factors and their impact on the liquidity of private commercial banks in Bangladesh.

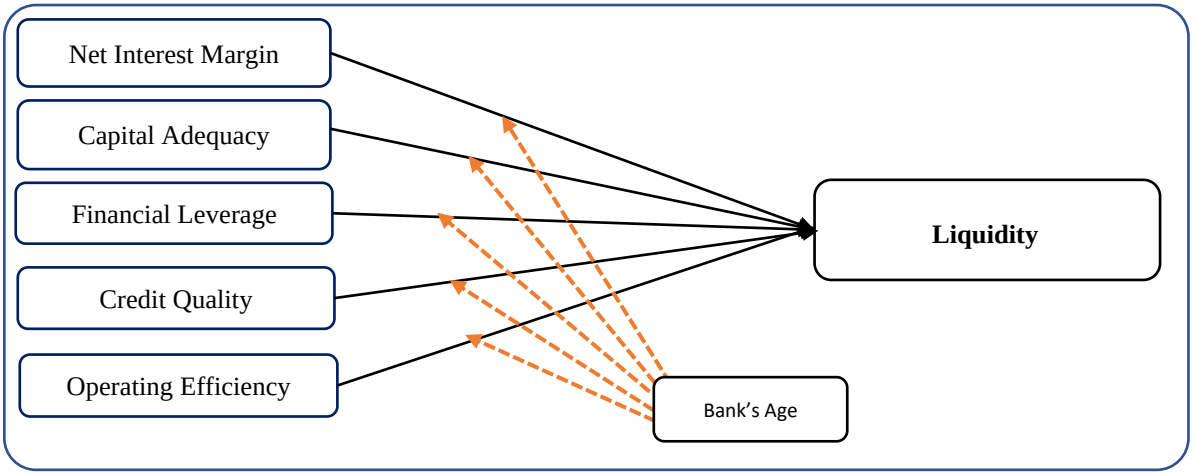

Fig. 1: Research Framework

4. Research Methodology

4.1 Sample and Data

The goal of the study is to examine the variables that significantly influence or have an impact on Bangladesh's private commercial banks' liquidity. Bangladesh has 61 scheduled banks, 33 of which are conventional private commercial banks (Bangladesh Bank, 2021). However, based on data availability and annual reports, twenty private conventional commercial banks are selected as samples. This study creates a panel dataset with 260 observations by analyzing data spanning 13 years, from 2010 to 2022.

4.2 Measurement of the Variables

The dependent variable used in this study is liquidity represented by LTD. The independent variables are NIM, CAR, FL, CR, and OPE, with AGE as the moderation variable. Table 1 describes the variables.

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Table 1: Variable Descriptions and Measurements

Variables	Abbr.	Description	Indication
Dependent	LTD	Total Loans and Advances/Total Deposits	Liquidity
Independent	NIM	Net Interest Income/Total Assets	Profitability
	CAR	Total Capital/Total Risk Weighted Assets	Capital Adequacy
	FL	Total Liabilities/Total Shareholder's Equity	Financial Leverage
	CR	Non-Performing loan/Total Loans and Advances	Credit Quality
	OPE	Total Operating Expense/Total Income	Operating Efficiency
	AGE	Current Year-Establishing Year	Bank's Age
	NIMAGE	Interaction between bank's age and profitability	
	CARAGE	Interaction between bank's age and capital adequacy	
	FLAGE	Interaction between bank's age and financial leverage	
	CRAGE	Interaction between bank's age and credit quality	
	OPEAGE	Interaction between bank's age and operating efficiency	

4.3 Model Selection and Specification

Suitable statistical models form the basis of potential estimations for testing the hypothesis. In order to provide significant results with fitted values, balanced panel data are examined to determine which model among the available alternatives is the best.

Table 2. Model Selection and Specification

Type of Tests	Estimations	Specifications
Wald chi2(23)	343.61^{***}	Random effects model
Hausman Test chi2(10)	18.11	Random effects model
Pesaran CD test	-2.536^{***}	Cross-sectional dependency
Breusch and Pagan LM test chibar2(01)	286.98^{***}	Random effects model
Modified Wald test chi2 (20)	147.30^{***}	Heteroskedasticity
Wooldridge test F (1, 19)	26.523^{***}	Serial correlation

F-test from the Random effects model extracted significant results constituting those Random effects model represented fitted values. Hausman test was also conferred for the random effects model. Similarly, the Breusch and Pagan Lagrangian Multiplier (LM) test suggested a Random effects model over the Ordinary Least Square (OLS) estimation. Modified Wald test identified heteroscedasticity in panel data, and the Wooldridge test picked out autocorrelation; the Pesaran CD test also indicates the presence of cross-sectional dependency, specifying that the Feasible GLS regression model had been used to find significant results.

The following statistical model has been developed to navigate the hypothesis;

$$LTD_{it} = \propto_0 + B_1 NIM_{it} + +B_2 CAR_{it} + B_3 FL_{it} + B_4 CR_{it} + B_5 OPE_{it} + B_6 AGE_{it} + B_7 NIM_{it} AGE_{it} + B_8 CAR_{it} AGE_{it} + B_9 FL_{it} AGE_{it} + B_{10} CR_{it} AGE_{it} + B_{11} OPE_{it} AGE_{it} + \varepsilon_{it}$$

Where $\propto_0$ refers constant, $\beta 1$ *to* $\beta 11$ represents coefficients, and $\mathcal{E}it$ represents the error term.

4.4 Tools for Analysis

Several tests, including the F-test, Breusch and Pagan LM Test, Modified Wald Test, Pesaran CD Test, and Wooldridge Test, evaluate the panel data and choose or identify the best statistical models. Descriptive statistics extract the mean, standard deviation, minimum, and maximum values. Correlation analysis and

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the variance inflation factor (VIF) test assessed multicollinearity concerns. Regression outputs are also obtained by running the Feasible GLS Model.

5. Empirical Results

5.1 Descriptive Statistics

Table 3 shows the results of the descriptive analysis of the study for the period from 2010 to 2022. The bank's liquidity, represented by LTD, has been taken as a dependent variable. In contrast, the independent variables are net interest margin, bank size, capital adequacy ratio, financial leverage, credit risk, operating efficiency, and age of banks. The minimum value of dependent variable liquidity is 0.6580, whereas the maximum value is 1.1278, with a mean of 0. 8890. The standard deviation for liquidity is nearly 9.26%, which indicates the spread from the mean. Based on Table 3, financial leverage has the highest mean value with a standard deviation of 6.1751 and the lowest standard deviation of 0.0066, indicating that the data is clustered around the mean and, therefore, more consistent.

Table 3: Results of Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
LTD	254	0.8890	0.0926	0.6580	1.1278
NIM	254	0.0222	0.0091	0.0013	0.0450
SIZE	254	5.3325	0.2568	3.9795	5.8529
CAR	254	0.1340	0.0795	0.0631	1.1430
FL	254	12.1897	6.1751	1.1680	96.4781
CR	254	0.0498	0.0304	0	0.3307
OPE	254	0.0227	0.0066	0.0118	0.0460
AGE	252	3.0739	0.4996	0.6931	4.1431

5.2 Correlation Matrix and Multicollinearity Test

A correlation matrix (Table 4) with independent and dependent variables is created to examine if multicollinearity exists. Bank age and liquidity have the most positive link. Older banks are better equipped to handle liquidity crises than younger ones since younger institutions are likelier to fail than older ones (Cole & Whilte, 2012). Kennedy (2008) states that there is no multicollinearity or that the correlation of coefficients is less than 80% between two variables. Therefore, multicollinearity issues between independent variables or dependent on independent variables are not conveyed by the research output. A VIF value greater than 10 (Hair et al., 2006) indicates the existence of multicollinearity. So, there is no multicollinearity problem in the dataset.

Table 4: Correlation and VIF Test

	LTD	NIM	CAR	FL	CR	OPE	AGE
LTD	1.0000						
NIM	0.0767	1.0000					
CAR	0.0179	0.0476	1.0000				
FL	-0.0006	-0.0001	-0.0346	1.0000			
CR	0.1178	-0.2155	-0.0538	0.0720	1.0000		
OPE	-0.0511	0.6728	-0.0445	-0.0440	-0.1730	1.0000	
AGE	0.2447	-0.1246	-0.0500	0.1878	0.2565	-0.1622	1.0000
VIF Test		1.88	1.05	1.06	1.13	1.86	1.89
Mean VIF	1.48						

5.3 Results of Estimated Model

Table 5 shows that the FGLS model does not yield an R-Sq value. The Wald test statistic indicates how well the predicted model fits the data. In this instance, the Wald test result for the FGLS model is 814.58, demonstrating the predicted model's strong fit. The Wald test's probability value of 0.00 indicates that the model's explanatory power is adequate. Nonetheless, most of the model's parameters align with our previous expectations.

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Table 5: Results of the selected FGLS model.

Variables	*β*	*SE*	*P*
NIM	4.5260	1.9412	0.020***
CAR	-0.4890	0.2024	0.015***
FL	0.0090	0.0041	0.030***
CR	-2.1869	0.8087	0.007***
OPE	14.2924	3.1845	0.000***
AGE	0.3120	0.0614	0.000***
NIMAGE	-0.2409	0.6166	0.696
CARAGE	0.1825	0.1108	0.100
FLAGE	-0.0023	0.0011	0.029***
CRAGE	0.6449	0.2390	0.007***
OPEAGE	5.4828	1.1325	0.000***
Wald chi2(42)		814.58	
Prob>chi2		0.0000	

Notes: p<0.050=***

6. Discussions

The study's results emphasize the importance of bank-specific variables in impacting the liquidity of private commercial banks in Bangladesh. Key criteria such as net interest margin, capital sufficiency, financial leverage, credit quality, operational efficiency, and bank age played essential roles. Notably, the moderating influence of bank age on financial leverage, credit quality, and operational efficiency highlights the dynamic interaction of these elements over time, providing valuable insights into liquidity management and optimization in the banking industry. The specific results of the study are discussed below.

6.1. Effect of NIM on Liquidity

It has been found that there is a very statistically significant positive relationship between NIM and bank liquidity, with a 1% increase in NIM translating into a 4.5260% increase in liquidity. The association between an increase in net interest margin and liquidity is logically justified. The results align with the findings of Al-Homaidi et al. (2019), who proposed a strong correlation between profitability and liquidity. So, it is recommended that banks focus on strategies to improve NIM, such as optimizing asset-liability management, diversifying revenue streams, and controlling funding costs. Also, maintaining a strong focus on profitability and liquidity management aligns with previous research. Emphasizing these aspects can enhance overall financial resilience and performance within the banking sector.

6.2. Effect of CAR on Liquidity

A statistically significant negative relationship has been found between capital adequacy and liquidity of private commercial banks in Bangladesh. The results presented here differ from those of Lestari (2019). This negative relationship implies that if banks hold more capital, it will reduce liquidity for investors. To address the negative relationship between capital adequacy and liquidity in Bangladeshi private commercial banks, it's crucial to strike a balance. Banks should aim for an optimal level of capital that ensures stability while maintaining sufficient liquidity to meet investor demands. Implementing risk management strategies, enhancing asset-liability management practices, and fostering transparency in reporting can help mitigate adverse effects on liquidity while maintaining regulatory compliance.

6.3. Effect of FL on Liquidity

Bank liquidity and financial leverage have been proven to correlate positively, meaning that companies with higher financial leverage will have better liquidity than those with lower levels. This occurs due to

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more levered businesses' increased ability to generate profits using less expensive funding sources. The results are in line with Alkhatib, K. (2012). Based on these findings, it's recommended that companies carefully manage their financial leverage to optimize liquidity. Striking a balance between leverage and liquidity is crucial, as excessive leverage can increase risk during economic downturns. Additionally, firms should diversify funding sources and maintain robust risk management practices to mitigate potential liquidity challenges associated with high leverage.

6.4. Effect of CR on Liquidity

As expected, a substantial negative link exists between credit risk and bank liquidity. Lower profit volumes eventually translate into smaller liquidity quantities for commercial banks with increasing credit risk. Because credit risk lowers interest income, lowers profitability because more extensive provisions must be kept, and reduces banks' ability to lend money. Institutions should prioritize risk management practices and strengthen credit assessment procedures to mitigate the negative link between credit risk and bank liquidity. Enhanced monitoring of loan portfolios, diversification of assets, and prudent provisioning can help cushion against potential losses. Additionally, fostering a culture of responsible lending and maintaining adequate capital buffers are crucial for sustaining liquidity in the face of heightened credit risk.

6.5. Effect of OPE on Liquidity

It has been discovered that operating efficiency positively affects private commercial banks' liquidity in Bangladesh. This shows how effectively management can cut expenses while raising revenue. Decreasing operating expenses and increasing efficiency can enhance banks' profitability. More substantial financial stability will result from operationally effective commercial banks since they will have more liquidity and a more significant capital buffer. So, it is recommended that banks implement cost-cutting measures, optimize operational processes, and invest in technology for improved efficiency. Training programs can enhance staff skills, and regular performance evaluations can ensure continued effectiveness. Additionally, fostering a culture of innovation and adaptability within banks can support long-term sustainability. Collaboration with regulatory bodies to align policies with operational realities is crucial for maintaining financial stability.

6.6. AGE Moderates the Effect of NIM on Liquidity

The coefficient of interaction between NIM and AGE is 4.2851, as seen in the above table. With a significance value of 0.696, higher than 5%, AGE moderation in NIM is ineffective in moderating the link between NIM and the bank's liquidity. This occurs due to older banks' incapacity to use their available capital to produce sufficient interest income. Based on the findings indicating ineffective moderation of the link between Net Interest Margin (NIM) and liquidity by age, recommendations might include exploring alternative strategies for older banks to enhance interest income generation. This could involve diversifying revenue streams, optimizing asset allocation, or reassessing operational efficiencies. Further research into age-specific factors impacting capital utilization and income generation could also inform targeted interventions for improving liquidity management.

6.7. AGE Moderates the Effect of CAR on Liquidity

Table 5 indicates that Bank AGE cannot moderate CAR on liquidity, with the coefficient of interaction between CAR and AGE as a moderating variable being -0.3065 and having a significance level of 0.100 (not significant). Because older banks might not have adequate earnings to meet regulatory capital requirements, ultimately diminishing bank liquidity, AGE cannot moderate the effect of CAR on liquidity in this study. Given the non-significant moderating effect of age (AGE) on the relationship between capital adequacy ratio (CAR) and liquidity, older banks must enhance earnings to meet regulatory capital standards. Strategies should bolster profitability and maintain sufficient liquidity reserves to offset potential regulatory

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constraints. Continuous monitoring and adaptation to changing regulatory environments are essential for ensuring long-term financial stability.

6.8. AGE Moderates the Effect of FL on Liquidity

As a moderating variable, AGE has a coefficient of interaction of 0.0067 with FL, with a significant level of 0.029, indicating that AGE moderates the impact of FL on liquidity. Older banks performing well can obtain the necessary capital at a reduced cost, boosting profitability and improving bank liquidity. Based on these findings, it's recommended that older banks leverage their strong performance to capitalize on decreasing costs of obtaining necessary capital. This can enhance profitability and improve liquidity. Strategic allocation of resources towards maintaining strong performance and accessing capital efficiently could further amplify these benefits, ensuring sustained financial health and resilience in dynamic market conditions.

6.9. AGE Moderates the Effect of CR on Liquidity

Table 5 also presents the findings of the moderation test, which indicates that the age of banks can moderate the relationship between credit risk and liquidity. The coefficient of interaction between credit risk and AGE is -1.542, with a significance level of 0.007. The bank's experience utilizing loanable capital and consequently producing sufficient earnings increases with age. Reduced credit risk means fewer provisions are needed, boosting bank liquidity. Based on the findings, it's recommended that banks consider leveraging their experience to manage credit risk more effectively, thereby enhancing liquidity. Focusing on strategies that capitalize on accumulated knowledge and resources over time can improve financial stability. Additionally, continuous monitoring and adaptation to market conditions can strengthen the relationship between credit risk management, liquidity, and long-term sustainability**.**

6.10. AGE Moderates the Effect of OPE on Liquidity

Table 5 indicates that AGE moderates the influence of CAR on liquidity, with a coefficient of interaction between OPE and AGE as a moderating variable of 19.7752 and a significant level of 0.000.OPE is a metric that assesses how efficiently a bank performs its daily operations. Because they may control operating expenses using their knowledge, older banks can lower the level of operational risk while simultaneously improving performance. Banks will have more liquidity if they operate well. Based on the findings, it's recommended that banks consider the moderating effect of age on the relationship between capital adequacy ratio (CAR) and liquidity. By leveraging their experience, older banks can potentially mitigate operational risks and enhance efficiency, ultimately improving liquidity. Therefore, optimizing operational performance, particularly in older banks, could lead to enhanced liquidity management and overall financial stability**.**

7. Implications of the Study

7.1. Theoretical Implications

This research contributes substantially to the theoretical comprehension of liquidity determinants in the banking sector, primarily emphasizing private commercial banks in Bangladesh. The research enhances the theoretical framework that governs liquidity practices by investigating the influence of various bank-specific factors, including net interest margin, capital adequacy, financial leverage, credit quality, operating efficiency, and bank age. Identifying these determinants illuminates the intricate interplay of economic variables that affect liquidity dynamics, furthering theoretical models and frameworks in the banking and finance literature. Additionally, investigating how bank age modifies the relationship between specific determinants and liquidity offers nuanced insights into the temporal influences on liquidity management

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strategies, thereby improving our theoretical comprehension of banking operations and risk management throughout the lifespan of financial institutions.

7.2. **Practical Implications**

The results of this study provide vital guidance for bank managers and policymakers in Bangladesh from a practical perspective. The research offers actionable insights for enhancing liquidity management practices within private commercial banks by emphasizing the importance of factors such as net interest margin, capital adequacy, financial leverage, credit quality, operating efficiency, and bank age in determining liquidity outcomes. Bank managers can employ these insights to enhance their liquidity strategies by concentrating on the areas where the study identifies substantial influences. In the interim, policymakers can utilize these discoveries to inform regulatory frameworks and guidelines designed to improve liquidity resilience in the banking sector, thereby contributing to financial stability and risk management in Bangladesh's banking industry.

8. Conclusion

In conclusion, this study underscores the critical bank-specific determinants influencing the liquidity of private commercial banks in Bangladesh over thirteen years from 2010 to 2022. Through rigorous regression analysis, it identifies net interest margin, capital adequacy, financial leverage, credit quality, operating efficiency, and bank age as statistically significant factors shaping bank liquidity in Bangladesh. The findings hold substantial implications for both policymakers and bank managers. By recognizing the pivotal role of these determinants, policymakers can craft targeted regulations and policies to enhance liquidity management within the banking sector. Similarly, bank managers can use these insights to fine-tune their strategies, emphasizing managing financial leverage, maintaining high credit quality, optimizing operational efficiency, and accounting for the varying impact of bank age on liquidity dynamics. Moreover, this study contributes to the broader economic landscape by fostering a deeper understanding of the factors driving liquidity within private commercial banks. Elucidating the intricate relationship between bank-specific variables and liquidity outcomes provides valuable insights into the stability and resilience of the banking sector in Bangladesh. This, in turn, has implications for economic growth and financial stability, as a well-managed and liquid banking sector is crucial for facilitating efficient capital allocation and supporting sustainable economic development. In sum, the significance of this study lies not only in its empirical findings but also in its potential to inform policy decisions, guide managerial practices, and contribute to the broader economic discourse surrounding banking sector stability and performance in Bangladesh. As such, it represents a meaningful contribution to academic research and practical policymaking in banking and finance.

9. Limitations and Direction for Future Research

Despite its exhaustive nature, this investigation contains numerous constraints. First, the study exclusively concentrates on private commercial banks in Bangladesh, which restricts the generalizability of the results to other banking sectors or countries with varying economic conditions. Second, economic factors such as global financial crises or pandemics could have influenced the study results, as it covers the years 2010 to 2022. However, these external factors are not considered in the analysis. Third, the dependence on financial statements, which may not adequately represent qualitative factors such as market sentiment or management practices, could also impact liquidity. A more comprehensive perspective for future research could be achieved by broadening the parameters to encompass public and foreign institutions in Bangladesh or other emergent economies. Furthermore, understanding liquidity determinants could be improved by incorporating qualitative data and considering the influence of external economic factors. The evolving impact of these variables could also be evaluated through longitudinal studies that extend beyond 2022.

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Authors' Contributions: Md. Amdadul Hoque conceived the idea, Ripa Akter and Fahmida Begum collected data, while Ripa Akter analyzed the data. Md. Amdadul Hoque and Fahmida Begum wrote the paper.

Conflict of interest: The authors declare no conflict of interest.

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