



Impact of Bank Specific and Macroeconomic Determinants on Banks Liquidity: An Empirical Study on Listed Commercial Banks in Bangladesh

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Research Article

Abstract

Purpose This study examines the influences of bank-specific and macroeconomic determinants on liquidity on 29 listed commercial banks of Bangladesh.

Methods To analyze the relationship, this study performs Pooled Ordinary Least Square method, fixed and random effect estimates, and implemented GLS random effect method on strongly balanced panel dataset over 2014 to 2019. Capital adequacy, nonperforming loans, and profitability are considered bank-specific factors while GDP, Monetary policy interest rate, and Interest rate spread are considered the macroeconomic factors.

Results Business cycle and monetary policy interest rate inversely affected bank liquidity. Contrary, bank liquidity has a positive association with profitability, nonperforming loans, capital adequacy, and interest rate spread. According to the findings, capital adequacy and business cycle have a significant impact on liquidity.

Implications This study has significant implications for bankers, consumers, and policymakers. The banking sector of Bangladesh will highly be benefited from this research as this paper critically analyzes the determinants of banks' liquidity risk. This research will help the banks and other financial institutions to understand the effect of capital adequacy, nonperforming loans on liquidity in the Bangladeshi context. This study infers that banks need to monitor the factors cautiously to avoid the liquidity crisis in the future.

Originality There are a few studies that examine these determinants with liquidity in the Bangladeshi context. This remarks the significance of the present paper as this study put an attempt to analyze bank-specific and macroeconomic determinants with bank liquidity in the Bangladeshi context has been conducted within a limited scope.

Keywords: Banking Sector, Bank liquidity, Macroeconomic determinants, Bangladesh.

1. Introduction

Bank liquidity refers to the banks' ability to meet the financial short-term obligations without having any substantial losses (Ojo, 2010). Liquidity risk occurs when the bank fails to meet adequate liquidity requirements. The increased risk causes a liquidity crisis and banks become unable to encounter their obligations. In the course of the financial crisis, many banks were on the verge of failing to meet the adequate liquidity requirements stated by the Bank for International Settlements (Committee, 2009). To survive in the financial system, banks are required to have an unprecedented amount of liquidity assistance from central banks (Malik & Rafique, 2013). Although the central bank supported extensively, evidence found that a significant number of bank failures and afterward those banks were necessitated to merge or indispensable to resolution. This crisis pushed to convert the market circumstances and consequently demonstrated the significance of maintaining adequate liquidity management. Banks need to preserve satisfactory liquid assets to respond to the demand aroused by the customers immediately with a rational cost. It is the art of bank management to keep liquidity at an optimal level. The entire banking

operation is highly dependent on holding a satisfactory level of liquidity since if a particular bank revealed liquidity shortage, the entire banking framework will be affected, according to the bank contagion effect, and eventually, it will result in to increase in the systemic risk.

When banks try to achieve the optimal level of liquidity, liquidity becomes exceedingly dependable on some properties like the size of the bank, banking nature and characteristics, banking involvement of complex activities. To manage the liquidity risk, the bank must have to follow a strict decisional structure, a suitable funding strategy, limiting the risk exposure factors as well as synchronized regulation to arrange liquidity just in case required (Van Greuning & Bratanovic, 2020). It is necessary to have a comprehensible liquidity management policy and a well-defined liquidity control strategy to manage banks' assets, liability as well as liquidity.

The position of the banking system is significantly crucial for growing and developing the economy. The financial institutions of Bangladesh experienced remarkable changes in the past few years as the number of the scheduled bank increased, technological innovation took place and thus it escalated the competition. The modifications demand to improve the performance to continue and compete in the banking industry.

One of the most significant rules of the bank is to meet the customer's demand and other expenses by ensuring adequate reserve of liquidity for smooth functioning of banking operations as economic development is highly reliable in the banking sector. Therefore, careful planning of holding liquidity position is highly significant for the banks otherwise banks' reputation and trustworthiness may be shaken. Here prevails the tradeoff between holding more liquidity and profitability because holding excessive liquid assets discourages investment opportunities and it is negatively associated with bank profitability. On the contrary, when banks hold less liquid assets it creates liquidity risk that will, in the long run negatively affect the banks' growth.

Banks of Bangladesh are also in the part of the DSE-30 index and being the market movers, banks contributed to market capitalization. Therefore, maintaining an optimal level of liquidity is the highest concern to create an efficient banking system as well as keep the banks away from insolvency or lower profitability otherwise it will destroy the shareholder's wealth and consequently the whole financial system framework.

This study attempts to address the gap empirically through assessing the bank-specific and macroeconomic factors influencing the liquidity of commercial banks of Bangladesh therefore, constructing a notable addition to the existing literature body as well as showing a strong value of originality. The evidence suggests that banks' liquidity becomes much significant problem and therefore this study aims to identify the influence of liquidity determinants on 29 listed commercial banks of Bangladesh. The next part presents the literature from empirical evidence. Further, the study focuses on the research methodology and study framework. Then the study looks into the data interpretation and findings. After that, the study deals with the discussion and the results of the study. Finally, the last section is wrapped up with the concluding remarks.

2. Banks in Bangladesh: An Overview

In 1846, before the independence of Bangladesh, the first bank in Bangladesh was named Dacca Bank, and its headquarter was located in Dhaka. The bank had limited business operations and was not involved in issuing banknotes. After the independence of Bangladesh (1971), 12 financial institutions took the operation of the banking system and the Government of the People's Republic of Bangladesh nationalized those banks. The central bank of Bangladesh – Bangladesh bank was established on 7th April 1972, after the liberation war of Bangladesh, and is in charge of developing and executing rules and regulations for the financial industry. Complying with the Basel accord, the Basel III program was implemented by Bangladesh bank to reduce the shocks of liquidity as well as reinforce liquidity buffer in opposition to risky investment. Increased capital requirements strengthen the liquidity base and decrease the bank leverage. Around 50 years of banking operations are taking place in Bangladesh with 60 scheduled commercial banks.

3. Literature Review

A limited number of studies analyzed the impact of macroeconomic and microeconomic variables on banks' liquidity in recent years using numerous statistical techniques. While microeconomic factors include bank-specific determinants and those are under bank managements' control, macroeconomic variables are not under the dominance of bank management and are considered as external factors. This study focused on determining the effect of both internal and external factors of the bank on bank liquidity in the Bangladesh context. This section presented a literature summary of bank liquidity on bank-specific and macroeconomic determinants that were studied in past.

Munteanu (2012) examined determinants of liquidity on 27 commercial banks of Romania during pre-crisis (2002-2007) and crisis period (2008-2010). During the crisis year, the empirical results showed that Z-score and bank stability significantly influenced liquidity. Except for loan loss provisions, Tier 1 capital, interbank funding, and impaired loans impacted negatively during pre-crisis on L1 (Net Loans/Total Assets). In the crisis period, Z-score found a positive link nonetheless impaired loans had negative influences over L1. Credit risk rate under macroeconomic variable impacted positively on liquidity. Over the study period, tier 1 capital, loan loss provisions, funding costs, and unemployment influenced positively however ROBOR 3m (months) had negatively influenced L2.

Vodova (2011) explored the macroeconomic and bank-specific determinants on commercial banks of the Czech Republic covering the period of 2001-2009. He found nonperforming loans, capital adequacy, interbank transaction, the interest rate on loans positively impacted liquidity. On the contrary, negative influences of the financial crisis, business cycle, and inflation recorded on liquidity. The relationship between bank size and liquidity was found ambiguous.

Similarly, Vodova (2012) examined bank-specific and external factors of commercial banks in Poland during 2001-2010. The researcher implemented a panel data regression approach on the unbalanced dataset and the empirical results suggest that all the variable significantly impacts liquidity except the money market interest rate. He found that a higher capital adequacy ratio, rate of inflation, nonperforming loans, loan interest rate (lending rate), and interbank bank transaction increase the liquidity of a bank. In contrast, larger bank size, higher return on equity, increased interest rate margin decrease bank liquidity. However, Lartey, Antwi, and Boadi (2013) investigated the association between profitability and liquidity over listed commercial banks in Ghana and argued that banks' liquidity has a positive influence.

Singh and Sharma (2016) explore the relationship between liquidity and both bank-specific and macroeconomic determinants on 56 banks of India throughout 2000-2013. The study conducted Ordinary Least Square, fixed and random estimates on an unbalanced panel dataset of 816 observations. The findings revealed that return on assets, inflation, deposits and capital adequacy impacted positively and significantly over the bank's liquidity. However, unemployment and the cost of funds insignificantly impacted liquidity. Business cycle and bank size have impacted inversely but significantly on Indian banks' liquidity.

Malik and Rafique (2013) studied determinants of Pakistani banks' liquidity in 2007-2011 covering the Asian financial crisis in 2008. Using a fixed-effect model, the study was conducted over 26 listed commercial banks. NPL, TOA, and monetary policy rate positively impacted the liquidity whereas inflation impacted negatively on liquidity. However, the study reported negative but significant effects of the financial crisis over banks' liquidity.

Al-Harbi (2017) analyzed key liquidity affecting determinants over 686 conventional banks from OIC countries. He performed fixed effect estimates from the Ordinary Least Square method on an unbalanced panel dataset during 1989-2008. Study results found that capital ratio, foreign ownership, rate of inflation, deposits insurance, credit risk, and monetary policy significantly and negatively impacted liquidity. On the contrary, efficiency, bank size, market capitalization, and off-balance sheet activities have a significantly positive relationship with liquidity. However, concentration showed a positive but statistically insignificant relationship with banks' liquidity.

Al-Homaidi et al. (2019) explored the influences of micro and macro-economic variables of liquidity on 37 listed Indian commercial banks by applying GMM and Pooled OLS model over the 2008-2017 years period. The results showed that from bank-specific variables; capital adequacy ratio, operation efficiency ratio, bank size, deposits ratio return on assets, and macroeconomic variables impacted positively and significantly on liquidity nonetheless, asset management ratio, net interest margin and profitability founded significantly negative impact on liquidity. Interest rate and exchange rate from macroeconomic variables significantly affected banks' liquidity. The study suggested that to boost the banks' performance, assets quality needs to be considered carefully.

Lee et al. (2013) investigated on influencing bank-specific and macroeconomic factors of liquidity on 15 commercial banks of Malaysia covering the year 2003-2012. Performing panel data analysis, the study concluded GDP, nonperforming loans, profitability have positive influence whereas capital adequacy, financial crisis, bank size, and interbank impacted negatively. Except interbank, all factors showed significant effects on banks' liquidity.

Tesfaye (2012) explored the impact of bank-specific and macroeconomic variables on liquidity on banks of Ethiopia. Implementing the panel data approach, he performed a fixed effect model on 8 commercial banks

covering the period 2000-2011 and found that nonperforming loans, inflation, capital adequacy, interest rate margin, short-term rate of interest, and bank size impacted positively on banks' liquidity while loan growth and business cycle found statistically insignificant.

Similarly, Melese (2015) conducted a study on 10 Ethiopian commercial banks during 2007-2013 using a balanced fixed-effect model. The outcome revealed that bank size impacted positively while GDP, capital adequacy, and profitability impacted negatively on banks' liquidity. During the study period, the research found no impact of inflation, loan growth, interest rate margin, and nonperforming loans on Ethiopian banks' liquidity.

Rafique et al. (2020) conducted a study on Pakistani banks from 2006 through 2016 and identified the determinants of macroeconomic and bank-specific factors over banks' liquidity reserve. Through the panel data method, the study implemented random-effects estimates over 20 banks dataset. The study results found that the size of the bank, business cycle, inflation, and credit risk has negative but significant effects on bank liquidity whereas capital revealed insignificant effect. The market competition also considered and showed a positive impact on banks' liquidity reserves.

Parvin & Akter (2016) investigated factors affecting liquidity levels on both Islamic and conventional banks in Bangladesh. Through implementing reliability tests, t-tests, and factor analysis, the study revealed that industry competition, bank size, monetary policy, loan, and investment policy have a significant impact on liquidity. On the other hand, the study found the least impact from the variables of GDP, clearinghouse, and branch expansion.

Moussa (2015) conducted a study on determinants of bank liquidity estimating two measures of liquidity from 2000 to 2010 on 18 Tunisian banks. Using both static and dynamic panel data methods, the study found that financial performance, inflation rate, capital impacted positively on liquidity while bank size, deposit, financial expenses concerning total loans have no impact on the liquidity of banks in Tunisia.

Rauch et al. (2010) explored the determinants of liquidity creation of 457 German saving banks from 1997 to 2006. Through implementing the "BB-Measure" and "Liquidity Transformation" techniques, the study found that bank size, monetary policy interest rate, and profitability have a negative influence on liquidity while delayed liquidity impacted positively on liquidity.

Chagwiza (2014) investigated factors of liquidity on commercial banks of Zimbabwe from January 2010 to December 2011. The study implemented regression analysis and found bank liquidity has a positive association with capital adequacy, GDP, total assets, and bank rate. However, a negative association has been found between the business cycle and the inflation rate. The size of the bank and liquidity are positively correlated.

Marozva (2015) explored the relationship between the performance of banks and liquidity on South African banks throughout 1998 to 2014 implementing the ARDL and OLS approach. Market liquidity risk and liquidity risk for funding are considered as liquidity and found a significant negative relationship between liquidity risk for funding and net interest margin. Nonetheless, no co-integrating relationship was found between both measures of liquidity risk and net interest margin.

Al-Qudah (2020) investigated the macroeconomic and bank-specific variables over Jordanian Banks liquidity and analyzed GDP and inflation from external factors, and profitability, CAR, NPLs, deposit growth from bank-specific factors. The study covers 13 scheduled commercial banks over 2011-2018. He used pooled least square method along with fixed and random estimators along with Hausman and Lagrange multiplier test. The empirical results identified a significantly positive relationship with inflation, capital adequacy, deposit growth but a negative impact on GDP, nonperforming loans, and bank size. However, profitability reported a negative and insignificant effect on liquidity. The study reported that banks need to carefully oversee economic as well as microeconomic variables to keep required levels of liquidity.

Several studies also highlighted the macroeconomic and bank-specific determinants of banks' liquidity risk. The researchers found liquidity risk increases during unfavorable economic conditions and when there is a significant gap between the demand and supply.

Ahamed (2021) examined key bank-specific and macroeconomic factors of liquidity risk based on selected commercial banks in Bangladesh. Using the panel data method, the study implemented a fixed effect regression model over 23 listed banks covering the year 2005-2018. The study stated larger banks size have less exposure to liquidity risk and found a negative impact on liquidity. Capital adequacy, return on equity, loan deposit ratio, GDP, and domestic credits impacted positively whereas inflation impacted negatively on liquidity risk.

Cucinelli (2013) explored the liquidity risk determinants based on 1080 Eurozone banks using OLS panel data regression technic. The empirical study suggests that larger banks are more exposed to liquidity risk and higher

capitalization leads to higher liquidity. Additionally, the study found that higher specialized lending activity showed better funding structure vulnerability.

Jedidia and Hamza (2015) conducted a panel study during 2004-2012 and analyzed the factors of liquidity risk on the Middle East and North Africa region (MENA) and Southeastern Asian Countries' Islamic banks only. The study concluded that profitability affects positively but the bank's investment, capital adequacy ratio, GDP impacted negatively over liquidity risk.

Nevertheless, according to the best of our knowledge, there are very few studies that examine these determinants with liquidity in the Bangladeshi context. This remarks the significance of the present paper as this study put an attempt to analyze bank-specific and macroeconomic determinants with bank liquidity in the Bangladeshi context has not been widely conducted before.

4. Methodology

4.1. Data Sources & Samples

This study examined a panel dataset of 29 out of 61 scheduled Bangladeshi banks for 2014 – 2019. However, to make this dataset strongly balanced, banks with a partial dataset were eliminated. The included banks are state-owned, foreign, conventional private and Islami Shariah banks with 174 observations. The essential bank-specific figures were collected from the financial report of the bank and the data of macroeconomic determinants was collected from World Bank and IMF database. Other secondary information was retrieved from the Bangladesh Bank report.

4.2. Description of Variables

The above literature revealed that the crucial part is to choose suitable explanatory variables. All the selected variables have been taken from previous appropriate studies. The variables that have been chosen, considered economic relevance in Bangladesh's condition. That being the case, this study removed the variables like economic reforms, exchange rates, or political incidents from consideration. Additionally, this study included some factors that might influence the liquidity condition in the banking sector of Bangladesh.

Liquidity: Banks' liquidity ratio can be estimated as liquid assets (cash and cash equivalents) over total assets (Delechat et al., 2012). Banks provide liquidity whenever demanded by the depositors (Diamond & Rajan, 2001a), and banks need adequate liquidity to conduct their daily operations. This study used liquidity as a dependent variable and explanatory variables are considered as the rest of the variables.

Non-performing Loans: Non-performing loans are those defaulted by borrowers due to not making scheduled payments within a specified duration. The views demonstrated in IMF, interest and principal amount are not being paid by a minimum of 90 days period (IMF, 2005). When non-performing loans increase, banks face liquidity problems and vice versa. This study takes the nonperforming loans to total loans ratio to measure nonperforming loans.

Capital Adequacy Ratio: The capital adequacy ratio measures the capital availability of banks to absorb unanticipated losses and thus it ensures the level of soundness along with capital solvency. It can work as a buffer against uncertain shocks encountered by businesses (Munteanu, 2012). To handle the unexpected financial distress, Bangladesh's bank was instructed to keep at least 11.6% CAR as of 2020 (CEIC DATA, 2020). According to Basel III, banks are required to maintain an 8% minimum capital to abstain from bank insolvency (Batani et al., 2014). The liquidity of a financial institution increases when it keeps a higher level of capital. For this study, core capital (Tier 1) and secondary capital (Tier 2) over risk-weighted assets are considered for the capital adequacy ratio.

Return on Assets: Return on asset measures a firm's profitability in response to its total assets and it states banks' ability to convert assets into earnings. Return on assets can also be used to measure per dollar of profit from assets perspectives (Ross et al., 1998). This study has taken return on assets as a proxy of profitability. Although the higher ratio of return on assets refers to higher profitability (Sandhar & Janglani, 2013), it is found by Bonfim & Kim (2012) that, the bank that earns more return likely to have a low liquidity buffer. If a bank's profitability increases, financial institutions tend to invest more in risky projects which may create a liquidity crisis.

Gross Domestic Product: For this study gross domestic product has been taken as a proxy of the business cycle. When the economic growth of a country increases, business and other economic activities demand more money

therefore banks' liquidity decreases. On the contrary, when the economy goes downward, business and economic activity shrink hence, the bank holds more liquid assets as it is unable to lend money for the time.

Monetary Policy Interest Rate: This study considered the repurchase rate (Repo) as the monetary policy interest rate. When Bangladesh bank lends money to other commercial banks in case of liquidity shortage that is known as repo rate. By increasing or decreasing this rate, the Bangladesh bank manages the money supply and control inflation (Bekaert et al., 2013). When the central bank decides to control inflation, it increases the repo rate, therefore the cost of bank loans increases hence, demand for money decreases. On the contrary, when the central bank decreases the rate, there is more money supply in the market that helps to expand economic growth.

Interest Rate Spread: The difference between the rate the bank reimburses its creditors and the rate bank collects from loans to clients can be stated as interest rate spread. This study considered lending rate subtracting deposit rate as interest rate spread. It is often interpreted as banks profitability and denotes characteristics of market microstructure for the banking sector (Ngugi, 2001). Banks with risk aversion tend to have a lower spread than that of risk-neutral commercial banks because bank interest rate upraises with risk aversion hence it decreases the supply of credit (Ng'etich Joseph Collins, 2011).

Table 1: Description of the Study Variables

Variables	Notations	Proxy/Calculation	Effect Estimation	Source
Dependent Variable				
Liquidity	LIQ	Cash and cash equivalents over total assets		Annual Reports
Explanatory Variables				
Bank-specific				
Nonperforming loans	NPL	% of classified loans on total assets	-	Annual Reports
Capital Adequacy Ratio	CAR	Tier 1 & Tier 2 Capital over Risk-weighted Assets	+	Annual Reports
Return on Assets	ROA	Profitability	-	Annual Reports
Macroeconomic Variables				
Gross Domestic Product	GDP	Business Cycle	-	WDI
Monetary Policy Interest Rate	MIR	Repurchase Agreement (repo)	-	IMF
Interest Rate Spread	IRS	The gap of Lending Rate and Deposit Rate	-	

Source: Author's compilation

4.3. Model Specification and Econometric Framework

To explore the impact of explanatory variables on Bangladeshi banks liquidity, the following equation is formulated:

Where β_0 is the intercept and β_1 to β_6 are the coefficients of determinants, ε indicates error term.

'i' = Number of banks (1, 2, ... ,29)

't' = Timespan (1,2, ... ,6)

$$LIQ_{it} = \beta_0 + \beta_1 NPL_{it} + \beta_2 CAR_{it} + \beta_3 ROA_{it} + \beta_4 GDP_{it} + \beta_5 MIR_{it} + \beta_6 IRS_{it} + \varepsilon_{it}$$

Where,

LIQ = Liquidity

NPL = Nonperforming Loans

CAR = Capital Adequacy Ratio

ROA = Return on Assets

GDP = Gross Domestic Product

MIR = Monetary Policy Interest Rate

IRS = Interest Rate Spread

This study considered the log value of LIQ, GDP, MIR, and IRS to make the dataset concise and get the relevant outcome. Stata 13.0 software package was used to estimate the above model.

4.4. Study Framework

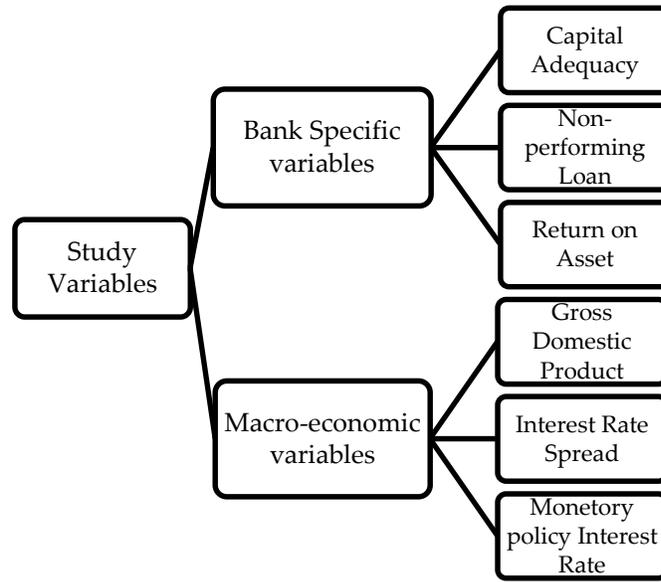


Fig. 1: Framework of the Study

5. Findings and Data Interpretation

5.1. Descriptive Statistics

The results of descriptive statistics contain dependent and independent variables and each of which contains 174 observations from 29 banks throughout 2014-2019. The table shows that the minimum value of dependent variable liquidity has 5.7% whereas the maximum value is around 25% with a mean of 11.3%.

Table 2: The Summary of Dataset

Variable	Obs	Mean	Std. Dev.	Min	Max
LIQ	174	.113	.034	.057	.25
NPL	174	.073	.063	.021	.353
CAR	174	.124	.018	.076	.179
ROA	174	.009	.005	-.011	.024
GDP	174	.072	.007	.061	.082
MIR	174	.058	.024	.006	.072
IRS	174	.034	.005	.028	.042

Source: Author's own calculation using Stata 13.0

The standard deviation for liquidity is nearly 7.8% which indicates the spread from the mean. The independent variable non-performing loans (NPL) has moderate variability a maximum value of 35% and a minimum value of 2.1% with a mean of 7.3% and 6.3% disparity. The capital adequacy ratio (CAR) has a low variability with the least value of 7.6% and highest value of 17.9% and a standard deviation of 1.8%. In this study period, CAR has an average of 12.4% which is higher than the minimum percentage of 11.6% set by the Bangladesh bank. Return on asset (ROA) indicates the bank's profitability over the study period and it records the least value of -1.1% and the highest value of 2.4% with a mean of 0.9% and standard deviation of 0.5%. Gross Domestic Product (GDP) has a

7.2% mean and 0.7% of standard deviation and values are ranging from 6.1% to 8.2%. Finally, indicators of monetary policy interest rate (MIR) and Interest rate spread ranges from 0.6% to 7.2% and 2.8% to 4.2%.

5.2. Correlation and Multicollinearity Diagnostics

5.2.1. Correlation Matrix

The correlation matrix examines whether two independent variables are highly correlated or not. It cannot be accepted if two independent variables have high collinearity (Singh & Sharma, 2016). A multi-collinearity problem occurs if the two independent variables are highly correlated with each other because statistically, it undermines the significance of an independent variable (Mansfield & Helms, 1982). It creates difficulties to declare a particular variable significant although it has a strong relationship with other variables. Such variables are recommended to be exempt to become free from high correlation coefficients (AL-QUDAH, 2020).

Table 3 Matrix of Correlation

Variables	LN_LIQ	NPL	CAR	ROA	LN_GDP	LN_MIR	LN_IRS
LN_LIQ	1.000						
NPL	-0.032	1.000					
CAR	0.185	-0.389	1.000				
ROA	0.098	-0.439	0.291	1.000			
LN_GDP	-0.148	0.131	0.292	-0.302	1.000		
LN_MIR	0.092	-0.102	-0.111	0.160	-0.488	1.000	
LN_IRS	0.125	-0.072	-0.194	0.122	-0.289	0.396	1.000

Source: Author’s own calculation using Stata 13.0

This study data shows no multicollinearity between any independent variables as no values of the correlation coefficient are higher than the cut-off level of 80% (Kennedy, 2008). Table 3 shows the highest collinearity between the monetary policy interest rate (MIR) and gross domestic product (GDP) is 48%, which is less than 80% level hence, this balanced panel dataset is free from multicollinearity.

5.2.2 Variance Inflation Factor (VIF) Test

The variance inflation factor diagnoses collinearity for multiple regression models (Craney & Surles, 2002). VIF indicates how the variance of bank-specific and macroeconomic independent variables is inflated by another predictor variable with its correlation. The multi-collinearity problem occurs if the VIF of any variable exceeds 10 (O’Brien, 2007). Table 4 shows the VIF of all the explanatory determinants is below the cut-off value of 5 (cut-off). Tolerance level is identified by the reciprocal of VIF (Miles, 2014).

Table 4: Variance Inflation Factor

	VIF	1/VIF
LN_GDP	1.682	.594
CAR	1.539	.65
ROA	1.462	.684
LN_MIR	1.459	.685
NPL	1.402	.713
LN_IRS	1.246	.803
Mean VIF	1.465	.

Source: Author’s calculation using Stata 13.0

Table 4 shows the VIF of all the explanatory determinants is below the cut-off value of 5 (cut-off). the tolerance value of predictor variables exceeded the statistical cut-off tolerance of 0.10 and all the explanatory variables values are within the VIF standard of $0.05 < VIF < 5$ hence, the multi-collinearity problem is absent.

5.3. Heteroscedasticity Test

Breusch-Pagan test of heteroscedasticity has been conducted in the linear regression model to check the joint significance of all the coefficients in the model and whether the error term variance depends on any of the predictor variables (Baum & Wiggins, 1999). The outcomes are:

The outcome of the Breusch-Pagan:

Variables: NPL CAR ROA LN_GDP LN_MIR LN_IRS

$$F(6, 167) = 0.47$$

$$\text{Prob} > F = 0.8296$$

It is focused on whether or not the coefficients on predictor variables are jointly significant when regression has run. In this test, the null is that those coefficients are zero (0) which would correspond to a homoscedastic error term without variability therefore, changes in that error variance cannot be predicted. The F statistics is 0.47 and the associated p-value is 0.83 (cut off 5%), so null that those coefficients are 0 cannot be rejected. Therefore, it has no predictability in that error variance and no evidence of heteroscedasticity.

5.4. Regression Analysis (Fixed and Random estimates)

After conducting the Pooled OLS and multicollinearity test, to select the most appropriate regression between the fixed-effect model (FEM) and random effect model (REM), this study conducted the Hausman test to decide which test to diagnose for this econometric model. The results of the random effect concluded that CAR, GDP, and IRS significantly affected banks' liquidity (Appendix B). Although the impact of NPL, CAR, ROA, and IRS was positive, GDP and MIR impacted negatively on liquidity. Results indicate an insignificant effect of NPL, ROA, and MIR on liquidity. Fixed effect estimates found dissimilar results than that of random effect estimates. Even though FEM demonstrates similar results as REM that NPL, CAR, ROA, and IRS impact positively, MIR and GDP impacted negatively on liquidity.

5.5. Hausman Test

Table 5: Hausman Specification Test

	Coef.
Chi-square test value	5.929
P-value	.431

Source: Author's own calculation using Stata 13.0

Hausman test suggests a random effect estimator over fixed effect estimator as the p-value of the test is .431, which is more than 0.05 level of significance. Therefore, this study cannot reject the null hypothesis and considers least-square models of random effect (REM) as an appropriate model.

5.6. Random Effect Regression Outcome

The above outcome manifests that the dataset is free from multicollinearity problems and heteroscedasticity in this strongly balanced panel dataset.

$$LIQ = -3.04 + .37NPL + 2.10CAR + 1.34ROA - 0.47GDP - 0.004MIR + 0.22IRS$$

The regression output of the random effect is statistically significant as it shows 1% that is below the 5% level of significance. Empirical findings point up that at the 5% level of significance, CAR and IRS have a positive impact nonetheless GDP has a negative impact on bank liquidity. The insignificant but positive impact has been found on non-performing loans, and return on assets, by contrast, monetary policy interest rate impacted insignificantly and negatively on liquidity.

Table 6: Regression Outcome

LN_LIQ	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
NPL	.373	.374	1.00	.319	-.361	1.106	
CAR	2.101	1.256	1.67	.094	-.361	4.562	*
ROA	1.341	4.631	0.29	.772	-7.735	10.418	
LN_GDP	-.47	.182	-2.58	.01	-.827	-.114	***
LN_MIR	-.004	.018	-0.25	.806	-.04	.031	
LN_IRS	.219	.104	2.11	.035	.015	.423	**
Constant	-3.036	.65	-4.67	0	-4.311	-1.762	***
Mean dependent var		-2.223	SD dependent var				0.290
Overall r-squared		0.085	Number of obs				174
Chi-square		16.717	Prob > chi2				0.010
R-squared within		0.096	R-squared between				0.156
*** $p < .01$, ** $p < .05$, * $p < .1$							

6. Discussion

Although this study expected a negative influence of non-performing loans on bank liquidity, the results reveal a positive influence with a coefficient of 0.37. Banks are acting cautiously to offset the credit risk. The outcome exhibits banking sector of Bangladesh is highly concerned with credit risk and therefore they maintain a strong risk management policy. The findings are in harmony with Malik and Rafique (2013), Vodova (2011), Tesfaye (2012). However, this study found an insignificant effect of NPL on bank liquidity.

The capital adequacy ratio exhibits a significantly positive statistical impact with a coefficient of 2.10 and a p-value of .09. The finding shows the liquidity of bank increases when the bank holds more capital to handle unanticipated customer demands, losses, or before being insolvent. The result is consistent with Vodova (2011), Tesfaye (2012), Laurine (2013), Singh & Sharma (2016), and Vodová (2013). When the bank has a capital buffer, it can absorb losses and become less fragile (Diamond & Rajan, 2001b). Risk absorption theory states a positive relationship with bank liquidity (Berger & Bouwman, 2009). This inferred that liquidity creation is impacted by higher capital levels and holding a high level of capital declines anticipated debt obligations. However, Moussa (2015), S. S. Bhati & De Zoysa (2012), Lee et al. (2013), Bunda & Desquilbet (2008) found capital adequacy has negative statistical significance on liquidity.

Return on assets impacted positively but insignificantly with the coefficient of 1.34 and p-value of 0.77. Ahamed (2021), Aspachs et al. (2005), and Vodova (2011) exhibited a similar outcome. By contrast, Valla et al. (2006), Vodova (2012), Delechat et al. (2012) found bank profitability has a negative and significant impact on liquidity. Under the researchers' expectations, the relationship between a bank's profitability and liquidity is significantly positive and the outcomes exhibited by Lee et al. (2013), Vodová (2013), Al-Homaidi et al. (2018), Lartey et al. (2013) Al-Homaidi et al. (2019). When the bank invests more in risky projects, it increases the probability of earning more profit. Therefore, an adequate liquidity buffer is highly required to handle the risk involved in investment.

With the probability of 0.01 and coefficient of -0.47, GDP has impacted significantly at a 1% level of significance but negatively on the banks' liquidity. The findings share similarities with most researchers Valla et al. (2006), Aspachs et al. (2005), Pilbeam (2018), Al-Homaidi et al. (2019), Bordo et al. (2001), Paineira (2010), Singh and Sharma (2016), Vodova (2011). According to this study's anticipations, the business cycle is inversely related to liquidity. This is because when economic expansion takes place, the borrowers demand more loans from the bank. Banks, in contrast, try to satisfy the increasing demands of borrowers and encounters liquidity shortages. When the economy goes downward, banks hold a higher portion of liquid assets due to less demand for loan requests.

However, Bunda & Desquilbet (2008), Al-Homaidi et al. (2019) S. Bhati et al. (2015), Ahmad & Rasool (2017), Lee et al. (2013), Moussa (2015), found a positive relationship between GDP and liquidity.

The regression results found that monetary policy interest rate has a negative impact with a coefficient of -.004 on the bank liquidity. This result is symmetrical with standard inferences in the literature due to the stringent effect of monetary policy on the bank (Vodová, 2013), (S. S. Bhati & De Zoysa, 2012), (Al-Harbi, 2017), (Laurine, 2013), (Valla et al., 2006), (Chen et al., 2014), (Malik & Rafique, 2013). However, the study found an insignificant impact on liquidity. Vodova (2012), Subedi and Neupane (2013) Vodova (2011), Munteanu (2012) share a similar outcome with these findings. The reason behind the findings is repo rate per annum is very minor and practically it has no effect. Tighten monetary policy environment reduces money supply as the central bank increases federal funds rate and sell securities, liquidity reserve in banking system declines. Thus, the fed takes this step to slow down inflation.

The result of Interest rate spread infers that an increase in the interest rate spread positively increases liquidity. The coefficient of 0.219 indicated that if IRS increases by 1%, liquidity will increase by 21.9% considering the ceteris paribus condition. The outcome is quite unexpected as it represents that banks are not encouraged to lend money when there is a higher interest rate spread preferably bank holds more liquid. Yet, similar outcomes are depicted by Tesfaye (2012), Melese (2015), Vodova (2012), Subedi & Neupane (2013). This is in line with the credit crunch and credit rationing problem, which means credit markets are having sudden but serious fund crises and limiting the lending activity as banks are alarmed of being bankrupted. With a p-value of 0.035, the result is statistically significant and this confirms the findings of Tesfaye (2012), Vodova (2012). However, Vodova (2011) and Melese (2015) found insignificant effects on liquidity.

7. Conclusion

The study aimed to assess the bank-specific and macroeconomic determinants influencing the commercial banks' liquidity of Bangladesh. To conduct the study, this paper implemented panel data regression analysis for liquidity and the study depicted that external factors have the most effect on liquidity. Nonetheless, these studied indicators impacted positively in some cases and negatively in others based on the microeconomic and macroeconomic environment.

The empirical outcomes indicated capital adequacy, GDP, and interest rate spread are the most significant predictor of bank liquidity in Bangladesh. The result revealed that capital adequacy leads the way to higher liquidity and when banks keep a higher CAR, it is expected that banks will have a better position to absorb the liquidity shock thus it provides greater safety for the banks. Additionally, increased economic growth enhances the business and other economic activities that lead to a decrease the liquidity as other economic activities demand more money. The interesting outcome is that interest rate spread represents banks are not encouraged to lend money when there is a higher interest rate spread preferably bank holds more liquid. This is because the banks are cautious about sudden but serious fund crises and limiting the lending activity as banks are alarmed about being bankrupted. The policy implication is therefore bank-specific factors should be tracked and maximized through enhancing the liquid assets. Bangladesh Bank – the central bank of Bangladesh needs to implement a tight monetary policy to handle the unwelcome effects of inflation on Bangladeshi banks' liquidity.

The government needs to administer sustainable macroeconomic policies that will foster sustainability of economic growth and favor business interests that will make practical and effective use of industry's capacity utilization. The economic regulators will be revitalized to utilize the study findings for modification and aligning present regulation policies and framework, especially in the Bangladesh scenario. The study, therefore, recommends that policymakers readjust the bank-specific and macroeconomic determinants like capital adequacy, GDP, and interest rate spread that influence bank liquidity.

8. Limitations and Directions for Future Research

The study considered 6-year period and could not cover all the listed banks because of either unorganized data or resource constraints. As this study did not have financial support, therefore, important data access and access to the literature was a barrier to conducting this paper. Future studies may examine banks' liquidity with other

independent variables like financial crisis, bank size, return on equity/ net interest margin as a proxy of profitability.

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