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INVESTIGATION OF BANK LIQUIDITY OF MACROECONOMIC AND BANK-SPECIFIC DETERMINANTS – A PANEL DATA APPROACH

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ABSTRACT

Liquidity is critically significant for the banks and banking system components. This study investigates the macroeconomic determinants along with bank-specific determinants of Indian banks. This study considered 50 banks for analysis from 2008 onwards. The result was drawn by employing the generalized method of moments. More precisely, the findings of this study indicate that liquid assets to total assets revealed a substantial relationship with bank determinants of deposits, capital, bank size, and net interest margin. The liquid assets to total assets was also found to have a significant association with macroeconomic determinants of interest rate, weighted average call rate, and gross domestic product. In the case of loans to total assets, bank-specific variables of asset management and net interest margin have a significant relationship, while for macroeconomic variables, only the interest rate has a significant association with bank liquidity. The other independent variables such as cash reserve ratio, return on assets, and non-interest income have an insignificant influence on the liquidity ratios. The findings are significant for bankers, regulators, analysts, and policymakers in managing bank liquidity. The current study is useful for other economies with a similar economic framework to India to improve their bank liquidity structure.

Contribution/Originality: Unlike previous studies that have only used one liquidity ratio, this study uses two liquidity ratios to examine bank liquidity in India and provide an explanation of the impact of macroeconomic and bank-specific determinants on liquidity ratios. The study also includes variables, such as net interest margin and cash reserve ratio, which have not been considered in previous studies.

1. INTRODUCTION

The financial crisis in 2008 had a devastating impact on the liquidity of banks, creating a liquidity crisis and bank failures. A bank's liquidity is significant for bank success; a bank has to keep sufficient cash and the required amount of liquid reserves to comply with its contracted obligations such as cash withdrawals (Subramoniam, 2018). The importance of liquidity falls beyond a specific bank due to idiosyncratic liquidity issues, which can rapidly spill over to other financial institutions and real economies (Mashamba, 2022). Low liquidity can be harmful to those banks with high capital revealed by the financial crisis. The banks may be profitable and highly capitalized, but any loss of customers' trust in a bank's efficiency to fulfil obligations upon request may cause unexpected large

withdrawals that may degrade a solvent institution (Bindseil & Fotia, 2021; Elliott, 2014). Banks did not have an accurate projection of liquidity framework and they were depending on repos and asset-backed securities to fund their business activities during the 2008 financial crisis. Banks heavily invest in asset-backed securities that are unsafe during periods of financial stress (Caverzasi, Botta, & Capelli, 2019; Kowalik, 2013).

The primary role of banks is to manage liquidity, as insufficient liquidity may result in a crisis in the banking industry. The financial crisis of 2008 disclosed the challenges faced by banks due to insufficient liquidity and highlights the importance of liquid assets for effective financial market operations, particularly in the banking industry (Cucinelli, 2013; Roman & Sargu, 2015). As per Ferrouhi and Lehadiri (2013), the financial crisis highlighted the significance of establishing a higher amount of liquidity to deal with adverse situations. Umar and Sun (2016) disclosed that an economy does not perform well when bank performance is poor. They also infer that bank liquidity is critical for an economy's smooth and efficient operation.

A bank with good asset quality, capital, and robust earnings may fail if its liquid reserves are insufficient (Crowe, 2009). Liquidity risk was measured as a secondary risk in previous literature before the financial crisis of 2008, according to Matz and Neu (2006). Though, after the monetary crisis, experts and policymakers focused on the consequences of liquidity risk. Liquidity risk refers to a bank's ability to satisfy its financial obligations without any loss from incurring an unacceptable expenditure. Banks should preserve enough liquid assets to avert such situations and maintain financial stability (Arif & Anees, 2012). Basel III imposed new norms of liquidity and capital on banks. It will have a significant impact on banks because they will be forced to maintain higher liquidity levels and capital reserves than previously required, which will unavoidably affect the role of liquidity creation performed by banks (Horváth, Seidler, & Weill, 2014).

According to Acharya and Kulkarni (2012) and Eichengreen and Gupta (2013), Indian banks are impacted by liquidity concerns that originate in other economies. Pushkala, Mahamayi, and Venkatesh (2017) focused their analysis on the issue of managing liquidity in India's public and private banks. According to this study, Indian banks are not fully prepared to deal with liquidity contingencies. Several Indian banks are dealing with a significant number of problematic loans, which is affecting their ability to manage liquidity. Various research has been carried out which has emphasized bank liquidity (Bonner, Lelyveld, & Zymek, 2015; El-Chaarani, 2019; Moussa, 2015; Pham & Pham, 2021), and it was found that understanding liquidity determinants is necessary to mitigate and manage liquidity problems in the banking industry. These studies suppose that liquidity is reliant on profitability, bank size, capitalization, asset, deposits, etc.

As previous studies were carried out in other countries, their findings and implications may not apply to Indian banks. After the global recession of 2007–2009, studies have indicated that Indian banks were also impacted by the crisis; however, such research is rare. This study aims to fill the gap in the literature in terms of studies exploring the impact of liquidity on Indian banks. The study observes the impact of capital, asset management, return on assets, deposits, non-interest income, size, interest rate, cash reserve ratio, call rate, gross domestic product (GDP), and inflation on bank liquidity in India by using generalized method of moments estimates.

The analysis of the results shows that the liquid assets to total assets ratio has a significant association with bank determinants, such as deposits, capital, bank size, and net interest margin. The liquid assets to total assets also found a significant relationship with macroeconomic variables, such as interest rate, weighted average call rate, and gross domestic product. In the case of loans to total assets, the bank-specific variables of asset management and net interest margin have a substantial relationship, while for macroeconomic variables, only interest rate has a significant association with bank liquidity. The other independent variables, such as cash reserve ratio, return on assets, and non-interest income have an insignificant influence on liquidity ratios. This study is significant and relevant to bankers, regulators, analysts, and policymakers in managing bank liquidity through a deep understanding of impact that these eleven variables have on bank liquidity and helps them to make appropriate decisions.

2. LITERATURE REVIEW

Several studies have examined bank liquidity in different countries and different regions or have specifically focused on one country (Bhati, Zoysa, & Jitaree, 2015; Bonner et al., 2015; El-Chaarani, 2019; Lee, Lim, Lingesh, Tan, & Teoh, 2013; Moussa, 2015; Sopan & Dutta, 2018).

A study by Mashamba (2022) investigates the dynamics of bank liquidity in developing economies. By considering a sample of 91 banks from 11 countries, Mashamba demonstrates that commercial banks in developing economies have focused on ratios of liquidity and moderately adjust due to frictions in the market. Overall, prudence and risk aversion play a significant role in elucidating bank liquidity dynamics in developing economics. Pham and Pham (2021) investigated the factors that have impacted bank liquidity in Vietnam since 2007. The banks' internal and external determinants that affect bank liquidity were investigated by using data from 30 banks. The results show that capital, bank size, and return on equity (ROE) had a negative influence on liquidity, whereas return on assets (ROA), loss loan provision, GDP, and inflation had a substantial positive impact. El-Chaarani (2019) examined the liquidity factors of Middle Eastern banks. The study used a weighted least squares regression on commercial banks from eight nations over three years (2014 to 2016). The result indicates that Omani banks have low liquidity levels, while Lebanese banks have high liquidity levels. The investigation also revealed that the liquidity of banks decreased in 2016 in the Middle East countries. Further, the results disclosed that asset quality, economic growth, bank size, and capital all have a significant effect on bank liquidity. Gockov and Hristovski (2019) looked at the variables that affect bank liquidity, with a focus on the association between liquidity and profitability, in Macedonia. A regression was carried out by using the GMM estimation technique on a 10-year dataset, from 2007 onwards. This research looked at seven different aspects of bank liquidity, five of which were internal and two of which were external. The result shows that profitability has a substantial effect on liquidity. The other important factors, such as non-performing assets, interest rate, and lagged liquidity, have a positive impact. Bank size has an adverse influence on the liquidity of banks, while capital and GDP show a insignificant influence on the liquidity of Macedonian banks. Al-Homaidi, Tabash, Farhan, and Almaqtari (2019) used data from commercial banks to analyze the liquidity factors of Indian banks by using different statistical techniques. Their study infers that deposit ratio, capital, bank size, and operational efficiency have an optimistic relationship with liquidity, whereas asset management, net interest margin (NIM) and asset quality all harmed liquidity. A study by Bhati, De Zoysa, and Jitaree (2019) uses 21 years of data from 1996 to 2016 to study the long-run influence of macroeconomic factors along with bank-specific factors on bank liquidity ratios in India. This study used four types of liquidity ratios. Indian banks are less dependent on liability liquidity and more reliant on asset liquidity. The call rate, discount rates, exchange reserve, inflation, and GDP all had a strong association with the percentage of liquid assets to total assets. The other variables, such as regulatory variables, profitability, and non-performing assets (NPA) did not influence liquidity. However, the liquidity ratio had a substantial influence on bank characteristics such as capital and bank size. Sopan and Dutta (2018) looked into the determinants that contribute to liquidity risk in India, taking into account both bank-related and macroeconomic determinants. The results show that liquidity was inversely related to bank parameters such as funding cost, profitability, asset quality, and size. Inflation, as the external factor, has a positive impact, while GDP adversely impacts liquidity. One limitation of this study was not including liquidity factors such as cash reserve ratio. An investigation by Singh and Sharma (2016) investigated the impact of internal and external bank variables on the liquidity ratio in India. Their findings revealed that profitability, deposit, inflation, and capital have a positive influence on liquidity. Other variables, such as GDP and size, have inversely affected bank liquidity. The unemployment rate and cost of funding had an irrelevant impact on liquidity. DeYoung and Jang (2016) looked at how US banks actively maintained their liquidity position before the implementation of the Basel III liquidity framework, and they found evidence of loan-to-core deposit and net stable funding ratios targeting all sizes of banks. Banks set low liquid targets as their size grows, often in contravention of Basel III criteria, but achieve that liquidity target proficiently. Umar and Sun (2016) examined the factors of

liquidity in association with diverse types of liquidity in BRICS countries (Brazil, Russia, India, China, and South Africa) for 12 years, from 2002 to 2014. Except for funding liquidity, size did not appear to be a significant factor of liquidity in the regression. In BRICS countries, the crisis had a significant influence on funding liquidity but no effect on stock liquidity. Inflation, interest rate, and national saving rates were significant factors of funding liquidity. This study reveals that stock price, profitability, volatility of stock returns, trading volume, and GDP impact stock liquidity, whereas the stock market index and market capitalization do not have any effect. The study infers that bank liquidity is unaffected by the size of banks, therefore, recommending that economists follow the same guidelines for both large and small banks. From 1998 to 2014, Marozva (2015) studied the association between liquidity and banks' performance in South Africa. The association between liquidity and net interest margin (NIM) was investigated using ordinary least square (OLS) and autoregressive distributed lag (ARDL) methodologies. The study discovered an inverse association between NIM and funding liquidity risk, but an irrelevant co-integrating nexus between liquidity risk and NIM. The study suggests that further research can examine liquidity from the viewpoint of asset liability mismatch. Trabelsi (2015) investigated the effect of liquidity determinants on bank profitability in Bahrain, as well as the effect of the financial crisis on bank profitability during the recovery period. Financial leverage, deposits, capital, and GDP appear to have had a positive significant impact, whereas the financial crisis and size have had an adverse influence. It is advised that banks should manage these variables properly to preserve a sufficient amount of liquidity, which would help to attain good profitability. Bharti and Singh (2014) examined the profitability and liquidity of Indian banks on credit-deposit, cash-deposit as well as investment ratios measured for several categories of Indian banks from 2005/2006 to 2011/2012. The study found that banks experienced a fall in the cash-to-deposit ratio and an expansion of investment and credit deposit ratios, except for foreign categories of banks. In comparison to other banks, the results suggest that foreign banks performed well. The study also found that profitability of private and foreign banks improved during the study timeframe, whereas public banks' profitability declined. Cucinelli (2013) used a regression model to study the association between the liquidity coverage ratio, net stable funding ratio, and liquidity risk along with bank characteristics. The findings show that large banks face a high risk of liquidity, whereas banks with high capital show better liquidity in the long term. In terms of specialization, asset quality determines the degree of liquidity risk in the short run; more specialized banks in loan activities exhibit a more vulnerable funding structure. A study by Munteanu (2012) used a regression model on panel data for Romanian banks to look into the factors that influence bank liquidity. The results demonstrate that communal and diversified factors for two ratios of liquidity are similar to those found in the literature. The pre-crisis period was analyzed separately from 2008 to 2010. A significant factor contributed to bank stability, and the Z-score had a substantial impact on liquidity during the crisis. Arif and Anees (2012) looked into the liquidity risk in Pakistan and how it affects bank profitability. From 2004 to 2009, the sample was taken from the balance sheets and income statements of 22 banks. The multiple regression techniques were employed to determine the influence of liquidity risk on Pakistan's bank profitability. The findings exhibit that liquidity risk has a major, negative impact on bank profitability. The study points out that contemporary risk managers mitigate liquidity issues by having sufficient cash reserves. This will shrink the liquidity gap, hence reducing the need for a repo market. Vodova (2011) looked at several factors of the liquidity of Czech banks by employing a sample covering a timeframe of nine years, starting from 2001. The regression results exhibit a substantial positive association between liquidity and capital, non-performing assets, interbank transaction, and interest rate. They also reveal a negative influence of business cycle, crisis, and inflation rate on bank liquidity. The study found an ambiguous relation between size and bank liquidity. Table 1 details various studies on bank liquidity along with the methodology and whether the study was based on a single country or a group of countries.

Table 1. Previous research investigated in different countries.

Author	Variables	Methodology	Period	Country
Mashamba (2022)	Bank size, capital, loan growth, asset quality, profitability, transaction deposits, deposit insurance coverage, GDP, monetary policy, saving ratio, and liquid assets ratio	GMM approach	2011 to 2016	Eleven emerging market countries
Pham and Pham (2021)	Capital, loss loan provision, ROA, ROE, size, return on assets, GDP, inflation, and ratio of liquid assets	Bayesian linear regression	2007 to 2018	Vietnam
Al-Homaidi et al. (2019)	Size, operational efficiency, capital, asset management, profitability, deposit, asset quality, capital, inflation interest rate, GDP, and liquidity ratio	OLS, fixed effects and random effects regression, GMM estimation technique	2008 to 2017	India
El-Chaarani (2019)	Capital, performance, size, asset quality, economic growth, inflation, unemployment, and loan to total asset	Weighted least squares regression	2014 to 2016	Middle East region
Gockov and Hristovski (2019)	Profitability, capital, non-performing loans, GDP, interest rate, asset, lagged liquidity	GMM estimation technique	2007 to 2017	Macedonia
Sopan and Dutta (2018)	Asset quality, capital, funding cost, size, profitability, deposit, inflation, GDP	Regression analysis	2005 to 2016	India
Ghenimi, Chaibi, and Omri (2017)	Capital, credit risk, NIM, liquidity gap, ROE, bank size, ROA, liquid assets to total assets, crisis, cost to income, income diversity, inflation, and GDP	GMM estimation technique	2006 to 2013	MENA region
Umar and Sun (2016)	National saving rates, interest rate, inflation, funding liquidity, stock price, profitability, trading volume, GDP, liquidity, stock market index, and capitalization	Multiple linear regression	2002 to 2014	BRICS countries
DeYoung and Jang (2016)	Assets, growth plan, equity, mortgages, commitments, branches, net stable funding ratio, and loans to deposits	GMM estimation technique	1992 to 2012	US
Singh and Sharma (2016)	Liquid assets to total assets, capital adequacy, funding cost, profitability, deposit, liquidity, size, GDP, unemployment rate, and inflation	OLS, regression fixed effects and random effects	2000 to 2013	India
Trabelsi (2015)	Bank capital, size, deposits, GDP, crisis, financial leverage, return on assets, and return on equity	Regression analysis	2007 to 2013	Kingdom of Bahrain
Marozva (2015)	Funding liquidity risk, market liquidity risk, credit risk, and net interest margin	OLS regression, autoregressive distributed lag (ARDL)	1998 to 2014	South Africa
Moussa (2015)	Net interest margin, liquid assets to total assets, loan to total assets, operating expense to total assets, ROA, ROE, size, deposits, capital, loan to deposits, GDP, and inflation	Fixed effects regression, random effects regression	2000 to 2010	Tunisia
Bonner et al. (2015)	Size, profit, capital, deposits, concentration, and liquidity buffer	Regression analysis	1998 to 2007	30 OECD countries
Cucinelli (2013)	Net stable funding ratio, size, capital, liquidity coverage ratio, crisis, inflation, and GDP	OLS regression analysis	2006 to 2010	Euro area
Vodova (2011)	Capital adequacy, return on equity, interbank transaction, interest rate, assets, financial crisis, business cycle, unemployment rate, and inflation	Regression analysis	2001 to 2009	Czech Republic

Only a few studies have focused on bank liquidity issues in India. It is a significant area to investigate the factors that influence liquidity management to tackle the bank liquidity crisis in India. Therefore, this study explores the impact of internal and external variables on bank liquidity by considering panel data for 12 years, from 2008 to 2020.

2.1. Factors of Bank Liquidity

Previous research has shown that bank liquidity is dependent on internal and external factors (Bonfim & Kim, 2012; El-Chaarani, 2019; Mashamba, 2022; Pham & Pham, 2021).

2.1.1. Bank-Specific Factor
2.1.1.1. Bank Size

The study by Bonfim and Kim (2012) found that bank size significantly affects bank liquidity. Bonner et al. (2015) found that the size of a bank has a significant impact on its liquidity. According to Aspachs, Nier, and Tiesset (2005), the size of banks has an insignificant influence on the liquidity of banks. As per Pham and Pham (2021), the association between liquidity and size is negative and significant.

2.1.1.2. Asset Management

Al-Homaidi et al. (2019) investigated the factors that influence bank liquidity in India for a study period of nine years, and the findings show that asset management has an inverse impact on liquidity.

2.1.1.3. Profitability

Profitability has a strong positive influence on liquidity, according to Lee et al. (2013). On the contrary, Arif and Anees (2012) and Sopan and Dutta (2018) found that bank profitability has a substantial negative impact on liquidity. However, as per Aspachs et al. (2005), bank profitability has little bearing on bank liquidity.

2.1.1.4. Deposits

Dinger (2009) investigated developing countries covering a timeframe of 10 years and revealed that bank liquidity reduces with a rise in deposit rates. However, the study by Moussa (2015) shows that deposit has an irrelevant impact on bank liquidity. In contrast, Bonner et al. (2015) claimed that liquidity asset holding rises as demand deposit increases.

2.1.1.5. Capital

According to Berger and Bouwman (2009), increased capital accessibility boosts banks' risk-absorbing capabilities. Munteanu (2012) and Vodova (2011) emphasized the link between capital and bank liquidity. These studies considered US and European banks engaged in trading activities from 2000 to 2006. They noticed that when a bank was experiencing liquidity issues, the capital ratio was lowered. They also found that when small banks faced liquidity challenges, solvency regulations helped them. Some studies, such as Lee et al. (2013), Bhati et al. (2019), and Moussa (2015), found an adverse influence of capital on bank liquidity.

2.1.1.6. Non-Interest Income

Al-Homaidi et al. (2019) investigated the issue of bank liquidity in India and studied the key determinants of bank liquidity. They demonstrated that non-interest income has a positive influence on bank liquidity.

2.1.2. Macroeconomic Factors of Bank Liquidity

2.1.2.1. Monetary Policy

According to Chen, Phuong, and Lin (2014), monetary policies have an inverse impact on surplus liquidity. Other studies, such as Al-Homaidi et al. (2019) and Valla, Saes-Escorbiac, and Tiesset (2006), revealed that monetary policy has a substantial negative impact on bank liquidity.

2.1.2.2. GDP

According to Aspachs et al. (2005), UK banks had a small amount of liquidity in case of a rise in GDP and vice-versa. Other studies, such as Pham and Pham (2021) and Trabelsi (2015), found that GDP has a positive influence on bank liquidity, whereas Vodova (2011) claimed that liquidity and GDP have a negative relationship.

2.1.2.3. Inflation

Tesfaye (2012) shows that bank liquidity is positively influenced by inflation, whereas Horváth et al. (2014) claimed an insignificant influence of inflation on liquid assets. Bhati et al. (2015) and Moussa (2015) found that inflation adversely impacts banks' liquidity.

Table 2. Variable descriptions.

Variables	Measurement	Notation	Prior studies
Dependent			
Liquidity	Liquid assets/Total assets	LQ	Bhati et al. (2019); Ghenimi et al. (2017); Gockov and Hristovski (2019); Moussa (2015)
Liquidity	Loan/Total assets	LT	Bhati et al. (2019); El-Chaarani (2019); Moussa (2015)
Independent (Bank-specific factors)			
Deposit	Deposit/Total assets	DP	Dinger (2009); Mashamba (2022); Trabelsi (2015); Sopan and Dutta (2018)
Capital	Capital adequacy ratio	CA	Berger and Bouwman (2009); Moussa (2015); Vodova (2011),
Asset Management	Operation income/Total assets	AM	Al-Homaidi et al. (2019)
Profitability	Net profit/Total assets	ROA	Mashamba (2022); Pham and Pham (2021); Gockov and Hristovski (2019)
	(Interest earned/interest paid)/Total assets	NIM	Al-Homaidi et al. (2019); Marozva (2015)
Non-interest income	Non-interest income/Total assets	NII	Al-Homaidi et al. (2019)
Size	Log of total assets	LogA	Cucinelli (2013); Mashamba (2022); Pham and Pham (2021); Sopan and Dutta (2018)
Independent (Macroeconomic factors)			
Interest rate	Repo rate	INT	Munteanu (2012); Vodova (2011)
Reserve ratio	Cash reserve ratio	CRR	Bhati. et al. (2019)
Call rate	Weighted average call rate	WACR	Munteanu (2012); Vodova (2011)
Gross domestic product	Annual GDP growth rate	GDP	Cucinelli (2013); Umar and Sun (2016); Trabelsi (2015)
Inflation	Consumer price index	INF	Bhati et al. (2015); Horváth et al. (2014); Moussa (2015); Tesfaye (2012)

2.2. Research Gap

Few studies have investigated net interest margin and cash reserve ratio determinants that affect bank liquidity in India. The current study examines the impact of eleven determinants of bank liquidity in India, thus providing a deep comprehension of the impact of these variables on bank liquidity in India. Most of the previous studies used the liquid asset ratio as a bank liquidity indicator but this study also includes loans to total assets as another

liquidity indicator. In previous research studies, only one study by Bhati et al. (2019) has used this liquidity ratio in the Indian context but failed to explain the impact of internal and external variables on bank liquidity. This study uses a statistical technique to investigate all these concerns in Indian banks, filling a research gap left by earlier studies.

2.3. Research Objectives

This study was carried out with the following objectives:

(1) To inspect the impact of bank-specific and macroeconomic determinants on liquid assets to total assets.
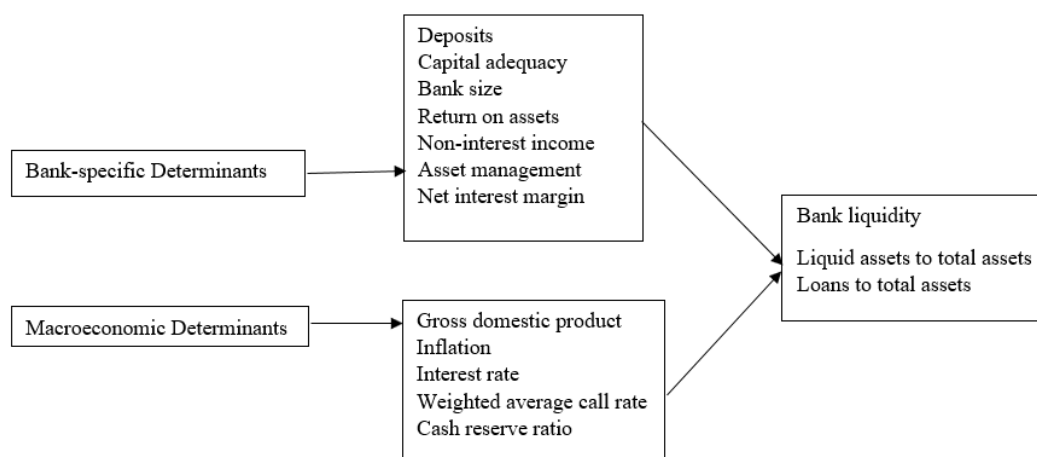(2) To inspect the impact of bank-specific and macroeconomic determinants on loans to total assets.

Figure 1. Bank liquidity model.

Figure 1 shows the bank liquidity model, consisting of bank-specific and macroeconomic determinants.

3. METHODOLOGY

The study investigates commercial banks in India from 2008 to 2020 by considering balanced panel data by applying the generalized method of moments (GMM) developed by Arellano–Bond and Blundell–Bover to the specified model. The regression models for the analysis are shown in the following equations:

$$LQ_{it} = \alpha_{it} + \beta_1 DP_{it} + \beta_2 CA_{it} + \beta_3 SZ_{it} + \beta_4 AM_{it} + \beta_5 NII_{it} + \beta_6 NIM_{it} + \beta_7 ROA_{it} + \beta_8 INT_{it} + \beta_9 CRR_{it} + \beta_{10} WACR_{it} + \beta_{11} GDP_{it} + \beta_{12} INF_{it} + \varepsilon_{it} \qquad (1)$$

$$LT_{it} = \alpha_{it} + \beta_1 DP_{it} + \beta_2 CA_{it} + \beta_3 SZ_{it} + \beta_4 AM_{it} + \beta_5 NII_{it} + \beta_6 NIM_{it} + \beta_7 ROA_{it} + \beta_8 INT_{it} + \beta_9 CRR_{it} + \beta_{10} WACR_{it} + \beta_{11} GDP_{it} + \beta_{12} INF_{it} + \varepsilon_{it} \qquad (2)$$

Where LQ and LT are proxies of liquidity ratio; LQ is liquid assets to total assets and LT is loans to total assets; α_{it} represents a constant term where i indicates bank entity I = 1, and t indicates years t = 1; β is the coefficient of variables; and ε indicates the error term. All variables included are further described in Table 2.

3.1. Sample

The sample consists of 50 banks covering a timeframe of 12 years, from 2008 to 2020, which comprises a total of 600 observations. All the required data used to estimate the specified model were taken from the database of the Reserve Bank of India and the IMF's world economic database. The liquidity determinants, such as capital, asset management, ROA, size, deposits, NII, cash reserve ratio, call rate, and interest rate, were collected from the Reserve Bank of India database. The other variables of liquidity factors, such as inflation and GDP, were extracted from the IMF world economic outlook database. The banks were chosen based on the data accessibility for the timeframe considered in this study.

3.2. Descriptive Data

Table 3 summarizes the mean, standard deviation, maximum and minimum values and the total observations to provide an understanding of the distribution of the variables. It can be observed that the average LQ was retained at .0856% during the study period and the average LT stands at 2.24%, though changes in banks relative to LT are higher than LQ. A higher standard deviation has been noted for deposits, which signifies that the deposits of the given sample banks vary. The results show that the independent variable CA has the highest average value, i.e., 17.6, after that INF, INT, WACR, GDP, SZ, CRR, NIM, DP, AM, NII, and ROA have values of 7.07, 6.72, 6.62, 5.91, 4.69, 4.65, 2.99, 2.68, 2.39, 1.36 and 0.895, respectively.

Table 3. Statistics summarize.

Variables	Observations	Mean	Standard Deviation	Maximum	Minimum
LQ	600	0.85	14.6	358	0.00
LT	600	2.24	40.1	983	0.07
DP	600	2.68	46.5	1140	0.00
CA	600	17.6	13.9	277	1.12
SZ	600	4.69	0.81	6.60	1.63
NIM	600	2.99	0.94	6.56	0.13
AM	600	2.39	1.28	9.29	-2.54
NII	600	1.36	0.93	10.6	-0.90
ROA	600	0.89	1.34	4.21	-9.62
INT	600	6.72	0.95	7.94	4.92
CRR	600	4.65	1.07	3.50	7.32
WACR	600	6.62	1.40	8.34	3.28
GDP	600	5.91	4.25	10.2	-7.25
INF	600	7.07	2.94	12.3	3.42

3.3. Correlation Matrix

Table 4 shows the matrix, which displays the relationship between predicting variables. Multicollinearity will not be an issue during the regression analysis because none of the predicting variables are significantly connected. According to Gujarati and Porter (2009), data with a correlation degree greater than 0.9 has a multicollinearity problem. Table 4 shows that the correlation degree between the predicted variable is less than 0.8 for the given data. The multicollinearity problem was also analyzed using the variation inflation factor (VIF). The highest VIF value is 4.11, which suggests that there is no problem with multicollinearity in the present data as the values are less than 10.

Table 4. Correlation matrix.

Variables	DP	CA	SZ	NIM	AM	NII	ROA	INT	CRR	WACR	GDP	INF
DP	1.00											
CA	-0.01	1.00										
SZ	-0.15	-0.43	1.00									
NIM	0.03	0.28	-0.30	1.00								
AM	0.06	0.17	-0.15	0.67	1.00							
NII	0.40	0.00	-0.08	0.37	0.62	1.00						
ROA	0.06	0.08	-0.12	0.48	0.70	0.39	1.00					
INT	0.01	-0.01	0.03	-0.05	-0.02	0.01	-0.04	1.00				
CRR	0.02	0.02	-0.22	0.18	0.25	0.20	0.29	-0.24	1.00			
WACR	-0.09	0.04	0.03	0.02	-0.03	-0.04	0.04	-0.18	-0.07	1.00		
GDP	0.04	0.03	-0.13	0.09	0.13	0.08	0.20	0.08	0.40	0.12	1.00	
INF	-0.03	-0.08	0.17	-0.21	-0.22	-0.08	-0.30	-0.07	-0.54	-0.03	-0.20	1.00
Multicollinearity												
VIF	1.38	1.32	1.42	2.06	4.11	2.28	2.19	1.34	2.25	1.18	1.37	1.70

4. REGRESSION ANALYSIS AND DISCUSSION

The results of our estimations are presented in Table 5. To address the issue of correlation between the error term and the lagged dependent variable, a two-step GMM model is used. The GMM approach also addresses the issue of weak instruments by taking into account both instruments at level and at differences. The results of the GMM show that the instrument is valid according to the Sargan test, with p-values above 0.05 in both cases, which validates the usage of dynamic panel data. Further, no second-order autocorrelation was indicated by a p-value from the Arellano and Bond second-order test (see Table 5).

The results for LQ in model 1 show that DP, CA, SZ, NIM, INT, WACR, INF, and GDP have a substantial influence on bank liquidity ratio at the 5% level. Other variables, AM, NII, ROA, and CRR, were found to be insignificant at the 5% level. The positive sign of the DP coefficient suggests that bank liquidity is positively associated with deposits. The problem of liquidity may arise when depositors withdraw their money unpredictably. To tackle such situations, banks are required to maintain a sufficient level of liquidity. This shows a positive association between liquidity and deposits. The coefficient sign for CA shows a negative relationship with bank liquidity. According to the concept of creating bank liquidity, a higher capital ratio improves a bank's ability to generate liquidity; however, the financial fragility hypothesis claims that a higher capital ratio diminishes bank liquidity (Diamond & Rajan, 2001). At the 5% level, the sign for size shows a positive link between size and liquidity. A small-sized bank emphasizes conventional intermediation as well as transformation activities and holds a lower amount of liquid resources. This implies that small banks have few reserves in other banks as they have lower trading volumes with different instruments of investments than loans. A positive association was also found between size and liquidity by Tesfaye (2012). The sign for net interest margin indicates a favorable link between NIM and bank liquidity. The positive impact of net interest margin is quite surprising as it emphasizes the fact that a high net interest margin does not encourage banks to advance more but motivates them to grasp liquid assets. This corresponds to the issue of credit rationing and credit crunch. A similar result was also obtained by Tesfaye (2012). Further, asset management has an insignificant impact on liquidity at the 5% level. The coefficient sign for asset management shows a negative association between asset management and liquidity, which indicates that better asset management helps bank to utilize idle resources in an appropriate manner to reduce liquidity in the banking system. An inverse relationship was also revealed by Al-Homaidi et al. (2019). The association between liquidity and non-interest income shows a positive insignificant impact. Similar results can be seen in Al-Homaidi et al. (2019). The regression results demonstrate an insignificant influence between liquidity and profitability. The coefficient sign for profitability indicates a favorable link between profitability and liquidity. Bank profitability could be enhanced by investing in riskier ventures; however, investment in unsafe projects or assets requires a sufficient liquid buffer. The rate of interest has a substantial negative influence on the liquidity of banks. An increase in interest rate reduces banks' borrowing capacity, affecting bank liquidity. Al-Homaidi et al. (2019) obtained a similar result showing a significant negative influence on liquid ratio. Another macroeconomic variable, WACR, has a substantial adverse impact on the LQ model. Banks can borrow funds from the interbank market to maintain the liquidity requirement. An upsurge in call rate results in the accessibility of funds at a higher rate, which affects banks' liquidity. An analysis by Bhati. et al. (2019) shows that call rate has a substantial influence on bank liquidity. The result shows that CRR has an insignificant impact on bank liquidity. The sign of the coefficient indicates an adverse association between CRR and liquidity. As expected, an increase in CRR by policymakers reduces liquidity as banks have to keep the required amount of funds with the central bank without earning any interest on it. The coefficient sign of GDP indicates a positive link with banks' liquidity. Research by Aspachs et al. (2005) and Vodova (2011) found that GDP had an adverse influence on liquidity, while some studies, such as Pham and Pham (2021) and Trabelsi (2015), argued that GDP had a positive influence on bank liquidity. The rate of inflation declines money value and enlarges banks' vulnerabilities that affect credit provided to their customers. Hence, inflation has significant negative influence on bank liquidity, implying that an upsurge in inflation rate diminishes bank liquidity

(Bhati et al., 2015; Moussa, 2015). A contradictory study by Tesfaye (2012) revealed a positive association between liquidity and inflation.

The regression results as per Equation 2 for the LT model are presented in Table 5. The NIM, AM, and INT have been discovered to be significant variables that influence bank liquidity at the 5% level. The coefficient signs of these variables are the same as shown in the LQ model. However, a larger impact of net interest margin, asset management, and interest rate are registered in the LT model compared to the LQ model. The other explanatory variables show an insignificant influence on the LT model and signs are similar to the LQ model, except for DP, CA, NII, WACR, and INF. Generally, banks tend to invest less in low-return liquid resources in case deposits are costly (Dinger, 2009). As predicted, capital has a positive significant impact, signifying that well-capitalized banks hold large liquid assets. WACR has a positive coefficient, which shows that banks hold large liquid reserves when the emergency cost of refinancing is high. Some research studies proposed that banks start to accumulate large liquid reserves to curb the influence of inflation on the economy when there is a rise in the inflation rate.

Table 5. GMM model estimations.

Variables	Model 1 (LQ)				Model 2 (LT)			
	Coefficient	Robust Std Err.	Z	P-value	Coefficient	Robust Std Err.	Z	P-value
Lag LQ/Lag LT	–0.00	0.00	-2.30	0.02	0.36	0.15	2.38	0.01
DP	0.80	0.10	8.05	0.00	–0.00	0.02	-0.10	0.92
CA	-2.03	0.41	-4.88	0.00	0.00	0.01	0.19	0.85
SZ	0.76	0.28	2.64	0.00	13.1	9.26	1.42	0.15
NIM	0.27	0.13	2.10	0.03	2.92	1.40	2.08	0.03
AM	-0.23	0.11	-1.95	0.05	-3.30	1.19	-2.77	0.00
NII	0.18	0.12	1.44	0.15	-0.01	0.68	-0.02	0.98
ROA	0.03	0.03	1.10	0.27	0.70	0.83	0.84	0.40
INT	-0.04	0.01	-3.36	0.00	-2.45	1.07	-2.29	0.02
CRR	-0.03	0.06	-0.53	0.59	-0.24	0.61	-0.41	0.68
WACR	-0.02	0.01	-2.26	0.02	0.55	0.78	0.70	0.48
GDP	0.01	0.00	3.55	0.00	0.11	0.18	0.59	0.55
INF	-0.04	0.01	-3.82	0.00	0.05	0.04	1.31	0.19
_cons	-3.60	1.4580	-2.47	0.01	-38.9	49.4	-0.79	0.43
Wald χ^2 (13)	2.52				1740			
$P > \chi^2$	0.00				0.00			
No. of groups	50				50			
No. of instruments	42				33			
Observations	550				550			
Sargan Test	39.4				28.9			
Sargan Test (p-value)	0.07				0.06			
Arellano–Bond AR (2)	–1.23				1.35			
AR (2) (p-value)	0.21				0.17			

Note: Significant at the 5% level. The model used the generalized method of moments (GMM) estimates followed by the Arellano–Bond and Blundell–Bover methods.

5. CONCLUSION

Liquidity is essential to the banking industry's effective operation. Banks benefit from meeting their obligations to depositors, creditors, and fund investments. Any liquidity issues may negatively impact the performance of banks. Under extreme conditions, it may be a reason for a bank's failure. Therefore, the study looked into the liquidity aspects of Indian banks, from 2008 to 2020. The results reveal that, in the LQ model, bank-specific variables, such as deposits, NIM, and bank size, have a substantial positive influence on bank liquidity, while capital has an inverse impact. Other independent variables, asset management, non-interest income, and return on assets, have an insignificant impact. The macroeconomic variables of inflation, interest rate, and weighted average call rate

have a significant negative influence, whereas GDP has a considerable positive impact on LQ. The CRR has an insignificant effect on the LQ model. In the second model of LT, the bank-specific variable of net interest margin has a positive significant effect, while asset management has a substantial negative influence on the LT model. For the macroeconomic variables, only interest rate has a substantial negative impact on the liquidity of banks. The other explanatory variables were found to have an insignificant influence on the LT model.

The study suggests that interest rate and net interest margin are the most significant indicators of liquidity that affect both liquidity ratios. The interest rate has a substantial negative impact on bank liquidity due to its volatility in the financial market. A bank's liquidity is directly affected by an increase or decrease in the interest rate. The net interest margin is positively associated with bank liquidity. Further, the cash reserve ratio was found to be insignificant for both liquidity ratios. Therefore, monetary policymakers should revise the continuation of the cash reserve ratio as a monetary instrument for Indian banks.

For bankers, regulators, analysts, and policymakers in India, the findings are significant for managing bank liquidity. The current study is useful for other countries with a similar economic framework to India to improve their bank liquidity structure. It should be noted that the study's findings are limited because the impact of bank ownership on liquidity was not taken into account. Bank liquidity may be affected in different ways depending on who owns the banks.

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