

“Factors affecting the liquidity of commercial banks in India: a longitudinal analysis”

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FACTORS AFFECTING THE LIQUIDITY OF COMMERCIAL BANKS IN INDIA: A LONGITUDINAL ANALYSIS

Abstract

This paper examines the long-term effect of various regulatory, bank-specific and macroeconomic factors on the determination of liquidity in Indian banks. For this purpose, the study uses a random effect panel data regression model and tests it with data on Indian banks for 21 years, covering the period from 1996 to 2016. The model considers the effect of regulatory factors, cash reserve ratio, and statutory liquidity, and incorporates four different liquidity ratios specific to the Indian banking scenario. The results of the analysis show contrasting relationships between the independent variables and the dependent variables measured by four liquidity ratios.

It is interesting to note that Indian banks rely more on asset-based liquidity and less on liability-based liquidity. More specifically, the most important liquidity ratio of L1 (liquid assets to total assets ratio) showed a significant relationship with macroeconomic variables of discount rates, call rates, foreign exchange reserve, exchange rate with US dollar, consumer price index and gross domestic product. L1 also showed a significant relationship with bank-specific variables of capital to total assets and bank size. However, the regulatory factors of cash reserve ratio and profitability determined by return on equity (ROE) and non-performing assets were not found to have any effect on liquidity of Indian banks.

Keywords

panel data regression, central bank policy, monetary policy, Indian banks, liquidity determinants

JEL Classification

C33, E52, E58, G21, G28

INTRODUCTION

The liquidity of a bank is critically important for bank success. It is a “measure of bank’s ability to find ready cash, short-term creditworthy securities, government bills, etc., which can be readily converted into cash” (Elliot, 2015, p. 11). The 2008 global financial crisis (GFC) had a devastating effect on bank liquidity, creating liquidity crisis and bank collapses. Wall (2015, p. 1) cites “the suspension of trading by BNP Paribas as a major shock for financial system followed by runs on Bear Sterns and Lehmann Brothers, resulting in their collapse”. After the global financial crisis, the Bank for International Settlements (Bank for International Settlements, 2010) has initiated several regulatory reforms aimed to manage the short-term liquidity of banks.

Basel Committee (2010) has issued a framework for measuring and managing liquidity, which sets out principles for assessment and management of liquidity in banks. For short-term liquidity management, it proposed the Liquidity Coverage ratio and for long-term liquidity management it proposed the Net Stable Funding ratio. Apart from internal management strategy and policy on liquidity management by

banks, BIS (2010) emphasized the role of supervisors in monitoring liquidity strategy of individual banks. Many of the regulators, including the Reserve Bank of India, have adopted BCSB regulations for banks in their country to manage liquidity. RBI publication on “Basel III framework for liquidity standards” highlights the regulatory approach to liquidity management by banks in India (RBI, 2014).

Banks in India have recently been exposed to considerable stress in terms of liquidity management. Pushkala, Mahamayi, and Venkatesh (2017) have highlighted some of the issues of liquidity management in relation to the public and private sector banks in India. They observe that public and private sector banks are not fully equipped to meet liquidity contingencies. Also, nearly 20% of total assets of banks are invested in government securities to meet statutory liquidity ratio (SLR) (Pushkala et al., 2017, p. 92). Many of the banks in India are faced with large volumes of non-performing assets (NPAs) that affect their ability to meet liquidity. These problems create a situation for Indian banks where they may not be able to meet liquidity and regulatory requirements.

While most of the studies on liquidity emphasize a short-term perspective on liquidity management, just recently, BIS has argued for a long-term perspective on liquidity management in terms of Net Stable Funding Ratio. However, the studies that have examined the long-term effect of various bank-specific factors and macroeconomic factors on the liquidity needs and management of Indian banks are limited. For example, the study conducted by Pushkala et al. (2017) was limited to examine the liquidity management of banks for over five years. However, given the recent events in India, such as operational risk in the state-owned bank of Punjab National Bank and identification of large NPA levels in some of the Indian banks, this study aims to conduct a longitudinal analysis to examine the effect of various bank-specific, macroeconomic variables on Indian banks’ liquidity management, covering a 21-year period from 1996. The study also expands the scope of research to cover all types of banks operating in India. Section 1 provides a review of the prior studies examining the determinants of liquidity in banks. Section 2 highlights the research methodology. Section 3 presents the results and a discussion, and the final section concludes.

1. LITERATURE REVIEW

Previous liquidity studies covered a wide range of topics, including studies that examined country-specific liquidity issues, measures of liquidity, a relationship between monetary policy, bank liquidity creation and financial crisis. This section provides a brief review of the main studies conducted in the broader area of liquidity management.

Valla et al. (2006) have presented asset-based measures of liquidity in the banking system in France for the period from 1993 to 2005 and examined stock liquidity changes arising due to the purchase and sale of bank liquid assets. They assessed expansion, contraction, and reallocation of liquidity in individual banks and found evidence of liquidity expansion, contraction, and reallocation of liquidity and positive and negative pro-cyclicality (Valla et al., 2006, p. 40). In their opinion, “liquidity flows in banks are driven by

funding versus profitability motive, and banks have to make a trade-off between expected return and interest rate risk. Liquidity ensures smooth financing of banking activities. Liquidity holdings of banks will reduce when alternative profitable investment opportunities are available to them” (Valla et al., 2006, p. 45). This study revealed that positive liquidity flows in French banking system were larger than negative flows during the period of research resulting in liquidity increases of 1% every quarter (Valla et al., 2006, p. 46). The study also found a correlation between liquidity expansions and GDP growth. However, the monetary policy was not found to have a long-term effect on liquidity. Valla et al. (2006) observed that liquidity reacted negatively to interest rate shocks, and recommended a macro prudential approach along with monitoring of individual financial institutions through bank regulations (Valla et al., 2006).

Based on an analysis of financial statement data of 457 German saving banks from 1997 to 2007,

Rauch, Stephen, Hackethal, and Tyrell (2009) measured the liquidity creation by German saving banks and determined the absolute and relative amount of liquidity creation undertaken by these banks. The study considered several factors that affected the banks' liquidity management. These included bank-specific factors, macroeconomic factors and legal developments in the German banking sector, particularly the effect of abolition of state government guarantees for banks. The study found that:

- 1) the total amount of liquidity created by German saving banks during the period under review increased from 120.7 billion Euros to 182.2 billion Euros in 2006;
- 2) the correlation between liquidity creation and monetary policy indicators was negative;
- 3) the liquidity created by banks decreased due to monetary tightening; and
- 4) there was no relationship between the bank-specific factors, such as profitability and size, and financial performance on liquidity created by banks (Rauch et al., 2009, pp. 22-24).

Bordeleau and Graham (2010) have studied the relationship between liquid assets and bank profitability using panel data analysis of US and Canadian banks from 1997 to 2009. They identified a non-linear relationship between profitability and liquid assets of a bank to improve when it holds some liquid assets (Bordeleau & Graham, 2010, p. 14).

However, having liquid assets beyond a point is found to have diminished profitability. When the impact of GDP growth and unemployment rate on bank's profitability was examined, the study found GDP having a statistically significant positive effect on bank profitability and the unemployment rate having a statistically significant negative effect on bank profitability. Furthermore, inflation rate also exhibited having a negative impact on lagged profitability. The results of this study suggest "a trade-off between resilience to liquidity shocks and cost of holding liquid assets" (Bordeleau & Graham, 2010, p. 15). In general, when funds are available easily in the market, banks do not need to hold a large stock of liquid assets.

A study conducted by Vodova (2011) on Czech commercial banks has used four different liquidity ratios based on assets and liabilities, and suggested different factors that determine each of these liquidity ratios. The first Liquidity ratio "(L1) – Liquid assets to total assets ratio – has a positive correlation with capital, interest rate on loans and percentage of non-performing loans to total assets and a negative correlation with financial crisis and inflation" (Vodova, 2011, p. 1062). The second liquidity ratio "(L2) – Liquid assets to Deposits + Short-term borrowings + Bills Payable ratio – has a positive correlation with capital, interest rate on loans and total assets and a negative correlation with inflation" (Vodova, 2011, p. 1063). The third liquidity ratio "(L3) – Loans to total assets ratio – has a positive correlation with GDP and a negative correlation with capital and percentage of non-performing loans to total assets" (Vodova, 2011, p. 1063). The fourth liquidity ratio "(L4) – Loans to Deposits + Short-term borrowings + Bills Payable ratio – has a positive correlation with total assets but a negative correlation with total capital, interest rate on loans and interest rate on interbank borrowing borrowings" (Vodova, 2011, p. 1063). The results of this study imply that the relationship of bank liquidity with bank-specific factors or macroeconomic variables depends on how the liquidity is determined, given the choice of asset or liability-based liquidity factors.

Munteanu (2012) analyzed the determinants of liquidity in Romanian banks from 2002–2010, considering two liquidity rates: *L1* – Net Loans/total assets ratio, and *L2* – liquid assets to deposits plus short-term funding ratio. Munteanu (2012, p. 997) found that z-score, the cost to income ratio and the macroeconomic variable of credit risk rate have positive correlations with *L1*, while the bank-specific factors, such as capital, impaired loans and interbank funding, have negative correlations with *L1*. In the case of *L2*, "loan loss provision, funding cost and unemployment rate were found to have a positive correlation with it, while the interest rate on three-month borrowing were found to be negatively correlated with *L2*" (Munteanu, 2012, p. 998). As in the case of Vodova (2011), the study concluded that factors determining liquidity depend on the way liquidity is defined.

Berrospide (2013) examined the reasons for liquidity hoarding of banks during the Global Financial Crisis (GFC). The author revealed that the anticipated future losses were the main reason for banks to increase the liquidity level. The study also found that “during the GFC, banks used exposure to security losses in their L2 investment portfolios as a proxy of liquidity risk-taking, and the liquidity hoarding was evident across all banks including small and large banks” (Berrospide, 2013, p. 22). The study also observed the exposure to drawdown in securities losses, loan losses and unused loan commitments in large banks as well as in small banks. In particular, large banks were found to be exposed to funding risks due to unused loan commitments. According to the study findings, loan loss reserves have also contributed to the hoarding of liquid assets, especially in the case of small banks. Interestingly, a significant difference was found between the movement of core deposits and non-core deposits in relation to liquidity hoarding and non-hoarding banks. Besides, there were inflowing of core deposits to liquidity hoarding banks and outflowing of non-core deposits from liquidity hoarding banks as well as from non-hoarding banks (Berrospide, 2013, p. 24). Many banks indulged in loan contraction during GFC forcing them to hoard liquid assets. Several factors, such as the availability of deposits, capitalization and the size of banks, were recognized as influencing the bank’s decision to accumulate liquidity (Berrospide, 2013).

When studying the liquidity and performance of banks in South Africa for the period from 1998 to 2014, Marozva (2015, p. 453) estimated “the relationship between interest margin and liquidity using OLS- and ARDL-bonds testing. The author used current ratio, loan to deposit ratio and provision for non-performing loans as proxies for market liquidity funding, liquidity and credit risks, which were regressed against net interest margin proxied by net interest income to total assets ratio”. Although the study did not find “any direct linkage between net interest margin and market liquidity, funding liquidity and credit risk in the long run, it found a negative relationship between net interest margin and funding liquidity risk” (Marozva, 2015, p. 459). The study recommended further research to investigate liquidity in the context of asset-liability mismatch.

Berger and Bourman (2017) examined the interplay between monetary policy, bank liquidity creation and financial crisis in US commercial and credit card banks’ (Berger & Bourman, 2017, p. 139). The study found that “high liquidity creation by banks is usually followed by a financial crisis. This is driven by off-balance-sheet liquidity creation by banks” (Berger & Bourman, 2017, p. 152). When it comes to bank’s liquidity creation, the bank size matters. During normal business cycle, monetary policy significantly influenced the liquidity creation of small banks, while its effect on the liquidity creation of medium and large banks was weak and mixed. However, the effect of monetary policy was found to be weaker during financial crisis. The researchers observed that “despite regulators’ consideration of monitoring liquidity creation to prevent financial crisis, the monetary policy did not appear to be an effective tool to manage liquidity” (Berger & Bourman, 2017, p. 153). The study suggested exploring other tools, such as capital requirements, and highlighted the need for expanding the scope of research to countries other than US and cross-country studies to understand the liquidity creation phenomenon.

In the Indian context, there have been several studies examining different aspects of liquidity and profitability of Indian banks (see, for example, Bharati & Singh, 2014; Singh & Sharma, 2016; Sopan & Dutta, 2018; Al-Homaidi et al., 2019; and Umar & Sen, 2016). Bharati and Singh (2014) analyzed the liquidity and profitability of commercial banks in India, based on cash-deposit, credit-deposit and investment ratios calculated for various groups of banks in India for the period from the financial year 2005/6 to 2011/12. They found that “during this period, except for foreign-owned banks, all other banks experienced a decline in cash deposit ratio and an increase in the credit deposit ratio and investment deposit ratios” (Bharati & Singh, 2014, p. 26). The results of their analysis suggested that “foreign-owned banks were outperforming all other banks in India in managing liquidity during the period of study” (Bharati & Singh, 2014, p. 28). In relation to the profitability of banks in India, the study observed that the “profitability of foreign-owned banks and private banks increased during the period, while that of public sector

banks declined” (Bharati & Singh, 2014, p. 28). The increase in credit deposit ratio and the decrease in cash deposit ratio suggest that liquidity risk of banks, particularly in the public sector banks, increased during the period under study, while the profitability of banks improved. However, this study did not investigate the impact of macroeconomic factors and bank-specific factors on liquidity risk.

Using the OLS regression model with fixed and random effects and data on Indian banks for the period from 2000 to 2013, Singh and Sharma (2016) examined the effect of bank-specific and macroeconomic factors on determining the liquidity risk of banks in India. The macroeconomic factors considered in the model were GDP, inflation, and unemployment rates, while the bank-specific factors consisted of profitability cost of funding, deposits, capital adequacy and bank size. The findings suggest that the ownership of banks affected their liquidity. Out of the bank-specific factors examined, bank size, deposits, profitability and capital adequacy were found to significantly affect liquidity, while the cost of funds did not affect liquidity (Singh & Sharma, 2016, p. 51). The results also revealed that while the macroeconomic factors, such as profitability, inflation, deposits, and capital adequacy, were found to have a positive effect on liquidity, factors, such as GDP and bank size, were found to hurt liquidity. Two other factors considered – unemployment rate and cost of funding – were not found to have any effect on liquidity. The results of the study found that private banks and foreign-owned banks held more liquidity in the banking system as compared to those in the public sector (Singh & Sharma, 2016, p. 51). However, surprisingly, none of these banks faced a credit crunch during the crisis period in India. The Government ownership and support to public sector banks are the main reasons for public sector banks to hold less liquidity (Singh & Sharma, 2016).

Recently, Sopan and Dutta (2018) studied the determinants of liquidity risks in Indian banks by examining several bank-specific factors (profitability, funding costs, bank size, asset quality, deposit rates and capitalization rate) and macroeconomic factors (gross domestic products and inflation rate). The study found that bank-specific

factors, such as size, profitability levels, funding costs and asset quality, had a negative relationship with the liquidity risks, while capitalization rate and asset quality had a negative relationship with liquidity (Sopan & Dutta, 2018, p. 52). In the case of macroeconomic factors considered in the study, inflation rate had a positive effect on liquidity, while gross domestic product had a negative effect on liquidity (Sopan & Dutta, 2018, p. 57). The major limitation of this study was that it only considered one aspect of liquidity and did not consider the liquidity policy factors, such as cash reserve ratio and statutory liquidity ratio (Sopan & Dutta, 2018).

Al-Homaidi et al. (2019), in their study on the liquidity of Indian banks have investigated the liquidity determinants of Indian banks from 2008 to 2017, using data on commercial banks listed on the Bombay Stock Exchange and several statistical models, such as pooled OLS, fixed and random effects regression analysis. Taking bank liquidity as the dependent variable, the study considered various bank-specific independent variables, such as bank size, capital adequacy ratio, deposit ratio, operation efficiency ratio, asset quality ratio, asset management ratio, return on equity ratio, net interest margin and return on assets (Al-Homaidi et al., 2019, p. 15). The models also incorporated various macroeconomic factors, such as interest rates and exchange rates. The study found that while bank size, capital adequacy ratio, deposit ratio and operation efficiency ratio had a positive effect on liquidity, asset quality ratio, asset management ratio, return on equity ratio and net interest margin harmed liquidity (Al-Homaidi et al., 2019, p. 17). The major limitations of the study were that it considered only one form of liquidity factors (liquid assets to total assets) and, like other liquidity studies on Indian banks, it failed to consider liquidity policy factors of cash reserve ratio and statutory liquidity ratio.

Umar and Sen (2016) explored the liquidity determinants in relation to three types of liquidity in the BRIC countries, including India, for the period from 2002 to 2014. These consisted of funding liquidity, liquidity creation and stock liquidity. The multiple linear regressions found that bank size was not a determinant of liquidity except for funding liquidity. Recent financial

crisis was found to have an effect on funding liquidity of banks in the BRIC countries but not on stock liquidity (Umar & Sen, 2016, p. 380). Effective interest rates, national saving rates and inflation rates were found to be determinants of funding liquidity. Among the factors that affected bank liquidity, bank leverage and profitability were found to be bank-specific factors, while the effective interest rates, stock market index, and unemployment rates were found to be macroeconomic factors. The study also found that profitability, price of stocks, trading volumes, volatility of stock returns and percentage change in GDP affected stock liquidity, while market capitalization and stock market index were not found to have any effect (Umar & Sen, 2016, p. 398). Given that size does not seem to matter for bank liquidity, the study suggests policy makers to pursue similar policies for both small and large banks but have different types of policies for different types of liquidity.

The literature review above highlights the need for a comprehensive review of key issues in assessing bank liquidity.

1. Bank liquidity depends on how the liquidity is defined (Umar & Sen, 2016; Vodova, 2011; Munteanu, 2012; and Bharati & Singh, 2014). All Indian studies have predominantly considered one aspect of liquidity ratios, with the exception of the study conducted by Bharati and Singh (2014), which examined credit-to-deposit ratio, cash deposit ratio and investment ratio, but failed to relate them to bank-specific and macroeconomic factors.
2. Bank liquidity depends on macroeconomic factors and bank-specific factors.
3. Long-term liquidity performance of banks is important.
4. Regulatory liquidity policies pursued by the Reserve Bank of India in the form of cash reserve ratio and statutory liquidity ratio become important in the Indian context. This study aims to bridge the research gap in the literature by examining all these issues in the context of Indian banks through a single statistical model.

2. METHODOLOGY

Following the literature, the study explored the effect of macroeconomic and bank-specific factors on liquidity creation by all commercial banks in India for which data was available for the 1996–2016 period. The data was obtained from the RBI database. First, four variables $L1$, $L2$, $L3$ and $L4$ of liquidity were created. $L1$ is defined as a ratio of liquid assets to total assets, $L2$ is defined as a ratio of liquid assets to liabilities such as deposits, short-term borrowings and bills payable. $L3$ is defined as a liquidity ratio of loans to total assets and $L4$ is defined as a liquidity ratio of loans to deposit plus short-term borrowings and bills payable. $L1$ and $L3$ are – liquidity ratios based on assets, whereas $L2$ and $L4$ are liquidity ratios based on liabilities. (Vodova, 2011, p. 1062; Bhati et al., 2015, p. 9).

$$L1 = \frac{\text{Liquid Assets}}{\text{Total Assets}}, \quad (1)$$

$$L2 = \text{Liquid Assets} / (\text{Deposits} + \text{Short-term borrowings} + \text{Bills Payable}), \quad (2)$$

$$L3 = \frac{\text{Loans}}{\text{Total Assets}}, \quad (3)$$

$$L4 = \text{Loans} / (\text{Deposits} + \text{Short-term borrowings} + \text{Bills Payable}). \quad (4)$$

The liquidity indicators mentioned above were created in accordance with the definitions of Vodova et al. (2011) and making the necessary modifications to make their use suitable in the Indian context. Other variables used in the model are defined in Table 1.

Data on bank-specific variables were obtained from the bank annual reports, and data on macroeconomic variables and regulatory factors were obtained from the Reserve Bank of India (RBI, 2018). The procedure adopted is similar to one of the authors' previous studies (Bhati et al., 2015). The data period used is 1996 to 2016. During this period, many banks either merged with others or ceased their operations or new banks were opened. Only banks with complete data were considered and included here. The

Table 1. Classification and description of independent variables

Variable	Description	Source
Bank-specific variables		
<i>Capital/TA</i>	Capital/Total assets	Singh and Sharma (2016), Al-Homaidi et al. (2019), Vodova (2011), Berrospide (2013)
<i>ROE</i>	Return on equity (net profit/total equity)	Al-Homaidi et al. (2019), Sopan and Dutta (2019), Berrospide (2013), Vodova (2011)
<i>NPA/Adv</i>	Non-performing loans/ Total loans	Vodova (2011), Munteanu (2012), Berrospide (2010)
<i>LogTA</i>	Logarithm of total assets	Singh and Sharma (2016), Umar and Sun (2016), Al-Homaidi et al. (2019), Sopan and Dutta (2018)
Macroeconomic variables		
<i>Lendrate</i>	Lending rate of banks	Vodova (2011), Munteanu (2012)
<i>Callrate</i>	Lending rate for money at call and short notice	Vodova (2011), Munteanu (2012)
<i>CPI</i>	Consumer price index, RBI	Singh and Sharma (2016), Al-Homaidi et al. (2019), Bordelau and Graham (2010)
<i>Exrates</i>	Rupee to USD exchange rate	Al-Homaidi et al. (2019)
<i>GDP</i>	GDP of India	Singh and Sharma (2016), Al-Homaidi et al. (2019), Sopan and Dutta (2018)
<i>Fxreserve</i>	Foreign exchange reserve with RBI	New variable introduced
Regulatory factors		
<i>Discrate</i>	Reserve Bank of India's discount rates for bills	Valla et al. (2006), Rauch et al. (2006)
<i>CRR</i>	RBI's cash reserve ratio	New variable introduced
<i>SLR</i>	RBI's statutory liquidity ratio	New variable introduced

study was not able to analyze data after 2016, since the data obtained for the post 2016 period consisted of many incomplete points. Thus, data beyond 2016 were excluded from the dataset, since they were considered not suitable for the analysis. The determinants of liquidity to be estimated are specified in the following model (Vodova, 2011, p. 1062; Bhati et al., 2015, p. 9).

$$\begin{aligned}
L_{it} = & \alpha_i + \beta_1 \text{Discrate}_{it} + \beta_2 \text{Lendrate}_{it} + \\
& + \beta_3 \text{Callrate}_{it} + \beta_4 \text{CRR}_{it} + \beta_5 \text{SLR}_{it} + \\
& + \beta_6 \text{Fxreserve}_{it} + \beta_7 \text{Exrates}_{it} + \beta_8 \text{CPI}_{it} + \quad (5) \\
& + \beta_9 \text{GDP}_{it} + \beta_{10} \text{CapitalTA}_{it} + \beta_{11} \text{LogTA}_{it} + \\
& + \beta_{12} \text{ROE}_{it} + \beta_{13} \text{NPA/Adv}_{it} + \mu_{it},
\end{aligned}$$

where α_i is a constant and β_i are coefficients, μ_{it} is an error term, and L_{it} is one of the four liquidity ratios in time t . The correlations among financial performance indicators, liquidity ratios and the variables were tested using the multicollinearity test. No significant multicollinearity was observed among independent variables. The data was analyzed using panel data regression. The random effect was found to be most suitable for analysis and results were based on the random effect model.

3. RESULTS AND DISCUSSION

The data obtained on the balance sheet and other financial statement variables of banks were analyzed using Stata 15 software. Table 2 gives descriptive statistics, while Table 3 presents the results of the panel data regression for random effect using Stata 15.

Table 3 shows that the four liquidity variables, $L1$, $L2$, $L3$ and $L4$, do not have the same level of explanatory power. $L1$ and $L3$ have more significant relationships as compared to $L2$ and $L4$. The explanatory power of $L1$ and $L3$ is much higher than that of $L2$ and $L4$. Since $L1$ and $L3$ are based on asset-based liquidity and $L2$ and $L4$ are based on liability based liquidity, this suggests that Indian banks rely more on asset-based liquidity and their dependence on liability-based liquidity is less significant. These results are similar to those of Vodova (2011), who found that the liquidity relationships depend on how liquidity is defined.

The four liquidity factors, $L1$, $L2$, $L3$ and $L4$, have different dependence on independent variables. $L1$ has a significant relationship with macroeconomic factors of discount rates, call rate, SLR, FEx reserves, exchange rate, consumer price in-

Table 2. Descriptive statistics of variables

Variables	Mean	Median	Minimum	Maximum	Standard deviation
<i>L1</i>	0.1904	0.1488	0.0111	0.9683	0.1465
<i>L2</i>	2.7341	0.1782	0	1449.6621	50.0285
<i>L3</i>	0.4652	0.4818	0	0.8775	0.1588
<i>L4</i>	1.2343	0.5834	0	897.2	21.4205
<i>Discrate</i>	7.6288	6.75	6	12	1.9056
<i>Lendrate</i>	11.8184	12	7.75	16.5	1.8685
<i>Callrate</i>	8.1127	6.98	3.51	28.75	5.1332
<i>CRR</i>	6.5957	5.5	4	14	2.7100
<i>SLR</i>	24.9197	25	21.25	31.5	2.4168
<i>Fxreserve</i>	167,428.43	141,514	21,687	369,955	123,947.5749
<i>Exrates</i>	48.0654	44.605	34.33	69.8356	9.4821
<i>Exrates1</i>	0.0215	0.0224	0.0142	0.029129042	0.00379608
<i>CPI</i>	654.0534	525	319	1224.7	283.8453
<i>GDP</i>	36,328.393	29,714.64	17,377.4	69,146.12	16,106.0032
<i>CapitalTA</i>	0.4430	0.0734	-0.4353	529.2419	12.5314
<i>LogTA</i>	5.6457	5.7760	0	8.1256	1.00177
<i>ROE</i>	0.1194	0.1071	-3.3621	31.2644	0.8155
<i>NPA/Adv</i>	4.4403	1.99	-3.35	72.15	6.6912

Table 3. Regression analysis results

Independent variables	Dependent variables			
	<i>L1</i>	<i>L2</i>	<i>L3</i>	<i>L4</i>
	Panel (RE)	Panel (RE)	Panel (RE)	Panel (RE)
<i>Discrate</i>	0.00623* (1.706)	0.443 (0.838)	0.0121*** (3.203)	0.795 (1.051)
<i>Lendrate</i>	-0.00169 (-0.300)	3.305* (1.927)	-0.00833 (-1.495)	1.871 (1.063)
<i>Callrate</i>	0.00168** (2.071)	0.148 (1.611)	0.00186*** (3.544)	-0.0243 (-1.123)
<i>CRR</i>	-0.00333 (-1.276)	-2.831* (-1.947)	-0.000245 (-0.0781)	-0.974 (-1.023)
<i>SLR</i>	-0.00661*** (-3.888)	-1.497** (-2.030)	0.00414** (2.308)	-0.978 (-1.075)
<i>Fxreserve</i>	-6.84e-07*** (-3.550)	7.54e-06 (0.110)	1.91e-07 (1.127)	-7.46e-05 (-1.185)
<i>Exrates</i>	-0.00351*** (-3.264)	-0.719 (-1.461)	0.000724 (0.593)	-0.407 (-1.126)
<i>CPI</i>	-0.000602*** (-4.052)	0.0448 (0.979)	-0.000174 (-1.211)	-0.0301 (-1.373)
<i>GDP</i>	1.53e-05*** (3.837)	-0.000557 (-0.417)	4.40e-06 (1.166)	0.00129 (1.280)
<i>CapitalTA</i>	-6.78e-05*** (-3.074)	-0.00633 (-0.738)	-0.000637 (-0.175)	-0.931 (-0.868)
<i>LogTA</i>	-0.0925*** (-5.906)	-12.62* (-1.777)	-0.000790 (-1.170)	0.0645 (1.279)
<i>ROE</i>	0.00291 (0.908)	-0.615 (-1.325)	-0.000890 (-0.237)	-0.0926 (-0.456)
<i>NPA/Adv</i>	-0.000220 (-0.221)	-0.0326 (-0.421)	-0.000914 (-1.303)	0.0366 (0.852)
Constant	0.953*** (8.164)	107.9* (1.804)	-0.105 (-0.791)	-4.244 (-0.843)
Group dummy	Yes	Yes	Yes	Yes
<i>R-squared</i>	0.3462	0.013	0.260	0.015
<i>F-statistic</i>	435.82	7.94	2,274.19	86.85
<i>P-value</i>	0.0000	0.9507	0.0000	0.0000

Note: Robust t-statistics are reported in parentheses. * indicates statistical significance at the 10% level, ** indicate statistical significance at the 5% level, and *** indicate statistical significance at the 1% level.

dex and GDP. *L1* has also a significant relationship with bank-specific factors of total assets and capital to total assets. *L2* has a significant relationship with lending rate, CRR, SLR and total assets. *L1* and *L2* are both based on liquid assets. On the other hand, *L3* has significant relationship only with discount rate, call rate which are macroeconomic factors and SLR which is a regulatory factor. *L3* does not have any significant relationship with bank-specific factors. *L4*, however, does not have any significant relationship with any of the macroeconomic variables or bank-specific factors.

The liquidity variable *L1*, which is an asset-based liquidity ratio, was found to have a positive relationship with discount rate as against negative relationship obtained by Valla et al. (2006) and Rauch et al. (2006). *L1* does not have any significant link with cash reserve ratio (CRR) but has a negative relationship with statutory liquidity ratio (SLR). This suggests that RBI policy on CRR is ineffective in managing liquidity of banks in India, but SLR, on the other hand, has a negative influence on bank liquidity in India. *L1* has a significant positive relationship with GDP, which is consistent with data from Vodova (2011), Valla et al. (2006), and Boedeleau and Graham (2010). However, this result is not consistent with the findings obtained by Singh and Sharma (2016), and Sopan and Dutta (2018) in the context of Indian banks. The results of this study support the view that an increase in liquidity will result in an increase in GDP. *L1* is further found to have a significant negative relationship with foreign exchange reserves, exchange rates, consumer price index, capital to total assets and bank size. The results of this study on the relationship between exchange rates and liquidity are consistent with those of Al-Homaidi (2019) for Indian banks, who also found a negative relationship between exchange rates and liquidity.

Regarding the relationship between the consumer price index and liquidity, the current study supports the view that there is a significant negative relationship between *L1* and CPI. This result is con-

sistent with the findings obtained by Vodova (2011), Bordeleau and Graham (2010) and is in disagreement with those of Singh and Sharma (2016) and Sopan and Dutta (2018). As to the *L1* and capital levels, this study found a negative relationship between them in the context of Indian banks, which is in disagreement with Vodova (2011), Berrospide (2013), Singh and Sharma (2016), and Al-Homaidi (2019).

The results of this study found a significant negative relationship between size, given by log of total assets, and liquidity as in the case of studies conducted by Singh and Sharma (2016) and Sopan and Dutta (2018), who also found a significant negative relationship between size and liquidity in the context of Indian banks. Since in the Indian context, larger banks are mainly in public sector, the results of the current study suggest that large banks in the public sector face more liquidity crunch as compared to small private sector banks. In contrast, profitability as measured by Return on Equity was not found to be a significant factor affecting liquidity, supporting the view expressed by Rauch (2006) that profitability of banks does not affect liquidity. Similarly, non-performing assets (NPAs) were not found to have any significant effect on liquidity of banks in India.

In the case of liquidity ratio of *L2*, a significant positive relationship with the lending rate, a negative relationship with CRR and SLR and a negative relationship with size (LogTA) were found. However, liquidity ratio of *L3*, which depends on loans and is considered less liquid, was found to depend only on macroeconomic variables, such as discount rate, call rate and regulatory factor of SLR. The lack of relationship between bank-specific factors and *L3* suggests that long-term liquidity of banks does not depend on capital or other bank-specific factors. The level of non-performing assets in banks also does not influence any of the four liquidity variables. *L2* and *L4* are both based on deposits, short-term borrowings, are liability-based and do not have a significant relationship with any of the bank-specific factors.

CONCLUSION

This study contributed to filling the gap in the literature on liquidity in Indian banks in several ways. First, it examined the effect of four different liquidity ratios, *L1*, *L2*, *L3* and *L4*, in contrast to previous liquidity studies on Indian banks. Secondly, it analyzed the long-term effect (21 years) of various

macro-economic factors, bank-specific factors and regulatory factors on liquidity. This is an important improvement of previous Indian studies that did not take this long period into account. Moreover, previous Indian studies did not study the effect of regulatory factors such as cash reserve ratio, statutory liquidity ratio, although they used some forms of funding rates or lending rates. Therefore, taking into account the effect of regulatory factors on liquidity is another contribution.

The study concludes that asset-based liquidity is more significant for banks than liability-based liquidity in the context of Indian banks. The study says that of the two policy measures of CRR and SLR, CRR does not have a significant effect on liquidity, except for L2. SLR, on the other hand, is found to have a negative relationship with all forms of liquidity in the Indian context. The study recommends that the RBI revise the continuation of CRR and SLR as policy instruments for Indian banks. It was found that foreign exchange reserves and exchange rates, consumer price index, capital levels and size were negatively related to L1 liquidity. In contrast, bank profitability and non-performing assets of the banks did not have a significant impact on bank liquidity in India. Finally, it should be noted that the findings of this study are limited because it did not consider the effect of bank ownership on liquidity. There may be different effect of ownership on bank liquidity.

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