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Full length article

An empirical analysis of macroeconomic and bank-specific factors affecting liquidity of Indian banks

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Abstract

This paper investigates bank-specific and macroeconomic factors that determine the liquidity of Indian banks. To explore the association, we perform OLS, fixed effect and random effect estimates on a data set of 59 banks from 2000 to 2013. Studied bank-specific factors include bank size, profitability, cost of funding, capital adequacy and deposits. GDP, inflation and unemployment are the macroeconomic factors considered. We also perform liquidity trend analysis of Indian banks based on ownership. Findings reveal that bank ownership affects liquidity of banks. Based on panel data analysis, we suggest that bank-specific (except cost of funding) and macroeconomic (except unemployment) factors significantly affect bank liquidity. These include bank size, deposits, profitability, capital adequacy, GDP and inflation. Further, bank size and GDP were found to have a negative effect on bank liquidity. On the other hand, deposits, profitability, capital adequacy and inflation showed a positive effect on bank liquidity. Cost of funding and unemployment showed an insignificant effect on bank liquidity. Our paper highlights new facts for enhanced understanding of liquidity in emerging economies like India.

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Keywords: Banks liquidity; Bank specific; Macroeconomic; Fixed and random effect

1. Introduction

A balance sheet provides vital information regarding a bank's financial position at any given point of time. The asset side includes loans forwarded to borrowers while the liabilities side, among other things, shows deposits made by customers (Diamond & Rajan, 1999). Banks not only support the economy by providing finance, but also assist in transactions carried out by an economic agent (Horváth, Seidler, & Weill, 2014). Further, banks play a crucial role of transforming illiquid assets into liquid assets through demand deposits (Diamond & Dybvig, 1983). However, an unexpected increase in liquidity demand forces banks to sell their illiquid assets at lower prices resulting in losses and increased risk (Allen & Gale, 2004; Allen & Santomero, 2001). A study on the association between capital level and risk explains that bank capital behaves as a

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buffer against the risk faced by banks (Bhattacharya & Thakor, 1993). On the other hand, Diamond and Rajan (2001) argued that greater capital buffer in banks led to less liquidity. Horváth et al. (2014) studied the relationship between capital and liquidity creation by banks and found that small banks with high level of capital created less liquidity whereas large banks having excessive capital consistently created more liquidity.

According to the guidelines of the Reserve Bank of India (2012), “liquidity is a bank’s capacity to fund increase in assets and meet both expected an unexpected cash and collateral obligations as they become due”.

Many researchers have emphasized that the fundamental role of banks as creators of liquidity makes them susceptible to liquidity risk (Ratnovski, 2013). Liquidity risk is the incapability of a bank to fulfill its financial commitments without losing assets or incurring undesirable expenditure. To avoid such a situation and maintain financial stability, it is preferable for banks to maintain a sufficient liquid buffer (Arif & Nauman Anees, 2012). After the global financial turmoil, low solvency of banks was assumed to be its root cause. The Basel Committee on Banking Supervision (2010) emphasized solvency of, and liquidity creation by banks, and proposed new capital rules to avoid such a situation in future. These rules included maintaining higher capital reserves by banks.

Liquidity risk had mostly been considered secondary risk in banking literature before the global financial crisis (Matz & Neu, 2007). However, after the crisis, attention of policy makers and researchers was drawn towards the grave effects of liquidity risk. It is noteworthy however, that extant literature does focus on banks’ insufficient risk management practices (Crowe, 2009). Consequently, inadequate liquidity gained significant attention, and became a solemn concern for banks (Jenkinson, 2008).

Literature immediately after the global financial crisis suggested that the crisis mainly affected developed economies, but when the Indian banking sector observed transfer of deposits from private sector banks to the public sector banks, it drew the attention of practitioners and researchers alike. Eichengreen and Gupta (2013), and Acharya and Kulkarni (2012) also asserted that post-crisis liquidity risk affected the Indian banking system. Similarly, studies on liquidity of Indian banks by Shukla (2014) highlighted that liquidity pressure affected Indian economy because of the extraction of investments made in the financial system of India. While it is generally believed that the Indian banking system has stringent rules and regulations and its policies would act as an insulator and protect Indian banking system from such a crisis, it is noteworthy that the liquidity problems faced by the Indian banking sector was not due to the inefficiency of the banking system or laxity in regulations, but because of the insecurity of the customers. Thus, it was customer sentiment that affected liquidity in Indian banks, especially in the private banking sector (Eichengreen & Gupta, 2013). Bhati and De Zoysa (2012) mentioned mismanagement of liquidity as one of the major reasons behind liquidity problems.

Although Indian banks have largely been able to adhere to guidelines of Reserve Bank of India for managing liquidity, factors affecting liquidity in Indian banks remain relatively unidentified owing to a scarcity of studies on management of liquidity in Indian banks (Bhati & De Zoysa, 2012).

The present study seeks to fill this gap by empirically analyzing macroeconomic [gross domestic product (GDP), inflation (INFLA) and unemployment (UNEM)] and bank-specific [return on assets (ROA), bank size (SIZE), deposits (DEP), cost of funding (COF), capital adequacy ratio (CAR)] factors affecting liquidity of Indian banks, thus making a significant contribution to existing body of literature, and bringing high originality value. Also, because we have considered both macro and bank specific factors to observe their effect on liquidity, we get a holistic view of the set of factors that influence liquidity, and the relationship that each factor shares with liquidity. This study provides deep insights into the relationships that liquidity shares with various macroeconomic and bank specific factors. Findings will enable bank managers to formulate appropriate strategies to maintain adequate liquidity while incurring minimum losses.

In this direction, the objective of this study is to identify macroeconomic and microeconomic (bank-specific) factors, which affect the bank liquidity.

The rest of the paper is structured as follows: Section 2 gives an overview of the Indian banking system and shows liquidity trends in the Indian banking system from 2000 to 2013. Section 3 presents literature review on determinants of liquidity. Section 4 describes data collection and research methodology. Section 5 shows results of analysis. Section 6 comprises discussion of the results. Section 7 includes conclusions and managerial implications.

2. Overview of Indian banking

In 1921, the banking system of India originated with the establishment of the Presidency Bank which led to the formation of the Imperial Bank of India for carrying out central banking functions. Later in 1934, Reserve Bank of India

(RBI) was set up to perform the function of a regulatory body, and was nationalized in 1949 according to the RBI act, 1932 (Das, 2013). Nationalization made RBI an authoritative body, and brought additional duties of regulating, controlling, and inspecting other banks. In 1955, RBI acquired Imperial Bank of India and renamed it State Bank of India. Seven subsidiaries of SBI were nationalized in 1959. With the objective of improving resilience and robustness of banks, 14 more banks were nationalized in 1969 by the Government of India. This was followed by nationalization of another six banks in the year 1980 (Das & Ghosh, 2006). Nationalization increased people's confidence in banks.

The Indian banking system comprises commercial and co-operative banks. After the introduction of new reforms in the economic and financial sectors in the 1990s, the Indian banking system witnessed considerable improvement and the problem of NPAs reduced significantly (Pennathur, Subrahmanyam, & Vishwasrao, 2012).

The Narasimham Committee (1992) recommended various reforms that strengthened the banking structure and ensured its stability (Sathye, 2003). Moreover, private sector banks were given entry in the Indian market by the Banking Regulation Act (1993). The reforms in the financial sector were significant because they included: (1) restructuring in the monetary framework; (2) deregulation of interest rates; (3) introduction of market based exchange rate system; (4) new regulatory standards such as capital adequacy; (5) fresh norms of asset classification and asset liability; and (6) new provisions and standards of risk management (Das, 2013). The Reserve Bank of India played an active role in improving the financial market's efficiency and increasing its depth. Reforms in the framework of the monetary policy reduced dependency on direct instruments; cash reserve ratio (CRR) was de-emphasized and open market operations (OMOs) were used as the instrument of liquidity management (Reddy, 1999). For ensuring stability, the following measures were adopted: interest rates deregulation; flexibility in the licensing policy of banks; escalation of capital structure; and independence of functionality in public sector banks (Das, 2013). Adoption of these measures boosted the growth of economy.

2.1. Liquidity trend of Indian banks

Currently, commercial banks of India are reported to be well regulated. They are sufficiently capitalized in terms of quantity and quality. Funding structure mainly depends on domestic retail deposits. Furthermore, there is ample diversification of assets and reduction of leverage ratio. However, in the Indian banking system, despite the strength and substantial ownership of public, the financial crisis (2007–2009) focused on the liquidity stress (Eichengreen & Gupta, 2013; Acharya & Kulkarni, 2012).

Dinger (2009) and Delechat, Arbelaez, Muthoor, and Vtyurina (2012) studied liquidity holding of the banks. Dinger (2009) found that foreign banks maintained less liquidity due to their ability to arrange funds from the parent branch. Similar results were found by Delechat et al. (2012). Fig. 1 illustrates the liquidity trend of Indian banks from 2000 to 2013. It highlights patterns of liquidity holdings of nationalized, private and foreign banks, and SBI and its associates. It can be observed that since 2002, foreign banks have maintained high liquidity as compared to public and private sector banks. Further, liquidity during the crisis period (2007–2009) was kept high by foreign and private banks. Pre-crisis (2000–2006), foreign banks maintained the highest level of liquidity followed by nationalized, private banks and SBI and its associates respectively.

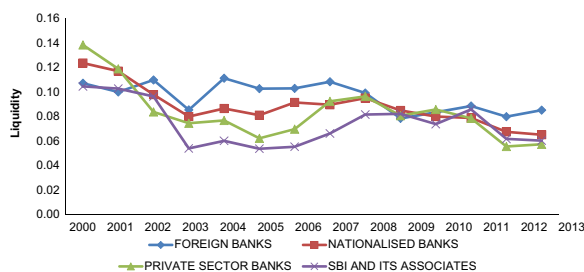


Fig. 1. Liquidity trend.

Sources – RBI (Trend and Progress of Banking in India).

3. Literature review

Existing literature suggests that bank liquidity is a function of micro and macro factors. Micro factors include bank specific determinants of liquidity whereas macro factors are external factors that influence bank liquidity but are not

under the control of bank management. Bank liquidity has been investigated by studies in the past while taking into account bank specific and macroeconomic variables (Bonfim & Kim, 2012; Bonner, van Lelyveld, & Zymek, 2013; Delechat et al., 2012; Eichengreen & Gupta, 2013). The various bank specific and macroeconomic variables are explained as follows (Fig. 2):

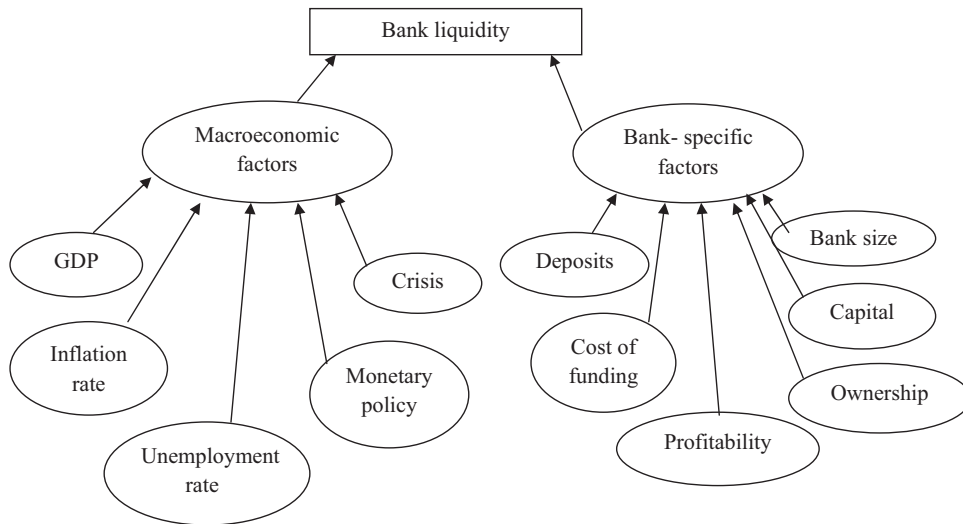


Fig. 2. Bank specifics and macroeconomic factors.

3.1. Bank-specific factors

3.1.1. Bank size

Kashyap, Rajan, and Stein (2002) and Delechat et al. (2012) observed the factors that influenced liquid asset holdings of banks and discovered that liquidity levels were significantly affected by bank size. There were other studies also to observe that bank size was a significant variable that affected liquidity of banks (Bonfim & Kim, 2012; Bonner et al., 2013; Dinger, 2009; Tseganesh, 2012). However, Aspachs, Nier, and Tiesset (2005) discovered that bank size had an insignificant effect on bank liquidity. Choon, Hooi, Murthi, Yi and Shven (2013) found a significant negative relationship between bank size and liquidity.

3.1.2. Profitability

In some studies, it was found that profitability positively affected bank liquidity (Choon et al., 2013; Vodova, 2013 and Lartey, Antwi, & Boadi, 2013). Contrary to this, Delechat et al. (2012), Valla, Saes-Escorbiac, and Tiesset (2006) claimed that profitability negatively affected bank liquidity. However, Aspachs et al. (2005) found that profitability displayed an insignificant relationship with bank liquidity.

3.1.3. Deposits

Moussa (2015) found an insignificant effect of deposits on bank liquidity. Bonner et al. (2013) and Kashyap et al. (2002) argued that as demand deposits increase, liquidity asset holdings also increase. Alger and Alger (1999) provided empirical insights into liquid assets held by Mexican banks. This study summarized 10 predictions based on various theories and applied panel data estimates from January 1997 to March 1999. They assumed that at a given level of deposits, if there is more risk for borrowers as in the case of economic recession, liquid assets should also be increased by banks. Dinger (2009) studied emerging economies for the period of 1994 to 2004 and found that as the deposit rate increases bank liquidity decreases.

3.1.4. Capital

It has been found that availability of high capital increases banks' risk absorbing capacity (Berger & Bouwman, 2009) and liquidity creation capability (Vodova (2013), Munteanu (2012) and Distinguin, Roulet, and Tarazi (2013) highlighted

the relationship between bank capital and liquidity creation. They considered European and US commercial banks involved in trading practices for the period 2000–2006 and found that banks decreased their capital ratio when encountered with liquidity problems. They also found that when a small bank faced liquidity problems, it strengthened its solvency standards. The study supported the implementation of minimum liquidity ratios by Basel Committee and questioned the behavior of large banks as compared to small banks during liquidity crisis. The concept of capital adequacy with bank liquidity was also studied by Choon et al. (2013), Delechat et al. (2012), Moussa (2015), Bunda and Desquilbet (2008), Bhati and De Zoysa (2012) and Bhati, DeZoysa and Jitaree (2015) and a significant and negative impact of capital adequacy on bank liquidity was found.

3.1.5. Ownership

Delechat et al. (2012) studied the role played by bank specific and macroeconomic variables and their impact on the liquidity of Central American banks. The study highlighted that foreign banks held less liquid buffer than other banks, which is similar to the findings of Dinger (2009).

3.1.6. Cost of funding

Few studies have observed the influence of funding cost and funding sources on bank liquidity (Bunda & Desquilbet, 2008; Munteanu, 2012; Alger & Alger, 1999). Alger and Alger (1999) and Munteanu (2012) further explained that if refinancing cost increased, banks tended to invest more in liquid assets. This means that if liability cost increases, then banks, instead of relying on interbank market, tend to rely more on liquid assets that act as a source of liquidity.

3.2. Macroeconomic factors

3.2.1. Monetary policy

Chen and Phuong (2014) stated that monetary policies had a negative impact on excess liquidity. Valla et al. (2006), Bhati and De Zoysa (2012), and Vodova (2013) emphasized that monetary policy had a negative impact on bank liquidity.

3.2.2. GDP

GDP is considered proxy for business cycle. Moussa (2015), Bunda and Desquilbet (2008) and Choon et al. (2013) found a positive impact of GDP on bank liquidity while Valla et al. (2006), Dinger (2009), Vodova (2011) and Aspachs et al. (2005) established negative relationships between the two. According to Aspachs et al. (2005), UK banks seemed to hold smaller amounts of liquidity when GDP increased and vice versa, for the period of 1985 to 2003.

3.2.3. Crisis

Seemingly, bank liquidity can be seriously impacted by financial crisis. It may be understood as the time when institutions or assets are rendered less than their nominal value, causing losses (Choon et al., 2013). Vodová (2013), Vodova (2011), Bunda and Desquilbet (2008) and Choon et al. (2013) found a negative correlation between financial crisis and bank liquidity. Although financial crisis could be caused by poor bank liquidity, the opposite relation may also hold true. This is how a financial crisis may cause poor bank liquidity: First, the volatility of vital macroeconomic variables could lead to unfavorable business environment for banks. Then, economic instability might worsen the business environment of borrowers and affect their ability to make loan repayments, ultimately leading to a decline in bank liquidity.

However, found banks more liquid during the crisis period. Eichengreen and Gupta (2013) observed the impact of transfer of deposits from private sector banks to public sector banks in the Indian banking system during 2007–2009 time periods.

3.2.4. Unemployment

According to Horváth et al. (2014), unemployment had a significantly negative impact on liquidity. Greater unemployment reduced capital and hampered liquidity creation. This finding is in accordance with the fact that banks suffer from a reduction in solvency and create lower liquidity in troubled economic times. Contrary to this, study by Munteanu (2012) suggested that increased unemployment rate of the economy results increased bank liquidity.

3.2.5. Inflation

Moussa (2015) empirically studied banks of the Tunisia and findings revealed that the impact of changes in inflation rates on bank liquidity is negative. Similar study is done by Bhati et al. (2015) on the Indian banks, and it is found that inflation rate negatively influences the banks liquidity. There are also other studies on banks liquidity and inflation by Tseganesh, (2012) and Horváth et al. (2014). According to Tseganesh, (2012), inflation has positive impact on the liquidity while study by Horváth et al. (2014) finds insignificant effect on the banks liquid assets.

3.3. Conceptual framework

Liquidity as a subject of study has gained considerable attention of researchers and policy makers in recent years. Liquidity problems arise when deposits in banks are withdrawn unexpectedly (Arif & Nauman Anees, 2012). To counter such situations, banks need to hold adequate liquidity levels. So, we can say that if deposits increase, liquidity held by banks should also increase, and hypothesize:

H1. Increase in deposits increases liquidity of banks.

When there is a sudden and increased demand of cash by depositors, banks are forced to borrow from the inter-bank market or the central bank. On the contrary, if banks maintain adequate liquidity, they become less dependent on external sources of funding. This means that as funding cost increases, banks would hold more liquidity themselves. Thus, we propose:

H2. Increase in cost of funds encourages banks to maintain high liquidity.

Berger and Bouwman (2009) explored the relationship between capital and liquidity. They stated that high levels of capital facilitated banks to create more liquidity. Capital provided risk bearing potential to banks. Hence, we can say that as the capital increases, bank liquidity also increases, and posit:

H3. Increase in capital increases bank liquidity.

According to Dinger (2009) and Delechat et al. (2012), bank size has negative and significant impact on liquidity. Large sized banks are able to arrange funds from external sources whereas small banks need to maintain sufficient liquidity. This implies that as bank size increases, liquid buffer of the bank decreases. We hypothesize that bank size would have a negative relationship with liquidity.

H4. Increase in bank size decreases banks liquidity.

Profitability of banks shows the ability of the banks to generate income out of assets. Banks with high profitability tend to involve in risky strategies that may cause liquidity problems. Thus we hypothesize:

H5. Increase in profitability decreases bank liquidity.

Gross domestic product growth indicates the business cycle of an economy. During economic downturn, banks hoard more liquidity due to lack of lending opportunity at such time. This means that as GDP growth increases, liquidity of banks decreases, and as GDP growth falls, liquidity of the banks increases. Thus, we hypothesize:

H6. GDP growth has negative relationship with bank liquidity.

Inflation rate decreases currency value and increases vulnerability of banks which affects loans provided to customers. Hence, we propose:

H7. Increase in inflation decreases bank liquidity.

Unemployment in a country significantly affects loan portfolio of banks. High level of unemployment adversely affects the demand for loan by the customers. So, as the unemployment rate of a country decreases, loan demand increases due to which banks need to keep more liquidity. To test the relationship between liquidity and unemployment rate, we formulate the following hypothesis:

H8. Increase in unemployment decreases bank liquidity.

4. Data and methodology

The aim of this study is to explore bank specific and macroeconomic factors influencing the liquidity of Indian banks. These variables include: bank specific factors-bank size; deposits; profitability; funding cost; and capital adequacy; and macroeconomic factors – inflation; GDP; and unemployment (Bonfim & Kim, 2012; Bonner et al., 2013; Delechat et al., 2012; Dinger, 2009; Munteanu, 2012; Tseganesh, 2012).

4.1. Data and sample

Our study considered balanced panel data of 59 commercial banks pertaining to the period 2000–2013. The banks include private banks, public banks, and foreign banks operating in India, with 816 bank–year observations. Banks with incomplete or inconsistent data series were excluded. Data were taken from the various issues of Trend and Progress of Banking in India as documented in the data base of Reserve Bank of India (RBI). On the basis of literature, we selected some significant variables that were expected to have a major impact on the bank liquidity. The summary of variables is given in Table 1 in appendix with the details of proxy of measurement, notation, data sources, and expected relationship with liquidity.

The dependent variable considered in this study is liquidity (liquid assets over total assets), which is defined as sum of cash in hand, available balances with RBI, available balances in current accounts with banks, and money at call and short notice scaled by total assets. Independent variables include bank specific variables, namely bank size (SIZE), profitability (return on assets, ROA), funding cost (Cost of funds, COF), deposits (Deposits over total assets, DEP) and capital adequacy (Capital adequacy ratio, CAR Tier I) and macroeconomic variables – inflation (INFLA), GDP and unemployment (UNEM).

4.2. Variable description

These variables are extracted from past literature on bank liquidity.

4.2.1. Dependent variable

4.2.1.1. *Liquidity.* Following Delechat et al. (2012), bank liquidity (LIQ) has been calculated as the ratio of liquid assets over total assets. Liquidity is required by banks for carrying out daily operations. It facilitates availability of funds in the event of expected or unexpected cash demands by customers. In this study, liquidity has been considered the dependent variable while all other variables included are explanatory variables.

Table 1
Summary of variable, expected relationship with dependent variable and data source.

Variable	Proxy/Measurement	Notation	Expected effect	Data source
Dependent variable				
Liquidity	Liquid assets over total assets	LIQ		Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Independent variables (Bank specific variables)				
Profitability	Return on assets	ROA	Negative	Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Funding cost	Cost of funds	COF	Positive	Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Bank size	Log of Total assets	SIZE	Negative	Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Deposits	Deposits over total assets	DEP	Positive	Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Capital adequacy	Capital adequacy ratio Tier I	CAR	Positive	Reserve Bank of India(Basic Statistical Returns of Scheduled Commercial Banks in India,2000-2013)
Independent variables (Macroeconomic variables)				
Inflation	Consumer price index(CPI)	INFLA	Negative	International Monetary Fund,World Economic Outlook database
Unemployment	Annual unemployment rate	UNEM	Negative	International Monetary Fund,World Economic Outlook database
GDP	Annual GDP growth rate	GDP	Negative	International Monetary Fund,World Economic Outlook database

4.2.2. Independent variables

4.2.2.1. Bank-specific factors

4.2.2.1.1. *Bank size.* The size of bank (SIZE) has been measured by taking the natural logarithm of total assets. Dinger (2009), Bonner et al. (2013), and Delechat et al. (2012) stated that bank size negatively affects liquidity, yet its impact is significant. Large sized banks are able to arrange funds from external sources whereas small banks need to maintain sufficient liquidity. It means that with an increase in bank size, liquid buffer of banks decreases.

4.2.2.1.2. *Profitability.* The proxy of profitability taken in this study is ROA. It is the financial ratio that represents the percentage of profit that a bank earns with respect to its total assets. Bonfim and Kim (2012) found that banks with more profitability tend to hold low liquid buffers. Banks normally tend to get involved in riskier projects to increase profitability.

4.2.2.1.3. *Funding cost.* COF refers to the cost paid by banks for funds. According to Alger and Alger (1999), an increase in liability cost leads to an increase in funding cost. In such cases, banks depend more on liquid assets. This implies that funding cost is positively related to bank liquidity.

4.2.2.1.4. *Deposit.* Deposits (DEP) have been calculated as deposits over total assets (Bonner et al., 2013). Deposits are the major source of funds for banks. However, banks are required to maintain adequate liquidity to meet customer demand.

4.2.2.1.5. *Capital adequacy ratio.* Capital adequacy ratio (CAR) is the ratio of capital that a bank has to maintain for absorbing the loss that arises from statutory capital requirements. CAR Tier-I is taken as the proxy of capital adequacy ratio in this study. It is a buffer against losses that arise in business (Munteanu, 2012). The relationship of CAR with banks is significant because CAR is larger for banks that are required to maintain less liquidity. It helps banks to stabilize and recover from uncertain shocks.

4.2.2.2. Macroeconomic factors

4.2.2.2.1. *Inflation.* Inflation (INFLA) is the rate at which the general price level of goods and services rises and, as a result, purchasing power of currency falls. Vodova (2011), Moussa (2015) and Bhati et al. (2015) advocated that banks maintain high liquidity as inflation rates fall and vice versa because this helps maintain economy stability and flow of liquidity in the system.

4.2.2.2.2. *GDP.* Gross domestic product (GDP) is the value of all final goods and services produced in a country in a given period of time (quarterly or yearly). It is also used as an indicator of business cycle. Bhati et al. (2015), Bunda and Desquilbet (2008), and Moussa (2015) stated that GDP has a positive impact on bank liquidity. Contrarily, Aspachs et al. (2005) and Chen and Phuong (2014) indicated a negative influence of GDP on bank liquidity.

4.2.2.2.3. *Unemployment.* Unemployment rate (UNEM) is the percentage of the unemployed workforce in a country. A high unemployment rate represents a weak or failing economy. Horváth et al. (2014) highlighted that increased unemployment rates decreased demand for loans which in turn increased bank liquidity.

4.3. Methodology

The present study analyzes balanced panel data of Indian commercial banks pertaining to the period 2000 to 2013 (summary statistics of used variables are presented in Table 2). We have applied fixed effect and random effect estimates on the considered model. Fixed effect estimates are usually preferred over random effect estimates because fixed effects yield consistent results. Fixed effect estimates are more robust unlike random effect estimates as they do not depend on the assumption that individual error term (ϵ) is not correlated to the regressors (β s). Hausman test was also applied to determine whether to select fixed effect estimates or random effect estimates.

4.4. Model specification

The specification of determinants of liquidity to be estimated has been formulated in the following equation:

$$LIQ_{it} = \alpha_{it} + \beta_1 ROA_{it} + \beta_2 COF_{it} + \beta_3 SIZE_{it} + \beta_4 DTA_{it} + \beta_5 CAR_{it} + \beta_6 INFLA_{it} + \beta_7 GDP_{it} + \beta_8 UNEM_{it} + \epsilon_{it} \quad (1)$$

Where, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ and β_8 are the coefficients of determinant variables and ϵ is the error term. After taking the logarithm model, Eq. (1) was converted to the equation given below.

We constructed a panel with indices 'i' and 't' which represent bank and year respectively. The data comprised 59 banks and spread over 14 years (2000–2013). The total number of observations was 816.

We took log of the variables to make the data concise as large data or sample could not provide a relevant result. A small data set provides accurate and coherent results by displaying small variance. We have taken the natural log of LIQ, COF, ROA, CAR, INFLA, GDP and UNEM. We expected liquidity to be positively related to the funding cost, and to be negatively related to bank size, profitability, capital adequacy, and deposits. EViews 8 was used for estimating the above model.

where,

LIQ=Bank liquidity (liquid assets over total assets)

ROA=Profitability (return on assets)

COF=Cost of funding (cost of funds)

SIZE=Bank size (natural log of total assets)

DEP=Deposits over total assets

CAR=Capital adequacy ratio (capital adequacy ratio Tier-I)

GDP=Gross domestic product

INFLA=Inflation rate

UNEM=Unemployment rate

ϵ =Error term

5. Result analyses

Data analyses are divided into descriptive analysis, correlation analysis and empirical analysis.

5.1. Descriptive analysis

In this section, normality of data distribution is analyzed. Descriptive statistics are shown in Table 2. The mean-median ratio is approximately 1, which indicates the normality of data. Compared to mean standard, values of error are low which represents small coefficient of variation. Further, to make data concise, we have taken the log of some variables and tested the normality of data through residual normality test also. Results are shown in Table 2.

Table 2 highlights descriptive statistics of variables for Indian banks. Based on the table, we can say that Indian banks hold, on an average, 14% of liquid buffer. Profitability measured by ROA came out to be 13%. Also, based on the figures in the table, it can be said that the data are normalized and could be considered for further analysis.

Table 2
Descriptive Statistics (Sample 2000–2013).

	LIQ	COF	CAR	ROA	INFLA	GDP	SIZE	UNEM	DEP
Mean	0.14	5.84	16.44	1.30	6.90	6.10	14.14	3.93	0.43
Median	0.10	5.79	9.71	1.10	6.15	7.86	14.58	3.90	0.18
Maximum	0.73	12.91	197.42	10.23	11.99	10.26	18.87	4.40	0.92
Minimum	0.02	0.10	0.85	0.02	3.68	3.80	8.01	3.50	0.00
Std. Dev.	0.12	1.80	21.35	1.05	2.95	2.25	2.19	0.31	0.37
Skewness	2.71	-0.07	4.09	3.53	0.36	-0.16	-0.74	0.06	0.22
Kurtosis	10.37	3.87	22.66	22.96	1.59	1.57	3.08	1.64	1.14
Jarque-Bera	2838.04	26.51	15418.74	15236.11	85.02	72.79	75.04	63.42	124.64
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	816	816	816	816	816	816	816	816	816

Note: LIQ is the ratio of bank liquidity over total asset (%), COF is cost of funds (%), CAR is the capital adequacy ratio (%), ROA is the return on assets (%), INFLA is annual inflation rate(%), GDP is Gross domestic product growth rate(%), SIZE is the natural log of total assets, UNEMP is annual unemployment rate(%) and DEP is deposits over the total assets (%).

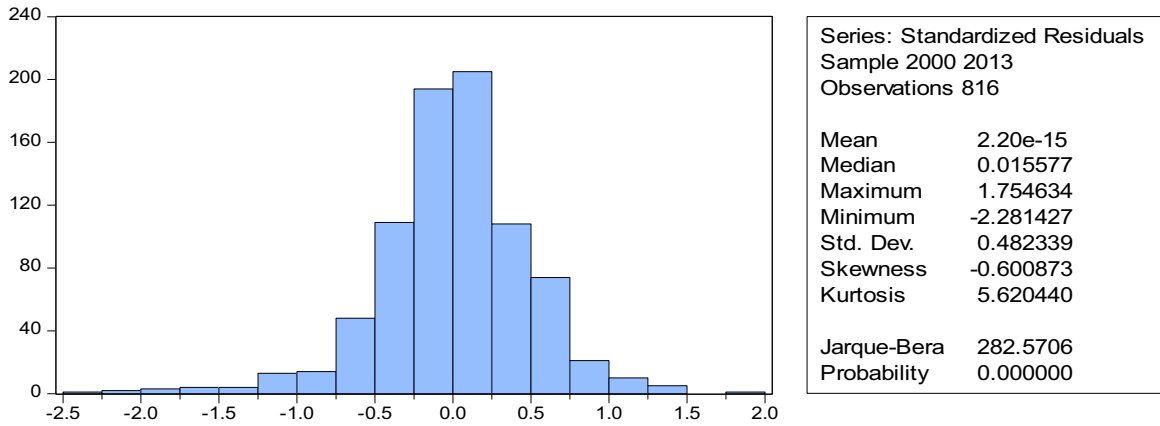


Fig. 3. Residual normality test.

The chart of residual normality test predicts that the residual is normally distributed and the panel data can be considered for empirical analysis (Fig. 3).

5.2. Correlation analysis

The table of correlation matrix explains correlation coefficients between dependent and independent variables. A high collinearity of independent variables is not acceptable. Moreover, if high correlation is found among variables, such variables are exempted and each of those is considered as an individual factor. The table below shows that there is no multicollinearity between liquidity and other variables. The collinearity between bank size (SIZE) and deposits (DEP) is 0.56 and between profitability (ROA) and capital adequacy (CAR) is 0.30. It is clear that the latter shows a higher correlation. The coefficient value is less than 0.56 for all variables, so we can say that these variables are free from the multicollinearity problem (Table 3).

5.3. Pooled OLS regression model

We run the pool regression model. As the considered model denies heterogeneity and individuality of data, we also run fixed effect method that allows heterogeneity or individuality among banks.

Table 3
Correlation matrix.

	LN_LIQ	LN_COF	LN_CAR	LN_ROA	LN_INFLA	LN_GDP	SIZE	LN_UNEM	DEP
LN_LIQ	1.000								
LN_COF	-0.289	1.000							
LN_CAR	0.511	-0.342	1.000						
LNROA	0.131	-0.321	0.303	1.000					
LNIN	-0.147	-0.198	0.071	0.105	1.000				
LNGDP	-0.083	-0.326	0.044	0.080	0.223	1.000			
SIZE	-0.555	0.201	-0.704	-0.131	0.289	0.080	1.000		
LNUNEM	0.190	0.154	-0.067	-0.101	-0.654	-0.305	-0.235	1.000	
DEP	-0.158	0.042	-0.447	-0.203	0.023	0.010	0.562	-0.013	1.000

Note: LIQ is the ratio of bank liquidity over total asset (%), COF is cost of funds (%), CAR is the capital adequacy ratio (%), ROA is the return on assets (%), INFLA is annual inflation rate(%), GDP is Gross domestic product growth rate(%), SIZE is the natural log of total assets, UNEMP is annual unemployment rate(%) and DEP is deposits over the total assets (%).

5.4. Regression analysis (fixed and random estimates)

The fixed effect and random effect regressions were run and Hausman test was carried out to choose the proper specification. Random effect estimates concluded that COF, INFLA, SIZE and UNEM significantly affected liquidity. However, the impact of COF, INFLA and UNEM was positive whereas the impact of SIZE was negative. Results suggest that CAR, ROA, GDP and deposits insignificantly affect liquidity. Fixed effect estimates provide different results than those of random effect estimates. Fixed effect estimates suggest that deposits, CAR, INFLA and ROA positively influence bank liquidity whereas GDP and SIZE have a negative effect on bank liquidity. COF and UNEM were found to have insignificant effect on bank liquidity. Fixed effect test demonstrated that the value of R-square is 0.758 which shows model fitness. This model also has Durbin Watson stat value of 1.63, which highlights absence of autocorrelation among variables (Table 4).

Hausman test was applied for deciding the appropriate test between fixed and random. The p value being less than 0.05, the acceptance of fixed effect estimates over the random effect estimates was confirmed. Table 5 shows Hausman test results.

Table 4
Regression Analysis.

Variable	Panel least square		Fixed effect estimates		Random effect estimates	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
LN_COF	-0.24*	-5.17	0.08	1.40	-0.05	-1.07
LN_CAR	0.24*	5.83	0.13*	2.38	0.09*	2.17
LNROA	0.00	0.10	0.06*	2.86	0.05*	2.62
LNIN	0.03	0.50	0.29*	4.32	0.11*	2.01
LNGDP	-0.15*	-2.81	-0.10*	-2.29	-0.09*	-2.27
SIZE	-0.12*	-8.71	-0.46*	-11.35	-0.21*	-11.01
LNUNEM	0.99*	3.34	0.03	0.14	0.70*	3.07
DEP	0.34*	6.00	1.45*	2.90	0.58*	6.10
C	-1.95	-3.34	2.79	3.16	-0.61	-1.16
R-squared		0.41		0.76		0.26
Adjusted R-squared		0.40		0.69		0.25
Prob(F-statistic)		0		0		0
Durbin-Watson stat		1.02		1.63		1.41

Note: LIQ is the ratio of bank liquidity over total asset (%), COF is cost of funds (%), CAR is the capital adequacy ratio (%), ROA is the return on assets (%), INFLA is annual inflation rate(%), GDP is Gross domestic product growth rate(%), SIZE is the natural log of total assets, UNEMP is annual unemployment rate(%) and DEP is deposits over the total assets (%).

5% significance level(*)

Dependent variable: LN_LIQ

Sample: 2000-2013

Periods included: 14

Total panel (unbalanced) observations:816

Table 5
Hausman test.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	87.31	8	0.0000

6. Discussion

In this paper, we have attempted to analyze the impact of bank specific (SIZE, DEP, COF, ROA, and CAR) and macroeconomic (GDP, INFLA and UNEM) factors on banks' liquidity. Various studies have examined bank liquidity and its relation with bank specific and macroeconomic factors. These studies have provided the base for developing the hypotheses in this paper.

Empirical findings highlight that at 5% significance level, bank size and GDP have a negative relationship with bank liquidity. While profitability, deposits, inflation and capital adequacy ratio have positive impact on liquidity, unemployment and cost of funding have an insignificant effect on bank liquidity. This indicates that bank size, deposits, inflation, GDP, profitability and capital adequacy significantly affect bank liquidity. Dinger (2009), Vodova (2013), Choon et al. (2013), Bonfim and Kim (2012), Bonner et al. (2013) and Delechat et al. (2012) explained that based on the availability of total assets, banks which are small in size are required to hold more liquidity due to limited external sources of funding while large banks hold less liquidity because they are able to arrange funds from the inter-bank market and other sources (Bunda & Desquilbet, 2008).

Banks are dependent on deposits and external funds for their liquidity needs. When funding cost rises, banks begin to hold more liquidity. Our results suggest that at 5% significance level, cost of funding and unemployment have insignificant impact on bank liquidity. Kashyap and Stein (2000) argued that liquidity buffer and other sources of capital insulated banks from the shock of increased cost of funding. Insignificant impact of cost of funding on bank liquidity suggests that liquidity of Indian banks is not affected by it. This may be due to banks maintaining adequate liquid buffer or capital from other sources. Our analysis show that deposits have a positive impact on bank liquidity, and similar result is found in the studies by Bonner et al. (2013).

Capital adequacy showed a coefficient of 0.13 and p value of 0.02, exhibiting a statistically positive impact on bank liquidity. Similar results were found from studies by Vodova (2011), Vodova (2013) and Tseganesh, (2012). According to Diamond and Rajan (2001), capital structure of banks becomes less fragile when there is adequate capital buffer. Berger and Bouwman (2009) stated that according to the risk absorption concept, capital has a positive effect on bank liquidity. This implies that high level of capital permits more liquidity creation. Holding liquidity is difficult for banks as no income is generated by liquid assets. But, it is obligatory to hold liquidity because if a situation of unpredicted customer demand arises, banks may face a liquidity stress which might lead to a crisis in the banking system as a whole. The results of this study stated that bank liquidity increased with an increase in the capital adequacy ratio.

With the probability of 0.00, profitability significantly and positively affected bank liquidity. Similar results were reported by Vodova (2013) and Lartey et al. (2013). Profitability of banks could be increased from investment in risky assets, but due to the risk involved in the investment, adequate liquid buffer is needed.

Gross domestic product and inflation have coefficient value of -0.10 and 0.29 . At 5% significance level, both the macroeconomic variables significantly determine bank liquidity. There are various studies on gross domestic product and its impact on bank liquidity. Among these studies, Aspachs et al. (2005), Chen and Phuong (2013), Vodova (2011) and Dinger (2009) emphasized that GDP had a negative impact on bank liquidity. On the other hand, Bhati et al. (2015), Choon et al. (2013), Moussa (2015) and Bunda and Desquilbet (2008) affirmed a positive impact of GDP on liquidity of banks.

Research on impact of inflation on bank liquidity suggests that increased inflation decreases bank liquidity (Vodova, 2011; Moussa, 2015; Bhati et al., 2013). Contrary to this, our results suggest that as the inflation rate of an economy increases, banks begin to hold more liquidity to curb the effect of inflation on the economy. Tseganesh, (2012) also had similar findings.

7. Conclusion and suggestions

This study has significant implications for bankers, policy makers and consumers. Liquidity trends show that there is significant impact of ownership on bank liquidity. Private and foreign banks held more liquidity in the Indian banking system during the crisis period as compared to public banks. While holding greater levels of cash could be seen as a liquidity management strategy of foreign and private banks for ensuring adequate liquid buffers during crisis, government backing seems to be the most logical reason behind public sector banks in India holding relatively

less cash. However, the fact that even during crisis, private and foreign banks considered in this study did not face liquidity crunch due to adequate reserves, is an encouraging one for customers, and strengthens the credibility of private and foreign banks operating in India. These findings are in contradiction with those of Delechat et al. (2012) who found that foreign banks held less liquid buffer than other banks. Dinger (2009) also had similar findings. The reasons behind such discrepancy in results in context of Indian banks are a subject for future study. The implications of this finding are that foreign and private sector banks need to maintain higher levels of liquidity to face crisis situations as they don't have government backing like public sector banks (Acharya & Kulkarni, 2012; Eichengreen & Gupta, 2013). On the other hand, customers have reasons to show faith in these banks as they maintained healthy levels of cash even during crisis. Thus, it can be said that these banks are safe for customers to deposit their money.

Another major finding of this study is that bank size has a negative relationship with liquidity. In other words, greater the bank size, lower the liquidity they hold. Majority of studies support the finding that bank size negatively affects bank liquidity (Bonfim & Kim, 2012; Bonner et al., 2013; Alger & Alger, 1999; Dinger, 2009; Vodova, 2013; Choon et al., 2013; Kashyap et al., 2002). One reason behind this may be that large banks are in a condition to create more liquidity as compared to smaller banks in crisis situations because they have easier access to the lender of last resort, and because they would be the first to benefit from the safety net (Distinguin et al., 2013). On the basis of the findings of this study, it can be said that managers of small banks should maintain high levels of liquidity because they may not be able to arrange funds as easily as large banks if such a need arises. Future research could look into how bank size affects bank liquidity under different types of ownership (public, private and foreign).

In the present study, CAR was found to positively influence bank liquidity which implies that higher capital adequacy ratio leads to greater liquidity. This finding is in line with the recommendations of Basel III, and several other studies e.g., Tseganesh, (2012); Vodova (2013); Vodova (2011); Alger and Alger (1999). While there are other studies with contradictory findings (Choon et al., 2013; Munteanu, 2012;), the study by Bhati et al. (2015) is particularly relevant due to its Indian context. Bhati et al. (2015) studied determinants of liquidity in Indian nationalized banks and found that capital negatively affected bank liquidity. It is noteworthy however, that our study has considered banks from private and foreign sectors also in addition with public sector banks which may be the reason behind discrepancy in results of the two studies. Higher CAR is expected to result in greater safety and higher liquidity for banks. Greater liquidity creation can also contribute to bank solvency and show the existence of a virtuous circle in favor of tightening capital requirements (Horváth et al., 2014).

Banks generate additional cash for the economy by turning deposits into loans. Our study shows that deposits have a positive association with bank liquidity. Bonner et al. (2013) also had similar findings. However, Alger and Alger (1999); Dinger (2009) and Kashyap et al. (2002) found a negative relationship between deposits and bank liquidity. It is noteworthy that these studies were not conducted in an Indian context. This finding implies that with an increase in deposits, banks should also increase their liquidity holding so that a bank run can be avoided in case of high deposit withdrawal.

In addition to the variables mentioned above, the present study examines the relationship of bank liquidity with profitability, GDP, unemployment, inflation and cost of funding. It was found that GDP shared a negative relationship with liquidity while unemployment and cost of funding had an insignificant influence on bank liquidity. Profitability and inflation were found to positively affect bank liquidity. However, no study in an Indian context examines these variables in relation with liquidity, particularly while considering private, public and foreign banks. This highlights the contribution of the present study to existing body of literature because an attempt to study bank liquidity (considering private, public and foreign banks) in relation with bank specific and macro-economic variables in an Indian context has not been made before.

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