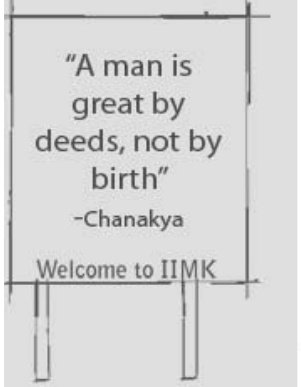

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What Explains Excess Liquidity of Banks? Empirical Evidence from India

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Abstract

We study excess liquidity in the banking system as well as at bank level in India. We apply Autoregressive Distributed Lag model for the aggregate level estimation and standard panel regressions for bank level estimation. We find different factors responsible for the prevalence of excess liquidity in the banking system as a whole and at the bank level. The common factors which are responsible for build-up of excess liquidity are required reserves, exchange rate and call rate. For instance, we find that the response of excess liquidity to required reserves is negative at both aggregate and bank-level. At the aggregate level, excess liquidity reacts negatively to exchange rate and positively to the inter-bank call rate. However, at the bank-level, exchange rate has a positive effect while the call rate has a negative effect on excess liquidity.

Key Words

Excess Liquidity, Required Reserves, Exchange Rate, Autoregressive Distributed Lag, Panel Regression.

1. Introduction

Excess liquidity is the difference between actual reserves maintained by banks with the central bank and required statutory reserves (Omer et al 2015). High level of excess liquidity can cause several unfavorable effects in an economy such as price instability and ineffectiveness of monetary policy transmission. For instance, Nissanke and Aryeetey (1998) and Agenor and Aynaoui (2010) argue that effectiveness of monetary policy is hampered by prevalence of excess liquidity in developing economies. Several other studies have also pointed out that excess liquidity works as an impediment to intended directions of monetary policy (Agenor et al 2004; Saxegaard 2006; Khemraj 2009). These studies have used aggregated banking data to

examine the demand and supply components of excess liquidity. Being a developing economy, India is no exception to the potential problems of excess liquidity. In this paper we examine the excess liquidity with Indian banks and identify factors which influence the same. This is the first study to analyze the determinants of bank-level as well as aggregate excess liquidity using bank balance-sheet and macroeconomic data respectively.

High level of excess liquidity can be explained from both structural and cyclical points of view (Saxegaard 2006; Omer et al 2015). Structural explanations range from the lack of financial development and high-risk aversion causing banks to hold large buffer reserves (Wyplosz 2003; Agenor et al. 2004; Mohanty et al. 2006). Cyclical explanations focus on the long run effects of macroeconomic instability due to factors such as inflation or policy changes in the capital account of the country (Zhang and Pang 2008; Menon 2009; Agenor and Aynaoui 2010).

Excess liquidity held by banks has important implications for the pass-through of monetary policy signals. Excess liquidity works as buffer which is freely available to banks that can be used for lending in the event of liquidity constraint caused by monetary policy tightening. Saxegaard (2006) decomposes the excess liquidity into voluntary and involuntary components. The former presents more of a liquidity management problem (excess reserves which provide insurance against possible increase in reserve requirements, signal of liquidity strength to customers etc.) which does not have major implications on monetary policy transmission while the latter is undesired liquidity imposed from outside and has larger implications including for the monetary transmission mechanism. Agenor and Aynaoui (2010) study the excess bank liquidity (by taking the difference between actual reserves minus desired reserve as a proxy for liquidity) and show that it weakens the impact of monetary policy changes. Nguyen and Boateng (2015) find that Chinese banks with larger involuntary excess reserves are less vulnerable to monetary policy shocks. Demiralp et al (2021) find that excess liquidity with

banks and reliance on retail deposits fundings may increase the banks' responsiveness to negative interest rates policy.

Most of existing literature examines the impact of monetary policy on bank lending with liquidity deficit scenario which is the rule in the banking system as deficit liquidity is desired for effective monetary policy transmission[1]. However, the literature has not sufficiently analyzed situations of surplus liquidity which is a characteristic of developing countries. Surplus liquidity may hinder or facilitate the effectiveness of monetary policy in India[2]. However, there are no studies that estimate the extent of excess liquidity in India, its components (voluntary and involuntary) and determinants. In this paper, we examine the prevalence and factors which influence and cause excess liquidity in the banking system in India. A novelty of this paper is that first we examine the factors which determine the excess liquidity in banking system as a whole with aggregate banking data. Second, we examine the determinants of excess liquidity at bank level with banks' balance-sheet data.

We find numerous bank-level as well as macroeconomic factors which determine excess liquidity in India. We observe similar and different factors which are responsible for persistence of excess liquidity. For instance, required reserves have a positive and significant effect on excess liquidity at the bank-level as well as at aggregate level. At the aggregate level, excess liquidity reacts negatively to exchange rate and positively to the inter-bank call rate. However, at the bank-level, exchange rate has a positive effect while the call rate has a negative effect on excess liquidity.

The remainder of this paper is ordered as follows. In section 2 we present a brief overview of the literature on excess liquidity. Section 3 explains the data and section 3 reports the

[1] https://core.ac.uk/download/pdf/6961926.pdf
[2] The Annual Report on the Working of the Reserve Bank of India (2021).

methodology. Section 4 presents the analysis of excess liquidity using aggregate data while in section 5 we discuss determinants of excess liquidity at bank level. Finally, section 6 concludes.

2. Literature Review

High level of excess liquidity can be explained from both structural and cyclical points of view (Saxegaard 2006; Omer et al 2015). In case of the structural view, there are two reasons for the presence of excess reserves. First, low degrees of financial development may compel banks to hold large buffer reserves due to unreliable payment systems, high costs of processing information, high costs of monitoring borrowers etc. Second, a high degree of risk aversion can lead to high-risk premia and low credit demands, leading to excess reserves held by banks. Empirical evidence on the structural view can be found in Wyplosz 2003 (Euro area), Agenor et al. 2004 (Thailand) and Mohanty et al. (2006) who argue that accumulation of excess liquidity is due to weak credit demand. From the cyclical point of view, inflation can be a cause of excess liquidity in the banking system. An increase in inflation leads to uncertainty about the value of collateral pledged by the borrowers, consequently banks may either increase the premium or do rationing of credit. In both the cases, excess liquidity goes up significantly (Agenor and Aynaoui 2010).

All these above-mentioned sources of excess liquidity are endogenous in nature while there are also exogenous sources of excess liquidity in the economy such as caused by policy changes. Large amount of capital flows facilitated by a liberalized capital account and intermediated by the banking system also contribute to rise in excess liquidity in developing countries. Asymmetric opening (i.e., lifting of restriction on capital movement for non-residents while controlling of foreign exchange operation by residents) of capital accounts by developing countries accompanied by privatization of large state-owned enterprises have led to large capital inflows (Khemraj 2007). Besides, foreign currency inflows – current account balance,

foreign direct investment, portfolio investment, and international aid — also increases capital inflows and consequently raises the excess liquidity in banking and financial system (Agenor and Aynaoui 2007). Although now with negligible prevalence, monetization of fiscal deficit also causes liquidity to go up in excess of what is optimal in an economy. In both managed float and pegged foreign exchange rate regimes, restricted inflows of capital (with sterilization of capital flows through exchange rate regulation) act as deterrent to mopping up of the liquidity in the economy. In the absence of these checks, monetary base blows up which results in surplus liquidity in the economy. During 2006-08, countries like India, China and South Korea hiked their required reserve ratios so that excess liquidity could be absorbed and thereby addressed the destabilization in macroeconomic scenario (Agenor and Aynaoui 2010).

Ali et al (2019) study the factors affecting excess liquidity in the Islamic banks in Malaysia. They find— among other factors— that "*Sukuk" (Islamic Bond)* has negative effect on excess liquidity and argue that *Sukuk* can be an effective tool to get rid of excess liquidity in Islamic banks. Aikaeli (2006) examines the factors which determine excess liquidity in the commercial banks of Tanzanian. They observe that credit risks, high cost of funds, required reserves and fluctuations in the cash preferences of deposit holders are factors that determine excess liquidity. There are many other studies which examine the causes or sources and effect of excess liquidity in developing economies (Hasanovic and Latic 2017 for Bosnia and Herzegovina; Pontes and Sol Murta 2012 for Cape Verde; Nwakanma and Mgbataogu 2014 and Ukeje and Amanze 2015 for Nigeria, and Kastrati 2015 for European Transition Economies). In these developing economies, there are structural deficiencies in the banking system which strengthens the argument that developing countries are more prone to have excess liquidity (Saxegaard 2006).

Excess reserves encourage banks to lend more and take more risks (Acharya and Naqvi 2012, Nguyen and Boateng 2015). There is wide array of issues which may arise and lead to

complexities faced by central banks in case of excess liquidity. These are spread from, but not limited to, the transmission mechanism of monetary policy, the conduct of central bank intervention in the money market to the central bank's balance sheet and income. Darvas et al (2018) examined the excess liquidity and bank lending risk in Euro area and they find that excess liquidity might create financial instability because banks can indulge into risky lending.

An optimal amount of liquidity with banks is necessary for the effectiveness of monetary policy to bring intended changes in macroeconomic variables in the economy. Both excess liquidity and liquidity deficit can jeopardize the supposed impact of monetary policy. The excess liquidity – voluntary and involuntary — has different implications on monetary transmission mechanism (Saxegaard 2006). The former involves more of a liquidity management problem (excess reserves which provide insurance against possible increase in reserve requirements, signal of liquidity strength to customers etc.) which does not have major implications on monetary policy transmission while the latter is undesired liquidity imposed from outside and has larger implications including for the monetary transmission mechanism. Excess liquidity may have implications for all the channel of monetary transmission, i.e., interest rate channel, exchange rate channel and credit channel. There are countries with excess liquidity which do not have significant pass through of monetary policy, for instance Czech Republic, Finland, Hungary, South Africa etc. Agenor and Aynaoui (2010) study the excess bank liquidity (by taking the difference between actual reserves minus desired reserve as a proxy for liquidity) and its implication for monetary policy transmission in low- and middle-income countries. They show that excess liquidity may lead to the stickiness of prices of deposits which in turn weakens the impact of monetary contraction. Nguyen and Boateng (2015) examine the response of banks' lending behaviour to monetary policy considering the excess reserve over and above precautionary level in China. They find that involuntary excess liquidity, among many other factors, is important in monetary policy transmission showing that banks with

larger involuntary excess reserves are less vulnerable to monetary policy shocks because involuntary excess reserves can be drawn down to maintain the credit supply. Demiralp et al (2021) examine the relationship among excess liquidity, negative interest rates and retail deposits in Euro area. They find that excess liquidity with banks and reliance on retail deposits funding may increase the banks' responsiveness to negative interest rates policy.

3. Data

Our data source is the Reserve Bank of India (RBI) website where all data related to the banking sector is available. We have two sets of variables; one is for aggregate level estimation while the second for the bank level estimation. We use fortnightly data for all aggregate variables and annual data for bank-level variables, both spanning the period 2005 to 2020. We make the following choices of variables for aggregate level estimation. Excess liquidity is measured as the difference between actual reserves maintained by banks with the central monetary authority (RBI) and required statutory reserves mandated to be maintained with RBI as a precautionary need (Omer et al. 2015). Statutory reserves in the Indian case are Cash Reserve Ratio (CRR) and Statutory Liquidity Ratio (SLR). CRR is a portion of net demand and time liabilities (NDTL) of banks to be mandatorily kept with the RBI in the form of liquid assets (4 percent of NDTL as at end-March, 2021). SLR is a percentage of NDTL which is kept by banks in the form of liquid cash, government securities, government approved other securities or gold (18.25 percent of NDTL as at end-March, 2021). We take the ratio of excess liquidity to total deposits as the dependent variable.

The independent variables for the aggregate level analysis, drawn from Saxegaard (2006) and Omer et al. (2015), are listed in Table A1 in the Appendix. First, we consider required reserves as it has a direct effect on excess liquidity because when the former increases the latter

decreases. To measure this variable, we take the ratio of required reserves to total deposits. The central bank's discount rate is proxied by the RBI's repo rate, that can have a negative effect on excess liquidity. Exchange rate captures the exchange rate risk. Interbank liquidity risk is proxied by volatility in Weighted Average Call Money Rate (WACR) as it makes bank more cautious about managing their liquidity holdings. Hence it has expected to have positive effect on excess liquidity. Private sector credit captures the non-food credit (as, in India, food credit is determined by the government's procurement policy). Index of Industrial Production (IIP) is a common measure for the production activities in India. The higher the IIP, the more will be excess liquidity because increase in economic activities increases money demand. Hence, banks are expected to maintain high level of liquidity holdings.

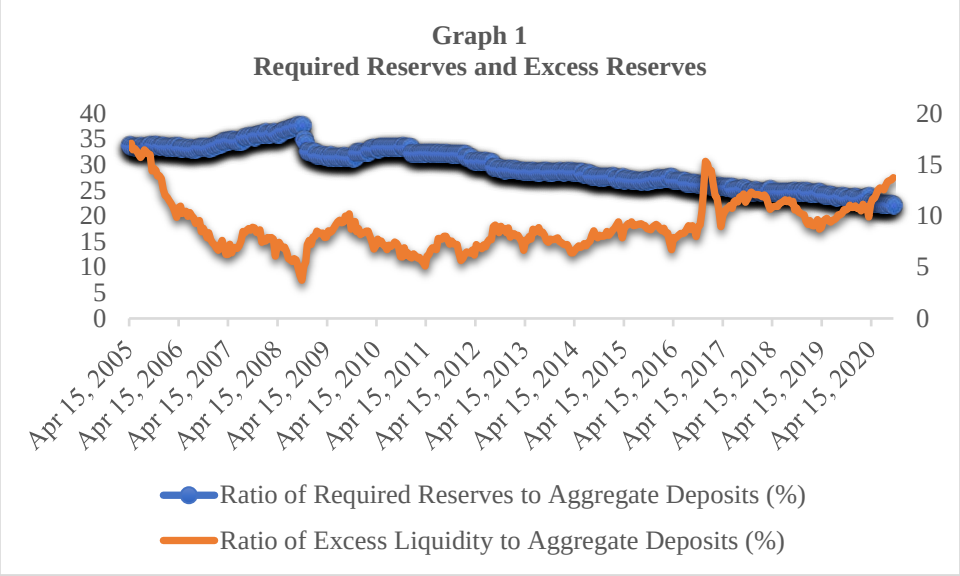
Volatility in RBI credit to the government increases the volatility of current deposits with banks heralding a better management of precautionary liquidity holdings by banks. RBI credit to the government results in new money creation and it increases the banks' deposits which further increases the excess liquidity holdings with banks. Commercial banks' credit to the government may lead to drawing down of excess liquidity with banks but the effect may be transient because it is just a matter of time when banks are replenished with almost the same amount of money once the government spends it (Omer et al. 2015).

Government securities gauges the government borrowings from sources other than central bank and commercial banks. We also use ratio of demand deposits to total deposits as larger proportion of demand deposits to total deposits obliges banks to maintain higher level of liquidity. Table 1 reports the descriptive statistics of the above variables used in our analysis of aggregate data. We report mean, median, maximum, minimum and standard deviation for all the variables.

Table 1
Descriptive Statistics: 2005-2020†

	Mean	Median	Maximum	Minimum	Std. Dev.
Excess Liquidity	9.077	8.595	17.103	3.732	2.382
Required Reserves	29.657	29.132	37.787	22.173	4.028
Repo Rate	6.697	6.500	9.000	4.000	1.156
Exchange Rate	4.007	4.005	4.337	3.670	0.196
Banks' Credit to the Government	14.474	14.551	15.359	13.521	0.552
Index of Industrial Production	4.662	4.699	4.970	3.989	0.179
Private Sector Credit	15.275	15.410	16.149	13.898	0.638
RBI Credit to the Government	7.459	7.199	11.853	1.946	2.059
Government Dated Securities	11.789	12.151	14.267	7.657	1.333
Ratio of Demand Deposits to Total Deposits	11.492	10.484	17.409	8.725	2.249
Volatility in RBI Credit to the Government	0.281	0.273	0.424	0.175	0.058
Volatility in WACR	0.478	0.437	3.724	0.159	0.228

†Fortnight Data



Graph 1 shows the trends in required reserves and excess liquidity in the Indian banking system over the period of 2005-20. We observe an overall declining trend in required reserves, while excess liquidity declined till 2008-09 and since then shows an upward movement. This graph shows the prevalence of excess liquidity in Indian banking that has ranged between 3.7% and 17.1% (as shown in Table 1).

Moving to the bank level estimation, we have used a few different independent variables along with some of the variables which are used in the aggregate level estimation. We use the following additional variables: WACR captures the banks' short-term borrowing cost. Banks may have to hold more excess liquidity if WACR goes up. Cash-Deposit Ratio is included because fluctuations in demand for cash as a percentage of deposits has an effect on excess liquidity. Higher the ratio higher the excess liquidity. Banks need to know it precisely for their day-to-day transactions. We use the ratio of internal debt to GDP to observe the crowding out of liquidity from commercial banks. Larger domestic debt of the government reduces liquidity with banks. Hence, we expect a negative relationship between excess liquidity and internal debt of the government. Ratio of demand to saving deposits captures the banks need for more cash or liquid assets if demand deposits are more in their liabilities so that an unexpected increase in withdrawal from current account deposits are honored. We include output gap to capture the demand for cash because there would be less demand for cash when there is a cyclical gap in the economy. Ratio of total advances by banks to GDP measures the magnitude of lending by banks in the economy and it is expected to show that more advances would result in less excess liquidity with banks.

We chose to have slightly different but comparable variables for aggregate level and bank level analysis. For instance, we have taken volatility in WACR for the aggregate level analysis while for the bank level analysis we have taken only WACR because, in the case of the former, frequency of data is fortnightly, and it is feasible to take 5 period (fortnight) moving average. However, in the case of the bank level analysis the data is annual, and the frequency is less which makes it less feasible to have 5 year moving average as the number of observations will be reduced. For a similar reason, the volatility in RBI credit to the government is not included in the bank level analysis.

Instead of taking private sector credit in bank level analysis, we have taken ratio of total advances to GDP because of availability of data with the same frequency. The RBI does not provide data on private sector credit at bank level on its website. For a similar reason we have not included banks' credit to government in the bank level analysis. Instead we have used RBI advances to commercial banks. It may be noted that the latter has an opposite effect on excess liquidity compared to the former because RBI advances to commercial banks is central bank asset but liability for commercial banks. Output gap and IIP can be interchangeably used for measuring potential growth of GDP in an economy. In our analysis we have used IIP at aggregate level since it is available at a monthly frequency and it took us only one level of interpolation to make it fortnightly. In our bank level analysis we have calculated output gap by applying the usual Hodrick-Prescott filter based on annual GDP.

We use ratio of demand deposits to total deposit for the aggregate level analysis instead of ratio of demand deposit to savings deposit used at bank level (a variable stylized in the literature), because at aggregate level RBI does not provide separate data for savings bank deposits. To capture monetary policy, we have used repo rate (a proxy for discount rate used by Omer et al 2015) in the aggregate level analysis. However, we do not use it in the bank level analysis because of the presence of WACR in the model which is the first leg of monetary policy transmission.

Table 2 shows the summary statistics for all the variables we have used in the bank level analysis. We report summary statistics for the full sample of all banks and also the sub-samples of public and private sector banks.

Table 2
Descriptive Statistics for All Banks[†], Public Sector Banks, and Private Sector Banks: 2005- 2020

	Mean	Median	Maximum	Minimum	Std. Dev.
All Banks					
Excess Reserves	13.031	11.490	257.873	0.790	11.593
Required Reserves	21.312	21.603	31.235	11.953	3.639
WACR	6.472	6.274	8.278	3.290	1.350
Cash Deposit Ratio	0.656	0.556	4.437	0.032	0.391
Ratio of Internal Debt to GDP	37.397	36.979	55.317	23.282	10.407
RBI Advances to Commercial Banks	0.595	0.143	2.871	0.002	0.865
RBI Advances to Government	0.057	0.021	0.432	0.001	0.105
Exchange Rate	4.003	3.978	4.305	3.722	0.193
Ratio of Demand to Saving Deposits	57.059	36.478	2793.733	9.892	117.782
Output Gap	3.911	-0.001	0.020	-0.016	0.012
Ratio of Total Advances to GDP	1.100	0.568	15.963	0.001	1.761
Government Securities	9.721	9.839	13.651	3.687	1.440
Public Banks					
Excess Reserves	13.670	12.204	87.918	1.230	7.476
Required Reserves	20.678	21.239	29.497	11.953	3.286
WACR	6.494	6.274	8.278	3.290	1.362
Cash Deposit Ratio	0.471	0.449	4.437	0.089	0.268
Ratio of Internal Debt to GDP	37.034	36.979	55.317	23.282	10.242
RBI Advances to Commercial Banks	0.583	0.143	2.871	0.002	0.866
RBI Advances to Government	0.054	0.021	0.432	0.001	0.101
Exchange Rate	3.997	3.978	4.305	3.722	0.190
Ratio of Demand to Saving Deposits	36.448	31.499	207.072	11.129	26.987
Output Gap	2.660	-0.001	0.020	-0.016	0.012
Ratio of Total Advances to GDP	1.500	0.946	15.964	0.001	2.100
Government Securities	10.388	10.386	13.651	3.687	1.011
Private Banks					
Excess Reserves	12.262	10.222	257.873	0.790	15.113
Required Reserves	22.076	22.514	31.235	12.463	3.892
WACR	6.444	6.246	8.278	3.290	1.337
Cash Deposit Ratio	0.879	0.812	2.101	0.031	0.401
Ratio of Internal Debt to GDP	37.835	40.861	55.317	23.282	10.602
RBI Advances to Commercial Banks	0.611	0.177	2.871	0.002	0.866
RBI Advances to Government	0.061	0.024	0.432	0.001	0.109
Exchange Rate	4.011	4.071	4.305	3.722	0.196
Ratio of Demand to Saving Deposits	81.904	58.227	2793.733	9.892	169.217
Output Gap	5.410	-0.001	0.020	-0.016	0.012
Ratio of Total Advances to GDP	0.617	0.213	6.822	0.007	1.053
Government Securities	8.916	8.919	12.685	5.317	1.470

† Public Banks and Private Banks Combined.

4. **Methodology**

4.1 Unit Root Test

Before proceeding to estimate the relationship among time-series variables we test for their stationarity using Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. Following Perron (1989) and Perron (1990) we apply the below equation for the unit root tests.

$$\Delta y_t = \mu_0 + \mu_1 \tau + \rho y_{t-1} + \sum_{p=1}^{k-1} y_p \, \Delta y_{t-p} + \varepsilon_t \qquad (1)$$

Where y_t is the series to be tested, μ_0 and μ_1 are parameters while τ is the deterministic trends. ρ and y stand for coefficients of unit root and lagged dependent variable. ε stands for the error term. The null hypothesis for the unit root tests is, there exists unit root in the series, i.e., the series is non-stationery. When the null hypothesis is rejected, we assume the series to be suitable for analysis at levels implying a short-run analysis. If the null hypothesis is not rejected, then a long-run analysis is considered appropriate. Later for the bank level analysis we use panel unit root tests (Levin et al. 2002; Im et al. 2003; Madalla and Wu, 1999; Choi, 2001) to assess stationarity of the variables.

4.2 Estimation of Excess Liquidity: Aggregate Level

After testing for unit roots, we follow the approach of Saxegaard (2006) and Omer et al. (2015) to study the determinants of excess liquidity in the banking system and its components (voluntary and involuntary excess liquidity). In the first step, we examine the relationship between excess liquidity and its determinants by applying an autoregressive distributed lag (ARDL) model:

$$EL_t = \mu + \sum_{j=1}^{m} \sum_{k=1}^{n} \psi_k^j \, x_{t-k}^j + \sum_{k=1}^{n} \alpha_k \, EL_{t-k} + \varsigma_t \qquad (2)$$

In equation *(2)* x_t is the set of regressors, ψ_k^j are coefficients for any *j*th regressor at lag *k*, and α_k represents the stickiness in dependent variable at lag *k*.

In the second step, we decompose excess liquidity into its voluntary and involuntary components using the following equations.

$$EL_t^s = a^s \hat{c} + \hat{a}_2 (L)X_t^1 \qquad (3)$$

$$EL_t^d = (1-a^s)\hat{c} + \hat{a}_3(L)X_t^2 + v_t \qquad (4)$$

We use equations *(3)* and *(4)* to separately estimate the voluntary and involuntary excess liquidity, respectively. In the above equations a^s and $(1-a^s)$ are the intercepts of the voluntary and involuntary components, respectively, which are not distinguishable. However, as we are interested in long-run relationships and long-run coefficients, estimating the separate intercept values is not necessary. Similarly, voluntary and involuntary parts of lagged dependent variable are also not separable (Omer et al 2015). From the list of determinants of overall excess liquidity, we consider determinants of voluntary excess liquidity to be the ratio of required reserves to total deposits, repo rate, volatility in WACR, ratio of demand deposits to total deposits and volatility in RBI credit to the government. On the other hand, private sector credit, exchange rate, Index of Industrial Production, RBI credit to the government, banks' credit to the government and government dated securities are the determinants of involuntary excess liquidity.

4.3 Estimation of Excess Liquidity: Bank Level

Additionally, we estimate the determining factors of excess liquidity at bank level. There are scant studies on the factors which impact excess liquidity at the bank level and none for India. A rare exception is Hasanovic and Latic (2017) for the case of Bosnia and Herzegovina. However, they had fewer variables to explain excess liquidity but, in order to be as close as possible with our aggregate level analysis, we have incorporated more variables in our estimable equation as follows.

$$\begin{aligned} Excess\ Liquidity_{it} = {} & \beta_0 + \beta_1 Required\ Reserves_{it} + \beta_2 Discount\ Rate_t + \beta_3 Cash\text{-}Deposit\ Ratio_{it} \\ & + \beta_4 Internal\ Debt_t + \beta_5 RBIAdvCom_{it} + \beta_6 RBIAdvGovt_t + \beta_7 Exchange\ Rate_t + \beta_8 DDSB\ Ratio_{it} \\ & + \beta_9 Output\ Gap_t + \beta_{10} TotalAdvGDP_{\ it} + \beta_{11} Govt\ Securities_t + \varepsilon_{it} \end{aligned}$$

Where *RBIAdvCom is* RBI advances to Commercial Banks as a ratio of GDP, *RBIAdvGovt* stands for RBI advances to Government as a ratio of GDP, *TotalAdvGDP* represents total advances by banks as a ratio of GDP and *DDSB Ratio* is the ratio of demand to saving deposits. We estimate the above equation using standard panel regression methods.

5. **Results**

5.1 Unit Root Test: Aggregate Level

Table 3 reports the unit root tests for all the variables used in estimating the prevalence of excess liquidity in banking system in India. We observe that most variables are stationarity at first difference (while considering ADF test with drift only) except excess liquidity, volatility in WACR, private sector credit, Index of Industrial Production, volatility in RBI credit to the government and RBI credit to the government. This indicates that there is a possibility of estimating the long-run relationship among the variables. Hence, we proceed with the estimation applying Autoregressive Distributed Lag (ARDL).

Table 3
Unit Root Test

	ADF Test		PP Test	
	Drift only	Drift with trend	Drift only	Drift with trend
Excess Liquidity	-2.894**	-3.978**	-2.932**	-3.443**
Required Reserves	0.009	-3.475**	0.087	-2.759
Repo Rate	-1.817	-2.171	-1.357	-1.707
Exchange Rate	-0.574	-2.710	-0.504	-2.664
Volatility in WACR	-6.617***	-6.620***	-8.639***	-8.669***
Private Sector Credit	-4.752***	-2.051	-7.576***	-1.809
Index of Industrial Production	-3.161**	-4.101***	-2.707*	-4.393***
Volatility in RBI Credit to the Government	-2.930**	-4.456***	-3.331**	-4.265***
RBI Credit to the Government	-4.008***	-5.535***	-15.982***	-16.823***
Banks' Credit to the Government	-0.729	-1.825	-0.480	-2.087
Government Dated Securities	-1.297	-2.189	-3.126**	-7.243***
Ratio of Demand Deposits to Total Deposits	-1.629	-0.851	-2.133	-2.703

The null hypothesis of ADF and PP tests assumes that the series has unit root. *, ** and ***Indicate the p- values at 10%, 5% and 1 %, respectively.

5.2 Long-run Determinants of Excess Liquidity: Aggregate Level

In Table 4, based on the ARDL model, we report the long-run determinants of excess liquidity. Here we observe that required reserves has negative and significant effect on excess liquidity implying that as required reserves (comprising of CRR and SLR) increases, the holdings of excess liquidity of banks decreases. The effect of repo rate (discount rate) on excess liquidity is positive and significant, which means that as discount rate increases banks increase their liquidity holdings to avoid cost of liquidity deficit. The negative coefficient of exchange rate shows that depreciation of Indian Rupee forces banks to decrease their liquidity holdings. Excess liquidity responds positively to the volatility in overnight call money rate (WACR). The coefficient of private sector credit is negative and significant. It shows that as more credit is disbursed to private sector less excess liquidity is left with banks. Index of Industrial Production has a negative impact on excess liquidity. However, the effect is not statistically significant.

Table 4
Long-run Determinants of Excess Liquidity

	Coefficient	Standard Error	P-Values
Required Reserves	-0.930	0.167	0.000
Repo Rate	0.733	0.184	0.001
Exchange Rate	-4.980	2.703	0.066
Volatility in WACR	2.262	0.988	0.023
Private Sector Credit	-18.135	1.768	0.000
Index of Industrial Production	-0.016	1.506	0.992
Volatility in RBI Credit to the Government	-2.699	3.261	0.408
RBI Credit to the Government	-0.069	0.097	0.473
Banks' Credit to the Government	18.189	2.425	0.000
Government Dated Securities	0.407	0.207	0.051
Ratio of Demand Deposits to Total Deposits	0.548	0.127	0.000
Intercept	54.850	22.440	0.015
Critical values for I (1) Boundary	*F- Statistics*	*F-Statistics Value*	
1%	3.61	3.55	
5%	3.04		
10%	2.77		

Dependent Variable: Ratio of Excess Reserves to Total Deposits (%). Excess Reserves has been calculated on the basis of Omer et al (2015).

Coefficients of both RBI Credit to the Government and Volatility in RBI Credit to the Government are negative but not significant alluding to a lack of role of government borrowings from RBI in determining excess liquidity in the banking system. This finding refutes the Ganley (2004) argument that monetizing government budget deficit is one of the main causes of excess liquidity in many countries. Banks' credit to the government and government dated securities have positive and significant effect on excess liquidity. It means that relying on these sources of finance by government causes an increase in excess liquidity. The effect of the ratio of demand deposits to total deposits is positive and significant implying that larger proportion of demand deposits warrants larger excess liquidity holdings.

5.3 Short-run Determinants of Excess Liquidity: Aggregate Level

Table 5 reports the estimation of short-run determinants of excess liquidity from the ARDL model. Here we observe the response of excess liquidity to some variables with lag(s). These variables are required reserves, exchange rate, volatility in WACR, private sector credit and banks' credit to the government.

Table 5
Short-run Determinants of Excess Liquidity

	Contemporaneous Response	Lag (1)	Lag (2)	Lag (3)	Lag (4)
Excess Liquidity		0.558***	0.176***	0.111**	
		(0.054)	(0.060)	(0.053)	
Required Reserves	-0.369***	0.139	-0.066	0.152**	
	(0.068)	(0.096)	(0.096)	(0.069)	
Repo Rate	0.114***				
	(0.027)				
Exchange Rate	2.833**	-1.104	-2.502***		
	(1.104)	(1.583)	(1.141)		
Volatility in WACR	0.279**	-0.187*	-0.056	0.155	0.160
	(0.101)	(0.114)	(0.113)	(0.112)	(0.101)
Private Sector Credit	-18.595***	6.844**	2.677	6.261***	
	(1.973)	(2.675)	(2.614)	(2.201)	
Index of Industrial Production	-0.002				
	(0.234)				
Volatility in RBI Credit to the Government	1.675	-2.093*			
	(1.385)	(1.165)			
RBI Credit to the Government	-0.011				
	(0.0147)				

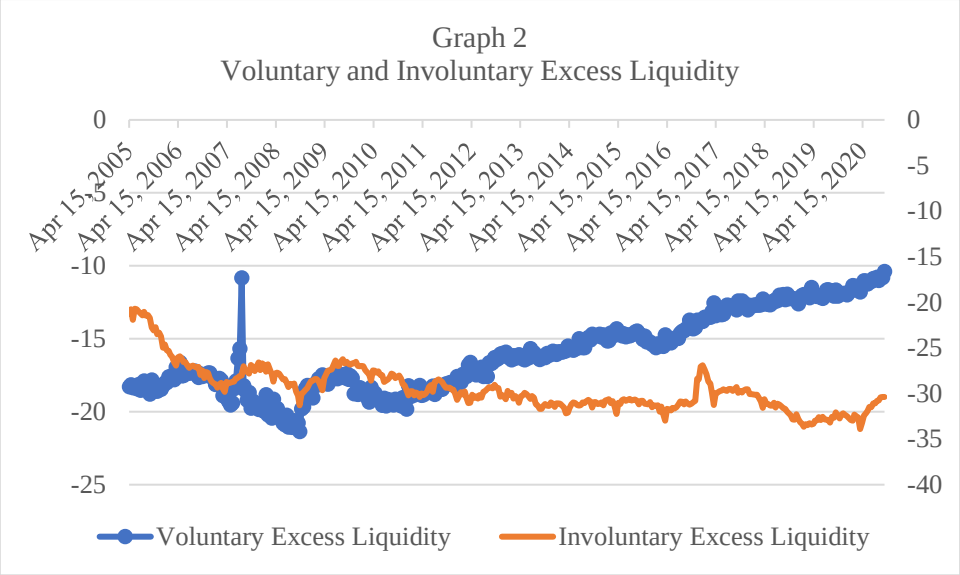
Banks' Credit to the Government	15.653***	-1.206	-10.502***	-2.855**	1.730
	(1.178)	(1.457)	(1.561)	(1.487)	(1.096)
Government Dated Securities	0.063**				
	(0.031)				
Ratio of Demand Deposits to Total Deposits	0.085***				
	(0.024)				
Intercept	8.504***				
	(3.125)				
Diagnostic Tests	*Statistics*	*P-Values*			
Adjusted R- squared	0.981				
F-statistics	678.215	(0.000)			
Normality Test	742.486	(0.000)			
Ramsey Reset Test	6.776	(0.010)			

Dependent Variable: Ratio of Excess Reserves to Total Deposits (%). Excess Reserves has been calculated on the basis of Omer et al (2015). Standard Errors in Parenthesis. *, ** and ***Indicate the p- values at 10%, 5% and 1 %, respectively.

The effects of various explanatory variables with lags may be responsible for structural persistence in excess liquidity. For instance, required reserves' effect on excess liquidity is up to three lags and exchange rate has impact up to two lags. Similarly, private sector credit has effect on excess liquidity up to three lags. This is in consonance with the argument of Fuhrer (2009) that persistence in an economic variable is structural if factors which explain an economic variable also have a persistence.

5.4 Decomposing Excess Liquidity: Aggregate Level

Using equations *(3)* and *(4)*, we have decomposed the total excess liquidity into voluntary and involuntary parts using the long-run coefficients from Table 2. The resultant outcome is shown in Graph 2.



Graph 2 shows the movement in voluntary and involuntary excess liquidity over the years (2005-2020). We observe that there was a spike in voluntary excess liquidity during the financial crisis year of 2008. After that there was decline and since then there has been steady rise in voluntary excess liquidity. This rise in voluntary excess liquidity may probably be because of the financial crisis of 2008 and implementation of Basel-III norms which introduced the Liquidity Coverage Ratio (LCR). As a part of post Global Financial Crisis (2008) reforms, the Basel Committee on Banking Supervision introduced LCR under which banks are required to keep High Quality Liquid Assets HQLAs. Unlike voluntary excess liquidity, involuntary excess liquidity shows a steady decline especially after 2012-13. This decline in involuntary excess liquidity may be because of banks' offsetting of increase in voluntary excess liquidity which would have been caused by stricter banking prudential norms initiated by the RBI.

6. Determinants of Excess Liquidity: Bank Level

Analyzing bank-level excess liquidity is important as there are varying factors that determine how much liquidity/ excess liquidity is maintained by a particular bank or group of banks which

may be different from the aggregate level factors. Considering the heterogeneous characteristics of banks in India, we have explored and estimated the factors that determine excess liquidity holdings at bank level.

6.1 Panel Unit Root Test: Bank Level

Before proceeding to analyze the bank-level determinants of excess liquidity, we apply four tests for panel unit roots, viz., Im, Pesaran and Shin (IPS), Levin, Lin, and Chu (LLC), Fisher Phillips–Perron (Fisher PP) and Fisher Augmented Dickey–Fuller (Fisher ADF). Fisher ADF and Fisher PP tests are based on combining the p-values of the underlying ADF and PP statistics (Madalla and Wu, 1999; Choi, 2001), while for LLC and IPS test, the null hypothesis (non-stationarity) is based on zero value of the ρ parameter (Levin et al. 2002; Im et al. 2003). Following Levin et al. (2002) and Im et al. (2003) we estimate the equation given below.

$$\Delta y_{it} = \alpha_1 + \delta_{it} + \rho_i . Y_{i,\,t-1} + \sum_{l=1}^{\rho i} \Phi_{il} \Delta y_{i,t-1} + \varepsilon it \qquad (1)$$

i= 1, ……, N; t= I, …., T

where y_{it} is the variable value for panel member i in period t, ϵ_{it} is assumed to be independent and identically distributed $IID\ (0, \sigma^2_{\varepsilon})$ across and Δ denotes the first-difference operator.

Table 6 reports the panel unit root tests for the variables used in the bank level estimation of excess liquidity.

We observe that almost all the variables are stationary at level satisfying the condition to proceed for bank level estimation applying panel regression analysis meant for short run analysis.

Table 6
Panel Unit Root Test

	Intercept Only in the regression				Intercept and trend in the regression			
	LLC	IPS	ADF	PP	LLC	IPS	ADF	PP
Excess Liquidity	-11.669***	-7.493***	209.269***	260.926***	-23.824***	-5.027***	183.672***	248.474***
Required Reserves	14.051	18.326	2.855	2.376	-13.005***	3.258***	184.986***	173.482***
WACR	-10.021***	-8.213***	230.688***	230.218***	-8.751***	-1.722**	110.242	113.606
Cash Deposit Ratio	-80.513***	-12.353***	166.613***	166.633***	-5.754***	-0.851	120.470*	130.565**
Ratio of Internal Debt to GDP	7.029	14.616	8.820	6.896	-5.317***	-2.245**	131.476**	87.774
RBI Advances to Commercial Banks	-7.578***	-4.799***	165.842***	148.615***	-10.692***	-3.666***	172.018***	141.442***
RBI Advances to Government	-14.416***	-9.571***	263.294***	342.922***	7.394	9.274	56.407	366.406***
Exchange Rate	1.616	9.322	10.992	7.445	-15.621***	-2.853***	125.982**	142.711***
Ratio of Demand to Saving Deposits	-16.431***	-2.473***	120.847*	134.948**	-14.240***	-4.194***	177.335***	196.945***
Output Gap	-12.057***	-11.191***	326.538***	190.694***	-10.038***	-4.760***	205.396***	87.4427
Ratio of Total Advances to GDP	0.737	2.918	98.979	110.918	1.772	5.879	67.308	28.387
Government Securities	-8.197***	0.582	110.477	143.982***	-1.693**	1.341	114.639	146.046***

The null hypothesis of LLC, IPS, ADF and PP tests assumes that the series has unit root. *, ** and ***Indicate the p- values at 10%, 5% and 1 %, respectively.

6.2 Determinants of Excess Liquidity: Bank Level

Table 7 reports the factors which influence the excess liquidity holdings at bank level in India. We observe from the fixed effects regression estimates (as recommended by the Hausman test) that there are various factors which have a statistically significant effect – positive or negative – on excess liquidity holdings with banks.

Table 7
Determinants of Excess Liquidity: All Banks[†]

	Fixed Effects	Random Effects
Required Reserves	-0.912***	-0.525**
	(0.285)	(0.266)
WACR	-0.797***	-0.974***
	(0.299)	(0.305)
Cash Deposit Ratio	0.329	0.277
	(1.578)	(1.500)
Ratio of Internal Debt to GDP	-0.985***	-0.817***
	(0.219)	(0.214)
RBI Advances to Commercial Banks	1.097**	0.926*
	(0.547)	(0.564)
RBI Advances to Government	-0.377	-1.176
	(4.139)	(4.295)
Exchange Rate	29.715**	35.767***
	(12.684)	(13.002)
Ratio of Demand to Saving Deposits	0.010***	0.009**
	(0.003)	(0.003)
Output Gap	-9.322	9.622
	(33.527)	(34.594)
Ratio of Total Advances to GDP	-1.026**	-1.089**
	(0.502)	(0.462)
Government Securities held by Banks	3.870***	1.581**
	(1.169)	(0.796)
Intercept	-82.429*	-96.239**
	(47.696)	(48.016)
No of Observations	730	730
R- Squared	0.032	0.057

Dependent Variable: Ratio of Excess Reserves to Total Deposits (%). Excess Reserves has been calculated on the basis of Omer et al (2015). [†] Public Banks and Private Banks Combined. Standard errors in parentheses. Hausman Test suggests Fixed Effects as appropriate model.

Required reserves has negative and significant impact on excess liquidity holdings with banks. It means that as monetary authority (RBI) increases the required reserves (CRR and SLR) the excess liquidity drains out from banks to the RBI or into government securities. It corroborates the theoretical prediction of Agenor et al. (2004) that increase in required reserves reduces the

excess liquidity and consistent with the empirical findings of Omer et al (2015) and Saxegaard (2006) based on their macroeconomic estimates. Excess liquidity responds negatively to overnight call money rate (WACR) which means that an increase in WACR is associated with lower excess liquidity of banks. Reaction of excess liquidity to government debt is negative. The RBI advances to commercial banks have positive effect on excess liquidity holdings with banks implying that all money that is borrowed by banks from the RBI is not used for lending purpose but may end up as reserves. Exchange rate has a positive impact on excess liquidity. As Indian Rupee depreciates, the banks tend to hold more excess liquidity and reduces excess liquidity holdings in case of appreciation of Indian Rupee. This implies that banks increase their excess liquidity holdings to hedge for falling value of foreign currency assets when there is depreciation in Indian Rupee. This is in contrast with Omer et al (2015) who found negative effect of foreign exchange on excess liquidity in Pakistan where foreign currency deposits have a larger share in banks' deposits. This contrary finding may be because of less foreign currency deposits in Indian banks but higher foreign currency assets which necessitates banks to hedge for depreciation of Indian Rupee.

The ratio of demand deposits to saving deposits has positive impact on excess liquidity holdings with banks. More the demand deposits with banks more the requirements of liquid assets to avoid dishonoring of withdrawal from saving and current accounts arising out of sudden surge in withdrawal (Saxegaard 2006). Excess liquidity reacts negatively to the ratio of total advances to GDP. When banks lend more the excess liquidity is poised to go down as money is being shelled out from deposit accounts of banks to loan accounts of borrowers. Response of excess liquidity to government securities held by banks is positive and significant. Cash-Deposit ratio, RBI advances to government and Output gap has positive, negative and negative effects on excess liquidity, respectively. However, these responses are not statistically significant. Response of excess liquidity to overnight call money rate (WACR) and exchange

rate is negative and positive, respectively which is in contrast to the findings from the aggregate level analysis. The possible reason for this puzzle could be a cross-sectional variation in response at bank level as we observe that excess liquidity of private sector banks does not respond to these two variables.

In the Indian banking system, banks are broadly categorized into two groups, viz. public sector banks and private sector banks. As the ownership and consequent policies of these banks are different, the prevalence and factors which influence excess liquidity may not be the same for these groups of banks. To observe this heterogeneity, we tried examining their determinants of excess liquidity by including an ownership dummy in the earlier specification. However, the coefficient of the ownership dummy turned out to be statistically insignificant. Instead, we studied the two groups separately as sub-samples. Table 8 reports the estimation of the determinants of excess liquidity for the bank groups, i.e., public sector banks and private sector banks, analyzed as separate sub-samples.

Table 8
Determinants of Excess Liquidity: Public Sector Banks and Private Sector Banks

	Public Sector Banks		Private Sector Banks	
	Fixed Effects†	Random Effects	Fixed Effects	Random Effects†
Required Reserves	-2.848***	-2.246***	0.386	0.552
	(0.250)	(0.201)	(0.557)	(0.524)
WACR	-0.622***	-0.963***	-0.466	-0.640
	(0.219)	(0.231)	(0.578)	(0.587)
Cash Deposit Ratio	-0.550	-2.516*	2.050	0.884
	(1.359)	(1.192)	(2.927)	(2.766)
Ratio of Internal Debt to GDP	-1.243***	-0.633***	-0.539	-0.524
	(0.171)	(0.159)	(0.427)	(0.423)
RBI Advances to Commercial	0.415	-0.068	2.580**	2.582**
Banks	(0.385)	(0.426)	(1.077)	(1.107)
RBI Advances to Government	6.061**	3.733	-5.084	-5.511
	(2.901)	(3.304)	(7.969)	(8.226)
Exchange Rate	17.054*	22.563**	24.024	28.728
	(9.160)	(9.913)	(24.416)	(24.924)
Ratio of Demand to Saving	0.173***	0.163***	0.007	0.007
Deposits	(0.020)	(0.015)	(0.005)	(0.005)
Output Gap	-48.555**	-26.255	32.575	46.296
	(23.294)	(26.130)	(66.285)	(67.893)
Ratio of Total Advances to GDP	-0.378	0.688***	-0.891	-1.395
	(0.309)	(0.220)	(1.408)	(1.380)

Government Securities held by Banks	6.632*** (1.644)	-4.408*** (0.520)	3.252* (1.821)	3.260** (1.432)
Intercept	-20.457 (35.505)	39.505 (36.256)	-101.295 (90.490)	-120.069 (90.759)
No of Observations	399	399	331	331
R- Squared	0.056	0.512	0.061	0.075

Dependent Variable: Ratio of Excess Reserves to Total Deposits (%). Excess Reserves has been calculated on the basis of Omer et al (2015). † Public Banks and Private Banks Combined. Standard errors in parentheses. Hausman Test suggests Fixed Effects for public sector banks and Random Effects for private sector banks as appropriate model.

Here, for public sector banks, we find almost similar results as observed in all banks sample discussed earlier but for private sector banks only two of the variables have significant coefficients. In particular, we highlight the following differences in the results for the sub-samples: RBI advances to commercial banks now has a positive effect on excess liquidity in the case of public sector banks but the coefficient is not statistically significant. It means that borrowings from the central bank do not result in excess liquidity for public sector banks, possibly because of their capital stressed nature due to high non-performing assets. However, for private sector banks the borrowings from the RBI seem to result in excess liquidity as they are not otherwise capital stressed.

RBI advances to the government has a positive and significant effect on excess liquidity of public sector banks only. When the government borrows from the central bank (through sale of government securities which are purchased by the central bank in the secondary market) it creates new deposits as borrowed money is credited in the government's account with the central bank. Whenever the government spends out of this account, it is more likely to end up as deposits with public sector banks (through various government agencies who hold accounts in these banks) resulting in excess liquidity. Output gap has a negative and statistically significant effect on excess liquidity of public sector banks due to credit demand as a result of improvement in economic activity. Excess liquidity responds negatively to the ratio of total advances to GDP, but the response is not statistically significant. The coefficient of government

securities held by banks is positive and statistically significant for both public and private sector banks. It means that the banks' investment in these securities are in excess of the required levels and thereby affect the excess liquidity.

7. Conclusions

In this paper we have investigated the factors which influence the excess liquidity in Indian banking system at aggregate as well as bank level. Overall, we identify various bank-level and macroeconomic factors that determine excess liquidity in India. There are many common as well as different factors which are responsible for the excess liquidity holdings at both levels. For instance, excess liquidity response to required reserves are similar (positive) at the aggregate level as well as at bank level. RBI credit to the government does not have statistically significant effect on excess liquidity either at bank level or at aggregate level. Exchange rate has a positive effect on excess liquidity at bank level while a negative effect at aggregate level. Reaction of excess liquidity to WACR is negative at bank level but positive at aggregate level.

The policy implication of this study is that to design a policy in a way to discount for excess liquidity so that amount of adequate liquidity is determined and the cost of having excess liquidity is eliminated. At aggregate level, a push for private sector credit by banks can be helpful in sorting their problem of excess liquidity out. Less investment in government dated securities and better management of required reserves position (as repo rate has a positive effect on excess liquidity) is important so that reliance on interbank market is reduced. Besides, understanding the distinction between the persistence of voluntary and involuntary excess liquidity need be considered well by the policy makers as it is the latter which is responsible for weakening of monetary policy (Saxegaard 2006). Hence, the focus of policy measures should be to stabilize the cyclical fluctuation in the economy. At bank level, internal debt and total advances by banks can be important for tackling the prevalence of excess liquidity with

banks as they negatively impact the excess liquidity. Targeting required reserves to tackle the issue of excess liquidity (at bank level and at aggregate level), may not be a useful policy measure. Required reserves only transfer the excess liquidity with banks or banking system to the RBI which is either unproductive or less productive than other potential uses of liquidity.

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Appendix A

Table A1
Description of Variables

Variables	Description
Excess Liquidity	Total liquid assets in excess of the statutory limit to the total time and demand liabilities of the banks
Required Reserves	Ratio of required reserves to aggregate deposits.
Repo Rate	
WACR	Weighted Average Call Money Rate
Volatility in WACR	Standard deviation of 5 period Moving Average of Weighted Average Call Money Rate
Ratio of Demand Deposits to Total Deposits	
Volatility in RBI Credit to the Government	Standard deviation of log of 5 period moving average of RBI credit to the government.
Private Sector Credit	Total Non- food credit
Exchange Rate	INR- USD Exchange Rate
Index of Industrial Production	Log of Index of Industrial Production (Base Year 2011-12)
RBI Credit to the Government	Log of total RBI credit to the government
Banks' Credit to the Government	Log of total credit by commercial banks by the government.
Government Dated Securities	Log of total dated securities issued by the government
Cash Deposit Ratio	
Internal Debt	Ratio of internal debt to GDP
RBI Advances to Commercial Banks	
Output Gap	Difference between actual GDP and potential GDP.
Total Advances	Ratio of total advances to GDP.
Ratio of Demand to Saving Deposits	

Table A2
Variables: Determinants of Voluntary and Involuntary Excess Liquidity

Determinants of Voluntary Excess Liquidity	Required Reserves
	Repo Rate
	Volatility in WACR
	Ratio of Demand Deposits to Total Deposits
	Volatility in RBI Credit to the Government
Determinants of Involuntary Excess Liquidity	Private Sector Credit
	Exchange Rate
	Index of Industrial Production
	RBI Credit to the Government
	Banks' Credit to the Government
	Government Dated Securities

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