Excess Liquidity and Bank Stability in Indian Banks: Is there a Favourable Nexus?

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Abstract

In this paper, we examine the effect of excess liquidity on bank stability in India. We employ both linear and non-linear regressions to examine the effect of excess liquidity on bank stability considering a sample period of 2006-2020. We find that reaction of bank stability to total excess liquidity and voluntary excess liquidity to be positive and statistically significant, in case of all banks put together. We observe heterogenous effects of different types of excess liquidity on bank stability of public sector banks and private sector banks. We also find non-linearity in the effects of excess liquidity on bank stability. We provide policy implications of our study.

Keywords

Excess Liquidity, Bank Stability, Panel Regression, Indian Banks, Z-Score.

JEL Classification

C23, G20, G21, E51, E40

1. Introduction

Excess liquidity is defined as the amount of liquid assets banks hold over and above regulatory requirement, mandated by central monetary authority (Omer et al. 2015). Generally, there are two notions of having sufficient liquidity or excess liquidity with banks. First, it guards against the liquidity shocks and provides financial stability (Diamond and Dybvig 1983 and Diamond and Rajan 2001). Second, excess liquidity increases the lenders risk propensity of banks as surplus liquidity acts as a buffer for banks (Wagner 2007 and Acharya and Naqvi 2012).

There may be serious implications of banks' excess liquidity on corporate governance. The prudential norms get diluted, and the interest of investors might be put at stake. This happens

because of reckless lending so that cost of holding excess liquidity can be minimized and some returns can be generated. There is evidence of positive nexus between high level of excess liquidity and risk taking by banks (Kaminsky and Reinhart 1998 and Darvas and Pichler 2018 and Odonkor et al. 2016). For instance, Kaminsky and Reinhart (1998) report a positive association between high level of excess liquidity and bank lending which ultimately leads to financial instability. Darvas and Pichler (2018) support the findings of Kaminsky and Reinhart (1998). In contrast, Odonkor et al (2016) argue the evidence of holding high excess liquidity to counter the market risk.

An established theoretical foundation (Wagner 2007 and Acharya and Naqvi 2012) of excess liquidity and banks behaviour is not backed by well researched empirical evidence. There is mere a few studies which examine excess liquidity and its implications on banks' behaviour (Ansari and Sensarma 2022, Ahmad et al. 2022, Dahir et al. 2019, and Khan et al. 2017). Adding to the scarce existing literature, in this paper, we examine the two aspects of excess liquidity, i.e., research questions. First, how banks' stability reacts to excess liquidity? Second, is there heterogenous effect of excess liquidity on banks' stability in public sector banks and private sector banks?

We chose to restrict our analysis to India for the following reasons. First, analysis at bank level, for a group of countries, may not be feasible because of varying conditions such as differences in macroeconomic and institutional set up. Hence, examining one country has the benefit of relative homogeneity within the sample which can be generalized in the similar cases and circumstances. Second, India is a fastest growing major and an important emerging economy. In addition, it is the sixth largest economy in the world. Finally, the primary source of India's finance is banks, i.e., India is a bank-based economy. Besides being an important source of financing firms, both private and public sectors, banks in India function as an important source of fundings of governments, both state and central governments. Banks provide direct loans to

the governments and through buying bonds issued by the governments. Since the capital account is partially convertible, banks remain a major source of finance in India. It is imperative to keep the stability of banks in a good shape so as to avoid any unwanted fluctuations in the banking system. This study will help establish the nexus between excess liquidity and bank stability furthering the policy making consistent with healthy financial environment.

The presence of excess liquidity held by banks have important implications for the monetary policy transmission. It may work as an obstacle to effective and intended transmission of monetary policy as excess liquidity is freely available to banks. Banks can use excess liquidity for lending at the time of liquidity constraint. The implications of excess liquidity in monetary policy transmission have been explored by many researchers (Saxegaard 2006, Agenor and Aynaoui 2010 and Nguyen and Boateng 2015). These studies argue that presence of excess liquidity held by banks leads to the weakening of monetary policy transmission. Moreover, excess liquidity can be decomposed to voluntary and involuntary segments. Saxegaard (2006) argues that involuntary liquidity has more implications on monetary policy transmission as it is unsought liquidity and imposed from outside. There may be accumulation of excess liquidity by banks in case of monetary easing when demand for credit is weak (Omer et al. 2015).

The stylized fact of existing literature is skewed towards the studies of monetary policy and bank lending in a liquid deficit state. The effective monetary policy transmission requires liquidity position in the banking system to be deficit (Ganley 2002). However, the developing countries are characterized by a situation where banks keep excess or surplus liquidity. The surplus liquidity held by banks either facilitate or hinder the effective monetary policy transmission in India (RBI Annual Report-2021).

The literature is quite scarce in examining the implications of having excess reserves or excess liquidity on macro-financial variables, e.g., bank stability. Ansari and Sensarma (2022)

estimate the determinants of excess liquidity in India, its components, i.e., voluntary and involuntary excess liquidity. Our study provides understandings of implications of excess liquidity held by banks.

We find that excess liquidity, in general, helps in financial stability of banks and work as a buffer for liquidity shocks. However, this finding is heterogenous for different ownerships of banks in India. Remainder of this paper is structured as follows. Section 2 discusses literature review. In section 3, we discuss data and methodology. Section 4 reports the results and in section 5 we conclude.

2. Literature Review

Although the literature on excess liquidity and its interaction with economic agents is still at nascent stage, a well-ordered study can be seen. Generally, there are two reasons for the build-up of excess liquidity by banks, viz. structural and cyclical. Both of these reasons for build-up of excess liquidity have been studied in the literature (Ansari and Sensarma 2022; Saxegaard 2006; and Omer et al 2015). The structural view argues two reasons for the presence of excess liquidity. First, banks keep a large buffer reserve owing to high information processing costs, unreliable payment system and high costs of monitoring borrowers. Second, higher risk aversion among banks leads to higher risk premia which eventually results into excess reserves held by banks. Both of these factors are prevalent in developing countries supporting our choice of studying the case of India. In India, we witness high risk aversion and low levels of financial development among state owned banks. We can observe empirical evidence on accumulation of excess liquidity as a result of weak credit demand (Wyplosz 2003-Euro area; Agenor et al. 2004-Thailand and Mohanty et al. 2006). The cyclical standpoint suggests that a rise in inflation forces banks to increase the risk premium or restrict the lending because of the erosion

of certainty in the value of collateral pledged by borrowers. In both the cases, excess liquidity goes up considerably (Agenor and Aynaoui 2010).

The above-mentioned sources of accumulation of excess liquidity are endogenous. The excess liquidity is also accumulated as a result of policy changes, i.e., exogenous sources of excess liquidity. A liberalized capital account leads to capital flows at larger scale causing a rise in excess liquidity held by banks because of the banks' intermediation in the process. Asymmetric capital account liberalization, i.e., restriction on foreign exchange operation by resident while no restriction in the movement of capital for non-residents has led to increase in capital inflow in large amount (Khemraj 2007). Moreover, privatization of big state-owned enterprises has also been a source of a capital inflows. In India, the capital account is partially convertible meaning restricted outward investments by residents while liberal inflows. The accumulation of excess liquidity due to liberal capital inflows can be deterred by exchange rate regulation, both in pegged and managed float regimes[1]. In the absence of these controls, monetary base shoots up which ends in surplus liquidity in the economy. Agenor and Aynaoui (2010) report that during 2006-08, the required reserve ratio of banks was increased by the countries like South Korea, India, and China helping them prevent macroeconomic destabilization by absorbing excess liquidity.

There is numerous more studies which investigate the cases of excess liquidity in developing economies. In developing economies, the presence of excess liquidity is mainly due to structural weaknesses and deficiencies in the banking system (Ansari and Sensarma 2022-India; Hasanovic and Latic, 2017-Bosnia and Herzegovina; Pontes and Sol Murta, 2012-Cape Verde; Nwakanma and Mgbataogu, 2014 and Ukeje and Amanze, 2015-Nigeria).

[1] RBI's Report of the Working Group on Instruments of Sterilization.

Another strand of literature examines the consequences and implications of excess liquidity on macroeconomic and macro-financial economic variables. Excess liquidity encourages banks to take risk by lending more (Darvas and Pichler 2018; Acharya and Naqvi 2012, and Nguyen and Boateng 2015). Darvas and Pichler (2018) argue that indulging in risky lending induced by excess liquidity can cause financial instability in Euro Area.

The effective transmission of monetary policy to real macroeconomic variables is possible only when an optimal amount of liquidity is available in the banking system. Neither liquidity deficit nor liquidity surplus helps in intended change in real macroeconomic variables as a result of change in monetary policy rate. Moreover, Saxegaard (2006) observes differential implications of involuntary and voluntary excess liquidity on monetary policy transmission. The involuntary excess liquidity, i.e., not desirable, is often imposed externally and has serious implications on transmission of monetary policy. On the other hand voluntary excess liquidity is more of a liquidity management wherein banks voluntarily keeps more liquid assets in order to insure against a possible rise in reserve requirements and indicate liquidity strength to their customers. The theoretical model for analysing the ramifications of excess liquidity in monetary policy transmission has been given by Agenor and Aynaoui (2010). They show weakening of monetary policy in the presence of excess liquidity. Nguyen and Boateng (2015) support Agenor and Aynaoui (2010) by showing a weakening of monetary policy in Chinese banks having larger involuntary excess liquidity. In contrast, Demiralp et al (2021) find increased response of bank lending to negative interest rates policy in Euro Area. This happens because of the presence of excess liquidity and dependence on retail deposits funding. The above-mentioned studies show the theoretical as well as empirical evidence of the implications of excess liquidity in monetary policy transmission. However the evidence is mixed.

The literature on excess liquidity and bank stability is not well researched. However, many studies mentioned above are related to excess liquidity and its interaction with other

macroeconomic variables. We do not find studies which categorically examine the relationship between these two variables in Indian banks' case. One paper which examine the effect of excess liquidity on bank stability is Ahmad et al. (2022). In this paper they examine the effect of excess liquidity on bank stability in Qatar, Indonesia, Saudi Arabia, Malaysia, UAE and Turkey (QISMUT). They find that conventional banks are more vulnerable to adversity of excess liquidity than Islamic banks. Their study is based in a completely different macroeconomic environment and financial set up. We do not find, to the best of our knowledge, other studies which examine the effect of excess liquidity on bank stability across globe. This gap inspires us to explore the excess liquidity-bank stability nexus in India.

3. Data and Methodology

3.1 Data

In this paper, we employ annual balanced panel data of selected banks in India spanning across 2006-2020, obtained from the website of India's Central Bank, the Reserve Bank of India (RBI). We choose this period for our analysis for the following reasons. First, regular and complete bank-level data are available from 2005-06 onwards. Since we have also employed dynamic threshold regression in our analysis the data needs to be balanced panel. Second, this period has relatively seen less paradigm shifting volatility in Indian economic environment including financial sector. There has been many domestic as well as international events, but the Indian economy has been less affected. Third, fifteen year is a considerable horizon which can produce a credible and conclusive observation from a set of variables. Our variables of interest are as follow. Financial stability, the dependent variable is measured by *Z-Score,* calculated following Laeven and Levine (2009) and Boyd et al. (1993). The *Z-Score* has been used extensively as a surrogate for bank stability in literature (Phan et al. 2022; Cihák et al. 2021; and Al-Shboul et al. 2020). Phan et al., (2022) examine the effect of geopolitical risk on bank stability in the US. They find the evidence of decline in bank stability as a result of

increase in geopolitical risk. It measures the insolvency of banks indicating stability. The primary independent variable is total excess liquidity proxied by ratio of excess liquidity to deposits of banks. Excess liquidity is calculated as the liquid assets held by banks over and above regulatory requirements (Ansari and Sensarma 2022 and Omer et al. 2015). We calculate voluntary and involuntary excess liquidity following Omer et al. (2015) and Nguyen and Boateng (2015). We use bank specific characteristics, i.e., size (log of total assets), capital (log of capital) and profit (return on assets) and macroeconomic factors, i.e., inflation (change in log of WPI) and GDP growth rate as control variables. These control variables are consistent with the existing literature and have widely been used in estimation models (Ansari and Sensarma 2023, Ansari and Sensarma 2023 and Dahir et al. 2018). We present descriptive statistics in Table 1 reporting mean, median, standard deviation, maximum and minimum values.

Table 1
Descriptive Statistics: All Banks† (2006-2020)

	Mean	Median	Std. Dev.	Min	Max
Z-Score	1.202	0.767	2.263	-3.498	11.535
Involuntary Excess Liquidity	52.413	54.106	5.673	34.193	64.395
Voluntary Excess Liquidity	-15.101	-15.402	3.132	-20.955	-3.389
Excess Liquidity	12.059	11.263	5.217	1.746	34.618
lnCapital	8.069	8.404	1.630	1.099	12.010
lnTotal Assets	13.731	13.926	1.487	9.189	17.492
Return on Assets	0.446	0.682	1.076	-4.128	1.960
Inflation	0.044	0.046	0.033	-0.025	0.091
GDP Growth Rate	6.672	7.168	1.539	3.087	8.498

†Public Sector Banks and Private Sector Banks combined.

3.2 Methodology

Our methodology consist of two-step process. In the first step we compute the *Z-Score* (bank stability), total excess liquidity and voluntary and involuntary excess liquidity. Following literature (see, e.g., Laeven and Levine, 2009 and Boyd et al. 1993), we compute Z-Score, the principal variable of interest and a surrogate for bank stability. We calculate *Z-Score* as follow.

$$Z\text{-}Score = (RoA + Equity/Assets)/\sigma_{ROA}$$

RoA stands for *Return on Assets* and σ_{ROA} is its standard deviation. A higher *Z-score* indicates higher bank stability and vice versa. The *Z-Score* is the sum of *Return on Assets* and *Equity-Assets Ratio* divided by Standard deviation of *RoA.*

Now, following Ansari and Sensarma (2022) and Omer et al. (2015), we calculate the total excess liquidity using formula given below.

$$Excess\ Liquidity\ Ratio\ (EL) = [(Cash\ and\ Balances\ with\ central\ banks - Required\ reserves) + Eligible\ Government\ Securities] \div Total\ time\ and\ demand\ liabilities$$

Decomposing total excess liquidity into its voluntary and involuntary components first requires estimation of the determinants of total excess liquidity. Hence, following Ansari and Sensarma (2022) and Nguyen and Boateng (2013), first we estimate the determinants of total excess liquidity.

$$Excess\ Liquidity_{it} = \beta_0 + \beta_1 Required\ Reserves_{it} + \beta_2 Discount\ Rate_t + \beta_3 Cash\text{-}Deposit\ Ratio_{it} + \beta_4 Internal\ Debt_t + \beta_5 RBIAdvCom_{it} + \beta_6 RBIAdvGovt_t + \beta_7 Exchange\ Rate_t + \beta_8 DDSB\ Ratio_{it} + \beta_9 Output\ Gap_t + \beta_{10} TotalAdvGDP_{it} + \beta_{11} Govt\ Securities_t + \varepsilon_{it} \qquad (1)$$

Now, we decompose the total excess liquidity into two components, i.e., voluntary and involuntary. Again, we Follow Ansari and Sensarma (2022), Saxegaard (2006) and Omer et al. (2015).

$$EL_t^s = a^s\ \hat{c} + \hat{a}_2\ (L)X_t^1 \qquad (2)$$

$$EL_t^d = (1\text{-}a^s)\hat{c} + \hat{a}_3(L)X_t^2 + v_t \qquad (3)$$

We have employed equations *(2)* and *(3)* to separately estimate the voluntary and involuntary excess liquidity, respectively. In the above equations a^s and $(1\text{-}a^s)$ represent the intercepts of the voluntary and involuntary components, respectively. However, these intercepts are not

distinguishable. The estimation of separate values of intercepts are not essential. Likewise, it is not possible to separate the voluntary and involuntary components of lagged dependent variable (Omer et al 2015).

We consider the repo rate, ratio of demand deposits to total deposits, ratio of required reserves to total deposits, fluctuations in WACR, and volatility in RBI credit to the government as the determinants of voluntary excess liquidity. The determinants of involuntary excess liquidity are exchange rate, Index of Industrial Production (IIP), government dated securities, RBI credit to the government, banks' credit to the government and private sector credit. These determinants of voluntary and involuntary excess liquidity altogether form the basis for determinants of total excess liquidity. However, in this paper, we do not examine the determinants of excess liquidity. But these determinants are required to separate voluntary and involuntary excess liquidity out of total excess liquidity.

In the second step, adopting Smaoui et al. (2020) and Hassan et al. (2019), we employ dynamic panel model in our study and estimate the following equation:

$$Z\text{-}Score_{it} = \beta_0 + \beta_1 Z\text{-}Score_{it-1} + \beta_2 EL_{it} + \beta_3 Capital_{it} + \beta_4 Profit_{it} + \beta_5 Size_{it} + \beta_6 Inflation_t + \beta_7 GDP_t + u_{it} \qquad (4)$$

In equation *(4)* Z-Score is a measure of bank stability. *EL* is excess liquidity. In addition to total excess liquidity we estimate the effect of voluntary and involuntary excess liquidity on bank stability.

Additionally, we use dynamic panel threshold regression to examine the effect of excess liquidity on bank stability. The dynamic panel threshold regression has been theorized by Seo and Shin (2016) by combining the GMM estimator of Arellano-Bond (1991) static threshold approach of Hansen (1999). The dynamic threshold regression has following advantages. First, this approach avoids correlation between error term dependent variables because of the

presence of forward orthogonal deviations. Second, endogeneity of explanatory variables is controlled. Third, dynamic threshold model avoids estimation biases and the division of data interval exogenously (Wu et al. 2020). We follow Seo and Shin (2016)[2], and estimate the effect of excess liquidity on bank stability. We estimate the following equation of a single threshold with two labor conditions regimes:

$$BS_{it} = \mu_{it} + \gamma EL_{it-1} + a'X_{it} + \beta_1' EL_{it} I(EL_{it} \leq \gamma) + \beta_2' EL_{it} I(EL_{it} > \gamma) + u_{it} \qquad (5)$$

Where *BS* represents *Bank Stability*. *EL* denotes *Excess liquidity*, which is independent variable of interest as well as threshold variable. *I (·)* is an indicator function. In above equation *(5)*, $EL_{it} \leq \gamma$ defines regime 1 (low excess liquidity) and $EL_{it} > \gamma$ defines regime 2 (high excess liquidity). X_{it} represents all the control variables which are size *(lnTotal Assets*$_{it}$), capital *(lnCapital*$_{it}$), profit *(Return on Assets*$_{it}$), Wholesale Price Index *(ΔlnWPI)*, i.e., a proxy for inflation and GDP growth rate.

4. Results

In Table 2, we report panel unit root test. We observe all the variables to be stationary at level. Hence, we use all the variables at level in our analysis.

[2] We use the STATA command *xthenreg* for estimating dynamic panel threshold regression provided by Seo et al. (2019).

Table 2
Panel Unit Root Test: All Banks† (2006- 2020)

	LLC	IPS	ADF	PP
Intercept Only in the regression				
Z-Score	1.688*	4.524	43.773	54.481
Involuntary Excess Liquidity	0.878	2.089	53.394	35.108
Voluntary Excess Liquidity	6.980	7.067	32.810	22.833
Excess Liquidity	-4.140***	-2.799***	92.987**	97.326***
lnCapital	8.321	5.588	106.631***	124.545***
lnTotal Assets	-17.384***	-11.567***	249.464***	287.763***
Return on Assets	1.598	4.469	45.063	56.322
ΔlnWPI	3.114	2.195	24.118	109.784***
GDP Growth Rate	-13.998***	-9.651***	200.407***	188.417***
Intercept and trend in the regression				
Z-Score	-2.344***	1.206	72.135	103.603***
Involuntary Excess Liquidity	-2.473***	-0.711	78.321*	47.731
Voluntary Excess Liquidity	-6.093***	-0.938	75.902	108.201***
Excess Liquidity	-6.097***	-2.123**	102.165***	125.343***
lnCapital	5.912	7.331	98.744***	128.329***
lnTotal Assets	-2.165**	6.566	59.726	100.763***
Return on Assets	-2.363***	1.218	72.203	102.525***
ΔlnWPI	-7.793***	-6.045***	132.841***	132.010***
GDP Growth Rate	-10.507***	-5.097***	117.830***	102.506***

This table reports panel unit root test for all banks together. LLC, IPS, ADF and PP stand for Levin Lin and Chu, Im Pearson and Sim, Augmented Dickey Fuller and Phillips- Perron Tests. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. †Public Sector Banks and Private Sector Banks only.

Table 3 reports the effect of total, voluntary and involuntary excess liquidity on bank stability for all banks put together. We find that only total and voluntary excess liquidity have positive and significant effect on bank stability. This suggests that excess liquidity among Indian banks work as a stabilizing factor and enhances banks stability. Our results support Diamond and Rajan (2001) proposition of excess liquidity as a tool for financial stability and a shield against liquidity risk. The voluntary excess liquidity gets accumulated at the discretion of banks to show liquidity strength to customers and act as an insurance against possible increase in reserve requirements (Ansari and Sensarma 2022 and Saxegaard 2006). Hence, it is a part of liquidity management. This shows that it is liquidity management by banks which is bringing banks' stability. However, bank stability does not respond to involuntary excess liquidity suggesting

that banks are immune to the risk of instability and/or benefit of stability even if they accumulate involuntary excess liquidity. Since the involuntary excess liquidity is imposed by monetary authority (RBI), it serves the purpose of regulation only and doesn't have any implication on bank stability.

Table 3
Estimated coefficients of Dynamic Panel Regression: Effects of Excess Liquidity on Bank Stability: All Banks†

	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation
$Zscore_{t-1}$	0.322***	0.299	0.339***	0.323**	0.317***	0.268
	(0.090)	(0.232)	(0.091)	(0.131)	(0.096)	(0.191)
Total Excess Liquidity	0.035***	0.035				
	(0.011)	(0.043)				
Voluntary Excess Liquidity			0.104***	0.099***		
			(0.037)	(0.036)		
Involuntary Excess Liquidity					-0.016	-0.020
					(0.031)	(0.029)
lnCapital	-0.014	-0.023	-0.064	-0.084	0.013	0.008
	(0.094)	(0.187)	(0.085)	(0.245)	(0.096)	(0.249)
lnTotal Assets	0.117	0.117	0.105	0.116	0.141	0.150
	(0.114)	(0.112)	(0.098)	(0.213)	(0.112)	(0.210)
Return on Assets	0.934***	1.006***	0.953***	0.958***	0.925***	0.981***
	(0.076)	(0.255)	(0.078)	(0.190)	(0.079)	(0.264)
Inflation	3.171***	3.194***	3.978***	4.035*	2.836***	2.928**
	(8.029)	(0.845)	(0.822)	(2.325)	(0.866)	(1.304)
GDP	-0.008	-0.004	-0.008	-0.008	-0.013	-0.009
	(0.013)	(0.019)	(0.012)	(0.009)	(0.013)	(0.026)
Intercept	-1.625	-1.646**	0.869	0.782	-0.851	-0.813
	(1.244)	(0.768)	(0.640)	(1.691)	(1.542)	(1.820)
No of Observations	448	448	448	448	448	448
No of Instruments	111	111	111	111	111	111
AR (1, 2) P- value	0.022	0.059	0.013	0.028	0.022	0.100
	0.202	0.267	0.220	0.209	0.149	0.175

Dependent Variable: Z-Score. †Public Banks and Private Banks Combined. Robust standard errors in parentheses. *, ** and ***indicate p- values at 10%, 5% and 1 % respectively.

Table 4 presents the effects of three types of excess liquidity on stability of public sector banks. We find a positive and statistically significant (5% significance level) effect of only involuntary excess liquidity on bank stability. This shows that only undesired liquidity, externally imposed and mandated by the regulator, held by public sector banks are favourable for stability. This finding contrasts Ahmad et al. (2022) where they observe that involuntary excess liquidity has a

negative effect on stability of banks. Since public sector banks are more prone to government supervision because of ownership structure are stable with maintenance of more excess liquidity at the behest of regulator. The non-response of *Z-Score* to total and voluntary excess liquidity does not come as a surprise. Public sector banks are generally risk averse and limit their banking activities to avoid unfavourable consequences. As discussed above, voluntary excess liquidity is a kind of liquidity management by banks, no role of it in bank stability raises the question of public sector banks' prowess in dealing with liquidity well. This is a governance issue which is not very robust in India's public sector banks.

Table 4
Estimated coefficients of Dynamic Panel Regression: Effects of Excess Liquidity on Bank Stability: Public Sector Banks

	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation
$Zscore_{t-1}$	0.099*	0.061	0.126**	0.080	0.073*	0.036
	(0.052)	(0.105)	(0.065)	(0.066)	(0.044)	(0.110)
Total Excess Liquidity	0.008	0.003				
	(0.007)	(0.016)				
Voluntary Excess Liquidity			0.056	0.045		
			(0.039)	(0.034)		
Involuntary Excess Liquidity					0.050**	0.042
					(0.025)	(0.083)
lnCapital	0.037	0.013	-0.024	-0.009	0.092	0.031
	(0.104)	(0.400)	(0.111)	(0.153)	(0.112)	(0.388)
lnTotal Assets	-0.045	-0.039	-0.102*	-0.075	-0.056	-0.061
	(0.048)	(0.096)	(0.055)	(0.193)	(0.050)	(0.141)
Return on Assets	0.954***	0.961***	0.948***	0.969***	0.955***	0.981***
	(0.067)	(0.069)	(0.068)	(0.195)	(0.066)	(0.111)
Inflation	2.048***	1.475*	2.778***	2.029	1.551**	1.078
	(0.756)	(0.880)	(1.067)	(1.850)	(0.661)	(1.376)
GDP	0.008	0.002	0.009	0.006	0.005	0.002
	(0.008)	(0.022)	(0.007)	(0.021)	(0.007)	(0.027)
Intercept	0.143	0.386	2.492	1.815	-2.843	-1.716
	(1.476)	(3.311)	(2.013)	(1.983)	(2.235)	(8.263)
No of Observations	238	238	238	238	238	238
No of Instruments	111	111	111	111	111	111
AR (1, 2) P- value	0.009	0.085	0.007	0.018	0.010	0.106
	0.117	0.240	0.075	0.315	0.182	0.411

Dependent Variable: Z-Score. Robust standard errors in parentheses. *, ** and ***indicate p- values at 10%, 5% and 1 % respectively.

In Table 5 we report the response of bank stability to three types of excess liquidity for private banks. Here, similar to the findings for all banks put together, we observe that only total and

voluntary excess liquidity have positive and statistically significant effects on banks' stability, again supporting the proposition of Diamond and Rajan (2001).

Table 5
Estimated coefficients of Dynamic Panel Regression: Effects of Excess Liquidity on Bank Stability: Private Sector Banks

	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation	One-step Estimation	Two-step Estimation
$Zscore_{t-1}$	0.352***	0.009	0.364***	0.183	0.338***	0.306*
	(0.083)	(0.174)	(0.088)	(0.200)	(0.083)	(0.190)
Total Excess Liquidity	0.025***	0.032**				
	(0.013)	(0.013)				
Voluntary Excess Liquidity			0.061*	0.035		
			(0.036)	(0.061)		
Involuntary Excess Liquidity					0.057	0.015
					(0.041)	(0.059)
lnCapital	-0.108	-0.774	-0.133*	-0.728	-0.058	-0.022
	(0.072)	(0.605)	(0.077)	(0.613)	(0.090)	(0.386)
lnTotal Assets	0.260**	0.934	0.260**	0.879	0.173	0.102
	(0.135)	(0.636)	(0.115)	(0.630)	(0.136)	(0.440)
Return on Assets	0.880***	0.999***	0.890***	0.988***	0.861***	1.131***
	(0.198)	(0.255)	(0.197)	(0.353)	(0.205)	(0.155)
Inflation	4.527***	6.920**	5.051***	6.185	3.994**	2.402
	(1.395)	(3.614)	(1.333)	(4.474)	(1.590)	(3.430)
GDP	-0.017	0.006	-0.015	-0.006	-0.020	-0.003
	(0.017)	(0.022)	(0.016)	(0.025)	(0.019)	(0.023)
Intercept	-2.183*	-6.025	-0.935	-4.897	-3.810*	-1.625
	(1.240)	(3.902)	(0.861)	(3.214)	(2.142)	(3.017)
No of Observations	210	210	210	210	210	210
No of Instruments	111	111	111	111	111	111
AR (1, 2) P- value	0.038	0.255	0.037	0.110	0.037	0.133
	0.308	0.025	0.413	0.002	0.325	0.261

Dependent Variable: Z-Score. Robust standard errors in parentheses. *, ** and ***indicate p- values at 10%, 5% and 1 % respectively.

Involuntary excess liquidity of private sector banks does not have any effect on its stability. This is contrary to the finding where only involuntary excess liquidity impacts banks' stability, in the case of public sector banks discussed above. This may be seen as a trade-off between the effects of voluntary and involuntary excess liquidity on banks' stability in different ownership structures. Since the private sector banks are more prudent in nature, they are better able to manage their liquidity position as their voluntary excess liquidity, in addition to total excess liquidity, is driving the stability of banks which itself is a liquidity management.

We conduct two robustness checks. First, we re-estimate equation (4*)* while including financial crisis dummy for 2007-08 and find results similar to main findings. We do not report the results to save the space. However, it is available on request. Second, we also employed dynamic threshold panel regression to see non-linearity in response. The results are reported in Table 6.

Table 6
Estimated Coefficients from Dynamic Panel Threshold Regression for the Effect of Excess Liquidity on Bank Stability: All Banks (2006- 2020)

	Z-Score
Low Excess Liquidity Regime	*Excess Liquidity ≤ 15.578****
Z-Score$_{it-1}$	0.191***
	(0.048)
Excess Liquidity	-0.029**
	(0.014)
lnCapital	0.166
	(0.139)
lnTotal Assets	-0.144
	(0.110)
Return on Assets	1.037***
	(0.095)
Inflation	0.104
	(0.955)
GDP Growth Rate	-0.101
	(0.018)
High Excess Liquidity Regime	*Excess Liquidity > 15.578****
Z-Score$_{it-1}$	-0.121***
	(0.034)
Excess Liquidity	0.048*
	(0.026)
lnCapital	-0.502**
	(0.204)
lnTotal Assets	0.269*
	(0.151)
Return on Assets	0.120
	(0.123)
Inflation	-0.536
	(2.865)
GDP Growth Rate	0.064*
	(0.035)
Intercept	-0.409
	(1.104)
T	15
N	32

Dependent Variables: Z-Score (Bank Stability). The threshold variable is *Excess Liquidity*. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively.

We find, for all banks, the total excess liquidity has a negative and statistically significant effect on *Z-Score* (bank stability) when ratio of excess liquidity to deposit is less than 15.58. This suggests that not all excess liquidity is having similar effects on bank stability. The negative relationship between excess liquidity (below the threshold) and bank stability supports the findings of Smaoui et al. (2020), Hassan et al. (2019) and Khan et al. (2017) arguing excess liquidity (high funding liquidity) increases insolvency risk and bank-risk taking behaviour. However, If the ratio is more than 15.58 the response of *Z-Score* to excess liquidity is positive and statistically significant. This suggests that if the total excess liquidity reaches at a certain level (15.58% of deposits), it works as a buffer for risk that may be being taken at lower than threshold level of excess liquidity. We do not find any significant threshold of excess liquidity in case of public sector banks and private sector banks, separately. Hence we do not report the result.

5. Conclusions

We examine the effect of three types of excess liquidity on bank stability in India considering a sample spanning over 2006-2020. We find positive effect of total excess liquidity and voluntary excess liquidity on bank stability, while estimating sample of all banks together. This findings support the proposition of excess liquidity as a buffer for liquidity shock which helps in maintaining bank stability. However, the findings are not uniform across bank groups, i.e., public sector banks and private sector banks. In the case of private sector banks we find similar results as in the case of all banks put together whereas, the bank stability of public sector banks react positively to only involuntary excess liquidity. Moreover, we find a non-linear effects of excess liquidity on bank stability. The total excess liquidity has negative and statistically significant effects on bank stability when total excess liquidity is less than 15.58% of total deposits. On the other hand, the response of bank stability to total excess liquidity is positive

and statistically significant in case of total excess liquidity is more than 15.58% of total deposits.

Our findings have numerous policy implications. First, the policy makers should consider keeping a buffer in the form of excess liquidity which may help maintain stability among banks in India reflecting the findings regarding all banks put together and private sector banks. Second, In case of public sector banks, managing only involuntary excess liquidity requires attention. Third, since there is an evidence of non-linear response of bank stability with different magnitude of excess liquidity, the policy makers should target managing excess liquidity considering the threshold level, i.e., ratio of excess liquidity to total deposits of 15.58%. This can help manage liquidity of banks better and avoid its unfavourable implications.

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