Working Paper

IIMK/WPS/428/ECO/2021/01

March 2021

Response of Bank Lending to Monetary Policy in India: Does Liquidity Matter?

Md Gyasuddin Ansari[1]
Rudra Sensarma[2]

[1]Doctoral Scholar, Economics Area, Indian Institute of Management, Kozhikode, IIMK Campus PO, Kunnamangalam, Kozhikode, Kerala 673 570, India;
Email - mdgyasuddin10fpm@iimk.ac.in

[2]Professor, Economics Area, Indian Institute of Management, Kozhikode, IIMK Campus PO, Kunnamangalam, Kozhikode, Kerala 673 570, India; Email - rsensarma@iimk.ac.in,
Phone Number - 0495-2809423

Abstract

We examine the role of bank liquidity in monetary policy transmission in India. We apply threshold panel regression with liquid assets of banks as the threshold variable. Using annual data for Indian banks covering the period 2005-2017, we find that there is a negative impact of monetary policy tightening on bank lending. In a low liquidity regime, banks react more strongly to monetary policy as compared to in a high liquidity regime. The reaction of different bank groups (public sector and private sector banks) to monetary policy is heterogenous across the liquidity regimes. Our results suggest that for effective transmission of monetary policy, any abundant liquidity with public sector banks must be neutralized by the monetary authority.

JEL Classification

C23, E52, E58, G21

Key Words

Monetary policy transmission, Panel Threshold Regression, Liquidity, Bank Lending, Lending Channel.

1. Introduction

Emerging and developing economies are closely dependent on banks for their domestic investment requirements, at least in the case of small and medium firms. Therefore, banks in countries like India have a greater role to play in the economy and consequently the bank lending channel is the most important channel of monetary policy transmission. Commercial banks' activities— deposit taking and lending— have a common thread which conjoin them together viz. liquidity. To align the assets-liabilities of banks, it is of utmost importance that

banks must have adequate liquidity at an affordable cost of time and money. Diamond and Rajan (2001) and Stein et al. (2002) argue that, to ensure commitment-based lending, provision of liquidity is necessary to avoid the cost of mismatch in lending and deposit taking. However, liquidity available with banks can also change the course of monetary policy transmission to bank lending. Banks with larger levels of liquid assets can manage to keep their lending activities ongoing even in case of tight monetary policy (Kashyap and Stein, 2000). However, this role of liquidity in influencing the monetary transmission process has been under-investigated in the literature. In this context our paper makes the following contributions to the literature. This is the first study to apply threshold regression techniques to identify the level of liquid assets of banks above which monetary policy becomes ineffective. This is also the first study to examine the role of bank liquidity in monetary transmission using bank-level data for India. Finally, we identify the threshold levels of liquid assets separately for public sector and private sector banks that shows that the extent of importance of liquid assets varies across ownership groups.

There are extremities in the liquidity situations across banking systems in the world. According to Saggar (2006), monetary policy in most developed countries is conducted with the system kept in liquidity deficit mode while surplus liquidity prevails in emerging economies. However, there are exceptions in developed economies such as surplus liquidity leading to liquidity trap as in the case of Japan (Goyal and McKinnon 2003) where slump in banks' credit resulted in piling up of large funds with banks. On the other hand, there are developing countries such as India where liquidity deficit has been officially recommended for optimal monetary transmission (RBI, 2011). Kirikos (2020) showed that monetary policy was ineffective in Sweden, Switzerland, and the UK when liquidity trap conditions prevailed. Improving the efficacy of monetary policy has motivated the Reserve Bank of India (RBI) to prefer deficit liquidity conditions over surplus liquidity in the money markets (RBI, 2011). In surplus

liquidity conditions, banks look for options to deposit their excess liquidity and the central bank's reverse repo rate (a deposit option for banks) becomes the effective policy rate. In deficit liquidity conditions, banks prefer to borrow from the central bank at the official repo rate which becomes the policy rate. Singh (2011) showed that the latter situation is the one where monetary policy is the most effective in India. Extending the argument from financial markets to bank balance sheets, we argue that banks with more liquidity on their balance sheets are the ones least likely to borrow from the central bank. Consequently, in this scenario banks with less liquid balance sheets are expected to be more responsive to monetary policy changes. This is in line with the evidence of Kashyap and Stein (2000) for U.S. commercial banks. However, there is no existing empirical study in the literature that identifies the threshold level of bank liquidity below which monetary policy is effective.

In this paper we analyze the role of liquidity in monetary policy transmission to bank lending in India. We study a panel data set of Indian banks during the period 2005-2017 and employ the technique of threshold panel regression. Our specification allows us not only to study the role of bank liquidity in monetary transmission but to also identify the level of bank liquidity above which monetary policy becomes ineffective. We also study the heterogenous behaviour of banks across ownership groups (public sector and private sector banks with the latter group further split into old and new private sector banks, as per RBI's categorization). There are several studies which have shown that these bank groups behave differently (e.g. Sensarma 2006 and Bhaumik and Piesse 2008). The reason behind examining these bank groups separately is that they have different organizational objectives linked to their ownership status. Public sector banks are not so inclined towards commercial motive; however, private sector banks are mostly run on the basis of profit maximization. Also, there is greater government influence on loan disbursal by public sector banks as compared to private sector banks.

The remainder of paper is organized as follows. In section 2, we summarize the relevant empirical literature and the Indian setting as a background to the study. Section 3 presents the details of data used in our analysis and section 4 describes the methodology. Sections 5 discusses the results and section 6 presents the robustness of the main findings. Finally, section 6 concludes with the policy implications.

2. Background

Empirical studies in the literature have provided evidence for the importance of banks in an economy as supply of credit plays a critical role in monetary policy transmission (Kashyap and Stein 1994, Kashyap et al. 1996). Kashyap and Stein (2000) study the impact of monetary policy on bank lending behavior in the U.S. They find that the response of banks with less liquid balance sheets is stronger than that of those with more liquid balance sheets. Ehrmann et al (2001) examine the role of banks in monetary policy transmission for European countries and find that the impact of monetary policy on bank loan supply depends on the liquidity of individual banks. Takeda et al. (2005) examine relationship between monetary policy and lending behavior of banks in Brazil. They find that the direct impact of liquidity on lending is positive, implying that liquid banks lend more. Khwaja and Mian (2008) examine the impact of a liquidity shock in Pakistan by estimating two separate channels simultaneously: the bank lending channel and the firm borrowing channel. They find evidence for the bank lending channel shown by a decline in bank lending due to a decline in liquidity supply.

Altunbas et al (2010) study the bank lending channel via factors such as bank risk, liquidity and size of the banks. They observe that low-risk banks can better shield their lending from monetary shocks as they have better prospects and easier access to uninsured fund raising. Jimenez et al (2012) examine the response of bank lending to monetary policy changes while considering capital and liquidity in Spain. They show that higher short-term interest rates reduce the probability that the loan is granted. They find the impact of capital and liquidity to

be nominal and insignificant. Gunji and Yuan (2010) study the impact of monetary policy on loan supply in China and the role played by size, liquidity and capital in the monetary transmission process. They find that monetary policy transmission is weaker in the case of banks with higher size, lower liquidity and higher profitability but there is no effect of capital. Fungacova et al (2016) investigate the influence of reserve requirement in monetary policy transmission through bank lending channel in China. They find evidence for changes in loan supply due to changes in reserve requirements even though the transmission does not go through the bank lending channel. They do not find any role of bank liquidity in the impact of monetary policy on loan supply.

The importance of liquidity in Indian banking system can be assessed by the prompt liquidity actions taken by the RBI time and again. The RBI manages liquidity in the banking system through its liquidity adjustment facility. Additionally, the Open Market Operations (OMO) and easing of mandatory reserve requirements are the signs that the central bank's intervention is required to sort out the liquidity constraint in the banking system, either by absorbing or injecting bank reserves. Some of the recent liquidity measures of the RBI after the onset of the Covid-19 pandemic include the introduction of term repo auction for longer duration, cut in policy rate by 135 bps in less than a year and reverse repo auction for longer terms. In the recent past, the RBI has taken recourse to issuance of treasury bills under market stabilization scheme to absorb the surplus liquidity after demonetization in 2016 and increased the "Facility to Avail Liquidity for Liquidity Coverage Ratio (FALLCR)" from 11 per cent to 13 per cent of bank deposits in 2018 to ease liquidity shortage. [1]

The liquidity management framework of the RBI is based on the Working Group to Review the Operating Procedure of Monetary Policy in India (RBI, 2011) that recommended the repo

[1]https://www.thehindubusinessline.com/money-and-banking/rbi-ready-to-meet-liquidity-needs-of-banking-system/article25055219.ece

rate to be the single policy rate for which liquidity in the inter-bank money market needs to be in deficit mode. Singh (2011) provides empirical evidence that monetary policy pass-through to financial markets and bank interest rates improve in deficit liquidity conditions. We argue in this study that deficit liquidity conditions are accentuated by the presence of banks with less liquid balance sheets as they are more dependent on the central bank's liquidity provisions and therefore transmit monetary policy signals more effectively. We use bank-level data to analyse the role of liquid assets on banks' balance sheets in transmitting monetary policy to bank lending.

In general, lending channel of monetary policy transmission in India is less explored in the literature as compared to other channels such as the interest rate channel. Specifically, the literature is almost negligible when it comes to the role of liquidity in the lending channel. To the best of our knowledge, Mishra and Burns (2017) is the only study that considers the interplay between liquidity, bank lending and monetary policy. However, their study uses time series analysis (Vector Auto Regression) to analyze aggregate data and the three factors are considered as independent variables without any interactions. Their study shows evidence for persistent and strong impact of monetary shock and liquidity shock on bank lending in India. There are other studies which explore the role of interest rate, exchange rate and balance sheet in monetary policy transmission in India, while incorporating liquidity as a control variable. Nachane et al (2006) examine monetary policy and its impact on bank lending behaviour in Indian banks, while considering as controls the capital constraint, the credit quality of banks' assets and liquidity of bank balance sheet. Singh and Kalirajan (2007) investigated whether monetary policy in India work through interest rate channel or not and show that there is an important role of interest rate in monetary transmission. Aleem (2010) studies the effects of unanticipated monetary policy tightening on the real sector in India. He finds evidence for the bank lending channel arguing that monetary tightening results in an increase in overnight call

money rate. He also finds that monetary transmission through asset price channel and exchange rate channel is very weak. Bhattacharya et al (2011) study the monetary policy transmission in India through various channels and find that the exchange rate channel is the most effective channel which impacts inflation. Bhaumik et al (2011) examine the reaction of banks to monetary policy in India for both easy and tight monetary policy regimes. They include size, liquidity, and capitalization of banks as control variables to find that the bank lending channel is more effective in a tight monetary period than in an easy monetary period and that there are differences in monetary policy impact on the less risky short run and riskier medium or long run lending. They also find heterogeneity in the response of banks to monetary policy across different ownership groups of banks.

Based on the above literature, it seems that the nature of dependence of the bank lending channel on bank liquidity is under researched. This motivates us to study the role of liquidity in the bank lending channel of monetary transmission and identify the level of bank liquidity above which monetary policy loses its efficacy.

3. **Data**

We take data from various online sources such as the website of the RBI, a popular private data provider indiastat.com and the FRED database of the Federal Reserve Bank of St. Louis. We collected bank level yearly data for all the variables covering the period from 2005 to 2017 but since changes or growth rates are studied, the period of analysis effectively begins in 2006. Descriptive statistics of all the variables for all banks together and banks of different ownership categories are given in table 1. Our main variables of interest are the measures of lending (Total Loans), monetary policy (WACMR) and bank liquidity while the rest are bank-level and macroeconomic control variables. WACMR is the Weighted Average Call Money Rate that we consider as the monetary policy instrument as has been previously used in the literature

(e.g. Aleem 2010). Bank liquidity is defined as liquid assets of banks which consists of cash in hand, balances with RBI and government securities (Borio et al. 2017).

Table 1 shows that public sector banks have – on an average – higher capital, total assets and liquidity levels than private sector banks but their loan growth is lower which reveals their conservative approach. The profitability of public sector banks is also lower. However, within private sector banks it is quite evident that the new private sector banks (those that started operations after 1993 when fresh banking licenses were given by the RBI) have higher loan growth and profitability than the old private sector banks, even while maintaining higher capital, total assets and liquidity levels.

Table 1
Descriptive Statistics: 2006-2017

	ΔlnTotal Loans	WACMR	lnCap	lnTotal Assets	lnRoA	lnLiq	ΔlnWPI	GDP
All Banks								
Mean	0.173	6.627	6.672	13.399	0.975	11.880	-0.002	6.916
Median	0.177	7.101	8.161	13.518	0.940	12.169	0.052	7.535
Minimum	-0.336	3.290	1.099	9.259	-2.070	7.868	-0.584	3.087
Maximum	1.152	8.278	10.731	16.976	21.890	15.766	0.091	8.498
S.D.	0.136	1.502	1.600	1.392	1.416	1.599	0.178	1.534
Public Sector Banks								
Mean	0.154	6.627	8.292	14.074	0.893	12.428	-0.002	6.916
Median	0.165	7.101	8.487	14.030	0.795	12.777	0.052	7.535
Minimum	-0.336	3.290	5.150	11.965	-1.143	8.374	-0.584	3.087
Maximum	0.446	8.278	10.731	16.976	21.890	15.766	0.091	8.498
S.D.	0.117	1.502	1.094	0.906	1.769	1.550	0.178	1.535
Private Sector Banks								
Mean	0.197	6.627	6.880	12.535	1.079	11.179	-0.002	6.916
Median	0.188	7.101	7.104	12.423	1.280	11.086	0.052	7.535
Minimum	-0.217	3.290	1.099	9.259	-2.070	7.868	-0.584	3.087
Maximum	1.152	8.278	9.591	15.818	2.130	14.301	0.091	8.498
S.D.	0.154	1.504	1.784	1.430	0.749	1.372	0.178	1.536
Old Private Sector Banks								
Mean	0.164	6.627	6.110	11.907	0.889	10.539	-0.002	6.916
Median	0.169	7.101	6.485	11.927	1.065	10.608	0.052	7.535
Minimum	-0.217	3.290	1.099	9.259	-2.070	7.868	-0.584	3.087
Maximum	0.594	8.278	8.143	13.760	2.000	12.281	0.091	8.498
S.D.	0.119	1.506	1.695	0.985	0.796	0.966	0.178	1.538

New Private Sector Banks								
Mean	0.265	6.627	8.420	13.793	1.457	12.460	-0.002	6.916
Median	0.234	7.101	8.313	13.888	1.570	12.584	0.052	7.535
Minimum	-0.186	3.290	7.117	9.456	-0.270	9.002	-0.584	3.087
Maximum	1.152	8.278	9.591	15.818	2.130	14.301	0.091	8.498
S.D.	0.191	1.502	0.503	1.355	0.452	1.150	0.178	1.543

We report descriptive statistics of all the bank groups as well as all banks put together. WACMR, Cap, ROA, Liq, and WPI stand for weighted average call money rate, capital, return on assets, liquid assets, and wholesale price index, respectively.

4. Methodology

Benchmark Model

Adopting from the empirical specifications of Kashyap and Stein (2000) and Gunji and Yuan (2010), we estimate the following equation as our benchmark model to study the role of bank liquidity in monetary transmission:

$$\Delta lnLoan_{it} = \alpha_1 + \beta_1 WACMR_{t-1} + \beta_2 WACMR_{t-1} * lnLiq_{it} + \beta_3 lnCapital_{it-1} + \beta_4 lnSize_{it-1} + \beta_5 lnProfit_{it-1} + \beta_6 \Delta lnWPI_{it} + \beta_7 GDP + \varepsilon_{it} \quad (1)$$

where $\Delta lnLoan_{it}$ is the log difference in total loans of banks such that the incremental response of bank lending to monetary policy can be captured. $WACMR_{t-1}$ is the lagged Weighted Average Call Money Rate, and we expect a negative coefficient for this term as monetary policy tightening should lead to reduced loan growth (Aleem, 2010). $lnLiq_{it}$ is the natural logarithm of liquid assets of banks and this term captures the impact of bank liquidity on loan growth (Gambacorta 2005). The term $WACMR_{t-1} * lnLiq_{it}$ is the interaction of weighted average call money rate and liquid assets. Liquid assets, during monetary contraction, can compensate for the deposit reduction (Kashyap and Stein 2000) and therefore we expect a positive coefficient for this interaction term such that the negative impact of monetary policy tightening is weakened by higher liquid assets. Considering the heterogeneity of banks in India we control for three bank specific characteristics. These are Capital $(lnCapital_{it-1})$, Size $(lnSize_{it-1})$ and Profit $(lnProfit_{it-1})$ which are measured by capital, total assets and return on assets of banks,

respectively. These control variables are consistent with literature and has been used in many studies, viz. Kishan and Opiela 2000, Gambacorta 2005, Hosono 2006, Ehrmann et al. 2001 and Bhaumik et al. 2011. We also control for inflation ($\Delta lnWPI_{it}$) and *GDP growth rate (GDP)* which act as the anchors for prevailing macroeconomic conditions in the economy (Ehrmann et al. 2001). Finally, ε_{it} is the disturbance term with mean zero.

Panel Threshold Model

The above panel regression model would tell us the role of liquidity but not the magnitude of liquid assets with banks that matters for monetary policy. There is no existing study that identifies a cut-off level of liquidity below and beyond which the effectiveness of monetary policy is different. Considering varying levels of liquidity with banks, we apply panel threshold regression to examine this phenomenon. Introduced by Hansen (1999), the threshold regression method allows us to divide the variable of interest into different thresholds and carry out the regression with single to triple thresholds— meaning two to four regimes. In our analysis, we examine the role of varying degrees of liquidity in monetary policy transmission to bank lending. Following Hansen (1999), our specification for single threshold with two liquidity regimes is given under:

$$y_{it}^{*} = \beta^{I\prime} x_{it}^{*} I(q_{it} \leq \gamma) + \beta^{II\prime} x_{it}^{*} I(q_{it} > \gamma) + u_{it}^{*} \qquad (2)$$

where, y_{it}^{*} represents lending by the banks. q_{it} represents the threshold variable, i.e. liquid assets and $I(\cdot)$ is an indicator function. In equation 2, $q_{it} \leq \gamma$ defines regime I (low liquidity) and $q_{it} > \gamma$ defines regime II(high liquidity). x_{it}^{*} stands for independent variables which, as before, are $WACMR_{t-1}$ (Weighted Average Call Money Rate as the monetary policy instrument), $lnCapital_{it-1}$ (capital), $lnSize_{it-1}$ (total assets), $lnProfit_{it-1}$ (return on assets), $\Delta lnWPI$ (wholesale price index) and GDP (real GDP growth rate).

5. **Results and Discussion**

5.1 Panel Unit Root Tests

Before proceeding to analyze the role of liquidity in monetary policy transmission to bank lending, we conducted preliminary tests to ascertain the stationarity of the variables. We report the results in Table 2. We observe from the usual panel unit root tests (see Pesaran, 2015, for an overview) viz. LLC (Levin-Lin-Chu), IPS (Im-Pesaran-Shin), ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) tests that all the variables are stationary at level— either with or without trend— except for total loans and price level (which are stationary in changes). Hence, we proceed with the variables by following the levels of stationarity recommended by the panel unit root tests.

Table 2
Panel Unit Root Test (2005- 2017)

	ΔlnTotal Loans	$WACMR_{t-1}$	$lnCap_{t-1}$	$lnTA_{t-1}$	$lnRoA_{t-1}$	lnLiq	ΔlnWPI	GDP GR
All Banks								
Intercept Only in the regression								
LLC	-1.716**	-11.988***	-1.405*	-15.673***	-1.270	-9.746***	-121.864***	-18.996***
IPS	2.061	-6.089***	3.089	-5.037***	2.387	-0.612	-100.577***	-11.891***
ADF	84.626	157.768***	77.262	168.277***	86.506	102.356*	813.012***	289.284***
PP	122.085***	157.768***	114.781***	239.077***	84.257	155.989***	998.012***	308.074***
Intercept and trend in the regression								
LLC	-9.612***	-9.259***	-6.264***	0.672	-7.357***	-4.122***	-114.735***	-29.145***
IPS	-2.511***	-3.178***	-0.964	7.446	0.599	1.115	-92.438***	-14.767***
ADF	122.151***	110.268**	105.104**	49.069	99.148*	84.942	750.248***	343.043***
PP	183.153***	106.282**	167.070***	52.521	93.029	95.377	750.248***	474.400***

This table reports panel unit root test for all banks together. However, we conducted panel unit root test for all group of banks, i.e. public sector banks, private sector banks, old private sector banks, and new private sector banks. The results are same and available in the Appendix A (see Table A1). ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively.

4.2 Standard Panel Regression

Table 3 shows the results of our benchmark model, i.e. standard panel regression. We report results for both fixed effects and random effects estimations. We observe from the results that the impact of monetary policy on bank lending is negative and statistically significant for all banks considered together. This result follows even when the banks are considered in their

respective ownership groups. The private sector banks, old private sector banks and new private sector banks show relatively larger impact of monetary policy than in the cases of public sector banks and all banks put together. However, the coefficient of the interaction term— monetary policy with liquidity— is positive (0.005 in the fixed effects model and 0.004 in the random effects model) and statistically significant at the 1 per cent level, which means that liquidity plays a moderating role in mitigating the negative impact of monetary policy on bank lending. This is also the case for all types of bank groups. Therefore, the assertion of Kashyap and Stein (2000) on the role of liquidity in monetary transmission – which they did not however empirically test – is supported by our results. Here too, the relatively larger effect is for private sector banks, old private sector banks, and new private sector banks.

The coefficients for bank specific control variables are almost as per established findings in the literature. For all the banks put together and bank group-wise, the coefficients for capital and profit (return on assets) are positive and significant which means that higher the capital and profit of the banks, more the lending by the banks (Bhaumik et al. 2011 and Riadi 2018). The results are similar for all type of banks as well as all banks put together. The coefficient for size i.e. total assets, is negative and significant which suggests that greater the total assets or bank size, less the loan growth of the banks, implying that smaller banks are more aggressive in their lending activities.

We also included two macroeconomic control variables which are inflation and GDP growth rate. For all the bank groups as well as all banks put together, the coefficients for inflation (based on WPI) is positive but significant only for all banks, public sector banks, and old private sector banks. The coefficients for GDP growth rate are, for all banks and all bank groups are negative but significant only for all banks, public sector banks, and old private sector banks.

Table 3
Estimated coefficients of Panel Regression

	All banks		Public Sector Banks		Private Sector Banks		Old Private Sector Banks		New Private Sector Banks	
	Fixed Effect	Random Effect	Fixed Effect	Random Effect	Fixed Effect	Random Effect	Fixed Effect	Random Effect	Fixed Effect	Random Effect
$WACMR_{t-1}$	-0.067***	-0.068***	-0.035**	-0.042***	-0.225***	-0.277***	-0.303***	-0.312***	-0.188*	-0.277***
$WACMR_{t-1}$ *lnLiquid Assets	0.005***	0.004***	0.002*	0.001**	0.019***	0.023***	0.027***	0.027***	0.015*	0.021***
$lnCapital_{t-1}$	0.039***	0.030***	0.009	0.013**	0.088***	0.029***	0.031	0.009*	0.151*	0.150
$lnTotal\ Assets_{t-1}$	-0.161***	-0.087***	-0.173***	-0.053***	-0.242***	-0.196***	-0.244***	-0.208***	-0.256***	-0.226***
$Return\ on\ Assets_{t-1}$	0.011***	0.014***	0.005*	0.006**	0.092***	0.097***	0.070***	0.064***	0.200***	0.187***
ΔlnWPI	0.077***	-0.006	0.105***	0.028	0.049	0.011	0.096*	0.079	0.012	0.052
GDP Growth Rate	-0.002	-0.006*	-0.002	-0.009**	-0.003	-0.007	-0.009	-0.011**	-0.0006	-0.002
Intercept	2.091***	1.273***	2.569***	1.011***	2.634***	2.529***	2.996***	2.751***	2.555***	2.791***
Number of Observations	492	492	276	276	216	216	144	144	72	72
R Squared	0.162	0.254	0.242	0.372	0.279	0.472	0.342	0.431	0.607	0.669

Dependent Variable: ΔlnTotal Loans. Log Liquid Assets: adopting Borio et al (2017) which include cash in hand, balances with RBI and government securities.

***, **, * Indicate significance at 1%, 5% and 10% levels, respectively.

4.3 Test for Multiple Thresholds

Next, we explore the nature of dependence of the bank lending channel of monetary transmission on the liquidity regime for which we use the threshold regression method. In order to carry out panel threshold regression, first we conducted the test for multiple thresholds (Hansen, 1999) which uses the bootstrapping method. The test is conducted to choose between none, one, two or more thresholds. In our analysis we use liquid assets of banks as the threshold variable. Table 4 presents the results of the test for multiple thresholds and we find that there is one threshold with the null hypothesis of no threshold getting rejected with a p-value of 0.01 while the test statistics for double and triple thresholds are not significant. Hence, based on the findings from the test for multiple thresholds, we proceed to analyse banks across two regimes viz. low liquidity and high liquidity regimes.

Table 4
Tests for the multiple threshold in Log Liquid Assets

All Banks					
			Critical Value of F		
Threshold value	F	p-value	10 per cent	5 per cent	1 per cent
Single threshold effect test (H_0: no threshold)					
10.90	54.43	0.004	31.13	34.56	43.93
Double threshold effect test (H_0: at most one threshold)					
10.94 13.08	26.53	0.16	29.58	33.44	46.01
Triple threshold effect test (H_0: at most two thresholds)					
10.94 13.08 13.10	27.14	0.26	36.81	43.04	60.28

We apply Hansen (1999)'s bootstrapping method for the tests of multiple thresholds.

We conducted tests for multiple thresholds at the level of bank groups as well. The results are reported in appendix A (see Table A2 Table A3). In all bank groups, we find at least one threshold with significant p-value. Therefore, we proceed with one threshold (i.e. two liquidity

regimes – high and low) in our threshold variable (liquid assets) and then carry out the panel threshold regression analysis.

4.4 Panel Threshold Estimation Results

The threshold level of liquid assets for the full sample of all banks is Rs. 54176 million[2], as estimated from Table 4. Based on this threshold, Table 5 presents the results of panel threshold regression for the full sample. The first specification considers only the call rate (WACMR) as a regressor, the second specification includes bank-level controls while the third and last specification considers bank-level as well as macroeconomic controls. We observe that the coefficient of WACMR is negative and statistically significant in both regimes in the first specification but significant only in the low liquidity regime when all the controls are included in the last specification. Therefore, the impact of the call money rate on bank lending can be considered as negative and significant in the low liquidity regime. It means banks with low levels of liquidity (liquid assets less than the threshold value of Rs. 54176 million) reduce loan supply when there is monetary tightening by the RBI. The coefficient for call money rate has a negative sign but it is not significant in the high liquidity regime (liquid assets above the threshold) which implies that in this scenario, a monetary tightening by the RBI does not affect bank lending as the banks in this regime have sufficient liquidity on their books and therefore are less dependent on the policy changes. It is interesting to note that both the mean liquidity level (Rs. 144351 million) and the median liquidity level (Rs. 192721 million) for the sample are higher than the threshold identified in our analysis which means that the banking system on an average holds more liquidity than is appropriate from the point of view of monetary transmission.

[2] USD to Indian Rupees (Rs.) exchange rate was Rs. 71.31 per USD as on October 15, 2020.

Table 5
Estimated Coefficients from Panel Threshold Regression of bank lending on monetary policy: All Banks

Low Liquidity Regime (Threshold ≤ 10.90)			
$WACMR_{t-1}$	-0.03^{***}	-0.01^{**}	-0.02^{***}
$lnCapital_{t-1}$		0.04^{**}	0.03^{**}
$lnTotal\ Assets_{t-1}$		-0.14^{***}	-0.14^{**}
$Return\ on\ Assets_{t-1}$		0.08^{***}	0.07^{***}
ΔlnWPI			0.12^{***}
GDP Growth Rate			-0.002
High Liquidity Regime (Threshold > 10.90)			
$WACMR_{t-1}$	-0.04^{***}	-0.007^{*}	-0.006
$lnCapital_{t-1}$		0.04^{**}	0.03^{**}
$lnTotal\ Assets_{t-1}$		-0.13^{***}	-0.14^{***}
$Return\ on\ Assets_{t-1}$		0.008^{**}	0.007^{**}
ΔlnWPI			0.03
GDP Growth Rate			-0.003
Intercept	0.38^{***}	1.72^{***}	1.86^{***}
Number of Observations	492	492	492
R Squared	0.17	0.22	0.21

Dependent Variable: ΔlnTotal Loans, Threshold Variable: Log Liquid Assets, adopting Borio et al (2017) which include cash in hand, balances with RBI and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value of liquid assets is Rs. 54176 million. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

Table 6 presents the results for the different bank groups' response to the change in monetary policy. The results are presented for public sector banks and private sector banks. Within the category of private sector banks, old private sector banks are separately analysed but the threshold panel regression for new private sector banks could not be estimated because of insufficient observations. We observe that for public sector banks in the low liquidity regime (i.e. liquid assets below Rs. 653436.08 million), the coefficient of WACMR is negative and significant at 10% level. However, in the high liquidity regime the coefficient of WACMR is negative but not statistically significant and in fact the size of the coefficient is lower. It means that lending by public sector banks with low liquidity are strongly affected by monetary policy tightening than lending by those public sector banks that have high liquidity. This is in line with the earlier findings for the full sample of banks. However the mean liquidity (Rs. 249696 million) and median liquidity (Rs. 353982 million) are lower than the threshold level identified

above which means that, on an average, public sector banks are able to effectively transmit monetary signals to loan supply. But there are certain public sector banks which hold excess liquidity (the maximum value in our sample being Rs. 7032128 million) and such banks would impede the monetary transmission process.

For private sector banks in general and old private sector banks in particular, the coefficient of WACMR is negative in both the liquidity regimes but statistically significant at 5% level only in the second regime (high liquidity scenario). In low liquidity regime (i.e. liquid assets below Rs. 233281 million for all private sector banks and Rs. 12582 million for old private sector banks), these banks do not appear to reduce their lending during monetary tightening. This finding is in contrast with our previous results for the full sample and for public sector banks. The reluctance of private sector banks to cut loan supply in the low liquidity regime may be possibly explained by these banks having an exclusive relationship with their customers (Bhaumik et al 2011). The negative reaction of private sector banks to monetary tightening in the high liquidity regime could be explained by their risk aversion. In case of monetary tightening these banks may avoid lending much even if they have enough liquidity in hand because of having better insight of the economy slowing down and therefore taking preventive action, being free from government influence. In case of the old private sector banks, the coefficient of WACMR is negative in both the regimes, however it is statistically significant at 1% level in only the second regime. Interestingly, the average liquidity levels (mean and median values) for private sector banks is below the threshold level i.e. the zone where monetary transmission is not significant. However for old private sector banks the average liquidity levels are above the threshold level which means that monetary policy signals get effectively transmitted in their case.

Table 6
Estimated coefficients from Panel Threshold Regression of bank lending on monetary policy for bank groups

	Public Sector Banks	Private Sector Banks	Old Private Sector Banks
Low Liquidity Regime	Threshold ≤ 13.39	Threshold ≤ 12.36	Threshold ≤ 9.44
$WACMR_{t-1}$	-0.007*	-0.02	-0.02
$lnCapital_{t-1}$	0.03*	0.04	-0.14***
$lnTotal\ Assets_{t-1}$	-0.17***	-0.14***	-0.02
$Return\ on\ Assets_{t-1}$	0.004	0.18***	0.09***
ΔlnWPI	0.09***	-0.31***	-0.07
GDP Growth Rate	-0.002	0.001	-0.006
High Liquidity Regime	Threshold > 13.39	Threshold > 12.36	Threshold > 9.44
$WACMR_{t-1}$	-0.003	-0.01**	-0.02***
$lnCapital_{t-1}$	-0.03	0.03	0.005
$lnTotal\ Assets_{t-1}$	-0.13	-0.12***	-0.08***
$Return\ on\ Assets_{t-1}$	0.05***	0.09***	0.07***
ΔlnWPI	0.15	0.07	0.08
GDP Growth Rate	-0.002	-0.001	-0.005
Intercept	2.30***	1.45***	1.19***
R Squared	0.30	0.29	0.49
Number of Observations	276	216	144

Dependent Variable: ΔlnTotal Loans, Threshold Variable: Log Liquid Assets, adopting Borio et al (2017) which include cash in hand, balances with RBI and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value for liquid assets of public sector banks, private sector banks, and old private sector banks are Rs. 653436.08 million, Rs. 233281.23 million, and Rs. 12581.72 million, respectively. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

6. Robustness Checks with Alternate Liquidity Measures

As the first test of robustness of our main results discussed above, we now employ a different measure of bank liquidity that was used by Bhaumik et al. (2011) which includes the following items from the balance sheet of each bank: cash in hand, balances with RBI and other banks, and the amount of government securities. [3] The results of the panel threshold regression are presented in Table 7. Consistent with our previous results, we find that the impact of monetary policy on bank lending is negative and statistically significant in the low liquidity regime. Contrary to our main results, here we find that in the high liquidity regime the impact is also statistically significant although at 10% level in the last specification. However, in the high liquidity regime, the magnitude of monetary policy impact is clearly smaller (shown by a lower coefficient value of 0.007 in absolute in the high liquidity regime compared with 0.03 in absolute in the low liquidity regime). This weaker impact of monetary policy in the high liquidity regime is in line with our results presented in the previous section and therefor attests to the robustness of our main findings.

[3] We exclude money at call and short notice and other approved securities from Bhaumik et al. (2011)'s definition of liquid assets because of unavailability of continuous data for all banks as threshold regression requires a balanced panel.

Table 7
Estimated Coefficients from Panel Threshold Regression of bank lending on monetary policy (with alternate measure of liquidity): All Banks

Low Liquidity Regime (Threshold ≤ 11.10)			
$WACMR_{t-1}$	-0.02***	-0.02***	-0.03***
$lnCapital_{t-1}$		0.05***	0.04**
$lnTotal\ Assets_{t-1}$		-0.14***	-0.15**
$Return\ on\ Assets_{t-1}$		0.09***	0.09***
ΔlnWPI			0.10**
GDP Growth Rate			-0.005
High Liquidity Regime (Threshold > 11.10)			
$WACMR_{t-1}$	-0.04***	-0.007**	-0.007*
$lnCapital_{t-1}$		0.04***	0.04**
$lnTotal\ Assets_{t-1}$		-0.13***	-0.14***
$Return\ on\ Assets_{t-1}$		0.009**	0.008**
ΔlnWPI			0.05
GDP Growth Rate			-0.002
Intercept	0.37***	1.71***	1.84***
Number of Observations	492	492	492
R Squared	0.17	0.23	0.22

Dependent Variable: ΔlnTotal Loans, Threshold Variable: Log Liquid Assets, adopting Bhaumik et al (2011) which include cash in hand, balances with RBI and other banks and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value of liquid assets is Rs. 66171 million. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

Table 8 shows the bank group wise results of panel threshold regression with the alternate measure of liquidity. Here, in the low liquidity regime, we find that all groups of banks show a negative relationship of bank lending with monetary policy, but the coefficients are statistically significant only for public sector banks. This is in line with the earlier findings for public sector banks. In the high liquidity regime, the relationship is negative for all bank groups but statistically significant for only private sector banks and old private sector banks. Private sector banks (old private sector banks)— in low liquidity regime— do not seem to reduce their lending in response to a monetary policy rate increase but they reduce loan supply in high liquidity regime. As discussed earlier, we may ascribe this behaviour of private sector banks (old private sector banks) to relationship banking (Bhaumik et al 2011) and commercial decisions unencumbered by government influence. This finding matches with the results of Gunji and Yuan (2010) for China who show that monetary policy has a stronger effect on banks with sufficient liquid assets. As before we could not estimate threshold regression for new private sector banks due to insufficient observations.

Table 8
Estimated coefficients from Panel Threshold Regression of bank lending on monetary policy for bank groups (with alternate measure of liquidity)

	Public Sector Banks	Private Sector Banks	Old Private Sector Banks
Low Liquidity Regime	Threshold ≤ 13.06	Threshold ≤ 9.68	Threshold ≤ 9.68
$WACMR_{t-1}$	-0.008*	-0.01	-0.02
$lnCapital_{t-1}$	0.007	0.07	-0.21**
$lnTotal\ Assets_{t-1}$	-0.13***	-0.16***	0.05
$Return\ on\ Assets_{t-1}$	0.002	0.20***	0.12***
ΔlnWPI	0.06**	-0.33***	-0.10
GDP Growth Rate	-0.002	-0.002	-0.02
High Liquidity Regime	Threshold > 13.06	Threshold > 9.68	Threshold > 9.68
$WACMR_{t-1}$	-0.007	-0.02***	-0.02***
$lnCapital_{t-1}$	0.04**	0.03	-0.006
$lnTotal\ Assets_{t-1}$	-0.16***	-0.11***	-0.06**
$Return\ on\ Assets_{t-1}$	0.06***	0.08***	0.06***
ΔlnWPI	0.21**	0.06	0.08
GDP Growth Rate	-0.007	0.0003	-0.004
Intercept	2.04***	1.35***	1.05***
R Squared	0.27	0.28	0.40
Number of Observations	276	216	144

Dependent Variable: ΔlnTotal Loans, Threshold Variable: Log Liquid Assets, adopting Bhaumik et al (2011) which include cash in hand, balances with RBI and other banks and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value for liquid assets of public sector banks, private sector banks, and old private sector banks, are Rs. 469771 million, Rs. 15994 million, and Rs. 16318 million, respectively. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

As a second robustness check of our main results, we consider the fact that part of bank lending is compulsorily directed towards a set of areas known as priority sector that is defined by the RBI. Banks may not have much freedom to change the composition of their lending to the priority sector. Priority sector lending refers to 40 per cent of the total advances by banks that have to be given to certain sectors which require special attention owing to their role in economic development. These include small businesses, agriculture, export, education, low cost housing etc. These loans are expected to be less affected by policy rate changes because of the priority sector lending mandate. Hence, we re-estimate our empirical specifications after excluding the priority sector lending from the total loans in the dependent variable.

The results have been reported in Appendix A. Table A 4 shows the results for the full sample of all banks. Once again, we find that in the low liquidity regime, the impact of monetary policy

on bank lending is negative and statistically significant. In the high liquidity regime, the impact of WACMR is negative but not statistically significant. Moreover, the magnitude of the impact is reduced. Table A 5 shows the bank group-wise results. Here too we find results similar to the main results presented earlier. The public sector banks respond significantly to monetary policy rate changes in the low liquidity regime while the response of private sector banks (old private) to monetary policy rate changes is negative and statistically significant in the high liquidity regime.

7. Conclusion

In this paper, we examine the role of liquidity in monetary policy transmission to bank lending in India and find a considerable role played by liquid assets of banks. In general, we find that there is a negative impact of monetary policy tightening on bank lending. Our main contribution is to show that banks with low liquidity react more strongly to monetary policy changes than banks with high liquidity. This is the first study to not only show the role of liquidity but also identify the threshold level of liquidity above which monetary policy effectiveness weakens. The reaction of monetary policy to bank lending is found to be heterogeneous for different groups of banks.

Our findings provide important implications for monetary policy decision making in India. For the RBI, managing liquidity should clearly be an important consideration while devising monetary policy. The RBI should monitor not only the system level liquidity in the inter-bank money markets but also the liquidity on individual banks' balance sheets. For effective transmission of monetary policy to bank lending, abundant liquidity with public sector banks should be neutralized while private sector banks can carry out transmission even when while holding high levels of liquid assets. Our findings strengthen the importance that the RBI places on liquidity management in the Indian banking system.

References

Aleem, A. (2010). Transmission mechanism of monetary policy in India. *Journal of Asian Economics*, 21(2), 186-197.

Altunbas, Y., Gambacorta, L., & Marques-Ibanez, D. (2010). Bank risk and monetary policy. *Journal of Financial Stability*, 6(3), 121-129.

Bhattacharya, R., Patnaik, I., & Shah, A. (2011). Monetary policy transmission in an emerging market setting. IMF Working Paper no. WP/11/5.

Bhaumik, S. K., & Piesse, J. (2008). Does lending behaviour of banks in emerging economies vary by ownership? Evidence from the Indian banking sector. *Economic Systems*, 32(2), 177-196.

Bhaumik, S. K., Dang, V., & Kutan, A. M. (2011). Implications of bank ownership for the credit channel of monetary policy transmission: Evidence from India. *Journal of Banking & Finance*, 35(9), 2418-2428.

Diamond, D. W., & Rajan, R. G. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy*, 109(2), 287-327.

Fungáčová, Z., Nuutilainen, R., & Weill, L. (2016). Reserve requirements and the bank lending channel in China. *Journal of Macroeconomics*, 50, 37-50.

Gambacorta, L. (2005). Inside the bank lending channel. *European Economic Review*, 49(7), 1737-1759.

Goyal, R., & McKinnon, R. (2003). Japan's negative risk premium in interest rates: The liquidity trap and the fall in bank lending. *World Economy*, 26(3), 339-363.

Gunji, H., & Yuan, Y. (2010). Bank profitability and the bank lending channel: Evidence from China. *Journal of Asian Economics*, 21(2), 129-141.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2), 345-368.

Hosono, K. (2006). The transmission mechanism of monetary policy in Japan: Evidence from banks' balance sheets. *Journal of the Japanese and International Economies*, 20(3), 380-405.

Jiménez, G., Ongena, S., Peydró, J. L., & Saurina, J. (2012). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review*, 102(5), 2301-26.

Kashyap, A. K., & Stein, J. C. (1994). Monetary policy and bank lending. In *Monetary Policy* (pp. 221-261). The University of Chicago Press.

Kashyap, A. K., & Stein, J. C. (2000). What do a million observations on banks say about the transmission of monetary policy? *American Economic Review*, 90(3), 407-428.

Kashyap, A. K., Rajan, R., & Stein, J. C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. *The Journal of Finance*, 57(1), 33-73.

Kashyap, A. K., Stein, J. C., & Wilcox, D. W. (1996). Monetary policy and credit conditions: Evidence from the composition of external finance: Reply. *The American Economic Review*, 86(1), 310-314.

Khwaja, A. I., & Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review*, 98(4), 1413-42.

Kirikos, D. G. (2020). Quantitative easing impotence in the liquidity trap: Further evidence. *Economic Analysis and Policy*,68, 151-162.

Mishra, A., & Burns, K. (2017). The effect of liquidity shocks on the bank lending channel: Evidence from India. *International Review of Economics & Finance*, 52, 55-76.

Nachane, D. M., Ghosh, S., & Ray, P. (2006). Basel II and bank lending behaviour: Some likely implications for monetary policy. *Economic and Political Weekly*, 41(11), 1053-1058.

Pesaran, M. H. (2015). *Time series and panel data econometrics*. Oxford University Press.

RBI (2011). Report of the working group on operating procedures of monetary policy.' 15th March. https://www.rbi.org.in/scripts/PublicationReportDetails.aspx?ID=631. Last accessed on 27th January 2021

Riadi, S. (2018). The effect of Third Parties Fund, Non-Performing Loan, Capital Adequacy Ratio, Loan to Deposit Ratio, Return on Assets, Net Interest Margin and Operating Expenses Operating Income on Lending (Study in Regional Development Banks in Indonesia). In *Proceedings of the International Conference on Industrial Engineering and Operations Management Bandung, Indonesia*.

Saggar, M. K. (2006). Monetary policy and operations in countries with surplus liquidity. *Economic and Political Weekly*, 41(11), 1041-1052.

Sensarma, R. (2006). Are foreign banks always the best? Comparison of state-owned, private, and foreign banks in India. *Economic Modelling*, 23(4), 717-735.

Singh, K., & Kalirajan, K. (2007). Monetary transmission in post-reform India: an evaluation. *Journal of the Asia Pacific Economy*, 12(2), 158-187.

Takeda, T., Rocha, F., & Nakane, M. I. (2005). The reaction of bank lending to monetary policy in Brazil. *Revista Brasileira de Economia*, 59(1), 107-126.

Appendix A

Table A 1
Panel Unit Root Test for All Types of Banks (2005- 2017)

	Total Loans	WACMR	Capital	Total Assets	Return on Assets	Liquid Assets	WPI	GDP
Public Sector Banks								
Intercept Only in the regression								
LLC	2.787	-8.978***	-1.847	-14.342***	3.070	-7.896***	-91.498***	-14.229***
IPS	5.893	-4.560***	4.356	-4.746***	4.289	-1.141	-75.516***	-8.908***
ADF	13.764	88.496***	39.574	98.882***	26.637	61.011*	454.040***	162.299***
PP	14.075	88.496***	38.509	108.519***	39.103	86.823***	559.223***	172.825***
Intercept and trend in the regression								
LLC	-6.526***	-6.934***	-2.203**	6.783	-4.616***	-2.592***	-85.957***	-21.824***
IPS	-1.106	-2.380***	0.986	9.177	1.186	1.649	-69.256***	-11.056***
ADF	65.832**	61.856*	51.009	8.100	51.659	40.086	423.676***	192.389***
PP	103.179***	59.621*	81.224***	4.930	61.933*	32.708	423.676***	266.059***
Private Sector Banks								
Intercept Only in the regression								
LLC	-6.534***	-7.943***	-4.804***	-8.158***	-3.651***	-6.061***	-80.943***	-12.588***
IPS	-3.613***	-4.034***	-1.010	-2.235**	-1.513*	0.383	-66.806***	-7.880***
ADF	70.857***	69.258***	45.439**	68.559***	59.870***	41.332	355.336***	127.016***
PP	107.993***	69.258***	76.004***	130.659***	45.162	69.068***	437.653***	135.254***
Intercept and trend in the regression								
LLC	-7.045***	-6.135***	7.455***	-4.485***	-6.299***	-3.301***	-76.042***	-19.307***
IPS	-2.518***	-2.106**	-2.716***	0.964	-0.617	-0.182	-61.268***	-9.781***
ADF	56.163**	48.409*	54.069***	41.001	47.419*	44.787	331.572***	150.566***
PP	79.350***	46.660	85.852***	47.597*	31.094	62.624***	331.572***	208.220***
Old Private Sector Banks								
Intercept Only in the regression								
LLC	-5.259***	-6.485***	-3.964***	-7.637***	-3.509***	-3.988***	-66.090***	-10.278***
IPS	-2.836***	-3.294***	-0.422	-1.492*	-1.398*	1.349	-54.547***	-6.434***
ADF	46.199***	46.172***	27.355	35.156*	39.263**	18.488	236.890***	84.678***
PP	60.903***	46.172***	58.571***	59.079***	33.142	18.276	291.768***	90.169***
Intercept and trend in the regression								
LLC	-5.889***	-5.009***	-5.681***	2.009	-4.843***	-1.356*	-62.088***	-15.764***
IPS	-2.265**	-1.719**	-1.529*	3.269	-0.422	0.604	-50.025***	-7.986***
ADF	38.595**	32.273	28.168	9.356	32.521	25.293	221.048***	100.377***
PP	53.744***	31.107	51.879***	4.121	23.031	30.748	221.048***	138.183***
New Private Sector Banks								
Intercept Only in the regression								
LLC	-3.909***	-4.586***	-2.701***	-3.903***	-2.096**	-5.133***	-46.733***	-7.268***
IPS	-2.243**	-2.329***	-1.111	-1.777**	-0.644	-1.293*	-38.570***	-4.549***
ADF	24.658**	23.086**	18.084	33.404***	20.607*	22.844**	118.445***	42.339***
PP	47.089***	23.086**	17.433	71.580***	12.019	50.793***	145.884***	45.085***
Intercept and trend in the regression								
LLC	-3.927***	-3.542***	-4.841***	-5.906***	-4.043***	-3.588***	-43.903***	-11.147***
IPS	-1.175	-1.216	-2.452***	-3.042***	-0.479	-1.116	-35.373***	-5.647***
ADF	17.568	16.136	25.901**	31.645***	14.968	19.494*	110.524***	50.188***
PP	25.607**	15.553	33.974***	43.476***	8.063	31.876***	110.524***	69.407***

LLC, IPS, ADF and PP stand for Levin-Lin-Chu, Im-Pesaran-Shin, Augmented Dickey-Fuller and Phillips-Perron tests. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively.

Table A 2
Tests for the multiple threshold

Public Sector Banks						Private Sector Banks					
			Critical Value of F						Critical Value of F		
Threshold value	F	p-value	10 percent	5 percent	1 percent	Threshold Value	F	p-value	10 percent	5 percent	1 percent
Single threshold effect test (H_0: no threshold)						Single threshold effect test (H_0: no threshold)					
13.39	24.37	0.60	52.55	62.73	80.46	12.36	32.57	0.09	31.34	36.23	45.68
Double threshold effect test (H_0: at most one threshold)						Double threshold effect test (H_0: at most one threshold)					
13.39	58.29	0.001	29.85	33.80	44.38	12.36	34.31	0.05	29.41	34.39	43.63
12.94						10.79					
Triple threshold effect test (H_0: at most two thresholds)						Triple threshold effect test (H_0: at most two thresholds)					
13.39	16.60	0.45	32.54	40.14	59.88	12.36	12.29	0.56	24.01	26.73	36.25
12.94						10.79					
13.98						12.20					

We apply Hansen (1999)'s bootstrapping method for the tests of multiple thresholds.

Table A 3
Tests for the multiple threshold

Old Private Sector Banks					
			Critical Value of F		
Threshold value	F	p-value	10 percent	5 percent	1 percent
Single threshold effect test (H_0: no threshold)					
9.44	53.44	0.02	37.11	43.69	58.17
Double threshold effect test (H_0: at most one threshold)					
9.44	15.25	0.22	20.14	23.39	30.85
9.10					
Triple threshold effect test (H_0: at most two thresholds)					
9.44	4.47	0.89	18.37	22.10	33.26
9.10					
10.91					

We apply Hansen (1999)'s bootstrapping method for the tests of multiple thresholds.

Table A 4
Estimated Coefficients from Panel Threshold Regression of bank lending on monetary policy (with alternate measure of total loans): All Banks

Low Liquidity Regime (Threshold ≤ 10.90)			
$WACMR_{t-1}$	-0.03***	-0.02**	-0.02***
$lnCapital_{t-1}$		0.01	0.007
$lnTotal\ Assets_{t-1}$		-0.14***	-0.15***
$Return\ on\ Assets_{t-1}$		0.07***	0.06***
ΔlnWPI			0.18***
GDP Growth Rate			-0.007
High Liquidity Regime (Threshold > 10.90)			
$WACMR_{t-1}$	-0.05***	-0.01*	-0.007
$lnCapital_{t-1}$		0.03	0.02
$lnTotal\ Assets_{t-1}$		-0.14***	-0.15***
$Return\ on\ Assets_{t-1}$		0.01**	0.01**
ΔlnWPI			0.08*
GDP Growth Rate			-0.009*
Intercept	0.41***	1.91***	2.16***
Number of Observations	492	492	492
R Squared	0.15	0.18	0.16

Dependent Variable: ΔlnTotal Loans, excluding priority sector lending, Threshold Variable: Log Liquid Assets, adopting Borio et al (2017) which include cash in hand, balances with RBI and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value of liquid assets is Rs. 54176. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

Table A 5
Estimated coefficients from Panel Threshold Regression of bank lending on monetary policy for bank groups (with alternate measure of total loans)

	Public Sector Banks	Private Sector Banks	Old Private Sector Banks
Low Liquidity Regime	Threshold ≤ 13.39	Threshold ≤ 9.44	Threshold ≤ 9.44
$WACMR_{t-1}$	-0.008*	-0.01	-0.02
$lnCapital_{t-1}$	0.007	0.07	-0.21**
$lnTotal\ Assets_{t-1}$	-0.13***	-0.16***	0.05
$Return\ on\ Assets_{t-1}$	0.002	0.20***	0.12***
ΔlnWPI	0.06**	-0.33***	-0.10
GDP Growth Rate	-0.002	-0.002	-0.02
High Liquidity Regime	Threshold > 13.39	Threshold > 9.44	Threshold > 9.44
$WACMR_{t-1}$	-0.007	-0.02***	-0.02***
$lnCapital_{t-1}$	0.04**	0.03	-0.006
$lnTotal\ Assets_{t-1}$	-0.16***	-0.11***	-0.06**
$Return\ on\ Assets_{t-1}$	0.06***	0.08***	0.06***
ΔlnWPI	0.21**	0.06	0.08
GDP Growth Rate	-0.007	0.0003	-0.004
Intercept	2.04***	1.35***	1.05***
R Squared	0.27	0.28	0.40
Number of Observations	276	216	144

Dependent Variable: ΔlnTotal Loans, excluding priority sector lending, Threshold Variable: Log Liquid Assets, adopting Borio et al (2017) which include cash in hand, balances with RBI and government securities. ***, **, * Indicate significance at 1%, 5% and 10% levels, respectively. The threshold value for liquid assets of public sector banks, private sector banks and old private sector banks are Rs. 653436 million, Rs. 12582 million, and Rs. 12582 million, respectively. USD to Indian Rupees (Rs.) exchange rate was Rs. 72.91 per USD as on January 26, 2021.

Research Office
Indian Institute of Management Kozhikode
IIMK Campus P. O.,
Kozhikode, Kerala, India,
PIN - 673 570
Phone: +91-495-2809238
Email: research@iimk.ac.in
Web: https://iimk.ac.in/faculty/publicationmenu.php