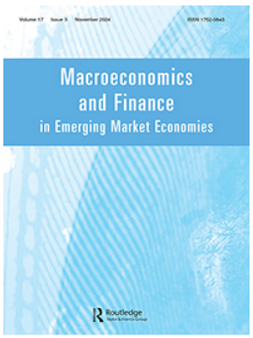

Routledge
Taylor & Francis Group

Macroeconomics and Finance in Emerging Market Economies

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/reme20

Monetary policy transmission in India: new evidence from firm-bank matched data

Pranav Garg, Saurabh Ghosh & Abhinav Narayanan

To cite this article: Pranav Garg, Saurabh Ghosh & Abhinav Narayanan (2024) Monetary policy transmission in India: new evidence from firm-bank matched data, Macroeconomics and Finance in Emerging Market Economies, 17:3, 526-542, DOI: 10.1080/17520843.2022.2067682

To link to this article: https://doi.org/10.1080/17520843.2022.2067682

MACROECONOMICS AND FINANCE IN EMERGING MARKET ECONOMIES
2024, VOL. 17, NO. 3, 526–542
https://doi.org/10.1080/17520843.2022.2067682

Monetary policy transmission in India: new evidence from firm-bank matched data

Pranav Garg[a], Saurabh Ghosh[b] and Abhinav Narayanan[b]

[a]Paris School of Economics, Paris, France; [b]Department of Economic and Policy Research, Reserve Bank of India, RBI, Mumbai, India

ABSTRACT

This paper uses a unique firm-bank matched data set for India to provide new insights into the monetary policy transmission mechanism. Our assessment of the bank-lending channel suggests that an increase in credit may have a heterogeneous effect on firms based on the liquidity positions of the lending banks. Investment in fixed assets is found to increase for firms that borrow from liquid banks, when these banks increase their lending. By contrast, we find increased financing of current liabilities – and not increase in long-term investment – for firms that borrow from the less liquid banks.

ARTICLE HISTORY
Received 30 March 2021
Accepted 15 April 2022

KEYWORDS
Monetary policy; transmission; firm-bank matched data

JEL CLASSIFICATION
C58; E44; E52

I. Introduction

Monetary policy transmission is the process through which policy action of the central bank is transmitted to meet the ultimate objectives of inflation and growth. In general, policy transmission is considered to be a two-stage process. In the first stage, the policy shock impacts different segments of the financial markets. In the second stage, it gets transmitted to the real economy (Mishkin 2012). The policy transmission mechanism hinges crucially on how changes in monetary policy affect household, firm and bank behaviours.

In this paper, we analyse how monetary policy shocks are transmitted to the banks and, in turn, are transmitted to the firms. We use unique firm-bank matched data to understand the mechanisms of monetary policy transmission by exploiting bank heterogeneity (in terms of liquidity) and firm heterogeneity (in terms of leverage).[1] First, we examine how policy rate changes affect the bank balance sheet, especially through the lending channel. Second, we analyse how changes in policy rate affect firms' balance sheets through their debt structure. Finally, we look at how the balance sheets of banks affect the investment decisions of the firms to which the banks lend. We exploit the heterogeneity of the banks in terms of their liquidity position to comment on whether more liquid banks induce a better transmission mechanism. Additionally, we comment on whether more leveraged firms respond quickly to bank balance sheet changes relative to less leveraged firms.

Literature has identified several channels through which the transmission of policy rates to operational targets takes place (Bernanke and Gertler 1995; Gertler and Gilchrist 1994). The most important among them are: (i) interest rate channel, (ii) credit channel,

CONTACT Abhinav Narayanan abhinav.narayanan@gmail.com

(iii) exchange rate channel, and (iv) asset price channel. Over the past few decades, academic literature has concentrated on three primary challenges relating to monetary policy transmission: (a) identifying the transmission channel(s); (b) identifying demand-side (firm, household) and supply-side (banks) frictions that dampen transmission; and (c) estimating long and variable lags. The first identification is perhaps the most challenging as some of the transmission channels work simultaneously instead of working in isolation.

To understand the underlying mechanisms, we must study the reasons for the heterogeneity in bank-level responses to changes in monetary policy. In this vein, it may be useful to identify some of the frictions affecting bank-specific transmission and the large body of empirical work that has attempted to address most bank-specific factors (bank size, liquidity and market capitalization) (Patrick et al. 2016; Khwaja and Mian 2005) on credit response to monetary policy change.

With regard to the impact of monetary policy transmission on investment demand, a large number of studies have analysed firm-level panel data to study the factors influencing rate transmission. Raj and Szeidl (2007) found evidence of demand-driven transmission that works through firms' creditworthiness (balance sheets), and is independent of the bank-lending channel.

While there has been considerable research on the conventional views of monetary policy transmission, separating demand shocks, which affect firms' demand for credit, from supply shocks. A handful of studies have attempted to address this question using a sample of matched firm-bank level data, information on relationship banking, and exogenous shocks. Amiti and Weinstein (2018) using granular bank supply shocks explain 30 to 40% of aggregate loans and investment fluctuations. Bottero, Mezzanotti, and Lenzu (2015), using bank-firm credit data for Italy, found that shocks to the sovereign bond market led to a drop-in bank lending to corporations, which in turn led to a decline in investment by smaller firms. Chodorow-Reich (2014) used the Lehman Brothers crisis as an exogenous shock and found that lenders' health has a significant effect on employment at small and medium firms.

For India, Ghosh (2007) suggests that a close loan relationship of a firm with a few banks could result in reduced interest cost in India. However, we haven't come across any study on India that explicitly analyses the interaction of firm-bank balance sheet data for the universe of corporate loans, preferred banking relationships, monetary policy transmission and external shocks. Our paper closely relates to this strand of literature as we have used firm-bank matched data for the universe of corporate loans to identify the bank-to-firm transmission mechanism. It is important to mention here that due to the limitation of firm-bank linked data for Indian firms, we do not have a clean identification strategy like in the studies mentioned above for other countries. In this paper, we look at monetary policy transmission through bank and firm balance sheets.

Our first stage results on the impact of monetary policy changes on a bank's balance sheet suggest a lagged response from the banks. In the second stage of our analysis, we examine the direct effect of monetary policy changes on the balance sheets of firms. We argue that these direct effects may not reflect the true effect of transmission. This is because firms' investment decisions may be correlated with demand conditions in the economy. In addition, these decisions may depend on the lending decisions of the banks

to which the firms are attached. In the third stage, using novel firm-bank matched data, we find that an increase in credit has a heterogeneous effect on firms based on the liquidity of their creditor institutions, unveiling a disguised mechanism at play behind policy transmission in India. Investments in fixed assets increase for firms that are attached to relatively more liquid banks when these banks increase their lending. By contrast, firms borrowing from the least liquid banks exhibit an increase in short-term capital in response to bank lending, presumably because less liquid banks cannot take on as much credit risk. In both cases, highly leveraged firms do not have differential outcomes, indicating that the balance sheet channel is weak.

The rest of the paper is structured as follows: Section II presents India's monetary policy and corporate finance background, Section III discusses the data, Section IV elaborates on the identification strategy and empirical equations used in our model, Section V presents our findings, and Section VI concludes the paper.

II. Monetary policy and corporate finance landscape in India

There is a general consensus that policy transmission is fast in the financial markets (European Central Bank (ECB) 2011). Money and bond markets react almost instantaneously to changes in policy rate. Prabu and Ray (2019) attempt to identify the impact of shocks on financial variables. Their results indicate that the impact varies in different segments of financial markets. While the impact is fast and efficient in money and bond markets, rate transmission is relatively limited in foreign exchange and stock markets.

Several studies have attempted to identify the most important monetary policy transmission channel for India. Aleem (2010) found that the bank-lending channel plays a pivotal role in rate transmission in India., while Bhoi et al. (2017) found that the interest rate channel of transmission was most dominant in India during the sample period.

In the Indian context, Prasad and Ghosh (2005) analysed the relationship between monetary policy and corporate behaviour in India and found evidence of strengthening of the interest rate channel operating through corporate investment after 1998. Ghosh and Ghosh (2006), on the other hand, found that monetary policy contraction especially reduces investment of highly leveraged firms. RBI (2014) notes that transmission lags vary from one to fourteen quarters for output for a gamut of countries – 42 months in the case of the United States (US) and 48 months for the euro area. Acharya (2017) notes that monetary policy actions are felt with a lag of two to three quarters on output and three to four quarters on inflation, and the impact persists for eight to twelve quarters.

III. Data

We have compiled four separate pieces of information to construct a novel data set for our analyses: monetary policy rates and spreads (liquidity spread and term spread), bank balance sheet data, firm balance sheet data, and data on lending relationships of firms. These data are combined mainly from two sources, described below.

III.1. Database on Indian economy

Data on policy rates and spreads, as well as detailed information on assets and liabilities, profit and loss, and key ratios of Scheduled Commercial Banks (SCBs) in India are publicly available on RBI's Database on Indian Economy.

Balance sheet data are reported annually from 2005 through various statutory returns submitted to the RBI at the level of individual banks.[2] Broadly, our sample contains all SCBs active in India between FY2005 and FY2019.

We consider policy rates and spreads that are important in the transmission of monetary policy We obtain annual aggregates of policy rates (see AnnexA for detailed data descriptions) by taking an unweighted average. Policy rate data are then matched with balance sheet data for each fiscal year, *e.g*. 2019 is April 2018 to March 2019, since balance sheet data is recorded over the fiscal year.

III. 2. CMIE prowess dx

Firms' annual financial statement data are maintained by CMIE Prowess dx. The database covers the profit and loss statements, balance sheets, and ratios based on over 40,000 Indian companies since 1990. The database comprises: (a) firms that are listed, and (b) unlisted public limited companies that have sales or assets exceeding INR 200,000,000. Our analysis focuses on financial accounts submitted by standalone firms and not the consolidated entities.[3]

This database also has an exhaustive list of creditor institutions (listed as banker0, banker1, banker2 ... banker40, and so on) for each firm. This information is available for each firm at an annual frequency. While the order of bank relationships reported might be based on the priority of the relationships, CMIE maintains that this reporting is dependent upon the firm's discretion and how they want to report lenders, which could be alphabetical, oldest to newest, by credit volume (*i.e*. prime lender), or random.[4] We use this information to create an annual register for every firm by matching SCBs in the RBI database with lenders for each firm in Prowess.

We have also excluded firms in agriculture, mining and public utilities. Finally, we have dropped financial sector firms from our sample. In doing so, we dropped an additional 22% of the firm sample. Our final sample consists of both listed and unlisted firms matched with all creditor SCBs for each fiscal year between 2005 and 2019. The final set of 12,364 firms are selected to focus on transmission after explicitly accounting for bank-firm relationship.[5]

IV. Identification strategy and empirical specifications

IV.1. Variable construction and identification

Our main objective is to identify the monetary policy transmission mechanism to the real economy. We approach this identification problem in three steps.

First, we study the effect of changes in policy rates and spreads on the growth of key banking variables. Our variables of interest include term loans and liquidity. Term loans provide the first-order evidence of an increase (decrease) in lending due to a change in

policy, which would directly establish the bank-lending channel. We define liquidity as the sum of cash in hand, investment in G-Secs and other approved securities normalized by total assets of the bank. Liquidity gives us a sense of how promptly banks may mobilize their liquid funds in response to monetary policy changes.

In the second stage, we investigate whether monetary policy directly impacts firms' short-term (current) and long-term (investment) borrowings, *i.e.* the demand side. This is the balance sheet channel wherein an increase in policy rate can directly affect firms' balance sheets by increasing their liabilities through interest payments, thereby adversely affecting their capacity to invest. Specifically, at this stage, we test whether dependence on external finance impacts the way firms internalize policy changes.

We create a novel database matching our firm-level database with a bank-level database through identification of bankers of each firm in each year, accounting for subsidiaries, mergers and acquisitions at the bank level. We then use the bank balance sheets specific to each firm-year to determine whether bank-level heterogeneity plays a role in the transmission of policy changes.

We rely on an analysis of aggregate lending for each bank, *i.e.* a bank × year variable. In essence, this means that any result driven by the bank-lending channel is not exclusive to a single firm, but to all firms for whom that bank is a lender. For identification at a bank × firm level, we interact characteristics of lenders with leverage ratios of individual firms. In essence, this allows us to identify whether, in response to a change in monetary policy, a firm's decision to increase (decrease) investment is driven by its lender's response to a policy change or through its own leverage ratio, or through an interaction of both these channels.

A firm may have multiple lenders and each lender will lend to multiple firms. For each firm, and in each year, we identify lenders with the most and least liquid balance sheets – out of all other lenders for that firm in that year. Then, we create two sub-panels: firms attached to most liquid and least liquid lenders.

IV.2. Empirical specifications

The objective of our empirical analyses is to highlight the transmission mechanism of monetary policy through the bank-lending channel. First, we identify the bank-lending channel by showing that monetary policy has a heterogeneous effect on lending institutions, namely banks. Second, a change in monetary policy may directly affect the firms by changing the liabilities side of the firm's balance sheet. Third, we try to estimate how a change in monetary policy may affect the banks' balance sheet differently based on the liquidity positions of the banks.

In order to investigate whether banks respond to monetary policy changes, we run the following specification at the bank level:

$$^{\Delta}B_{b,t} = \sum_{k=1}^{2} \beta_k .^{\Delta}MP_{t-k} + \sum_{k=1}^{2} \delta_k .\Psi_{t-k} + \alpha_b + \varepsilon_{b,t} \quad (1)$$

where $^{\Delta}B_{b,t}$ is the percentage change in key balance sheet elements for bank b in year t (winsorized at 5%).[6] We focus primarily on term loans and liquidity on the assets side of banks' balance sheets. We also look at the first-difference of reference rate at

the bank level, which is defined as BPLR (till 2010), Base Rate (between 2010 and 2016), and MCLR (post 2016).[7] $^{\Delta}MPt$ is the difference between t and $t-1$ of policy variables. Ψt denotes controls for macroeconomic conditions, specified as percentage growth in Gross Value Added (GVA) between t and t − 1. α_b controls for bank-level unobserved characteristics that influence the evolution of balance sheet elements for individual banks. One concern that may arise while using the above specification is the stickiness of the bank balance sheet variables. Specifically, the balance sheet items may be driven by own past values, in which case the coefficients may be biased. However, balance sheet items may be sticky in levels and less likely to be so in changes (growth rates). Nonetheless, to allay this concern, we run a dynamic panel specification of the following form using generalized method of moments (GMM) techniques.[8]

Second, we look at whether changes in monetary policy affect growth in investment and current liabilities through firms' leverage ratio using the following specification:

$$^{\Delta}F_{f,t} = \beta_1 . \left(\left(\frac{Debt}{Equity} \right)_{f,t-1} * {}^{\Delta}MP_{t-1} \right) + \beta_2 . \left(\frac{Debt}{Equity} \right)_{f,t-1} + \beta_3 . {}^{\Delta}MP_{t-1} + \lambda . X' + \alpha_f + \alpha_t + \varepsilon_{f,t} \tag{2}$$

where $^{\Delta}Ff,t$ denotes growth in firms' capital expenditure and current liabilities (winsorized at 5%), denoting growth in investment in fixed assets and in short-term capital, respectively. We include $^{\Delta}MPt-1$ which is the lagged growth monetary policy instrument and *(Debt/Equity)f.t-1* which is the one-year lagged growth in leverage ratio. We interact the policy instrument and the leverage ratio to tease out the effect of a change in monetary policy on the capital expenditure of the firm with high or low leverage ratio. We also include growth in two firm-specific controls (X ′) in our model (suppressing subscripts): growth in cash flows and growth in net sales, both in lag terms. The control variables are chosen based on the literature that studies that have studied the lagged effects of monetary policy on firms' activities (Romer and Romer, 1989).

In the above specification, α_t captures the cyclical factors that have common effects on all firms, and α_f accounts for unobserved firm-specific effects. The main coefficient of interest is β_1 which tells us whether the responses of firms to a change in monetary policy are different based on the leverage ratio of the firms. We cluster the standard errors at the firm level. Once again, like in the first stage, we also run a dynamic panel specification to account for stickiness in firm-level variables. We use the following specification.[9]

Equations 1 and 2 show the impact of monetary policy on banks and firms, respectively, but are not sufficient to comment on transmission via banks to firms. This could be because banks, on average, respond to monetary policy changes that may be confounded with demand-side factors, in which case identification of the shock (policy change) becomes difficult. On the other hand, firms may increase their investments due to demand-side factors and such an exercise may overlap with a monetary policy easing cycle. Thus, although we may observe a response from banks and firms to a change in monetary policy, these changes could show

some correlations which may not purely be driven by policy changes. Thus, we need to identify how firms respond to a change in policy and this response must not conflate with any other factors that may affect firm investment.

In order to do this, we adopt the following empirical strategy. We first match the firms to their set of lenders. Note that a firm may have multiple lenders and each lender will lend to multiple firms. This variation in lender and firms is central to our identification strategy (see Table 1 for the distribution of bank-level and firm-level variables). This is because lenders react differently to a change in policy and these lenders are attached to different firms. Thus, a firm attached to a lender that responds quickly to a change in monetary policy may also respond quickly (in the desired way) compared to firms that are attached to lenders that are sticky in their responses. We argue that the response of the firms that we estimate from this set-up is more precise compared to what we obtain from the firm-level regressions discussed above. The primary reason for this is that we attempt to focus purely on the supply-side channel that includes the lenders attached to those firms. For a better identification strategy we need information on the banks attached to the firms and the quantum of their lending. If we had this information, the empirical strategy would have produced a more precise estimation of a firm's response to policy changes. However, Prowess does not report the exact amount of loans that are extended by these banks to the firms.

In absence of quantum of bank wise lending data to firms, we run this estimation at the firm × bank × year level. Essentially, this structure of the data allows us to tease out the effect of a monetary policy change on the firm through the bank-lending channel. We use the following specification:

$$F_{f,t} = \beta_1 . \left(\left(\frac{Debt}{Equity} \right)_{f,t-1} * {}^{\Delta}TermLoans_{b,t-1} \right) + \beta_2 . \left(\frac{Debt}{Equity} \right)_{f,t-1} + \beta_3 . {}^{\Delta}TermLoans_{b,t-1} + \lambda . X' + \alpha_f + \alpha_b + \alpha_t + \in_{f,t} \tag{3}$$

Table 1. Descriptive Statistics for Key Variables.

Variables	N	Mean	Std. Dev.	25th perc.	50th perc.	75th perc.	90th perc.
Policy Rates & Spreads (first diff.)							
Repo Rate	206,686	−0.0777	1.062	−0.563	−0.344	0.667	1.167
3-month MIBOR	206,686	0.0572	1.701	−0.607	0.0608	1.172	2.298
CRR	206,686	−0.0511	0.808	−0.156	0	0.208	0.854
WACR–Repo	206,686	0.124	0.897	−0.173	0.0489	0.763	1.433
10Y-91D G-Sec	206,686	0.0383	1.155	−0.312	0.0377	0.355	0.625
Firm (% change, winsorized at 5%)							
Net Cash Flow from operating activities	165,016	−32.22	172.1	−101.3	−30.82	38.61	150
Sales	179,647	15.28	34.90	−2.201	10.67	26.52	52.04
Current Liabilities	188,980	25.96	57.76	−4.383	12.17	37.45	85.88
Leverage Ratio (D/E)	188,559	8.802	29.93	−4.904	6.419	21.11	42.86
CapEx (total capital)	49,510	−45.11	116.5	−100	−100	−38.75	71.57
Bank (% change, winsorized at 5%)							
Liquidity	192,867	−1.167	11.54	−7.799	−2.394	5.160	15.18
Term Loans (non-banking, within India)	193,077	18.41	17.75	8.239	17.31	27.81	38.65
Reference Rate (first diff.)	191,523	−0.253	1.835	−0.575	−0.0625	0.500	1.375

Source: RBI, Database of Indian Economy; CMIE Prowess dx.

where the explained variable F*f,t* denotes growth in firms' capital expenditure and current liabilities (winsorized at 5%). We use lagged values of the independent variables (by one time period) to allay endogeneity concerns. Our model includes the following fixed effects: α_t that captures common trends and business cycle effects; α_b that captures unobserved supply-side variations at a bank level, such as bank-level liquidity and capital adequacy differences; α_f that captures unobserved demand-side variations idiosyncratic to firms (Khwaja and Mian 2005). Standard errors are clustered at the firm level.

The main coefficients of interest in this specification are β_1, β_2, and β_3. The first coefficient tells us how, on average, more leveraged firms respond to a change in bank lending. Since we use firm × bank matched data, our identification of β_1 is achieved entirely through the variation in bank lending. Note that firms in our data set are attached to different banks, and these banks respond differently to a change in monetary policy, as we show using our bank-level specification. We hypothesize that a bank that responds more to a change in monetary policy (*e.g.* by increasing term loans) has a greater effect on highly leveraged firms which are attached to that bank. A point to note here is that the coefficient β_1 gives us the marginal effect as we include debt-equity ratio (firm level) and term loans (bank level) separately in the specification. We run this specification separately for more liquid and less liquid banks to tease out the variation in bank characteristics (in terms of liquidity) and the firms attached to these banks.

B_2 highlights the balance sheet effect, while β_3 captures the bank-lending effect in our model. Specifically, it is through β_3 that we comment on the impact of lenders on borrowing firms' balance sheets, namely the growth in their capital expenditure and current portion of their liabilities. For robustness, we use a dynamic panel version of the above specification that includes the first lag of the dependent variable.[10]

V. Results

V.I. Monetary policy transmission to banks

In this section, we discuss the results from Equation 1, presented in Table 2. The table presents 10 separate regression estimations, regressing three bank balance sheet elements, namely term loans and liquidity on five policy instruments separately.[11]

V.1.1 Repo rate

The impact of a change in the policy repo rate on the growth rate of two bank balance sheet variables is presented in columns 1 and 6 of Table 2. Column 1 corresponds to liquidity. We define liquidity and the sum of cash in hand, investment in G-Secs and in other approved securities normalized by total assets of the bank. Indian banks seem to respond to an increase in repo rate with a lag. An increase in repo rate raises liquidity. This is expected as follows: (a) an increase in repo rate is likely to increase G-Sec yields, making bond prices cheaper; (b) the decline in credit caused by a rise in repo rate will lead to an increase in investment in alternative

Table 2. Bank Response to Monetary Policy: Ordinary Least Squares.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Liquidity	Liquidity	Liquidity	Liquidity	Liquidity	Term Loans	Term Loans	Term Loans	Term Loans	Term Loans
L1. $^{\Delta}$Repo rate	1.503***					−1.517				
	(0.50)					(1.07)				
L2. $^{\Delta}$Repo rate	−0.389					−2.241***				
	(0.56)					(0.78)				
L1. $^{\Delta}$3-month MIBOR		1.458***					−1.548**			
		(0.36)					(0.77)			
L2. $^{\Delta}$ 3-month MIBOR		−0.032					−1.565***			
		(0.37)					(0.53)			
L1. $^{\Delta}$ CRR			2.421**					0.19		
			(1.03)					(1.84)		
L2. $^{\Delta}$ CRR			−1.34					0.03		
			(0.86)					(1.86)		
L1. $^{\Delta}$ WACR − Repo				0.98					−0.864	
				(0.84)					(1.70)	
L2. $^{\Delta}$ WACR − Repo				−0.841					−0.564	
				(0.86)					(1.28)	
L1. $^{\Delta}$ 10Y − 91D GSec					−1.828***					2.030*
					(0.47)					(1.08)
L2. $^{\Delta}$ 10Y − 91D GSec					0.30					2.388***
					(0.55)					(0.71)
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Macro-controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	840	840	840	840	840	825	825	825	825	825
No. of Banks	83	83	83	83	83	82	82	82	82	82

Bank-level controls include 2 lags of capital level and GNPA-Assets ratio.
Macro controls include 2 lags of GVA growth and volatility in call rates.
The dependent variables are in percentage changes.
Standard errors are clustered at the bank level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

assets, *i.e*. G-Secs. Column 6 presents the results for term loans. We find that an increase in repo rate in the previous year decreases bank lending along expected lines. However, the coefficient is not significant. Interestingly, the second lag of repo rate has a negative and significant effect on term loans. It may be mentioned that the literature clearly indicates that a change in repo rate impacts lending with a lag in India. Actually, financial market rates (*e.g*. WACR, MIBOR *etc.)* adjust instantaneously, but institutional procedures (*e.g*. paperwork, loan sanctions and disbursements) take time. These results capture the heterogeneous responses of Indian banks and the lagged transmission of repo rates to bank lending.

V.1.2 Three-month MIBOR

A change in repo rate is similar to a change in MIBOR (Columns 2 and 7) from the perspective of banks, as an increase (decrease) in either results in a rise (fall) in the external finance premium for banks. We find similar results for a change in MIBOR as we have found for a change in repo rate.

V.1.3 CRR

An increase in CRR (Columns 3 and 8) requires banks to keep higher reserves (as a proportion of net demand and time liability) with the RBI, which would reduce liquidity in the banking system and vice versa. However, CRR has seldom been used by the Reserve Bank compared with other policy tools (*e.g*. repo rate, Open Market Operations (OMO), *etc*.) and has also been at times viewed as a macro-prudential tool. Therefore, it is unlikely that CRR will show up in a significant way in annual banking aggregates other than their

liquid assets holdings. Since CRR increase absorbs excess liquidity from the interbank market, banks may hold more liquid assets to meet quick funds and reserves requirements, captured by the positive and significant one lag regression coefficients.

V.1.4 Spread 1 (WACR-repo)

An increase in the spread between WACR and repo rate (Spread 1 or policy spread) generally represents a tightening of liquidity in the market. A contraction in liquidity conditions in the market increases the bargaining power of banks, who are able to charge higher loan rates in search of higher return on investment, therefore assigning less funds to the G-Sec market. However, the SLR, which is linked to their net demand and time liabilities (NDTL), keeps them anchored to the G-Sec market.[12] We do not however find any significant effect of a change in liquidity spread on either liquidity or terms for the banks.

V.1.5 Spread 2 (10Y-91day G-sec yield)

Rise in term spread can be interpreted in two different ways. First, it can indicate good economic conditions in the longer term. Therefore, banks may sell risk-free long-term bonds and increase credit in the expectation of higher returns on riskier assets. However, an increase in term spread may also indicate higher government borrowing, excess supply of Gsec, and possible crowding out of private investment. These two effects in principle operates through the supply and demand sides in the credit market.

Column 5 in Table 2 shows that liquidity of banks decrease as spreads increase. This could be due the fact that banks find riskier assets more attractive and sell of their G-secs. The excess liquidity available to the banks is then directed towards increased lending (Column 10 in Table 2). This is evident from the negative and positive effects of lagged term spread increase on liquidity and term loans respectively.[13]

In this paper, we essentially try to disentangle the transmission channel through the bank balance sheet items. However, transmission can also take place through changes in bank-level lending rates. Since SCBs may respond differently to policy changes, this could affect the lending decision of the firms that are attached to the banks. Thus, as an extension to our baseline analysis on bank balance sheet items, we also look at how banks change their lending rates in response to changes in policy rates.[14]

V.2 Monetary policy transmission to firms

Table 3 presents our baseline estimation of Equation 2, *i.e.* the impact of monetary policy on firms' investment decisions through firm leverage (debt-equity ratio). Firms that are highly leveraged are expected to face a higher interest repayment burden when faced with a tighter monetary policy. We, therefore, expect the coefficient of the interaction term (debt-equity ratio and monetary policy change variables) to be negative and significant.

Columns 1 to 5 present the results of the impact of policy instruments on the current liabilities and column 6 to 10 report similar effects of these policy changes on the capital expenditure of the firms based on their leverage ratio. We couldn't decipher a unidirectional robust impact of rate changes from these results. Further, a change in Spread 1 does not significantly affect the current liabilities of the firm. However, an increase in Spread 2, which represents term premium, seems to decrease the current liabilities.

While the regression results in Table 3 are rather mixed, as such these effects may not reflect the true nature of transmission. This is because the firms may be attached to banks that are sticky in changing their lending decisions in response to change in policy rates at the macro level. In fact, due to the lagged nature of monetary policy transmission, banks may react differently to changes in policy rates. In addition, firms' lending decision may be correlated with the demand conditions prevailing in the economy. Thus, it is important to disentangle these effects to identify how firms react to policy changes.[15]

V.3 Bank-lending and balance sheet channels of transmission

In the first two sections, we discussed the results for bank-level and firm-level specifications separately. We find that policy transmission occurs at the bank level with a lag; however, we find mixed or weak direct effect of policy changes on firms' investment decisions. In the final stage, we ask whether firms attached to banks that increase their credit lines increase investments in a relative sense.

Table 3. Firms' Response to Change in Monetary Policy: OLS.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	CL	CL	CL	CL	CL	CapEx	CapEx	CapEx	CapEx	CapEx
L1. Debt/Equity × Δ MP	−0.000	−0.017*	0.024**	0.021*	0.014**	0.072**	−0.088***	0.082***	0.054	0.052***
	(0.010)	(0.010)	(0.010)	(0.012)	(0.007)	(0.034)	(0.029)	(0.031)	(0.038)	(0.019)
L1. Debt/Equity	−0.098***	−0.098***	−0.097***	−0.097***	−0.098***	0.282***	0.286***	0.288***	0.286***	0.282***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
L1. Δ WACR − Repo#	0.000					0.000				
	(.)					(.)				
L1. Δ 10Y − 91D GSec#		0.000					0.000			
		(.)					(.)			
L1. Δ Repo rate#			0.000					0.000		
			(.)					(.)		
L1. Δ CRR#				0.000					0.000	
				(.)					(.)	
L1. Δ 3-month MIBOR#					0.000					0.000
					(.)					(.)
L1.Cash flow	−0.002	−0.002	−0.002	−0.002	−0.002	0.016*	0.016*	0.016*	0.016*	0.016*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
L1.Sales	0.031***	0.031***	0.031***	0.031***	0.031***	0.080*	0.081*	0.082*	0.082*	0.081*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	67640	67,640	67,640	67,640	67,640	10,712	10,712	10,712	10,712	10,712
No. of Firms	12,296	12,296	12,296	12,296	12,296	3296	3296	3296	3296	3296

CL and CapEx refer to Current Labilities and Capitals Expenditure (in percentage change) respectively. Control variables include lagged net sales and cash flow.
Standard errors are clustered at the firm level. #: The time varying variables get dropped from the specification due to the inclusion of year fixed effects. These are represented by the zero coefficients in the table.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

There are two main channels at play here: (a) a balance sheet channel, owing to the impact of change in policy on the valuation of firms' balance sheets, specifically on their leverage; (b) a bank-lending channel, owing to the impact of change in policy on cost of capital for commercial banks and on their subsequent decision to extend/reduce credit supply to the market. In this section, we essentially try and exploit the variation in the increase in credit by different banks and the variation in leverage ratios of the firms attached to these banks.

Results from the estimation of Equation 3 are presented in Table 4. We have divided the banks into two sets: less liquid (Columns 5 to 8) and more liquid (Columns 1 to 4). First, when examining the effect of term loans in general for the less liquid lenders, we find that an increase in term loans by the banks does not affect the capital expenditure of firms. Interestingly, however, we find that an increase in term loans by these banks leads to an increase in current liabilities of the firms that are attached to those banks. For the highly liquid banks, we see that firms increase capital expenditure in response to an increase in term loans by the attached banks. Firms borrowing from more liquid lenders increase investment through capital formation because liquidity ensures that these lenders can keep lending channels active during the longer-term investment cycle. Unlike the less liquid lenders, we do not find any effect on the current liabilities of the firms. For less liquid banks, lending for short-term (current) purposes mitigates their liquidity risk.

Second, we focus on the coefficient attached to the debt-equity ratio which will tell us the correlation between firm leverage and the dependent variables. For both sets of sub-samples, we find that higher leveraged firms have higher capital expenditure and lower current liabilities. This indicates that more leverage for firms channels into long-term investment growth.

Table 4. Monetary Policy Transmission: OLS.

	Most Liquid Lenders				Least Liquid Lenders			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CL	CL	CapEx	CapEx	CL	CL	CapEx	CapEx
L1. Debt/Equity× $^{\Delta}$ B	0.002[a**]	0.008	0.002	0.106***	0.002**	0.013	0.006*	0.108***
	(0.001)	(0.012)	(0.002)	(0.027)	(0.001)	(0.011)	(0.003)	(0.022)
L1. $^{\Delta}$ Term Loans	0.015		0.262*		0.074**		0.129	
	(0.028)		(0.138)		(0.034)		(0.169)	
L1. $^{\Delta}$ Reference Rate		2.406***		2.857		3.661***		5.601
		(0.760)		(2.688)		(0.886)		(3.696)
L1. Debt/Equity	−0.11***	−0.064***	0.206***	0.281***	−0.110***	−0.067***	0.149**	0.304***
	(0.023)	(0.015)	(0.067)	(0.052)	(0.023)	(0.015)	(0.072)	(0.051)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
N	26863	26,398	5122	5020	26,791	26,876	5085	5142
No. of Firms	4548	4508	1458	1441	4554	4546	1458	1463

CL and CapEx refer to Current Labilities and Capital Expenditure (in percentage change) respectively. Columns 1–4 are for most liquid lenders. Columns 5–8 are for least liquid lenders. Standard errors are clustered at the firm level. Reference rate defined as BPLR (till 2010), Base Rate (between 2010 and 2016), and MCLR (post 2016).

[a]$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Third, we shift our attention to the coefficient of the interaction between term loans and leverage, which tells us how relatively more leveraged firms respond to changes in term loans of the banks that are attached to those firms. Although we find significant coefficients on capital expenditure and current liabilities, which means more leveraged firms increase their capital expenditure and current liabilities in response to an increase in term loans, the economic significance of these coefficients is less which is indicative of a weak balance sheet channel.

Next, we look at the effect of change in bank-lending rates on current liabilities and capital expenditure of the firm. We find that an increase in lending rate by the banks increases current liabilities for firms regardless of whether they are attached to most or least liquid lenders. We do not find any significant effect of change in lending rate on the firm's capital expenditure indicating that a change in the lending rate first affects short-term loans by changing the total borrowing cost of firms which in turn increases current liabilities. However, for capital expenditure that is mainly financed by long-term loans, we didn't find a statistically significant relation.[16]

These results hint at an important mechanism at play: The transmission of monetary policy to long-term investment decisions of the firms is influenced by highly liquid lenders. These banks respond relatively quickly to policy changes and are thus able to transmit these changes to the firms that are attached to them. On the other hand, firms that are attached to less liquid lenders are not able to increase their investments as these lenders are slow to respond to policy changes and are plagued by liquidity risk. This striking result hints at a heterogeneous transmission mechanism based on the liquidity of the banks.[17]

VI. Conclusions

In this paper, we use a unique firm-bank matched data set and provide new evidence of the monetary policy transmission mechanism in India. We show that in addition to slow or lagged monetary policy transmission, an increase in credit may not always find its way towards increasing investments. Firms may use their credit lines to finance their current liabilities rather than undertaking capital formation.

At the firm level, in some cases, we find counter-intuitive results of a change in monetary policy on the firm's balance sheet. This may be because firms' investment decisions may be correlated with the demand conditions in the economy, which may in turn be correlated with the monetary policy cycle. Thus, the effect of monetary policy that we estimate on firms may not reflect the true effect of the policy itself.

Using firm-bank matched data we find evidence that firms which borrow from less liquid banks do not increase their capital expenditure, while current liabilities increase for these firms. This tells us that firms channel their credit lines towards meeting current liabilities while investments take a back seat. On the other hand, we find that firms who borrow from relatively more liquid banks are more responsive to increasing their capital spending when the lenders increase their supply of credit.

The above findings have several policy implications. Policies directed at influencing the term spread could complement policy rate changes in strengthening rate transmission. Further, in the presence of a weak balance sheet channel of policy transmission, an expansionary monetary policy could help firms in meeting their current liabilities rather than raising their fixed capital expenditure.

Notes

1. We define liquidity as the sum of cash in hand, investment in G-Secs and other approved securities normalized by total assets of the bank. Firm leverage is defined as the debt-equity ratio.
2. The number of individual SCBs in the sample varies from 88 in 2005 to 95 in 2019.
3. There are around 1,900 consolidated firms each year compared to 20,800 standalone firms.
4. Hence, we do not assume a pre-given attribution for all firms, and we do not try to associate borrowing data for banker0 with the primary banker.
5. The coverage of firms by NIC-2 sectors in the final panel are available on request.
6. $^{\Delta}B_{b,t} = 100 * \frac{Balancesheetelement_{b,t} - Balancesheetelement_{b,t-1}}{Balancesheetelement_{b,t-1}}$
7. Since we are using annual data, the best proxy for future interest rate expectations in our model is the current interest rate. Other macro-indicators that will shape the future interest rate path, is incorporated in the time dummies.
8. We use the Arellano and Bond (1991) estimation technique for this specification. The GMM results are available on request.
9. GMM results are available on request.
10. GMM results are available on request.
11. Banks may also respond to a monetary policy change by changing their lending rates.These results are available on request.
12. Term spread could also be influenced by the expectation of fiscal supply and monetary policy forward guidance. Forward-looking variables are not included in this study and could be an important extension to the existing literature.
13. The GMM results are available on request.
14. Results are available on request.
15. The GMM results are available on request.
16. The GMM results are available on request.
17. We also use an alternative identification strategy where we use the predicted values of the term loans (from the first stage regressions) to factor out the supply side effects, if any. The results do not change significantly. These results are available on request.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Compliance with Ethical Standards

The authors declare that they have no conflict of interest, no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Notes on contributors

Pranav Garg is a graduate student in Paris School of Economics.

Saurabh Ghosh and *Abhinav Narayanan* are Director and Manager, respectively, in the Department of Economic and Policy Research, Reserve Bank of India.

References

Acharya, V.V. 2017. Monetary transmission in India: why is it important and why hasn't it worked well. *Reserve Bank of India Bulletin* 71, no. 12: 7–16.

Aleem, A. 2010. Transmission mechanism of monetary policy in India. *Journal of Asian Economics* 21, no. 2: 186–97. doi:10.1016/j.asieco.2009.10.001.

Amiti, M. , and D.E. Weinstein. 2018. How much do idiosyncratic bank shocks affect investment? Evidence from matched bank-firm loan data. *Journal of Political Economy* 126, no. 2: 525–87. doi:10.1086/696272.

Arellano, M., and S. Bond. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies* 58, no. 2: 277–97. doi:10.2307/2297968.

Bernanke, B.S., and M. Gertler. 1995. Inside the black box: the credit channel of monetary policy transmission. *The Journal of Economic Perspectives* 9, no. 4: 27–48. doi:10.1257/jep.9.4.27.

Bhoi, B.K., A.K. Mitra, G. Sivaramakrishnan, and J.B. Singh. 2017. Effectiveness of alternative channels of monetary policy transmission: some evidence for India. *Macroeconomics and Finance in Emerging Market Economies* 10, no. 1: 19–38. doi:10.1080/17520843.2016.1188837.

Patrick, B., L. Gambacorta, P. Emilio Mistrulli, and X. Freixas. 2016. Relationship and transaction lending in a crisis. *The Review of Financial Studies* 29, no. 10: 2643–76. doi:10.1093/rfs/hhw041.

Bottero, M., F. Mezzanotti, and S. Lenzu, 2015. Sovereign debt exposure and the bank lending channel: impact on credit supply and the real economy. *Temi di discussione (Economic Working Papers)*, 1032, Bank of Italy, Economic Research and International Relations Area.

Raj, C., and A. Szeidl. 2007. Consumption Commitments and Risk Preferences. *The Quarterly Journal of Economics* 122, no. 2: 831–77. doi:10.1162/qjec.122.2.831.

Chodorow-Reich, G. 2014. The employment effects of credit market disruptions: firm-level evidence from the 2008–09 financial crisis. *The Quarterly Journal of Economics* 129, no. 1: 1–59. doi:10.1093/qje/qjt031.

European Central Bank (ECB). 2011. *Euro area markets for banks' long-term debt financing instruments: recent developments, state of integration and implications for monetary policy transmission*. *ECB Bulletin*. Frankfurt am Main, Germany: European Central Bank.

Gertler, M., and S. Gilchrist. 1994. Monetary policy, business cycles, and the behavior of small manufacturing firms. *The Quarterly Journal of Economics* 109, no. 2: 9–340. doi:10.2307/2118465.

Ghosh, S. 2007. "Relationship lending and financing constraints: firm-level evidence for India." *MPRA Paper*, University Library of Munich, Germany.

Ghosh, S., and S. Ghosh. 2006. Does monetary policy affect a firm's investment through leverage? Micro evidence for India. *Economia Internazionale/ International Economics* 59, no. 1: 17–31.

Khwaja, A.I., and A. Mian. 2005. Do lenders favor politically connected firms? Rent provision in an emerging financial market. *The Quarterly Journal of Economics* 120, no. 4: 1371–411. doi:10.1162/003355305775097524.

Mishkin, F. 2012. *The economics of money, banking, and financial markets*. London, United Kingdom: Pearson.

Prabu, E., and P. Ray. 2019. Monetary policy transmission in financial markets. *Economic & Political Weekly* 54, no. 13: 68–74.

Prasad, A., and S. Ghosh. 2005. "Monetary policy and corporate behaviour in India." *IMF working paper* 05.25.

Rajan, R.G., and L. Zingales. 1998. Financial dependence and growth. *The American Economic Review* 88, no. 3: 559–86.

Reserve Bank of India (RBI). 2014. *Report of the expert committee to revise and strengthen the monetary policy framework*. Committee Report, Reserve Bank of India.

Romer, C.D., and Romer D.H. 1989. Does monetary policy matter? A new test in the spirit of Friedman and Schwartz. *NBER macroeconomics annual* 4, 121–170.

Appendix A: Sources and Definitions

Table A1. Description of Variables

Variable Name	Variable Description	Source
Mumbai Interbank Offered rate (3-month)	The interest rate benchmark at which banks borrow unsecured funds from one another in the Indian interbank market.	RBI DBIE
Liquidity Spread (SPD-1)	The difference between the Weighted Average Call Rate (WACR) and the repo rate provides a measure of liquidity constraint.	RBI DBIE
Repo Rate	The benchmark interest rate at which the RBI lends money to commercial banks for a short term, against G-sec with a repurchasing agreement.	RBI DBIE
Term Spread (SPD-2)	The difference between the yield on a representative 10-year G-sec and the 91-day T-bill yield.	RBI DBIE
Liquidity Ratio	Ratio of liquid assets to total assets for Scheduled Commercial Banks (SCBs), where liquidity is calculated as the total of cash in hand, investments in government securities (G-Secs) and in other approved securities.	RBI DBIE
Term Loans	A measure of long-term loans advanced by commercial banks. It is recorded on the assets side of their balance sheet.	RBI DBIE
Cash Flows	Cash flow from operating activities is the cash generated from the main or primary business activities of a company during an accounting period.	CMIE Prowess dx
Current Liabilities	A firm-level measure of accounts payable (owed to vendors), notes payable, deferred revenues (goods that have been paid but have not been delivered), wages and salaries, property taxes, insurance, interest, dividends, utilities, employee benefits, and short-term bank loans.	CMIE Prowess dx
Capital Expenditure	A measure of investment by firms, calculated as a change in total capital.	CMIE Prowess dx
Debt-Equity Ratio	A measure of a company's financial leverage captured by its debt relative to the value of its net assets.	CMIE Prowess dx
External Financial Dependence (EFD) Ratio	A firm's dependence on external finance is defined as capital expenditures minus cash flow from operations divided by capital expenditures (Rajan and Zingales (1998).	CMIE Prowess dx
Net Sales	A higher net sales reflecting a good sales turnover/ size of the company.	CMIE Prowess dx