Financial Acceleration Through Banks *

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Abstract

Holmstrom and Tirole (1997) show that financial accelerators amplify demand shocks due to changes in firms' and banks' net worth. Extant studies focus more on the firm net worth channel and do not provide micro-evidence for the full chain of events in financial acceleration models. We find a novel bank net worth channel of financial acceleration that operates through the banks' exposure to price-rigid borrowers. This channel exacerbates the effects of monetary policy shocks on price-rigid firms and causes spillover effects on non-price-rigid firms. In terms of relative magnitude, the two channels contribute equally to the overall financial acceleration effect.

Key Words: Monetary policy transmission, Price rigidity, Financial accelerator, Collateral squeeze, Capital crunch

JEL Classification: E50, E51, E58, G21

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1 Introduction

This paper seeks to provide micro-evidence for the full chain of events in financial acceleration models like Holmstrom and Tirole (1997), Kiyotaki and Moore (1997), and Bernanke et al. (1999). In those papers, there is first a shock, either a total factor productivity shock or a monetary policy shock. The shock has a first-round effect due to price stickiness. But it then gets amplified through financial channels: the first round shock reduces borrower net worth, making it harder for them to borrow, and also reduces bank net worth, making it harder for them to lend. Although these channels are qualitatively well understood, their relative magnitudes are unknown. This gap in the literature is due to almost all empirical studies on financial accelerators focusing on the amplifications of initial demand shocks due to changes in firm (borrower) net worth and not much on those caused by changes in bank (lender) net worth.[1] Even the studies that document the bank net worth channel identify the maturity mismatch between banks' assets and liabilities as the mechanism that renders banks' capital sensitive to monetary policy shocks.[2] The mechanism is unrelated to initial demand shocks that disproportionately impact price rigid firms.

Given the above gap in the literature, three important questions remain unanswered: Is credit supply by banks that have high exposure to price-rigid borrowers more sensitive to monetary policy shocks? How big are the spillovers on non-price-rigid firms that come through banks relative to the first-order effect on price-rigid firms? What are the relative magnitudes of the financial accelerator effect caused by shocks to firm net worth and bank net worth? We attempt to answer these questions using the Indian setting.

The availability of product-level data on quantity and revenue and data on bank loans of Indian firms makes the setting apt for this study. Although we derive prices from product revenue, we can identify product prices before any trade discounts or discounts linked to order size, as the accounting standards require these discounts to be shown separately. We discuss this point in section 3.2. We follow De Loecker et al. (2016) and Khandelwal (2010) in this regard. We obtain product-level information for a large set of Indian firms from the database maintained by the Centre for Monitoring Indian Economy (CMIE). We obtain information on loans using the database maintained by the Ministry of Corporate Affairs.

Our measure of price rigidity is based on the idea that a price-rigid firm is unlikely to be able to pass on input price shocks to its customers. We define an "input price shock" as a situation where the input prices of a firm increase at a rate higher than the general inflation rate. Firm-years where product prices rise at a rate lower than the general inflation

[1] See: Bernanke et al. (1994); Almeida and Campello (2007); Ottonello and Winberry (2020); Lian and Ma (2021); Cloyne et al. (2023)

[2] See: Van den Heuvel (2002); Bolton and Freixas (2006)

rate despite the firm facing an input price shock are considered price-rigid firm years. We recognize that one year's price reaction is not sufficient to characterize a firm as price-rigid or flexible, especially given that we do not see intra-year price movements. A firm's price reaction in a year could be driven by several year-specific and other idiosyncratic factors not reflective of the firm's long-term pricing behavior. Therefore, we add a second layer- the frequency of price rigidity. The idea is to characterize firms that repeatedly show price-rigid behavior, as defined above, as price-rigid (PR) firms.[3]

Because our data are at an annual level, we can measure frequency only by creating an estimation period longer than a year. Our estimation period spans the years 2000 to 2010. We estimate the ratio between the number of years in which the firms are price-rigid and the total number of years in the estimation period. We then divide the firms into two groups - firms that lie above and below the median based on the ratio estimated above. Finally, we classify the firms in the above-median group as PR firms. Using the above definition, we study the behavior of firms and banks in the subsequent period, from 2011 to 2021.

The second prerequisite is the identification of first-order demand shocks that trigger the financial accelerator. We use unexpected monetary policy shocks for this purpose. Our measure of monetary policy shock is based on the change in bond yields following the monetary policy announcements. The above measure captures the unanticipated component of monetary policy announcements.

Unexpected changes in nominal interest rates are likely to have a higher first-order impact on PR firms than other firms.[4] In line with the above thesis, we find that the investments and loan performance of PR firms are more responsive to monetary policy shocks compared to non-PR firms. We also find that the differential response of PR firms percolates to banks that have high exposure to PR firms (PR banks): the non-performing assets and capital of PR banks are more responsive to monetary policy shocks compared to other banks. Thus, the first-order monetary policy shocks affect PR firms and banks, potentially initiating the financial accelerator effects. The impact on PR banks could trigger the financial accelerator due to changes in bank net worth (Bernanke et al. (1994), Kiyotaki and Moore (1997)).

We then take up the first question - Is credit supply by banks that have high exposure to price-rigid borrowers (PR banks) more sensitive to monetary policy shocks? To this end, we limit the sample to PR firms and test whether the lending by PR banks to such firms

[3]A limitation in our data is that the product level information is available only at an annual frequency. We mitigate the concern to a large extent by using multiple years of data and determining PR firms by determining the frequency of price-rigid behavior.

[4]See: Bernanke and Gertler (1995); Taylor (1995); Friedman and Schwartz (2008); Pasten et al. (2020); Meier and Reinelt (2022); Woodford (2022); Holm et al. (2021); Baqaee and Farhi (2020); Moran and Queralto (2018); Sheremirov (2020)

shows differentially higher responses to monetary policy shocks compared to other banks. We also include firm × year fixed effects to absorb firm-driven demand effects and the financial acceleration due to firm net worth (Khwaja and Mian (2008)).[5] We find that, within a firm-year, PR banks differentially reduce lending by 11% more than non-PR banks in response to a monetary policy tightening of 10 basis points. Given that the effects due to initial demand shock are largely constant within PR firms, the above result reflects the existence of acceleration due to shocks to PR banks' net worth caused by initial demand shocks.

We proceed to the second question - How big are the spillovers on non-price-rigid firms that come through banks relative to the first-order effect on price-rigid firms? To investigate the above question, we restrict the data to non-PR firms and estimate the differential effect of lending by PR banks to such firms compared to non-PR banks. As before, we include firm × year fixed effects to absorb any time-varying and time-invariant firm-level heterogeneities. We find that within a firm-year the PR banks differentially reduce lending by 8% more than non-PR banks in response to a monetary policy tightening of 10 basis points. The above result captures the spillover effect in the sense that even firms not impacted directly by the demand shock get affected due to the accelerator originating from bank net worth effects.

Finally, we attempt to disentangle the relative magnitudes of the financial accelerator effect caused by shocks to firm net worth and bank net worth. To disentangle the financial accelerator into firm net worth-driven and bank net worth-driven parts, it is necessary first to identify the magnitude of the entire financial accelerator. To quantify the full financial accelerator, we need a comparison (control) group that is potentially not affected by the financial accelerator relative to which we can estimate the magnitude of the financial accelerator. We conjecture that firms affiliated with business groups are close to an ideal control group in the Indian context because such firms have access to funds through internal capital markets.[6] The transactions in the internal capital markets are less likely to suffer from information asymmetries and monitoring costs. Therefore, the financial accelerator channels are expected to have a lower effect on business group firms. A clarification is in order here - we do not claim that the net worth of business group firms is immune to monetary policy shocks. We argue that the business group firms have access to internal sources of credit even when they face rationing by external creditors due to depleted net worth. In line with the above thesis, we find that business group firms show differentially lower responses to monetary policy shocks compared to other firms. Moreover, business group firms use related party loans and investments to offset the bank net worth effects.

[5]Note that the inclusion of firm × year fixed effects does not affect the exposure of banks to first order shocks, which is defined based on the asset composition of the banks.

[6]See: Gopalan et al. (2007); Khanna and Palepu (2000); Almeida et al. (2015); Bertrand et al. (2002); Khanna and Yafeh (2007); Almeida et al. (2015); Masulis et al. (2011); Bae et al. (2002)

Therefore, using firms belonging to business groups as the base in a regression setup, we compare the non-business group firms based on their affiliation to PR banks. We limit the entire sample to PR firms so that first-order demand effects are similar for all firms. Using the firm-bank-year level sample consisting of both business group and non-business group firms, we create two interaction terms: PR bank with non-business group firms and non-PR banks with non-business group firms. The firm-bank-year pairs identified by the first interaction term are exposed to both the firm net worth and bank net worth effects. The second interaction term only captures the firm net worth effect. Finally, the difference between the two terms represents the bank net worth channel of the financial accelerator. We estimate the specification with the logarithm of the loan amount extended by the bank to the respective firm as the outcome variable. Our empirical evidence points to significant magnitudes of both firm and bank net worth effects.

The coefficient on the second interaction term implies that the response of lending to monetary policy shocks is differentially higher by 4.1% in response to a monetary policy shock of 10 basis points due to firm net worth effects. The difference between the coefficients suggests that the response of lending to monetary policy shocks is differentially higher by 4.9% in response to a monetary policy shock of 10 basis points due to bank net worth effects. Thus, we find that the firm net worth effect contributes about half to the total effect of the financial accelerator, whereas the bank net worth effect contributes the remaining half. We also find that the financial accelerators operating through the net worth of firms and banks affect the response of investments to monetary policy shocks.

In the last part of the paper, we conduct robustness tests to address the concerns relating to identification. First, there could be a concern that the results may be due to observable and unobservable endogenous differences between PR and non-PR firms. We address the concern in three ways. First, we use 33 unanticipated monetary policy shocks for identification. Second, we show that PR and non-PR firms are not significantly different based on observable characteristics. Third, we show the robustness of our results with an alternative identification of PR firms based on the four popular theories of price stickiness identified by Blinder (1994). There is a very low likelihood of the existence of a factor (i) that moves precisely with repeated unanticipated monetary policy shocks, (ii) is also related to the price-stickiness theories, and (iii) is not identified by the comparison based on observables.

Second, a reader may be concerned that the results are due to systematic differences between PR and non-PR banks. To address the above concern, we show that the differential susceptibility of PR banks' non-performing assets and capital to monetary policy shocks flow from the PR firms: We conduct borrower level test and show that PR firms indeed default more (less) in response to an unanticipated rate hike (cut). Moreover, we control for alter-

native bank balance sheet factors identified by the extant literature that could potentially influence the bank lending channel of monetary policy transmission and their interaction with monetary policy shock in all our specifications.[7] Finally, we match PR and non-PR banks based on observable characteristics and show that our estimates remain largely unchanged in the matched sample. Hence, there is a low likelihood that any factor other than PR banks' exposure to monetary policy influences their response to monetary policy shocks.

Third, there could also be a concern that business groups systematically differ from non-business groups. Therefore, we match the business group and standalone firms based on observable characteristics and show that our results remain largely unchanged in the matched sample. Finally, we address the following other potential concerns with our identification in section 6 - 1) firms' incomplete pass-through of input prices is due to markup adjustments or local costs, 2) our measure of the firm-level price is affected by product replacement bias, and 3) the observed spill-over effects to non-PR firms is due to supply chain linkages between PR and non-PR firms. Overall, we robustly show the existence of a bank net worth channel of financial acceleration and document that firm and bank net worth channels contribute equally to the overall financial acceleration of shocks.

2 Related Literature

We contribute to the literature that studies the financial accelerator. The literature argues that business fluctuations cause endogenous developments in credit markets due to the presence of credit market frictions that amplify and propagate the initial shocks (Bernanke et al. (1999), Bernanke et al. (1994), Kiyotaki and Moore (1997), Carlstrom et al. (2016), Ottonello and Winberry (2020)). Bernanke et al. (1999) term the above channel of propagation of shocks as the 'financial accelerator.' Holmstrom and Tirole (1997) and Bernanke et al. (1999) theoretically document that the financial accelerator can operate through the firm as well as bank net worth channels. However, a majority of empirical investigations focus on the firm net worth channel of the financial accelerator (Almeida and Campello (2007); Bernanke et al. (1994); Ottonello and Winberry (2020); Lian and Ma (2021); Cloyne et al. (2023)). We contribute to the above literature by empirically showing the financial acceleration through the bank net worth effect. Moreover, we also contribute by quantifying the relative importance of the firm net worth and bank net worth effects.

Our study also speaks to the literature on the bank lending channel of monetary policy transmission. There are two broad strands within this literature. Under the first strand,

[7]See: Kashyap and Stein (2000); Bernanke and Gertler (1995), Drechsler et al. (2017), Jiménez et al. (2014), Bolton and Freixas (2000); Van den Heuvel (2002)

financial market frictions operate through channels other than bank net worth and exacerbate the reaction of bank lending to monetary policy shocks (Kashyap et al. (1996); Bernanke and Gertler (1995); Kashyap and Stein (2000); Friedman and Schwartz (2008); Jiménez et al. (2012, 2014); Drechsler et al. (2017); Pasten et al. (2020); Meier and Reinelt (2022); Holm et al. (2021); Baqaee and Farhi (2020); Moran and Queralto (2018); Sheremirov (2020)). For instance, in Kashyap and Stein (2000), the non-substitutability of bank deposits and commercial papers is the financial market friction at play. Similarly, in Drechsler et al. (2017), the market power of the banks is the friction that drives the deposit channel of policy transmission. In all of the above studies, frictions are unrelated to the initial firm-level demand shocks. We show a bank lending channel that originates from the demand shocks that differentially affect PR firms and, in turn, the PR banks.

A second strand of literature documents that the bank lending channel operates through the impact of monetary policy changes on banks' net worth (Bolton and Freixas (2006), Kashyap and Tantri (2023), Van den Heuvel (2002)). In the above strand of literature, the duration mismatch between assets and liabilities plays a central role. For instance, an increase in interest rate drives up the cost of short-term liabilities but not earnings from long-term assets - thereby depleting banks' net worth. However, in a recent paper Drechsler et al. (2021) show that despite a maturity mismatch between banks' assets and liabilities, the banks' net worth is immune to changes in interest rates due to deposit franchise. We show that monetary policy can still affect banks' net worth due to the portfolio composition of the banks' assets. The net worth of the banks with high exposure to PR firms is more affected by monetary policy changes.

Finally, we also contribute to the literature that studies the consequences of price rigidity. The literature shows that some sort of price rigidity is central to the transmission of monetary policy shocks through the traditional demand channel (Bernanke and Gertler (1995); Taylor (1995); Friedman and Schwartz (2008); Pasten et al. (2020); Meier and Reinelt (2022); Woodford (2022); Holm et al. (2021); Baqaee and Farhi (2020); Moran and Queralto (2018); Sheremirov (2020)). D'Acunto et al. (2018) show that firms with rigid prices take lower leverage ex-ante because they are aware of their vulnerability to shocks. We show that the presence of PR firms in a bank's portfolio influences its lending not only to PR firms but also to non-PR firms when faced with monetary policy shocks. Thus, our study uncovers a bank net worth channel through which price rigidity helps propagate shocks.

3 Institutional Background

3.1 Monetary policy in India

The Reserve Bank of India (RBI or the central bank) reviews its monetary policy stance and rates on a bi-monthly basis. Its primary mandate in conducting the monetary policy is to maintain price stability. The RBI regularly uses two important tools for implementing monetary policy: Repo and reverse repo rates and Cash reserve ratio (CRR).

Repo and Reverse Repo Rates : Repo rate is the rate at which commercial banks can borrow reserves from the central bank by selling eligible collateral such as government and other approved securities. Repos are short-term transactions that can vary from 1 day to 30 days, after which the bank buys back the collateral security from the RBI. The repo rate is the most widely used monetary policy tool. During our sample period, the repo rate varied from a minimum of 4% to a maximum of 8.5%. The repo rate was changed 33 times during this period: of these, in 16 instances, the repo rate was increased.

The reverse repo is the opposite of the repo. Here, the banks lend reserves to the RBI, receive securities in the first leg of the transaction, and reverse the same after a stipulated number of days. The RBI occasionally varies the spread between the repo and reverse repo rates based on its assessment of the liquidity situation.

On a day-to-day basis, the RBI ensures the transmission of its monetary policy stance by maintaining the interbank lending rate for reserves (call rate) within a tight corridor around the repo rate. It conducts appropriate auctions of securities to influence the call rate. The auction it conducts to absorb (release) reserves and raise (reduce) rates in the interbank market is known as the variable rate reverse repo auction (variable rate repo auction).

Cash reserve ratio or *CRR* is the minimum percentage of total deposits that a bank has to maintain as reserves with the RBI. Banks do not earn any interest on these CRR balances. The CRR varied from 4.5% to 9% during the sample period, and there were 7 occasions when the RBI changed the CRR.

However, since 1997 and in line with global practice, the RBI uses the repo rate for its monetary policy operations. As noted above, the policy corridor that guides the movement of interbank lending rate is defined around the repo rate.

3.2 Disclosure of product mix data

As alluded to in section 1, it is necessary to identify PR firms to investigate the central questions of our study. To identify PR firms, we require information on product prices. Schedule VI of The Companies Act 1956 (hereafter, the Act) in India required firms belonging

to the manufacturing sector to report the audited product level information in their annual report. The Indian GAAP mandated firms to report the production capacity, the quantity of sales, and sales value at the product level in their annual 'profit and loss statement.' The regulation applied to manufacturing firms. The reported sales value is before any trade discount. Hence, the sales values are unaffected by any trade discounts. This is because, under the Indian GAAP, trade discounts must be reported separately in financial statements. From the product-wise quantity and revenue information, we derive the price per unit of each firm's product as in Khandelwal (2010), De Loecker et al. (2016) and Bau and Matray (2023).

Such audited firm-product level information is not a mandatory reporting requirement under other accounting standards such as US GAAP or IFRS, the most widely used accounting standards in the US, Europe, and the UK. Even though some firms report the product-level revenue breakdown, they rarely report the quantities at the product level. Therefore, it is not possible to calculate unit prices under those accounting standards. Thus, the product-level audited sales and quantity data available in the Indian companies' financial reports provide us with a unique setting to measure the price rigidity of firms.[8]

To harmonize Indian accounting standards with international standards, the Ministry of Corporate Affairs amended the Companies Act in 2011. Under the revised accounting standards, which closely follow IFRS reporting standards, the quantity and revenue disclosures at the product level were discontinued after 2011. Firms are now required to disclose operating revenues under the classification of revenue from products, revenue from services, and revenue from other operating income. Therefore, we use the price data until the year 2010 for identifying price-rigid firms as explained in section 4.1.1.

3.3 Business Groups

As we describe further in section 5.4.1 below, we need a control group that is less likely to be affected by the financial accelerator channels. We conjecture that firms belonging to business groups fit the purpose. Therefore, we elaborate on the institutional structure of the business group firms below.

Business groups are a collection of firms with diverse businesses acting as independent legal entities but connected by common ownership by an individual, family, or holding firm (Bertrand et al. (2002), Khanna and Rivkin (2001)). Khanna and Palepu (2000) argue that business groups originated and proliferated in India plausibly in response to limited access to capital caused by agency and information problems. Entrepreneurs overcame the limited access to capital by utilizing finance from family to set up businesses, which later led to the

[8]This dataset has been used by several studies in the literature and is representative of the organized manufacturing sector operating in India (Goldberg et al. (2010b), Goldberg et al. (2010a)).

evolution of family-owned business groups. Although the structural changes in the economy following the economic liberalization of 1991, resulted in improved access to capital, the frictions in the capital market remained an impediment (Khanna and Yafeh (2007)). As a result, the business groups continued to flourish even in the post-liberalization period.

The firms affiliated with such business groups could potentially access information about the activities of other firms within the group relatively easily. Consequently, they could mitigate the agency and information problems to a large extent when extending financial resources to other group firms. In sum, the business groups could potentially internally replicate the functions provided by standalone financial intermediary institutions without the associated credit market frictions (Khanna and Palepu (2000), Dai et al. (2024)).

4 Data

The data we use fall under the following five broad categories: (i) raw material and product prices, (ii) key monetary policy tools, (iii) variables from financial statements of firms, (iv) bank loans, and (v) measures of bank health and their operating performance.

4.1 Product prices

We estimate the prices of products using product-level disclosures of revenues and sales quantities for a large set of Indian firms from the database maintained by the CMIE. As noted in section 3.2, we determine the prices of the products as the ratio between revenues and sales quantities. This dataset, available in the "products produced and traded" section in the CMIE, provides product-by-product sales quantities and revenues for 10,073 products related to 6,028 firms. The database also includes disclosures regarding the quantities and costs of raw materials, which aids in determining the prices of these raw materials.

A notable advantage of this product level dataset is its extensive coverage, as the firms included represent almost 70% of the economic activity within the organized industrial sector in India and make up for 75% of the corporate taxes collected by the Government of India (Goldberg et al. (2010b), Goldberg et al. (2010a)).

The product-level data has been used extensively in several notable studies (De Loecker et al. (2016), Khandelwal (2010), Peter et al. (2023), Alfaro and Chari (2014), Stiebale and Vencappa (2022)). For instance, De Loecker et al. (2016) use the price dataset to draw inferences about the impact of trade liberalization on prices. In another study, Khandelwal (2010) employs the price information to examine the quality of exports.

4.1.1 Measure of price rigidity

As elaborated above in section 4.1, a unique feature of the Indian institutional setting is that manufacturing firms were mandated to disclose the sales revenue and quantities at the product level. We exploit the above data to define the measure of price rigidity. Commonly, the literature identifies price-rigid firms (PR firms) based on the intra-year frequency of price changes (Gorodnichenko and Weber (2016); Nakamura and Steinsson (2011, 2012); Bils and Klenow (2004); Klenow and Kryvtsov (2008); Nakamura and Steinsson (2008)). Unfortunately, a limitation of our data is that we observe the product-level disclosures only at a yearly frequency. Therefore, we create a new measure of price-rigidity in a similar spirit as above using the price data at annual frequency. Our measure is based on the intuition that a price-rigid firm is unlikely to pass on the shocks to input prices to their customers.

We identify the shocks to input prices as instances when the change in input prices is higher than the change in the consumer price index (the inflation) as estimated by the National Statistical Office in India. We use inflation as the benchmark since one would expect the price changes to be aligned with the inflation every year. Thus, we categorize firm-years in which product prices change less than the inflation in spite of input prices changing more than the inflation as price-rigid firm years. Note that in our sample period India experienced a positive inflation in all the years. Therefore, our measure is defined for only one direction of change in input and output prices.

However, we recognize that identifying a firm as price-rigid based on the behavior of their prices in a single year is problematic. The behavior of prices in a particular year could be driven by idiosyncratic factors that are specific to that year. Therefore, we add a second layer to the definition of PR firms - the frequency with which we observe the price-rigid behavior. Given that our data are at an annual level, we need a period that is longer than a year for implementing the above definition. As a result, we base our identification of PR firms on the repetitive behavior of firms over a decade-long time period. To implement the above, we divide our sample into two periods - 1) the estimation period - from 2000 to 2010 and 2) the test period - from 2011 to 2021. We use the "estimation period" to determine whether the firm is price-rigid and then implement the tests in the "test period."

Identifying PR firms: We explain the identification of PR firms in detail below. We start with the data related to sales revenue and sales quantities at a firm-product-year level. We use the above data to calculate the product prices as elaborated in section 4.1. Next, we estimate the year-on-year change in product prices at the firm-product-year level.

We then collapse the price changes to a firm-year level before determining the price-rigidity for two reasons. First, to define price rigidity at the firm-product-year level, we will need a one-to-one mapping between a product and raw materials used in that specific

product. However, our data does not allow that level of mapping. Second, all our further tests and definitions are based on firm-level identification of price-rigidity. Therefore, we do not need a price-rigidity measure at the firm-product level.

To aggregate the changes in the product prices from the firm-product-year level to the firm-year level, we take a weighted average of the price changes across all products each year, weighing each price change by the sales revenues. We repeat the above steps to obtain the change in raw material prices at the firm-year level. The only difference is that, in the final step, we weigh the raw material price changes with the Indian Rupee (INR) value of the raw material purchased instead of sales revenues.

Having estimated the firm-year level product and raw material price changes, we identify the firm-years in which the change in product price is below inflation and the change in raw material price is above inflation as PR firm-years. We then calculate the fraction of the years in our estimation period – 2000 to 2010 - which are PR firm-years as per the above definition. In the above step, we require that a firm has at least three years of price data in the estimation period for it to be included in the sample. Finally, we divide the set of firms into two groups - 1) firms that have above the median value of the fraction of PR firm-years and 2) firms that have below the median value of the fraction of PR firm-years. We identify the former set as PR firms and the latter set as non-PR firms.

We illustrate the above measure with an example. Let us say there is a firm A with an average product and average raw material price change of 5% and 30%, respectively, in the year 2002. Let the inflation be 10%. Therefore, in 2002, firm A's change in product price was below inflation when the change in raw material price was above inflation. Therefore, the year 2002 is identified as a PR year for firm A. Similarly, we identify the fraction of years – between 2001 and 2010 – in which firm A meets the above criteria. If firm A has an above median value of the above-estimated fraction among all the firms, it is classified as a PR firm and a non-PR firm otherwise. We do a sanity test in section B of the online appendix and show that sales by the PR firms are less sensitive to changes in input prices. The above result shows that the identified PR firms are indeed less likely to pass on changes in input prices to their customers.

A clarification is in order here. A concern related to using data at annual frequency for measuring price-rigidity could be that the prices of even the price-rigid firms are likely to be flexible at the annual horizon. Hence, any unexpected shock to the input price may fully pass on to the output price within the year, and the year-end price of PR and non-PR firms may not show any difference. For instance, Bils and Klenow (2004) estimate a median duration of price-rigidity to be 4.3 months. Therefore, using year-end prices at an annual frequency may not show any variation between PR and non-PR firms.

However, the reader may note that we use average prices within the year for our measure, not year-end prices. Therefore, even if the PR firm fully passes on an unexpected increase in input price to output price within the year, it will have sold more units at a lower price than non-PR firms because of slow price adjustment. Our measure will correctly identify the PR firm as the one with the lower average price during the year.

Identifying PR banks: We next measure the banks' exposure to PR firms. The exposure is defined as the ratio between banks' outstanding loans to price rigid firms and the total outstanding loans to our sample of firms. For illustration, let a bank have 100 borrowers, of which the measure of price-rigidity is available for 80 borrowers. Let 30 of the 80 firms be price-rigid (PR firms). The exposure of banks to PR firms is defined using the sample of 80 firms for which price-rigidity is identified. The exposure is the ratio between banks' outstanding loans to these 30 PR firms and the total banks' outstanding loans to all the 80 firms. We update the measure of exposure each year based on the outstanding loan with the sample of these 80 firms in the respective year. The implicit assumption in the above measure is that the distribution of PR firms is the same in the sample of the rest of the 20 firms for which price-rigidity could not be estimated.

Having identified the PR firms and banks' exposure to the PR firms, we next estimate our regression models on the data from the "test period" - 2011 to 2021. We consider the set of PR firms to be constant throughout our "test period." Note that the set of PR banks keep changing every year during the "test period" based on the banks' exposure to PR firms.

4.2 Measure Of Monetary Policy Shock

Extant literature has documented that the current and expected macroeconomic environment may be endogenous to changes in policy rates (Nakamura and Steinsson (2018), Romer and Romer (2004)). The above issue may potentially introduce bias in identifying the effects of policy rate changes on firm outcomes. Specifically, the threat to our identification follows from the reverse causality concern pointed out by Nakamura and Steinsson (2018) - "Output and interest rates are jointly determined. An assumption must be made about whether the contemporaneous correlation between these variables is taken to reflect a causal influence of one on the other or the reverse." In our setting, the expected change in firm outcomes may influence the decision to change policy rates. The above scenario results in a reverse causality concern - the expected future firm performance impacts policy rate changes.

A solution proposed in the literature for the above concern involves measuring the unexpected component of the monetary policy change using the reaction of high-frequency indicators such as interest rate futures to monetary policy announcements (Gorodnichenko

and Weber (2016), Hanson and Stein (2015)). The rationale is that the expected changes in the macroeconomic environment are already captured in the futures price. Consequently, any change in price around the policy announcement captures the shock component that is exogenous to the macroeconomic environment.

The interest rate futures market was non-existent in India during the majority of our sample period. Therefore, any price discovery is expected to happen in the spot markets. Consequently, we rely on the yield of publicly traded 3-month government bonds for estimating the monetary policy shock.[9] Our thesis is that any expected changes in the macroeconomic environment are already priced in the bond market. Thus, the bond's reaction to the monetary policy announcement captures the unexpected component of monetary policy or the "monetary policy shock." We derive the measure in the following way.

We collect the data on the announcement dates of the RBI's monetary policy from their website. Next, we calculate the cumulative change in yield in the one-week (7-day) period after each monetary policy announcement date. Finally, we cumulate the 7-day change in yields corresponding to each monetary policy announcement within the year to arrive at a yearly measure of monetary policy shock - MP_shock. The average monetary policy shock in a year stands at 10 bps (refer table 2). We present an elaborate discussion about the measure in section C of the online appendix.

Impulse Response: We validate whether the above measure of monetary policy shock affects the aggregate macroeconomic variables in the expected direction. We use time-series aggregate data for the tests. Therefore, to ensure that we have power in the tests, we estimate the following specification on quarterly data in the estimation period - 2000 to 2011.

$$Y_q = \alpha + \beta_1 \times \sum_{i=q-1}^{i=q-6} MP_shock_i + \epsilon_q \tag{1}$$

Where Y_q represents GDP growth and year-on-year growth in GDP deflator. The growth in the GDP deflator represents the measure of price inflation. We plot the coefficient of the estimates in Figure A1 of the online appendix. We show that both GDP growth and price inflation have a negative relationship with monetary policy shock, as expected. We find that the response of GDP growth to monetary policy shock starts from the subsequent quarter and persists until the fourth quarter. We find that the effect on growth in the GDP deflator starts from the second quarter and persists until the fifth quarter. Hence, the measure of monetary policy shock affects growth and price inflation in the expected direction.

[9]The policy rates represent the short-term interest rate. Therefore, we use the return of the 3-month government bond in our estimation.

4.3 Financial And Lending Data

We use the prowess database to obtain firm-year-level outcomes such as asset size, investments, interest coverage ratio, ROA, and debt outstanding from the "standalone financial statements" section. We obtain financial measures for banks, such as gross non-performing assets (GNPA), return on assets (ROA), capital adequacy ratio, and other financial characteristics from the same section of the database as above. Further, we source group affiliation of firms from the "Ownership" subsection within the "Identity" section of the prowess database. We also obtain the loan performance data at the firm-bank-year level from TransUnion CIBIL, the largest credit bureau in India.

Finally, we obtain data relating to bank loans from the database maintained by the Ministry of Corporate Affairs (MCA). The data include all secured loans issued in India that have been registered with the MCA and cover more than 50% of all the private commercial credit in India (Chopra et al. (2021)). The database includes identifiers for borrowers and lenders, amount of loan, loan issuance date, and loan repayment date.

4.4 Sample Construction

To create the sample of firms, we start with 12,352 manufacturing firms that exist in the sales and raw material quantity dataset in the "estimation period" - from 2000 to 2010. Of these, 9,183 firms have at least one year of price data in the sample. From the above sample, we drop firms with less than three years of data in the sample. The above filter finally leaves us with a sample of 6,838 firms for which we could determine the price-rigidity identifier. We show the above sample construction in Table 1. The above constant sample of 6,838 firms is used in our estimations in the "test period" - from 2011 to 2021.[10] The financial data are available for 6,028 of the above firms, 2,816 of which are categorized as PR firms. A total of 684 out of the 2,816 PR firms are associated with business groups.

Using the lending data from MCA, we create a firm-bank-year level panel using the following algorithm. We start with a panel of all firm-bank-year observations having a lending relationship in 2011. We add a firm-bank pair to the above panel whenever the bank extends a new loan to the firm and drop the firm-bank pairs whenever the firm fully repays the outstanding loan to the bank. Our panel spans the years 2011 to 2021.

Overall, there are 53,372 firm-year observations corresponding to the 6,028 firms with financial data for tests related to firm outcomes. However, we have information about investment available for 52,035 of the firm-year observations. Our bank-level tests involve

[10]Our sample size of firms where price level information is available is broadly in line with the sample sizes reported in other prominent studies such as Bau and Matray (2023) and Goldberg et al. (2010a).

1,572 bank-quarters corresponding to the 54 banks in our sample. Finally, the panel of firm-bank lending relations created above includes 152,064 firm-bank-year observations. We present the sample construction in Table 1 and the summary statistics of the variables in Table 2. We define the variables in Table A1 of the online appendix.

5 Results

5.1 Susceptibility of PR firms and banks to monetary policy shocks

We conjecture that the bank net worth channel of the financial accelerator should manifest through banks that have high exposure to borrowers with nominal price rigidities. The intuition is as follows. Extant literature documents that firms differ in their vulnerability to the demand channel of monetary policy transmission based on the extent of their price rigidity.[11] Thus, the first-order effects of monetary policy shocks are expected to impact the performance of price-rigid firms (PR firms) differentially. In turn, the financial performance of the banks that have high exposure to such borrowers (PR banks) should also respond more to the monetary policy shocks. The impact on financial performance should lead to the net worth of impacted banks responding more to monetary policy shocks and, in turn, activate the bank net worth channel of financial accelerators (Holmstrom and Tirole (1997)).

We next examine the entire chain of events laid out above in the sections below.

5.1.1 PR firms and monetary policy shocks

We focus on the response of PR firms first. We formally test whether PR firms are more vulnerable to the demand channel of monetary policy transmission. We estimate the following specification using firm-year level. The sample spans 2011 to 2021.

$$\begin{aligned} Y_{i,t} =& \alpha + \beta_1 \times rigid_i + \beta_2 \times MP_shock_{t-1} + \beta_3 \times rigid_i \times MP_shock_{t-1} \\ &+ \beta_4 \times X_{i,t} \times MP_shock_{t-1} + \delta_i + \gamma_t + \epsilon_{i,t} \end{aligned} \tag{2}$$

Here, $Y_{i,t}$ represents investments and loan delinquencies for firm i in year t. We use the natural logarithm of addition to gross fixed assets (*Log gfa*) and the natural logarithm of addition to gross property, plant, and equipment (*Log ppe*) as measures of investment. We gauge loan delinquencies by the firm using the indicator variable *default* that is set to one if the firm fails to repay any of its borrowing liabilities in the year and zero otherwise.

[11] See: Bernanke and Gertler (1995); Taylor (1995); Friedman and Schwartz (2008); Pasten et al. (2020); Meier and Reinelt (2022); Woodford (2022); Holm et al. (2021); Baqaee and Farhi (2020); Moran and Queralto (2018); Sheremirov (2020)

The indicator variable *rigid* is set to one for PR firms and zero otherwise. The PR firms are as defined in section 4.1.1 above. The variable MP_shock is as defined in section 4.2. A positive value of MP_shock represents 'contractionary monetary policy,' while a negative MP_shock represents 'expansionary monetary policy.'

The term $X_{i,t} \times MP_shock_{t-1}$ represents a vector of firm-level time-varying control variables and their interactions with MP_shock. We follow D'Acunto et al. (2018) and include the following set of control variables - 1) the total assets of the firm, 2) the return on assets, 3) the ratio between total borrowings and total assets, and 4) the market power of the firm measured by their market share in the respective industries. The above variables are likely to influence the pricing power of firms (Schwartzman (1959); Deneckere and Kovenock (1992)). The interaction of the control variables with the MP_shock ensures that we also account for the heterogeneous reaction of the cross-section of firms to monetary policy shocks that are correlated with the above set of control variables.

The variables δ_i and γ_t represent firm and year fixed effects, respectively. The firm-level fixed effects absorb any firm-level time-invariant shocks, whereas the year-level fixed effects capture the impact of any common time-specific trends. The coefficient of interest is β_3, which represents the differential change in outcomes of PR firms compared to other firms in response to monetary policy shocks.

The estimates from the above model are presented in Table 3. The data are organized at a firm-year level. The dependent variable is the natural logarithm of addition to gross fixed assets in the regression models of Columns 1 and 2, the natural logarithm of addition to the property, plants, and equipment (PPE) in Columns 3 and 4, and *default* in Columns 5 and 6. The main explanatory variable is an interaction between *rigid* and MP_shock. We include firm-year level control variables listed above in the even-numbered columns. We also include firm and year fixed effects in all the columns. The standard errors are two-way, clustered at the industry and year level, and adjusted for heteroskedasticity. We use the National Industrial Classification (NIC)'s two-digit classification to identify industries.[12]

We first discuss the estimates of the difference in investment activities of PR firms and other firms after changes in monetary policy presented in Columns 1 to 4 of Table 3. The coefficient on the interaction term is negative and statistically significant across specifications. The PR firms decrease investments more than non-PR firms following monetary policy tightening and vice versa. The PR firms exhibit a 1.3% larger decline in investment in response to a monetary policy tightening of 10 basis points. Since the mean level of annual investment rate in the gross fixed assets of a firm is 17%, our regression coefficient represents an economically meaningful 8% of the unconditional rate of investment in gross fixed assets.

[12]NIC is a 5-digit code for the classification of firms based on their major business activity.

We next investigate the differential change in the likelihood of loan delinquency by PR firms in response to monetary policy shocks. The results presented in Columns 5 and 6 show that the response of the likelihood of loan delinquencies to monetary policy shocks is higher for PR firms compared to other firms. A monetary policy tightening of 10 basis points is associated with a 5 basis points higher likelihood of default by PR firms compared to other firms and vice versa. The higher default rate of 5 basis points represents an economically significant 20% of the unconditional average of the year-on-year change in the rate of default.

The above results are consistent with the thesis that PR firms are more vulnerable to the demand channel of monetary policy transmission compared to other firms.[13]

Impulse response: To estimate the dynamic effects of monetary policy shocks on the investments and loan performance of PR firms, we also implement the following specification. The data are at the firm-year level and span from 2011 to 2021.

$$\begin{aligned} Y_{i,t} =& \alpha + \beta_1 \times rigid_i + \sum_{n=1}^{n=6} \beta_{2,n} \times MP_shock_{t-n} + \sum_{n=1}^{n=6} \beta_{3,n} \times rigid_i \times MP_shock_{t-n} \\ &+ \delta_i + \gamma_t + \epsilon_{i,t} \end{aligned} \tag{3}$$

Here, $Y_{i,t}$ represents investments and loan delinquencies for firm i in year t as in equation 2. The variable MP_shock_{t-n} is the measure of monetary policy shocks in the year $t-n$. We plot the coefficients $\beta_{3,n}$ in Figure 1. In panel A, the dependent variable is the natural logarithm of gross fixed assets, while in panel B, the dependent variable is an indicator that identifies loan delinquency. Consistent with the result above, we find that the differential response of PR firms' investments and loan delinquencies to monetary policy shocks starts from the immediate subsequent year and lasts for just one year.

5.1.2 PR Banks and monetary policy shocks

We next focus on the PR banks. As shown above, loan delinquencies by PR firms are differentially more sensitive to monetary policy shocks. The loan delinquencies by the PR firms could potentially percolate to the balance sheets of their lenders. Therefore, the non-performing assets of the banks that are more exposed to PR firms (PR banks) are more likely to be responsive to monetary policy shocks. Consequently, we expect banks' profits to be more responsive to such shocks, which translates to a differentially higher responsiveness of

[13] We also test the thesis using the stock returns of the firms on the monetary policy announcement dates. We ask whether PR firms' stock prices show a differentially higher negative response to an announcement of an increase in repo rates. We present the results in Table A2 of the online appendix and find that the stock prices of PR firms are indeed more likely to move down in response to an increase in repo rate.

banks' capital or net worth. We test the above hypothesis using the following specification estimated on bank-quarter level data for the sample period from 2011 to 2021.[14]

$$\begin{aligned} Y_{j,t} =& \alpha + \beta_1 \times rigid_exposure_{j,t-1} + \beta_2 \times MP_shock_{t-1} + \beta_3 \times rigid_exposure_{j,t-1} \\ & \times MP_shock_{t-1} + \beta_4 \times X_{j,t} \times MP_shock_{t-1} + \delta_j + \gamma_t + \epsilon_{j,t} \end{aligned} \tag{4}$$

Here, $Y_{j,t}$ represents bank j's performance in quarter t. The performance is measured using GNPA slippage and capital adequacy ratio. GNPA slippage is the percentage of fresh addition of gross non-performing assets (GNPA) during the year in relation to the total outstanding loans of the bank. A positive value of GNPA slippage indicates a fresh accumulation of non-performing loans and a worsening loan quality of the bank. Capital adequacy ratio is the ratio between total capital and the total risk-weighted assets of the bank in the year. We define an indicator variable *rigid_exposure* that takes the value of one for bank-years having high exposure to PR firms in the previous year and zero otherwise. High exposure is defined based on the proportion of a bank's loan book exposed to PR firms at the end of the previous year. A level of exposure that is above the median level of exposure for all banks is considered high exposure. For simplicity, we refer to the banks with high exposure to PR firms as *PR banks*. The variable MP_shock is as defined in Section 4.2.

Finally, the term $X_{j,t} \times MP_shock_{t-1}$ represents a bank-quarter level vector of control variables and their interactions with monetary policy shocks (MP_shock). The control variables are- 1) liquid assets to total asset ratio, 2) the proportion of a bank's outstanding loan coming from districts in which the bank under consideration has a dominant (greater than 75%) market share in the loan market, 3) deposit to total asset ratio, 4) capital adequacy ratio of the banks and 5) ratio between the weighted number of days of deposit and the weighted number of days of advances.[15]

We include the above control variables to alleviate the concerns about endogeneity from alternative bank lending channels of monetary policy transmission. The first term, 'liquid assets to total assets ratio and its interaction with change in monetary policy,' controls for liquidity in the bank balance sheet. The variable and its interaction with MP_shock are likely to absorb the impact of the traditional bank lending channel that works through the loss of reserves and the difficulty of replacing reservable deposits. Banks with more liquid

[14]Note that, unlike yearly frequency data of firms used in section 5.1.1, we employ quarterly frequency data for bank-level tests because bank-level information is available at a quarterly frequency in prowess. Moreover, India had 54 scheduled commercial banks during our sample period. Thus, employing quarterly frequency data allows us to test our hypothesis without compromising on the power of the test.

[15]We define the market share of a bank as the ratio between the bank's outstanding loan with the firms in the district to the total outstanding loan by the firms in the district at the start of our sample period.

balance sheets should be less impacted by the above channel (Kashyap and Stein (2000); Bernanke and Gertler (1995)).

The second term accounts for the market power of the bank to account for the working of the deposit channel of monetary policy transmission (Drechsler et al. (2017)). Under the deposit channel, the local monopoly power of a bank allows it to increase spreads on deposits when monetary policy tightens. This leads to an outflow of deposits and a contraction in lending. Since the source of the working of the channel is the banks' market power, we include the bank's extent of lending in districts in which it enjoys a high market share and its interaction with MP_shock as a control variable. Moreover, we also control for the deposit to total asset ratio (the third term) because the deposit channel shown by Drechsler et al. (2017) is a function of dependence of banks on deposits.

We include the fourth term to account for the the capital channel of monetary policy transmission (Jiménez et al. (2014)). Finally, we include the 'ratio between the weighted number of days of deposit and the weighted number of days of advances' to control for maturity mismatch between assets and liabilities in the bank balance sheet. This control is crucial because changes in interest rates can have a larger effect on longer-term assets and liabilities than short-term assets and liabilities. Thus, the above variable and its interaction with MP_shock helps alleviate the concern that the results are driven by the differential responsiveness of banks' capital to monetary policy shocks owing to maturity mismatch between assets and liabilities (Bolton and Freixas (2000); Van den Heuvel (2002)). Thus, our proposed channel of differential transmission of monetary policy due to its impact on banks' capital is over and above the other potential channels.

The variables δ_j and γ_t represent bank and year fixed effects. The fixed effects absorb bank-level time invariant shocks and time-varying economy-wide shocks affecting all banks. The coefficient of interest is β_3, which represents the differential change in GNPA or capital adequacy ratio after monetary policy change for PR banks compared to other banks.

The results are presented in Table 4. The dependent variable in Columns 1 and 2 is *GNPA slippage*. The dependent variable in the regression models of Columns 3 and 4 is *capital adequacy ratio*. The main explanatory variable is an interaction between indicator variable *rigid_exposure* and MP_shock.

In columns 1 and 2, the measure of bank performance is *GNPA slippage*. We find that the coefficient on the interaction term between *rigid_exposure* and MP_shock is positive and statistically significant. The PR banks experience an 8.7 basis points higher increase in GNPA slippage in response to a monetary tightening of 10 basis points compared to other banks, and vice-versa. The difference is economically significant as it is close to 30% of the unconditional average of the year-on-year change in GNPA slippage in our sample. The

results imply that banks highly exposed to PR firms face higher NPA additions following a monetary policy tightening and vice versa.

We present the results with capital adequacy ratio as the dependent variable in columns 3 and 4 of Table 4. We find that the coefficient on the interaction term *rigid_exposure* and MP_shock is negative and statistically significant. The PR banks experience an 8 basis points larger decline in capital adequacy ratio in response to a monetary tightening of 10 basis points compared to other banks and vice versa. The difference in differences coefficient is economically significant as it is close to 1.6 times the unconditional average of the year-on-year change in capital adequacy ratio in our sample. Thus, the monetary policy shock has a more pronounced impact on the capital of the PR banks than on non-PR banks.

The above results validate the thesis that the NPAs and, in turn, the capital of the PR banks are differentially more responsive to monetary policy shocks compared to other banks.

A reader may be concerned that any factor other than banks' exposure to PR firms drives the differential susceptibility of PR banks to monetary policy shocks. Two features of our identification strategy substantially reduce such possibility. First, we show the sensitivity of PR banks' GNPAs to monetary policy transmission in two steps: 1) PR firms' default rate is more sensitive to monetary policy transmission, and 2) PR banks' NPAs are relatively more sensitive to monetary policy than those of other banks. Hence, the sensitivity of PR banks' NPAs is directly linked to the sensitivity of PR firms' loan default rate to monetary policy shocks. Second, we account for other determinants of banks' sensitivity to monetary policy shocks by including a comprehensive set of control variables and their interaction with MP_shock. Therefore, any other factor needs to meet the following conditions to be a threat to our identification - 1) the factor moves precisely with monetary policy shocks; 2) the factor affects the cross-section of both PR firms and PR banks differentially more; and 3) the factor is orthogonal to other known determinants of monetary policy transmission through bank lending channel. The likelihood of such a factor being present is very low.

5.2 Financial acceleration due to bank net worth effects

Having shown that the net worth of PR banks is more responsive to monetary policy shocks, we take up the question - are the effects on price-rigid firms bigger at more affected banks (PR banks)? Holmstrom and Tirole (1997) show that the shocks to the net worth of banks lead to a "credit crunch" that translates to real effects such as a reduction in lending. Therefore, we hypothesize that the effect of monetary policy shocks on PR firms is larger through their PR banks. The above thesis encapsulates the financial accelerator through bank net worth.

To test the thesis, we organize the data at the firm-bank-year level. We limit the sample

to PR firms and ask whether the response of lending to monetary policy shocks is higher in the case of PR banks compared to other banks. We estimate the following empirical specification on data spanning from 2011 and 2021.

$$\begin{aligned} Y_{i,j,t} =& \alpha + \beta_1 \times MP_shock_{t-1} + \beta_2 \times rigid_exposure_{j,t-1} + \beta_3 \times rigid_exposure_{j,t-1} \\ & \times MP_shock_{t-1} + \beta_5 \times X_{j,t} \times MP_shock_{t-1} + \delta_{i,t} + \gamma_j + \epsilon_{i,t} \end{aligned} \tag{5}$$

Here, $Y_{i,j,t}$ is the natural logarithm of loans extended by bank j to firm i in year t. The indicator variable *rigid_exposure* denotes PR banks and is defined in section 5.1.2. The variable $X_{j,t}$ represents bank-year level control variables and their interactions with MP_shock as listed in equation 4. The coefficient β_3 estimates the additional response of lending by PR banks due to monetary policy shocks compared to other banks.

The variables $\delta_{i,t}$ and γ_j represent firm $\times$ year and bank fixed effects. The inclusion of firm $\times$ year fixed effects absorbs any effect due to firm demand and the firm net worth channel (Khwaja and Mian (2008)). Thus, the estimates are within the firm across PR and non-PR banks. Note that the inclusion of firm $\times$ year fixed effects does not block the demand shocks (monetary policy shocks) from operating through the bank net worth. The above channel is identified through our definition of PR banks based on their exposure to PR firms, which is unrelated to the fixed effects.

Results are presented in columns 1 and 2 of panel A of Table 5. We include the bank-year level control variables in column 2. We also include $firm \times year$ and bank fixed effects in all columns. In our most saturated specification, we find that the coefficient of the interaction is negative and statistically significant. The above result indicates that, within a firm-year, the response of lending to monetary policy shocks is higher for PR banks compared to non-PR banks. The coefficient implies that the PR banks experience a 11% higher decline in lending in response to a monetary policy tightening of 10 basis points compared to non-PR banks and vice versa.[16]

We also present the results with an indicator variable that identifies if the bank extends a loan to the respective firm as the dependent variable in columns 3 and 4 of panel A of Table 5. Our conclusions remain largely similar to columns 1 and 2, as discussed above.

Overall, our results are consistent with the thesis that the effects are larger on PR firms at affected banks. Moreover, in a sample restricted to PR firms, any first-order demand effect is cross-sectionally absorbed. Therefore, the results essentially reflect the financial acceleration due to the bank net worth channel operating through the PR banks.

[16]Note that the magnitude of our estimate of the effect of financial acceleration is 28% increase in lending for a 25 bps change in policy rate. It is comparable to Bernanke et al. (1999), who document an effect of nearly 40% differential increase in output after two-quarters of a 25 bps rate shock.

Event study: We also estimate the dynamic effects of monetary policy shocks on lending by PR banks. We implement the following event study specification. The data are at the firm-bank-year level and span from 2011 to 2021.

$$\begin{aligned} Y_{i,j,t} =& \alpha + \sum_{n=1}^{n=6} \beta_{1,n} \times MP_shock_{t-n} + \sum_{n=1}^{n=6} \beta_{2,n} \times rigid_exposure_{j,t-n} \\ &+ \sum_{n=1}^{n=6} \beta_{3,n} \times rigid_exposure_{j,t-n} \times MP_shock_{t-n} + \delta_{i,t} + \gamma_j + \epsilon_{i,t} \end{aligned} \tag{6}$$

Here, $Y_{i,j,t}$ is the natural logarithm of loans extended by bank j to firm i in year t as in equation 5. The variable MP_shock_{t-n} is the measure of monetary policy shocks in the year $t-n$. The variable $rigid_exposure_{j,t-n}$ represents exposure of banks to PR firms in the year $t-n$. We restrict the data to PR firms and plot the coefficients $\beta_{3,n}$ in panel A of Figure 2. Consistent with the result above, we find that the differential response of lending by PR banks to monetary policy shocks start from the immediate subsequent year and last up to four years.

5.3 Spill over to non-PR firms

We next investigate the second question - how big are the spillovers on non-price-rigid firms that come through banks relative to the first-order effect on price-rigid firms? The non-PR firms are relatively less affected by the demand channel. Therefore, the impact of the bank net worth channel on non-PR firms is a spillover effect. To estimate the spillover effects, we limit the sample to non-PR firms and ask whether the response of lending to monetary policy shocks is larger in the case of PR banks compared to non-PR banks.

We implement the following specification on a firm-bank-year level data spanning from 2011 to 2021 for the estimation. We restrict the sample to non-PR firms.

$$\begin{aligned} Y_{i,j,t} =& \alpha + \beta_1 \times MP_shock_{t-1} + \beta_2 \times rigid_exposure_{j,t-1} + \beta_3 \times rigid_exposure_{j,t-1} \\ &\times MP_shock_{t-1} + \beta_4 \times X_{j,t} \times MP_shock_{t-1} + \delta_{i,t} + \gamma_j + \epsilon_{i,t} \end{aligned} \tag{7}$$

The variables are as defined in equation 5. The coefficient of interest is β_3, which represents the within a firm-year incremental response of lending to monetary policy shock in PR banks compared to other banks.

We present the results in columns 1 and 2 of panel B of Table 5. The dependent variable is the natural logarithm of the loan amount extended by the banks to respective firms. We

include the bank-year level control variables and their interactions with MP_shock in column 2. All columns include firm × year and bank fixed effects. The firm × year fixed effects ensure that any time-varying and time-invariant firm-level shocks are absorbed. As expected, the coefficient on the interaction term is negative and statistically significant. The response of lending to monetary policy shocks is higher in PR banks compared to other banks.

In the full-fledged specification of column 2, the coefficient on the interaction term is -0.821. The coefficient implies that, within a firm-year, the PR banks exhibit an 8% higher decline in lending in response to a monetary policy tightening of 10 basis points compared to non-PR banks, and vice-versa. The estimate represents the spill-over effect of exposure of banks to PR firms on lending supply to non-PR firms.

We also present the results with an indicator variable that identifies if the bank extends a loan to the respective firm as the dependent variable in columns 3 and 4 of panel B of Table 5. Our conclusions remain largely similar to columns 1 and 2. The above results indicate that bank net worth channels operating through the PR banks have spill-over effects on firms that are otherwise unaffected by the traditional demand channel (non-PR firms).

We also plot the event study coefficients analogous to equation 6 for data restricted to non-PR firms in panel B of Figure 2. Consistent with the result above, we find that the spillover effects on non-PR firms starts from the immediate subsequent year and lasts up to four years.

5.4 Disentangling channels of financial accelerator

Finally, we investigate the question - what are the relative magnitudes of the financial accelerator effect caused by shocks to firm net worth and bank net worth? To answer the above question, we need to estimate the magnitude of the overall financial accelerator first. This requires a sample in which the demand channel is largely similar and a comparison group relatively immune from the financial accelerator. To meet the former requirement, we restrict the sample to PR firms so that the demand effect is largely constant in the cross-section.

We lean on the theoretical literature documenting financial accelerator channels to meet the latter requirement of a control group less exposed to the financial accelerator. Holmstrom and Tirole (1997) show that demand-side shocks such as TFP shocks or monetary policy shocks that result in collateral squeeze (reduction in firm net worth) or credit crunch (reduction in bank net worth) lead to a reduction in aggregate investment. Two factors play an important role in the model. First, there is information asymmetry between borrowers and their external lenders. Since the external lenders cannot perfectly observe the output of the borrowers, they demand collateral against the loans. Second, even though the banks are

less vulnerable to information asymmetry due to their ability to monitor, they need to maintain capital to make a credible commitment to monitoring. Hence, the financial acceleration of shocks can operate through constraints on the net worth of banks as well as firms.

Therefore, a set of firms that are less affected by their own net worth constraints and the constraints faced by their lenders is a good control group. We hypothesize that business group firms closely fit the criteria. As elaborated in section 3.3 above, such firms have easy access to internal capital markets (Gopalan et al. (2007), Khanna and Palepu (2000), Almeida et al. (2015)). The business group firms are less likely to face information asymmetry when extending credit to firms within the group (Khanna and Palepu (2000)). Thus, the collateral squeeze or firm net worth channel is less intense. The business group firms also face lower monitoring costs for intra-group transactions. Thus, the credit crunch or bank net worth channel is less intense. In fact, overcoming financial market frictions that cause the financial accelerator is one of the important motivations for business group formation (Khanna and Palepu (2000)). Therefore, the business group firms are close to the ideal control group.

Our claim is not that the net worth of business group firms is unaffected by monetary policy shocks. Our argument is that the business group firms can fulfil their loan demand from internal capital markets even when the net worth falls below the threshold at which such borrowers would face rationing from external creditors. Therefore, the business group firms are relatively immune from the financial acceleration channel in the above sense.

We first show that the business group firms are less vulnerable to monetary policy shocks. Then, we proceed to conduct tests for disentangling the two channels.

5.4.1 Response of Business groups to monetary policy shocks

If business group firms are less affected by the financial accelerator, they should show a lower response of investments to monetary policy shocks. We test the thesis by estimating the following specification using firm-year level data. The sample spans 2011 to 2021.

$$\begin{aligned} Y_{i,t} =& \alpha + \beta_1 \times group_i + \beta_2 \times MP_shock_{t-1} + \beta_3 \times group_i \times MP_shock_{t-1} \\ &+ \beta_4 \times X_{i,t} \times MP_shock_{t-1} + \delta_i + \gamma_t + \epsilon_{i,t} \end{aligned} \tag{8}$$

Here, $Y_{i,t}$ represents the outcome related to investments for firm i in year t. We use the natural logarithm of addition to gross fixed assets and the natural logarithm of addition to gross property, plant, and equipment (PPE) as measures of investment. The indicator variable *group* takes a value of one for business group-affiliated firms and zero otherwise. The rest of the variables are as defined in equation 2 above. The coefficient of interest is β_3, which represents the differential change in outcomes of business group firms compared

to other firms in response to monetary policy shocks.

We present the result in Table 6. In columns 1 and 2 (3 and 4), the dependent variable is the logarithm of gross fixed assets (logarithm of gross PPE). We include the firm-year level control variables listed in equation 2 in the even-numbered columns. We incorporate firm and year-level fixed effects across all columns to absorb time-invariant firm-level heterogeneity and time-variant shocks.

In column 2, we find that the coefficient of $group \times MP_shock$ is positive and significant, suggesting that group-affiliated firms are less impacted than standalone firms following adverse monetary policy shocks. In terms of economic magnitude, business group firms exhibit a 2.2% lower decline in investments in response to a monetary policy tightening of 10 basis points compared to non-group firms and vice versa.[17] The differential investment of 2.2% is an economically significant 13% of the unconditional rate of investment. Our results remain similar when we use the logarithm of gross PPE for measuring firm investments in columns 3 and 4. Overall, our inferences are consistent with business group firms being less impacted by monetary policy shocks.

A critical question for our further analysis is the following - is the lower response of business group firms to monetary policy shocks due to lower financial acceleration effects? We hypothesize that business group firms are less vulnerable to both firm net worth and bank net worth effects. As elaborated above in section 5.4, the business group firms face lower information asymmetry when borrowing in intra-group internal capital markets (Gopalan et al. (2007), Khanna and Palepu (2000), Almeida et al. (2015)). Therefore, they are less likely to be affected by collateral squeeze or firm net worth effects. Moreover, the business group firms that are exposed to bank net worth effects have access to internal capital markets that can potentially replace the decline in lending from external capital markets.

To test the above thesis, we ask whether the business group firms that are more vulnerable to financial acceleration through the bank net worth channel are more likely to access internal capital markets in response to monetary policy shocks. We identify the business group firms that have high exposure to PR banks as the ones that are more vulnerable to the banks' net worth effects. We estimate the following specification using firm-year level data that is restricted to business group firms for the test.

$$\begin{aligned} Y_{i,t} =& \alpha + \beta_1 \times PR_bank_exp_{i,t} + \beta_2 \times MP_shock_{t-1} + \beta_3 \times PR_bank_exp_{i,t} \times MP_shock_{t-1} \\ &+ \beta_4 \times X_{i,t} \times MP_shock_{t-1} + \delta_i + \gamma_t + \epsilon_{i,t} \end{aligned} \tag{9}$$

Here, $Y_{i,t}$ is the natural logarithm of the sum of investments and loans received by the

[17] $2.2\% = exp^{0.224*0.1} - 1$

firm i in the form of related party transactions (RPTs) in year t. The variable PR_bank_exp takes a value of one for firms that exclusively borrow from PR banks and zero otherwise. The rest of the variables are as defined in equation 2. The coefficient of interest is β_3, which represents the differential amount of loans and investments in the form of RPTs received by business group firms with high exposure to PR banks in response to monetary policy shocks.

We present the estimates in Table A3 of the online appendix. We include firm-year level control variables and their interactions with MP_shock in column 2. We find that the coefficient on the interaction term - β_3 - is positive and statistically significant. This implies that business group firms with exclusive borrowing from PR banks receive about 8.4% differentially more RPT loans and investments in response to a monetary policy tightening of 10 basis points compared to other business group firms. Thus, business group firms that are more vulnerable to the financial accelerator operating through the net worth of banks indeed increase access to internal capital markets in response to monetary policy shocks.

5.4.2 Relative magnitudes of firm and bank net worth channels

To disentangle the financial accelerator effect through the net worth of firms and banks, we keep the business group firms in the base and compare non-business group firms based on their relationship with PR banks. As explained above, we limit the sample to PR firms so that the demand channel is largely uniform in the cross-section. Additionally, the business group (control) firms are in the base. As a result, we can identify the effect of the financial acceleration by estimating the impact on the non-business group (treated) firms.

We then create interaction terms involving non-business group firms with PR banks and non-business group firms with non-PR banks in a regression setting. The differential effect of shocks on lending to non-business group firms from PR banks captures the overall financial acceleration. The differential effect of shocks on lending to non-business group firms from non-PR banks captures the firm net worth channel of the financial accelerator.

Consequently, in a regression setup, the coefficient on the interaction between PR banks and non-business group firms represents the combined effect of firm and bank net worth channels. The coefficient on the interaction between non-business group firms and non-PR banks estimates the effect of the firm net worth channel. Thus, the difference between the above two coefficients represents the additional impact of the bank net worth channel.

We estimate the relative magnitudes of the two channels by running the following regression. Our data are at the firm-bank-year level spanning the years 2011 to 2021, with the

sample limited to PR firms.

$$\begin{aligned} Y_{i,j,t} =& \alpha + \beta_1 \times MP_shock_{t-1} + \beta_2 \times rigid_bank_nonbg_{i,j,t-1} + \beta_3 \times nonrigid_bank_nonbg_{i,j,t-1} + \\ & \beta_4 \times rigid_bank_nonbg_{i,j,t-1} \times MP_shock_{t-1} + \beta_5 \times nonrigid_bank_nonbg_{i,j,t-1} \times MP_shock_{t-1} \\ & + \beta_6 \times X1_{i,t} \times MP_shock_{t-1} + \beta_7 \times X2_{j,t} \times MP_shock_{t-1} + \delta_i + \zeta_j + \gamma_t + \epsilon_{i,j,t} \end{aligned} \tag{10}$$

Here, $Y_{i,j,t}$ is the natural logarithm of loans extended by bank j to firm i in year t. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *nonrigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group.

We make one additional adjustment to our sample. The idea is to further purge the effect of financial accelerator from the control group. There could be situations where a business group firm lends to another PR firm within the group. Hence, such firms are likely to be subject to the effect of financial acceleration analogous to a PR bank. Such firms may make our control group susceptible to financial acceleration. Therefore, we reduce such a likelihood by dropping the firms that are affiliated with a business group in which more than 50% of the firms are price-rigid. We illustrate the sampling with an example below.

Let firms F1 and F2 belong to group G, where firm F1 is price-rigid. Firm F1 borrows from firm F2 through a related party transaction. Since firm F1 is price-rigid, a demand shock could potentially result in a default by F1 on the lender F2 (as discussed in section 5.1.1). Thus, it reduces the ability of F2 to lend to any other firm within the group and hurts the ability of internal capital markets to shield the firms within the group from demand shocks. Overall, the above example demonstrates that a higher exposure of business group firms to PR firms can still make them vulnerable to such shocks. Therefore, we remove the firms belonging to business groups in which more than 50% of the firms are price-rigid from the set of control group firms.

The variable MP_shock represents the measure of monetary policy shock as defined in section 4.2. The terms $X1 \times MP_shock$ and $X2 \times MP_shock$ represent firm and bank-year level control variables and their interactions with MP_shock, respectively. The firm-year level control variables are listed in section 5.1.1, and the bank-year level control variables are listed in section 5.1.2. The variables δ_i, ζ_j, and γ_t represent firm, bank, and year fixed effects, respectively. The fixed effects absorb any time-invariant firm and bank-level heterogeneity and time-variant shocks that affect all firms and banks.[18]

[18]We do not include firm × year fixed effects because only one of the interaction terms is estimated after the inclusion of firm × year fixed effects. However, we want both the terms to be estimated to compare the magnitudes of the two channels.

The coefficients of interest are β_4 and β_5. As highlighted above, the coefficient β_4 represents the combined effect of firm and bank net worth channels of the financial accelerator. The difference between the coefficients β_4 and β_5 represents the bank net worth channel of the financial accelerator. The response of lending to monetary policy shock is expected to be more enhanced due to both the above channels of financial accelerator. Therefore, we expect β_4 and β_5 to be negative. Moreover, we expect the magnitude of β_4 to be larger than the magnitude of β_5 since β_4 represents the combined effect.

We present the results in columns 1 and 2 of Table 7. The dependent variable is the natural logarithm of the loan amount extended by the banks to respective firms. We include the firm and bank-year level control variables and their interactions with MP_shock in column 2. All columns include firm, bank, and year-level fixed effects. As expected, the coefficient on both interaction terms across specifications is negative and statistically significant. Reassuringly, the magnitude of β_4 is (economically and statistically) significantly larger than the magnitude of β_5. We conduct an f-test for the difference in coefficients and find that the magnitude of β_4 is statistically larger than the magnitude of β_5.

Coming to the economic magnitude, we focus on the full-fledged specification of column 2. The coefficient β_4 is -0.972 while the coefficient β_5 is -0.418. The difference between the two coefficients is -.554. The coefficient β_4 implies that the response of lending by PR banks to non-business group firms exhibits a 9% larger response to a monetary policy change of 10 basis points compared to the base. The above estimate represents the magnitude of the overall financial accelerator. The coefficient β_5 implies that the response of lending by non-PR banks to non-business group firms exhibits a 4.1% larger response to a monetary policy change of 10 basis points compared to the base. The above estimate represents the magnitude of the firm net worth channel. The difference between the two coefficients implies that the bank net worth channel of the financial accelerator results in a 4.9% larger response of lending to a monetary policy change of 10 basis points.

Overall, the above findings indicate that both bank and firm net worth channels of financial accelerator exacerbate the first-order effect of monetary policy shocks. In relative magnitudes, the firm net worth channel contributes about half, and the bank net worth channel contributes the remaining half to the overall financial acceleration.

We also present the results with an indicator variable that identifies if the bank extends a loan to the respective firm as the dependent variable in columns 3 and 4 of Table 7. Our results remain largely unchanged.[19]

[19]In Columns 1 and 2 (3 and 4) of Table A4 of the online appendix, we also include industry × year (district × year) fixed effects to control for any industry and region-specific time-varying and time-invariant factors. The results remain qualitatively unchanged.

Note that we do not include a third interaction term between firm-bank pairs that represent business group firms and PR banks and MP_shock in equation 10. As discussed in section 5.4.1, business group firms are less likely to be impacted by financial accelerator channels due to access to internal capital markets. Therefore, we do not expect the above interaction term to have a significant effect on the estimates. Nevertheless, in untabulated results, we include the interaction term in addition to the terms specified in equation 10. We find that the coefficient on the additional interaction term is statistically indistinguishable from zero. The coefficients on the other two interaction terms (pertaining to non-business group firms) are qualitatively similar to the original specification.

5.5 Effects of firm and bank net worth channels on investments

A natural question that follows is whether the financial accelerator channels operating through the net worth of banks and firms affect firm investments. We follow the empirical strategy in section 5.4.2 above to answer the question. We limit the data to price-rigid firms. We keep the business group firms (control group) in the base and compare non-business group firms based on their relationship with PR banks. Specifically, we estimate the following specification using a firm-year level panel limited to price-rigid firms.

$$\begin{aligned} Y_{i,t} =& \alpha + \beta_1 \times MP_shock_{t-1} + \beta_2 \times PR_bank_borrowing_{i,t-1} + \beta_3 \\ & \times nonPR_bank_borrowing_{i,t-1} + \beta_4 \times PR_bank_borrowing_{i,t-1} \times MP_shock_{t-1} + \beta_5 \\ & \times nonPR_bank_borrowing_{i,t-1} \times MP_shock_{t-1} + \beta_6 \times X1_{i,t} \times MP_shock_{t-1} + \delta_i + \gamma_t + \epsilon_{i,t} \end{aligned} \tag{11}$$

Where $Y_{i,t}$ represents the investment outcome of the firm i in the year t. As before, we use two measures of investments calculated as the natural logarithms of addition to gross fixed assets (*Log gfa*) and addition to the gross property, plant, and equipment (*Log ppe*). *PR_bank_borrowing* is an indicator variable set to one if the firm is a non-business group firm that borrows exclusively from PR banks, zero otherwise.

The variable *nonPR_bank_borrowing* is set to one if the firm is a non-business group firm and borrows from at least one non-PR bank. The variable *PR_bank_borrowing* identifies firms that are likely to be impacted by both the firm and bank accelerator channels. The variable *nonPR_bank_borrowing* represents firms that are impacted by the firm net worth channel but are less likely to be impacted by bank net worth effects because they have affiliation with some non-PR bank. The rest of the variables are as explained in equation 10. Therefore, the coefficient β_4 represents the combined effect of firm and bank net worth channels of the financial accelerator on investments. The difference between the coefficients β_4 and β_5 represents the bank net worth channel of the financial accelerator on investments.

We present the results in Table 8. The dependent variable is the natural logarithm of gross fixed assets in columns 1 and 2 and the natural logarithm of property, plant, and equipment in columns 3 and 4. We include firm-year level control variables listed in equation 10 in the even-numbered columns. We also include firm and year-level fixed effects in all columns. Across specifications, we find that the coefficients on both the interaction terms are negative and statistically significant. Moreover, as expected, the coefficient on β_4 is higher than β_5 and the difference between the two coefficients is statistically significant.

In column 2, the coefficient β_4 is -0.574, while β_5 is -0.475. The magnitude of β_4 implies that the combined firm and bank net worth channels result in a 6% larger response of investments to a monetary policy change of 10 basis points. The magnitude of β_5 implies that the response of investment by non-business group firms with high exposure to PR banks exhibits a 4.6% larger response to a monetary policy change of 10 basis points compared to the base.[20] The estimate represents the magnitude of the firm net worth channel.

Note that the relative magnitudes of the response of investments to firm and bank net worth channels are different from the relative magnitudes of the response of lending. Our preferred empirical specification for the quantification of magnitudes is lending because the specification is at the firm-bank-year level (see equation 10). Therefore, we can cleanly separate firm-bank pairs into groups that are more and less affected by firm and bank net worth channels to identify the relative magnitudes of the two channels. On the other hand, the specification involving investment is at the firm-year level. We need to define the exposure of firms to PR banks to disentangle the two channels of the financial accelerator. Therefore, the estimates are potentially sensitive to the definition of firms' exposure to PR banks.

6 Robustness tests

6.1 Endogeneity concerns

A reader may be concerned about two potential threats to our identification. Below, we first explain the concerns and then elaborate on the way in which we address them.

Endogenous differences between PR and non-PR firms: First, the worry could be that the differences in the responses of PR and non-PR firms to monetary policy are due to some factor other than price rigidity. Note that such factors need to move precisely with the monetary policy shocks. To address the above concern, we use 33 unanticipated monetary policy shocks in our analysis. Hence, the other endogenous factors otherwise unrelated to monetary policy shocks need to change every time there is an unanticipated monetary policy

[20] $6\% = exp^{-0.574X0.1} - 1$ and $4.6\% = exp^{-0.475X0.1} - 1$

shock, and they need to change in the same direction as monetary policy shock.

We also compare the PR and non-PR firms based on various observable characteristics that could be potentially correlated with firms' ability to change prices. For instance, firms could differ in terms of access to credit. A firm that can easily avail of trade credit may be in a better position to pass on the inflation in input prices to customers. Hence, access to credit and firms' price rigidity are correlated. Similarly, other firm characteristics, such as marketing intensity, leverage, and industry competition, could potentially be correlated to firms' pricing strategies.

To alleviate the concern, we compare the PR and non-PR firms based on the above set of characteristics. To account for access to credit, we use the following factors - trade credit received (Love et al. (2007)), inventory and working capital management policies (Chen and Kieschnick (2018)), audit effort (Kim et al. (2011), Jiang and Zhou (2017)), and financial constraints. Specifically, we compare the two sets of firms based on - trade credit turnover, working capital cycle days, auditor fees, and the Kaplan-Zingales index. We also compare other characteristics highlighted above - marketing expense, advertising spending, leverage, and competition within the industry (HHI of the industry). We present the comparison of all the above characteristics that can potentially influence the pricing of products in Table A5 of the online appendix. We do not find any significant difference between the two groups of firms based on the above characteristics. Thus, the differences in price-rigidity in our sample are unlikely to be correlated with the above factors.

Finally, we instrument price rigidity using the four most popular theories of price stickiness identified in a survey conducted by Blinder (1994). We elaborate on the measures and present the results in section D of the online appendix. We find that our main results remain largely unchanged using the above instrument. However, due to the large number of assumptions involved, we use these results for robustness only.

Given the above set of evidence, any observable or unobservable factor can be a threat to our design only if it (i) moves precisely with unanticipated monetary policy shocks, (ii) fails exclusion restriction even when we use measures based on theories of price rigidity, and (iii) is not apparent based on observable characteristics. We think that the chance of such a factor being present is significantly low.

Endogenous differences between PR and non-PR banks: Second, there could also be a concern that the banks with high exposure to PR firms are systematically different than other banks on other observable or unobservable dimensions, which makes them more susceptible to monetary policy shocks. In other words, the differential impact of monetary policy on PR banks is not due to deterioration in the health of PR borrowers, as we claim.

To address the concern, as elaborated in section 5.1.2, we control for various other balance

sheet characteristics of banks to alleviate concerns arising from alternative bank lending channels of monetary policy transmission. These characteristics are known to impact monetary policy transmission through the bank lending channel. The factors that we control for are - liquidity of bank balance sheet (Kashyap and Stein (2000); Bernanke and Gertler (1995)), local monopoly power of banks (Drechsler et al. (2017)), deposit-to-asset ratio (Drechsler et al. (2017)), maturity mismatch between assets and liabilities (Bolton and Freixas (2000); Van den Heuvel (2002)), and capital adequacy ratio (Jiménez et al. (2014)). We also interact the monetary policy shock variable with these other bank balance sheet characteristics. Our main results remain almost unchanged.

Additionally, we also examine the possible differences between PR and non-PR banks based on their financial characteristics. We compare the PR and non-PR banks based on size, non-performing assets (NPA), capital adequacy ratio, ROA, asset-liability mismatch, liquidity, and market power. We measure market power by the percentage of districts in which the bank has more than 75% market share. We present the comparison in panel A of Table A6 of the online appendix. We find that they differ marginally on size, NPA, capital adequacy ratio, and ROA.

In order to address the concern that the above differences drive our results, we add the comprehensive set of bank characteristics listed above and their respective interaction with MP_shock as control variables in specifications 5 and 10. The interaction term controls for any differential response to monetary policy shocks arising due to systematic differences in observable bank characteristics. For example, if smaller-sized banks are more sensitive to monetary policy shocks independent of such banks' exposure to PR firms, the banks' size may confound our results. The inclusion $size \times MP_shock$ in the set of control variables orthogonalizes our specification to the differential transmission due to size. We present the results in panels A and B of Table A7 of the online appendix. All the results go through. Hence, the persistence of results after the inclusion of interaction terms between bank characteristics and MP_shock substantially alleviates the concern that results are due to systematic differences between PR and non-PR banks.

We also employ the entropy balancing technique to match the PR banks with non-PR banks. The entropy balancing technique re-weights the treatment and control groups to achieve a set of pre-specified balance conditions on multiple covariates (Hainmueller (2012); Hainmueller and Xu (2013)). We match the banks based on five covariates - size, gross non-performing asset addition during the year, capital adequacy ratio, ROA, and market power. Panel B of Table A6 of the online appendix shows that the entropy balancing technique minimizes the differences between the two sets of banks. We rerun our specifications 5, 7, and 10 after reweighing the sample with the weights generated by the entropy balancing

algorithm.

The estimates of equation 5 and 7 are presented in Tables A8 and A9 of the online appendix, respectively. The findings in the above two tables confirm that the bank net worth channel has direct and spillover effects on PR firms and non-PR firms, respectively. Finally, we rerun equation 10, which examines the relative magnitudes of the two channels using the matched sample observations. The results presented in Table A10 of the online appendix remain qualitatively similar to our main findings documented in section 5.4.2. Thus, our results are unlikely due to time-varying differences between PR and non-PR banks.

Hence, our empirical strategy substantially allays the concern that our results are due to any other observable or unobservable differences between PR and non-PR banks.

6.2 Differences between group affiliated and stand alone firms

Our identification relies on the group-affiliated firms as the control set of firms to identify the financial accelerator channels operating in the non-group (treated) firms. A concern related to the above empirical strategy could be that group and non-group firms are fundamentally different, and the effects attributed to financial accelerator tests are due to these differences. We compare the group and non-group firms based on size, market power, leverage, liquidity, and profitability. The measures of size include total assets and gross fixed assets. The measure of market power is the market share of the firms in the respective industry. The measure of leverage is the leverage ratio. The measure of liquidity is the current ratio. Finally, the measure of profitability is the ROA. We present the comparison in panel A of Table A11 of the online appendix. We find that the group firms have larger asset sizes, larger market share, lower leverage, and higher ROA compared to standalone firms.

Recall that we account for the observed differences by including the above variables and their interactions with monetary policy shock as control variables in our regression specifications (see equation 10). Thus, the financial accelerator effects documented in section 5.4 are unlikely due to such differences between the control and treated set of firms.

Nevertheless, we also implement the entropy balancing technique as above to control for the observable covariates that differ across business group and non-business group firms. We implement entropy balancing at the firm level on four covariates: total assets, leverage ratio, market share, and ROA. First, we show in panel B of Table A11 of the online appendix that there is no significant difference between the group-affiliated and non-group-affiliated firms after entropy balancing. Thus, the treated (non-group firms) and control (group firms) firms are now comparable in terms of these covariates.

Then, we rerun equation 10 using the re-weighted sample. Results are documented in

Table A12 of the online appendix. We find that our inferences remain largely similar. Thus, the effects reported in the study are unlikely due to differences in firms' group affiliations.

6.3 Alternative determinants of price pass-through

Nakamura and Zerom (2010) document that there are potentially three determinants of incomplete pass-through from input to output prices - 1) markup adjustment, 2) local costs that are unrelated to shocks to input prices, and 3) price rigidities due to menu costs. Our measure of price-rigidity is based on the frequency with which the product prices change less than the rate of inflation when input prices change more than the inflation. Therefore, a concern could be that the incomplete pass-through can be rationalized by firm-specific price markups or region-specific local costs and not necessarily a reflection of price rigidity.

To address the concern related to markups, we limit the data to industries that are highly competitive and estimate our specification using the sub-sample. It is unlikely that the observed incomplete pass-through is due to an increase in markups in highly competitive industries. We measure the HHI of the industries in 2010 and divide the industries into two groups – 1) industries having above the median level of HHI and 2) industries having below the median level of HHI. We define the later group as highly competitive industries. We then estimate equations 5 and 10 using the above sub-sample. We present the results in panels A and B of Table A13 of the online appendix. We find that the results are qualitatively similar to the main specification.

To address the concern related to local costs, we control for the local inflation. To operationalize the robustness test, we use the measure of inflation at the local state level while defining the measure of price rigidity. The measure of local state-level inflation is the year-on-year change in state level GDP deflator. Then, we redefine the measure of price rigidity based on the frequency with which the product prices change less than the rate of local inflation when input prices change more than the local inflation. We also redefine the PR firms and PR banks accordingly. We then estimate equations 5 and 10 using the above definitions and present the estimates in panels A and B of Table A14 of the online appendix. Across specifications, we find that our results remain qualitatively unchanged.

6.4 Product replacement bias

Nakamura and Steinsson (2012) argue that the aggregate price indices suffer from product replacement bias. Firms are often likely to change their prices by replacing their products. Since statistical price indices estimate the change in prices of similar products before aggregating them into a price index, they miss out on the price change due to product replacement

when the new product is first introduced. For instance, say product A selling at INR 10 is replaced with product B with similar quality selling at INR 11 in year y. However, a statistician can not estimate the change in price for product B in year y since the product did not exist in previous year. Hence, such price increase involving product replacement get dropped from aggregate price indices.

In a similar vein, we also aggregate price changes across products within the firm year to arrive at the firm level price change. Hence, our measure may potentially suffer from product replacement bias. To address the concern, we limit the sample to firms in which all products continue throughout the sample period. We define PR firms and PR banks based on the above sample of firms. Finally, we estimate equations 5 and 10 using the above sub-sample of firms and present the results in panels A and B of Tables A15 of the online appendix. I find that the estimates are qualitatively unchanged compared to the baseline specification.

6.5 Supply chain linkages between PR and non-PR firms

A reader may argue that, by construction, a PR firm's suppliers will be categorized as non-PR firms since the suppliers' output prices, which are the current firm's input prices, grow at a rate above inflation according to our definition of price-rigidity. The concern that follows is that shocks potentially flow from PR to non-PR firms through the supply chain link rather than being mediated by banks. The above concern is less likely in our analysis because if the shock flows through supply chain links, one would expect all banks to curtail lending to non-PR firms. However, we find that PR banks decrease lending differentially more than non-PR banks to non-PR firms. Hence, the spill-over effects on non-PR firms likely flow through the bank channel.

Nevertheless, we address the above concern by showing that the PR banks decrease lending to non-PR firms even within a sub-sample in which none of the industries related to the concerned non-PR firm through supply chain linkages are price-rigid. To operationalize the above test, we identify industries with at least one PR firm. We designate such industries as price-rigid industries (PR industries). Next, we use the input-output matrix published by the Ministry of Statistics and Programme Implementation (MOSPI) to identify industries that are linked to the respective industries of the non-PR firms through supply change linkages.[21] We drop all firms from the sample for which the related industries are price-rigid. We then re-estimate equation 5 using the restricted sample. We present the results in Table A16 of the online appendix and find that the results are largely unchanged.

[21] https://www.mospi.gov.in/sites/default/files/reports_and_publication/statistical_manual/Chapter%2028.pdf

6.6 Alternative measure of monetary policy shock

We also show that the results are robust to an alternative definition of monetary policy shock. We elaborate on the details in section E of the online appendix.

7 Conclusion

Bernanke et al. (1999) underscore the importance of the financial accelerator as - "the financial accelerator can generate serially correlated movements in aggregate output, even though the exogenous shocks to the system are i.i.d." Holmstrom and Tirole (1997) show that the financial accelerator amplifies the first-order demand shocks due to changes in firm net worth and bank net worth. Most scholarly investigations have focused on the firm net worth channel. In this paper, we attempt to identify the full chain of events in the financial accelerator channel. Specifically, we verify the existence of the bank net worth channel and identify its spillover effects.

We find that a monetary policy shock of 10 basis points causes bank lending to fall by 11% due to the bank net worth effect of the financial acceleration. Further, we find that close to half of the overall financial accelerator is due to changes in bank net worth, and the remaining half is due to changes in firm net worth. Thus, we establish that the bank net worth effect is an important channel of financial acceleration.

A caveat is in order here. The use of business group firms as control can lead to precise estimates only under the strong assumption that the business group firms are completely immune from financial acceleration. Nevertheless, the study is useful to give a broad estimate of the financial accelerator and for estimating the relative magnitudes of the firm and bank net worth channels of the financial accelerator.

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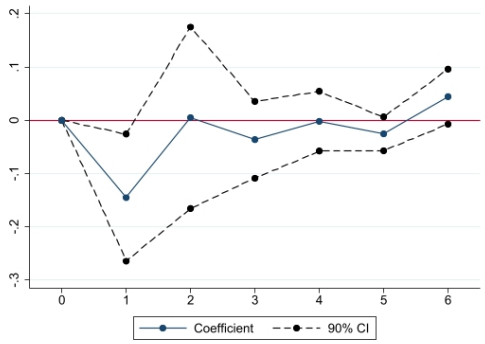
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Figure 1: Impulse Response: Response of PR firms to monetary policy

The figure plots the coefficient corresponding to an impulse response specification that studies the differential effect of monetary policy on investments and loan performance of PR firms. The data are organized at firm-year level and span from 2011 to 2021. The dependent variable in panel A(B) is natural logarithm of gross fixed assets in year t (an indicator variable that takes a value of one if the firm defaults on its loan in year t and zero otherwise). Each dot represents the coefficient on the interaction between an indicator variable that identifies PR firms and the monetary policy shock in the year $t-n$. The number on the x-axis represents the year relative to t. The dotted lines represent the 90% confidence interval on the two sides of the point estimates.

(a) Panel A: Log gfa



(b) Panel B: Default

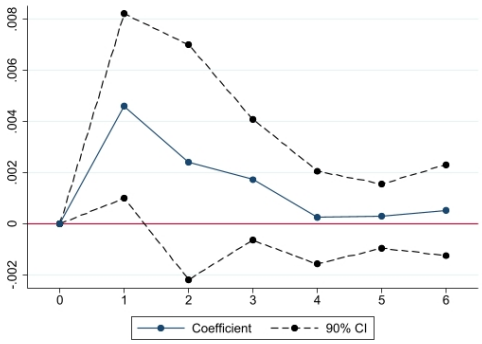
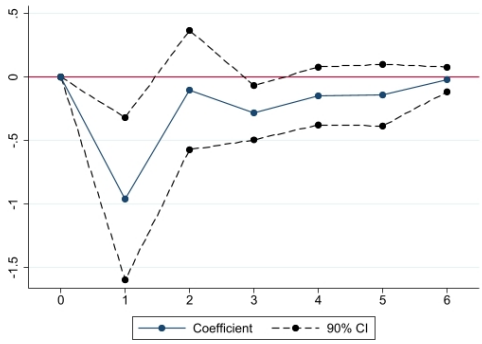


Figure 2: Impulse Response: Response of PR banks to monetary policy

The figure plots the coefficient corresponding to an impulse response specification that studies the differential effect of monetary policy on investments and loan performance of PR firms. The data are organized at firm-year level and span from 2011 to 2021. The dependent variable is natural logarithm of loan amount in year t. In panel A(B), we restrict the sample to PR firms (non-PR firms). Each dot represents the coefficient on the interaction between an indicator variable that identifies PR banks and the monetary policy shock in the year $t-n$. The number on the x-axis represents the year relative to t. The dotted lines represent the 90% confidence interval on the two sides of the point estimates.

(a) Panel A: PR Firms



(b) Panel B: Non-PR firms

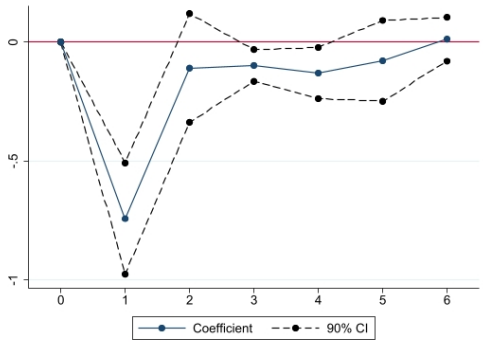


Table 1: Sample construction table

The table shows the details of sample construction.

Sample construction table	
Price-rigidity Estimation period	
Period	2000-2010
Number of unique firms	12,352
Less: Number of unique firms with missing price data for all years	(3,169)
Less: Number of unique firms with less than three years of data	(2,345)
Final number of unique firms with price rigidity classification	6,838
Number of PR firms	3,248
Test sample period	
Period	2011-2021
Number of unique firms with financial data	6,028
Firm-year sample	
Number of firm-years with price-rigidity measure	53,372
Number of firm-year obs where investment in gross fixed assets is available	52,035
Bank-quarter sample	
Number of banks	54
Number of bank-quarters where price rigid exposure of banks is available	1,605
Number of bank-quarters where price rigid exposure and GNPA is available	1,572
Firm-bank-year sample	
Number of firm-bank-year observations where loan data are available	152,604
Number of firm-bank-year observations where firm is price-rigid	35,945

Table 2: Descriptive statistics

Panels A and B of the table present the descriptive statistics of the main variables for the price-rigidity estimation period and model estimation period, respectively. The variable *Price change* (*Raw material price change*) is the year-on-year change in the price of a firm's product (raw material). The indicator variable *Rigid* is defined in section 4.1.1. All the other variables are as defined in Table A1.

Variables	N	Mean	Median	SD	1st %ile	99th %tile
Panel A: Price-Rigidity Estimation period - 2000 to 2010						
Firm-year level						
Price change	52,401	0.251	0.025	1.848	-0.999	12.218
Raw material price change	52,401	1.091	0.048	7.985	-0.837	75.588
Panel B: Model estimation period - 2011 to 2021						
Firm-year level						
Rigid	53,372	0.468	0	0.499	0	1
Group	53,372	0.253	0	0.435	0	1
Fixed asset investment in INR million	52,039	533	19	5654	0	7437
PPE investment in INR million	51,986	497	18	5064	0	7166
Default	53,372	0.028	0	0.166	0	1
ROA	53,095	0.031	0.022	4.292	-0.626	0.320
Leverage ratio	52,962	1.186	0.298	31.501	0.000	5.739
Total assets in INR million	53,322	9896	1073	68,820	5	1,43,370
Market share in %	53,331	0.428	0.047	2.584	0	6.769
Bank-year level						
Rigid exposure	1,605	0.437	0	0.496	0	1
GNPA slippage in %	1,572	3.652	2.758	2.987	0.432	13.669
Liquid assets to total assets	1,572	0.007	0.005	0.019	0.000	0.015
Asset liability mismatch	1,572	1.458	1.225	0.984	0.531	3.744
Capital adequacy ratio	1,572	13.102	12.640	2.809	8.500	22.040
Firm-bank-year level						
New loan in INR million	1,52,604	162	0	2910	0	2930
Log loan	1,52,604	3.572	0	7.462	0	21.796
Time series						
MP_shock	11	0.106	0.090	0.432	-0.480	0.920

Table 3: Price-rigidity and firm outcomes

The table shows the difference in firm-level outcomes for PR firms compared to non-PR firms in response to monetary policy change. PR firms are as defined in section 4.1.1. The data are organized at a firm-year level. The dependent variable is the natural logarithm of addition to gross fixed assets (*Log gfa*) in Columns 1 and 2, and the natural logarithm of addition to property, plant, and equipment (*Log ppe*) in Columns 3 and 4. In Columns 5 and 6, the dependent variable is *Default* that takes a value of one if the firm is delinquent on any of its borrowing liabilities in the year, and zero otherwise. The indicator variable *Rigid* is as defined in section 4.1.1. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We include firm-year level control variables - total assets, ROA, leverage ratio, and market share of the firms in their respective industry - and their interactions with *MP_shock* in the even-numbered columns. We also include firm and year fixed effects in all the columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log gfa		Log ppe		Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Rigid × MP_shock	-0.144**	-0.132**	-0.134**	-0.121*	0.005***	0.005***
	(0.048)	(0.054)	(0.053)	(0.058)	(0.001)	(0.001)
Observations	51,842	51,340	51,789	51,294	53,189	52,503
R-squared	0.644	0.641	0.640	0.637	0.523	0.523
Control variables	No	Yes	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes

Table 4: Price-rigidity of borrowers and bank performance

The table shows the difference in sensitivity of banks' performance to monetary policy change between price rigid banks (PR banks) and other banks. PR banks are identified as banks with high exposure to PR firms. PR firms are as defined in section 4.1.1. The data are organized at a bank-year-quarter level and span the years 2011 to 2020. The dependent variable in Columns 1 and 2 (3 and 4) is the fresh GNPA added during the quarter as a proportion of advances (Capital adequacy ratio), which we denote as *GNPA slippage* (*Capital adequacy ratio*). The measures are defined in detail in Table A1 of the online appendix. The indicator variable *rigid exposure* is one if the bank has an above the median value of the proportion of its total outstanding loans owed by PR firms among all the banks in the previous year and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We include the bank-year level control variables - cash to asset ratio, the ratio between the weighted number of days of deposit and the weighted number of days of advances, the proportion of banks' outstanding loan in districts in which it has more than 75% market share, capital adequacy ratio, and deposits to asset ratio - and their interactions with *MP_shock* in the even-numbered columns. We also include bank and year fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the bank and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	GNPA slippage		Capital adequacy ratio	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	0.992***	0.873***	-0.659**	-0.783**
	(0.260)	(0.260)	(0.252)	(0.334)
Rigid exposure	-0.736***	-0.632***	0.682*	0.794*
	(0.150)	(0.150)	(0.326)	(0.352)
Observations	1,572	1,560	1,572	1,560
R-squared	0.583	0.600	0.726	0.741
Control variables	No	Yes	No	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table 5: Lending by PR banks

The table shows the estimates for the differential effect on lending to PR (non-PR) firms by PR banks and non-PR banks in panel A (B), following monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms (non-PR firms) in panel A (B). In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* and the indicator variable *rigid exposure* are as defined in Table 4. We include the bank-year level control variables from Table 4 in the even-numbered columns. We also include firm × year and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Lending to PR firms				
	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.845**	-1.182***	-0.042***	-0.059***
	(0.261)	(0.338)	(0.013)	(0.015)
Rigid exposure	0.391	0.432	0.021	0.022*
	(0.244)	(0.241)	(0.012)	(0.011)
Observations	27,146	23,099	27,146	23,099
R-squared	0.388	0.409	0.393	0.414
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Panel B: Lending to non-PR firms				
Rigid exposure × MP_shock	-0.678***	-0.821***	-0.035***	-0.043***
	(0.114)	(0.165)	(0.004)	(0.008)
Rigid exposure	0.308	0.263	0.017	0.014
	(0.267)	(0.260)	(0.014)	(0.013)
Observations	72,962	63,261	72,962	63,261
R-squared	0.449	0.465	0.449	0.465
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

Table 6: Business groups' response to monetary policy

The table shows the difference in firm-level outcomes for firms that are affiliated to business groups compared to non-business group firms in response to monetary policy change. The data are organized at a firm-year level. The dependent variable is the natural logarithm of addition to gross fixed assets (*Log gfa*) in Columns 1 and 2, and the natural logarithm of addition to property, plant, and equipment (*Log ppe*) in Columns 3 and 4. The indicator variable *Group* is set to one for firms that are affiliated to business groups, zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We include firm-year level control variables listed in Table 3 in the even-numbered columns. We also include firm and year fixed effects in all the columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log gfa		Log ppe	
	(1)	(2)	(3)	(4)
Group × MP_shock	0.226**	0.224**	0.227**	0.224**
	(0.096)	(0.087)	(0.099)	(0.086)
Observations	51,842	51,340	51,789	51,294
R-squared	0.644	0.641	0.640	0.637
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table 7: Financial Accelerator Channels

The table disentangles the financial accelerator effects on borrowings of firms owing to the firm net worth and bank net worth channels, in response to monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2021 and are limited to PR firms. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *non_rigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group. The firms belonging to business groups are in the base as control group. We also remove the business group firms whose groups have more than 50% PR firms from the base. We include the firm-year level control variables from Table 3 and bank-year level control variables from Table 4 in the even-numbered columns. We also include firm, year, and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
MP_shock × Rigid_bank_non_bg	-0.785***	-0.972**	-0.037***	-0.048*
	(0.184)	(0.385)	(0.011)	(0.022)
MP_shock × Non_rigid_bank_non_bg	-0.316**	-0.418*	-0.014*	-0.019
	(0.108)	(0.199)	(0.008)	(0.011)
Rigid_bank_non_bg	0.239	0.311	0.014	0.017
	(0.271)	(0.325)	(0.014)	(0.017)
Observations	28,283	21,050	28,283	21,050
R-squared	0.185	0.196	0.190	0.201
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table 8: Financial Accelerator Channels and Investments

The table disentangles the financial accelerator effects on investments by firms owing to the firm net worth and bank net worth channels in response to monetary policy shocks. The data are organized at a firm-year level from 2011 to 2021 and are limited to PR firms. In columns 1 and 2, the dependent variable is the natural logarithm of the addition to gross fixed assets. In columns 3 and 4, the dependent variable is the natural logarithm of addition to gross property, plant, and equipment. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *PR_bank_borrowing* identifies non-business group firms with exclusive borrowing relations with PR banks. The variable *PR_bank_borrowing* identifies non-business group firms with at least one outstanding loan with non-PR banks. The firms belonging to business groups are in the base as the control group. We include the firm-year level control variables from Table 3 in the even-numbered columns. We also include firm and year fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

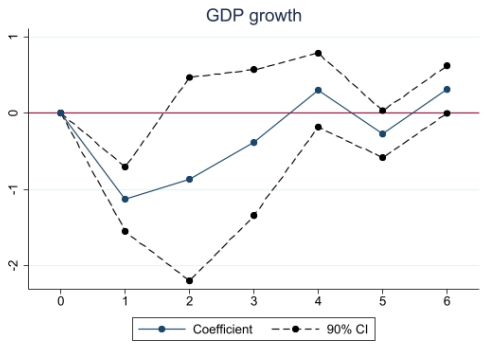
	Log gfa		Log gppe	
	(1)	(2)	(3)	(4)
MP_shock × PR_bank_borrowing	-0.583**	-0.574**	-0.587**	-0.576**
	(0.252)	(0.267)	(0.251)	(0.266)
MP_shock × nonPR_bank_borrowing	-0.469*	-0.475*	-0.470*	-0.472*
	(0.235)	(0.255)	(0.239)	(0.260)
PR_bank_borrowing	0.099	0.101	0.113	0.116
	(0.131)	(0.131)	(0.130)	(0.130)
Observations	20,266	20,059	20,252	20,045
R-squared	0.647	0.644	0.644	0.641
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Internet Appendix

A Figures and Tables

Figure A1: Impulse Response of GDP growth and GDP deflator to monetary policy shock. We use a quarterly data for the analysis. The dependent variables are year-on-year GDP growth and year-on-year growth in GDP deflator in quarter q in panels A and B, respectively. The explanatory variables are lagged MP_shock - lagged upto six quarters. We plot the point estimates of the coefficients (represented by dots connected by solid line) and 90% confidence intervals around each point estimate (represented by dots connected by dashed line). The number on the x-axis represents the year relative to q.

(a) Panel A



(b) Panel B

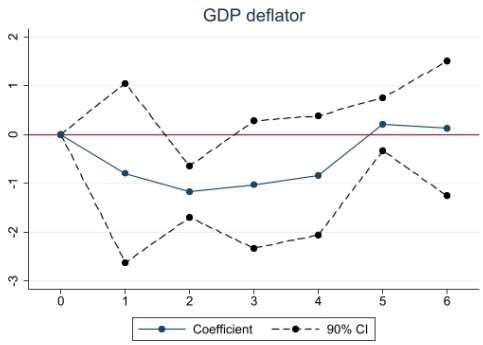


Table A1: Variable definitions

The table presents the definition of the variables used in our analyses.

Variable	**Definition**
PR firms	Firms with above median frequency of instances when product sales prices change less than the inflation in spite of input prices changing more than the inflation as price-rigid firm years.
PR banks	An abbreviation for banks that have high loan exposure to PR firms.
Rigid	An indicator variable that identifies PR firms.
Rigid exposure	A bank-year level measure that determines whether a bank is more exposed to PR firms. The variable is set to one if the bank has an above the median value of the proportion of its total lending to PR firms and zero otherwise.
MP_shock	Cumulated yearly return of 3-month government bonds 7-day return after the monetary policy announcement.
log(assets)	Natural logarithm of the total assets of the firm.
Log(gfa)	Natural logarithm of the total gross fixed assets of the firm.
log(ppe)	Natural logarithm of the value of the total property, plant, and equipment of the firm.
Leverage ratio	Ratio of total debt to total assets of the firm.
ROA	Return on assets of the firm in the year.
Log(loan)	Natural logarithm of the value of total loan given by a bank to a firm in a year.
New loan	An indicator variable that identifies whether a bank lends a loan to a firm in a year.
GNPA slippage	GNPA_slippage measures the percentage of fresh addition of GNPA during the year in relation to the total outstanding loans of the bank.
Capital adequacy ratio	Total capital to the total risk-weighted assets ratio of a bank.
Liquid assets to total assets	Total cash to total assets ratio of the bank. It measures the liquidity position of the bank.
Asset liability mismatch	Ratio between the weighted number of days of deposit and the weighted number of days of advances of the bank in the year.
Deposit Ratio	Ratio between deposits and total assets of the bank.

Table A2: Price-rigidity and Stock Market Returns

The table shows the difference in stock market returns for PR firms compared to non-PR firms in response to an increase in repo rate. PR firms are as defined in section 4.1.1. The data are organized at a firm-date level. The sample is limited to dates on which monetary policy announcements were made. The dependent variable is stock market return. The indicator variable *Rigid* is as defined in section 4.1.1. The variable *Repo_increase* takes a value of one if the central bank announces an increase in repo rate and zero otherwise. We include firm-year level control variables - total assets, ROA, leverage ratio, and market share of the firms in their respective industry - and their interactions with *Repo_increase* in the even-numbered columns. We also include firm and year fixed effects in all the columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Return	
	(1)	(2)
Rigid X Repo_increase	-0.050*	-0.051
	(0.026)	(0.034)
Repo_increase	-0.151	-0.157
	(0.282)	(0.290)
Observations	113,426	110,515
R-squared	0.053	0.053
Control variables	No	Yes
Firm F.E.	Yes	Yes
Year F.E.	Yes	Yes

Table A3: Related Party Transactions

The table shows the RPTs in response to monetary policy shocks in business-group firms. The data are organized at a firm-year level and span the years 2011 to 2020. The sample is restricted to business group firms. The dependent variable in columns 1 and 2 is *Log RPT loans and investments* which is the natural logarithm of the sum of loans and investments received in the form of related party transactions during the respective year. The variable *PR bank exp* is set to one if the firm exclusively borrows from PR banks and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We include the control variables listed in Table 3 in the even-numbered columns. We also include firm and year fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log RPT loans and investments	
	(1)	(2)
MP_shock × PR bank exp	0.881**	0.843**
	(0.281)	(0.303)
PR bank rel	0.052	0.066
	(0.245)	(0.247)
Observations	8,994	8,901
R-squared	0.408	0.412
Control variables	No	Yes
Firm F.E.	Yes	Yes
Year F.E.	Yes	Yes

Table A4: Financial Accelerator Channels

The table disentangles the financial accelerator effects on borrowings of firms owing to the firm net worth and bank net worth channels, in response to monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2021 and are limited to PR firms. In columns 1 and 3, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 2 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *non_rigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group. The firms belonging to business groups are in the base as control group. We also remove the business group firms whose groups have more than 50% PR firms from the base. We also include firm, industry × year, and bank (firm, district × year, and bank) level fixed effects in columns 1 and 2 (3 and 4). The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan	New loan	Log loan	New loan
	(1)	(2)	(3)	(4)
MP_shock X Rigid_bank_non_bg	-0.867***	-0.041***	-0.794***	-0.038***
	(0.185)	(0.012)	(0.139)	(0.007)
MP_shock X Non_rigid_bank_non_bg	-0.331**	-0.014	-0.422**	-0.019*
	(0.142)	(0.011)	(0.167)	(0.009)
Rigid_bank_non_bg	0.234	0.014	0.268	0.016
	(0.274)	(0.014)	(0.272)	(0.014)
Observations	28,211	28,211	27,808	27,808
R-squared	0.194	0.199	0.215	0.219
Firm F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Industry × Year F.E.	Yes	Yes	No	No
District × Year F.E.	No	No	Yes	Yes

Table A5: PR versus non-PR firms

In this Table, we compare PR firms and non-PR firms based on various characteristics that may be potentially correlated with their pricing behavior. For instance, a firm that can easily avail of trade credit may be in a better position to pass on the inflation in input prices to customers. Hence, access to credit and firms' price rigidity are correlated. Similarly, other firm characteristics, such as marketing intensity, leverage, and industry competition, could potentially be correlated to firms' pricing strategies. To account for access to credit, we compare the two sets of firms based on the following factors - trade credit received (Love et al. (2007)), inventory and working capital management policies (Chen and Kieschnick (2018)), audit effort (Kim et al. (2011), Jiang and Zhou (2017)), and financial constraints. Specifically, we compare the two sets of firms based on - trade credit turnover, working capital cycle days, auditor fees, and the Kaplan-Zingales index. We also compare other characteristicsthat may be potentially correlated with pricing behavior - marketing expense, advertising spending, leverage, and competition within the industry (HHI of the industry).

Variable	PR firms	non-PR firms	Difference	t-stat
Trade credit	652	942	-290	-1.651
Trade credit days	1877	1491	386	0.356
Auditor fees	1.295	1.239	0.056	0.464
Marketing expense	1.367	1.378	-0.011	-0.086
Advertising expense	0.479	0.550	-0.071	-0.360
HHI	0.048	0.045	0.003	1.853
KZ Index	10.681	9.348	1.333	0.583
Leverage	12.296	12.568	0.272	0.153

Table A6: Comparisons

Panel A of the table compares the characteristics of PR banks with non-PR banks. We compare the PR and non-PR banks based on size, non-performing assets (NPA), capital adequacy ratio, ROA, asset-liability mismatch, liquidity, and market power. We measure market power by the percentage of districts in which the bank has more than 75% market share. Panel B of the table compares the characteristics of the PR and non-PR banks after weighing the observations with weights estimated using entropy balancing. The comparison is presented on the basis of the mean and variance of the variables in panel B.

Panel A: PR versus non-PR banks				
Variable	Non-PR banks	PR banks	Difference	t-stat
Loans and Advances in billion	358	271	87	1.807
GNPA slippage	2.223	2.302	-0.079	-0.487
NNPA slippage	1.143	1.368	-0.226	-1.660
Capital Adequacy Ratio	13.594	13.133	0.461	1.249
ROA	1.107	1.015	0.092	1.217
ALM	1.792	1.710	0.082	0.644
Liquidity	0.013	0.015	-0.002	-2.173
High market share	0.007	0.011	-0.004	-1.883
Panel B: Entropy matched PR versus non-PR banks				
	Mean		Variance	
	Non-PR banks	PR banks	Non-PR banks	PR banks
Loans and Advances in billion	1,549	1,548	5,130,000	6,010,000
GNPA slippage	3.094	3.087	-0.398	-1.515
Capital Adequacy Ratio	13.53	13.53	16.520	6.497
ROA	0.693	0.695	1.005	0.987
High market share	0.011	0.011	3.381	3.147

Table A7: Bank-level control variables

The table presents the main results with a comprehensive set of bank-level control variables. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms. In column 1 of panels A and B, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In column 2 of panels A and B, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid exposure* is as defined in Table 4. The variables *Rigid_bank_non_bg* and *Non_rigid_bank_non_bg* are as defined in Table 7. We include the bank-year level control variables from Table 4, and add GNPA slippage and capital adequacy ratio to the set of control variables in all columns. We also include the interaction of the control variables with *MP_shock* in the specifications. Finally, We include firm × year and bank (firm, bank, and year) level fixed effects in panel A (B). The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Panel A		Panel B	
	Log loan	New loan	Log loan	New loan
	(1)	(2)	(1)	(2)
Rigid exposure X MP_shock	-0.830*	-0.044*		
	(0.433)	(0.021)		
Rigid exposure	0.386	0.020		
	(0.299)	(0.014)		
MP_shock X Rigid_bank_non_bg			-0.947**	-0.046*
			(0.405)	(0.023)
MP_shock X Non_rigid_bank_non_bg			-0.437	-0.020
			(0.334)	(0.019)
Rigid_bank_non_bg			0.275	0.016
			(0.333)	(0.017)
Observations	20,269	20,269	20,949	20,949
R-squared	0.395	0.400	0.194	0.199
Control variables	Yes	Yes	Yes	Yes
Firm X Year F.E.	Yes	Yes	No	No
Firm F.E.	No	No	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A8: Lending by PR banks to PR firms: Entropy matched

The table disentangles the financial accelerator effects on borrowings of firms owing to the firm net worth and bank net worth channels, in response to monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms. We estimate the lending after matching for PR banks with non-PR banks using entropy balancing technique. The covariates along which the matching has been done are specified in panel B of Table A6 of the online appendix. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The indicator variable *rigid exposure* is one if the bank has an above the median value of the proportion of its total outstanding loans owed by PR firms among all the banks in the previous year and zero otherwise. We include the bank-year level control variables from Table 4 in the even-numbered columns. We also include firm × year and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.831***	-1.065***	-0.042***	-0.054***
	(0.192)	(0.285)	(0.008)	(0.013)
Rigid exposure	0.384	0.374	0.021	0.020
	(0.271)	(0.238)	(0.013)	(0.011)
Observations	23,218	23,099	23,218	23,099
R-squared	0.416	0.418	0.422	0.423
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

Table A9: Lending by PR banks to non-PR firms: Entropy matched

The table shows the differential impact on lending by PR banks and non-PR banks to firms that do not exhibit price-rigidity, in response to monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to non-PR firms. We estimate the lending after matching for PR banks with non-PR banks using entropy balancing technique. The covariates along which the matching has been done are specified in panel B of Table A6 of the online appendix. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The indicator variable *rigid exposure* is one if the bank has an above the median value of the proportion of its total outstanding loans owed by PR firms among all the banks in the previous year and zero otherwise. We include the bank-year level control variables from Table 4 in the even-numbered columns. We also include firm × year and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.649***	-0.713***	-0.034***	-0.038***
	(0.150)	(0.202)	(0.007)	(0.010)
Rigid exposure	0.235	0.217	0.013	0.012
	(0.242)	(0.237)	(0.012)	(0.012)
Observations	63,555	63,261	63,555	63,261
R-squared	0.472	0.472	0.473	0.473
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

Table A10: Financial Accelerator Channels: Entropy Matched banks

The table estimates the relative magnitudes of the financial accelerator channels after controlling for differences between group PR banks and non-PR banks using the entropy matching technique. Specifically, the table estimates the difference in lending activities between PR banks and other banks in response to monetary policy shocks. PR banks are banks that are more exposed to PR firms as defined in Table 4. The data are organized at a bank-firm-year level from 2011 to 2021 and are limited to PR firms. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We estimate the lending after matching for PR banks with non-PR banks using entropy balancing technique. The covariates along which the matching has been done are specified in panel B of Table A6 of the online appendix. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *non_rigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group. The firms belonging to business groups are in the base as control group. We include the firm-year level control variables from Table 3 and bank-year level control variables from Table 4 in the even-numbered columns. We also include firm, year, and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
MP_shock × Rigid_bank_non_bg	-0.667***	-0.805*	-0.032**	-0.040
	(0.192)	(0.412)	(0.013)	(0.023)
MP_shock × Non_rigid_bank_non_bg	-0.336***	-0.484*	-0.015*	-0.023*
	(0.071)	(0.240)	(0.007)	(0.013)
Rigid_bank_non_bg	0.192	0.247	0.012	0.012
	(0.272)	(0.305)	(0.014)	(0.016)
Observations	25,328	21,050	25,328	21,050
R-squared	0.199	0.198	0.203	0.203
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A11: Business group versus non-business group firms comparisons: Entropy matched

Panel A of the table compares the characteristics of business group firms with non-business group firms. Panel B of the table compares the characteristics of the Business group versus Non-Business group firms after weighing the observations with weights estimated using entropy balancing. The comparison is presented on the basis of the mean and variance of the variables in panel B.

Panel A: Business group versus Non-Business group firms				
Variable	Non-business group	Business Group	Difference	t-stat
Size in million	5,905	21,702	-15,797	-23.147
Gross fixed assets in million	2,858	10,378	-7,520	-21.419
Market share in %	0.3	0.8	-0.5	-21.581
Leverage ratio	1.361	0.669	0.692	2.199
Current ratio	3.973	4.350	-0.377	-0.817
ROA	0.036	0.015	0.021	0.478
Panel B: Entropy matched Business group versus Non-Business group firms				
	Non-business group	Business Group	Non-business group	Business Group
Size in million	20,842	20,851	7,200,000,000	4,010,000,000
Market share in %	0.8	0.8	0.352	0.171
Leverage ratio	0.659	0.655	60.31	65.67
ROA	0.014	0.014	10.380	6.228

Table A12: Financial Accelerator Channels: Entropy Matched firms

The table estimates the relative magnitudes of the financial accelerator channels after controlling for differences between group firms and non-group firms using the entropy matching technique. Specifically, the table estimates the difference in lending activities between PR banks and other banks in response to monetary policy shocks. PR banks are banks that are more exposed to PR firms as defined in Table 4. The data are organized at a bank-firm-year level from 2011 to 2021 and are limited to PR firms. The dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. We estimate the lending after matching for group affiliated firms with non-group firms using entropy balancing technique. The covariates along which the matching has been done are specified in panel B of Table A11 of the online appendix. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *non_rigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group. The firms belonging to business groups are in the base as control group. We include the firm-year level control variables from Table 3 and bank-year level control variables from Table 4 in the even-numbered columns. We also include firm, year, and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
MP_shock × Rigid_bank_non_bg	-1.074***	-1.094**	-0.052***	-0.053**
	(0.234)	(0.359)	(0.015)	(0.021)
MP_shock × Non_rigid_bank_non_bg	-0.351**	-0.414	-0.016	-0.018
	(0.149)	(0.343)	(0.010)	(0.017)
Rigid_bank_non_bg	0.374	0.444	0.021	0.024
	(0.352)	(0.346)	(0.017)	(0.017)
Observations	24,088	20,903	24,088	20,903
R-squared	0.170	0.180	0.175	0.185
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A13: High Competition Industry

The table presents the main results with a comprehensive set of bank-level control variables. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms and to industries with above median level of HHI as on 2010. In column 1 of panels A and B, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In column 2 of panels A and B, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid exposure* is as defined in Table 4. The variables *Rigid_bank_non_bg* and *Non_rigid_bank_non_bg* are as defined in Table 7. We include the bank-year level control variables from Table 4 in all columns. We also include the interaction of the control variables with *MP_shock* in the specifications. Finally, We include firm × year and bank (firm, bank, and year) level fixed effects in panel A (B). The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Panel A		Panel B	
	Log loan	New loan	Log loan	New loan
	(1)	(2)	(1)	(2)
Rigid exposure X MP_shock	-0.954*	-0.050*		
	(0.539)	(0.026)		
Rigid exposure	0.408	0.021		
	(0.315)	(0.015)		
MP_shock X Rigid_bank_non_bg			-0.827**	-0.039*
			(0.323)	(0.019)
MP_shock X Non_rigid_bank_non_bg			-0.396*	-0.016
			(0.220)	(0.013)
Rigid_bank_non_bg			0.275	0.016
			(0.333)	(0.017)
Observations	18,554	18,554	19,040	19,040
R-squared	0.395	0.400	0.197	0.201
Control variables	Yes	Yes	Yes	Yes
Firm X Year F.E.	Yes	Yes	No	No
Firm F.E.	No	No	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A14: Local Inflation

The table presents the main results with a comprehensive set of bank-level control variables. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms. In column 1 of panels A and B, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In column 2 of panels A and B, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid exposure* is as defined in Table 4, except that we use state level inflation while defining the price-rigidity. The variables *Rigid_bank_non_bg* and *Non_rigid_bank_non_bg* are as defined in Table 7. We include the bank-year level control variables from Table 4 in all columns. We also include the interaction of the control variables with *MP_shock* in the specifications. Finally, We include firm × year and bank (firm, bank, and year) level fixed effects in panel A (B). The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Panel A		Panel B	
	Log loan	New loan	Log loan	New loan
	(1)	(2)	(1)	(2)
Rigid exposure X MP_shock	-1.052**	-0.057**		
	(0.456)	(0.024)		
Rigid exposure	1.735**	0.088**		
	(0.663)	(0.035)		
MP_shock X Rigid_bank_non_bg			-0.630**	-0.030**
			(0.207)	(0.012)
MP_shock X Non_rigid_bank_non_bg			-0.423	-0.020
			(0.602)	(0.031)
Rigid_bank_non_bg			1.209**	0.067**
			(0.486)	(0.024)
Observations	20,395	20,395	21,047	21,047
R-squared	0.395	0.401	0.196	0.201
Control variables	Yes	Yes	Yes	Yes
Firm X Year F.E.	Yes	Yes	No	No
Firm F.E.	No	No	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A15: Product Replacement Bias

The table presents the main results with a comprehensive set of bank-level control variables. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms. While defining the PR firms and PR banks, we limit the sample of firms to firms that do not discontinue any product during the sample period. In column 1 of panels A and B, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In column 2 of panels A and B, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock as defined in section 4.2. The variable *rigid exposure* is as defined in Table 4. The variables *Rigid_bank_non_bg* and *Non_rigid_bank_non_bg* are as defined in Table 7. We include the bank-year level control variables from Table 4 in all columns. We also include the interaction of the control variables with *MP_shock* in the specifications. Finally, We include firm × year and bank (firm, bank, and year) level fixed effects in panel A (B). The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Panel A		Panel B	
	Log loan	New loan	Log loan	New loan
	(1)	(2)	(1)	(2)
Rigid exposure X MP_shock	-1.020**	-0.051**		
	(0.436)	(0.021)		
Rigid exposure	0.614	0.030		
	(0.377)	(0.019)		
MP_shock X Rigid_bank_non_bg			-0.845**	-0.042**
			(0.280)	(0.016)
MP_shock X Non_rigid_bank_non_bg			-0.450	-0.020
			(0.529)	(0.026)
Rigid_bank_non_bg			0.312	0.018
			(0.436)	(0.022)
Observations	13,053	13,053	12,040	12,040
R-squared	0.379	0.385	0.190	0.195
Control variables	Yes	Yes	Yes	Yes
Firm X Year F.E.	Yes	Yes	No	No
Firm F.E.	No	No	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table A16: Lending by PR banks to non-PR firms

The table shows the estimates for the differential effect on lending to non-PR firms by PR banks and non-PR banks. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to non-PR firms which are not related to any industries with PR firms through supply chain links. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* and the indicator variable *rigid exposure* are as defined in Table 4. We include the bank-year level control variables from Table 4 in the even-numbered columns. We also include firm × year and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.845**	-1.182***	-0.042***	-0.059***
	(0.261)	(0.338)	(0.013)	(0.015)
Rigid exposure	0.391	0.432	0.021	0.022*
	(0.244)	(0.241)	(0.012)	(0.011)
Observations	27,146	23,099	27,146	23,099
R-squared	0.388	0.409	0.393	0.414
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

B Validation of measure of price rigidity

A direct consequence of price rigidity is that firms should sell too much (too few) in quantity when they are unable to pass through the increases (decreases) in their input costs to their prices. Therefore, a straightforward validation of our measure of price rigidity is that price-rigid firms' sensitivity of quantity of sales to input price is relatively lower. We use the following specification to test the thesis.

$$\begin{aligned}\Delta Y_{i,t} =& \alpha + \beta_1 \times rigid_i + \beta_2 \times \Delta RM_price_{i,t} + \beta_3 \times rigid_i \times \Delta RM_price_{i,t} + \beta_4 \times X_{i,t} \\ &+ \delta_i + \gamma_t + \epsilon_{i,t}\end{aligned} \tag{12}$$

Where $Y_{i,t}$ is the year-on-year change in the quantity of products sold by a firm. We calculate the above firm-level measure by weighting the sales quantity of each product and its contribution to the firm's overall sales. The indicator variable $rigid$ is set to one if the firm is a PR firm, as defined above. The variable ΔRM_price is the firm-level raw material cost weighted average ratio between the year-on-year change in raw material price and the previous year's raw material price.

The term $X_{i,t}$ represents a vector of firm-level time-varying control variables. We follow D'Acunto et al. (2018) and include the following set of control variables - 1) the total assets of the firm, 2) the return on assets, 3) the ratio between total borrowings and total assets, and 4) the market power of the firm measured by their market share in the respective industries. The above variables are likely to influence the pricing power of firms (Schwartzman (1959); Deneckere and Kovenock (1992)). The variables δ_i and γ_t represent firm and year fixed effects, respectively. The firm-level fixed effects absorb any firm-level time-invariant shocks, whereas the year-level fixed effects capture the impact of any common time-specific trends. The coefficient of interest is β_3, which represents the differential sensitivity of sales quantity to input price in PR firms.

We present the results in Table B.1 of the online appendix. The sample period spans 2001 to 2010. We find that the coefficient on β_2 is negative and statistically significant. As expected, the growth in sales declines as input prices increase. The coefficient on the interaction term, β_3, is positive and statistically significant. Consistent with our thesis, PR firms experience a lower sensitivity of sales quantity to raw material prices.

Table B.1: Validation for measure of price rigidity

The table presents the estimate for the test that validates the measure of price rigidity.. The data are organized at a firm-year level and span the years 2001 to 2010. The dependent variable is the sales-weighted average change in sales quantity divided by the sales quantity in the previous year. The indicator variable *Rigid* is as defined in section 4.1.1. The variable $\Delta RM\ price$ is the average change in raw material price divided by the raw material price in the previous year. We include the control variables listed in Table 3 in the even-numbered columns. We also include firm and year fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Δsales quantity	
	(1)	(2)
Rigid X ΔRM price	0.338**	0.242**
	(0.124)	(0.104)
ΔRM price	-0.254**	-0.241**
	(0.097)	(0.091)
Observations	51,842	51,340
R-squared	0.644	0.641
Control variables	No	Yes
Firm F.E.	Yes	Yes
Year F.E.	Yes	Yes

C Measuring monetary policy shock

To create a measure of unanticipated components of monetary policy announcements, we rely on the data related to the yield of short-term (3-month) government bonds. Such bonds are publicly traded. Therefore, we expect any anticipated component of the monetary policy announcement to be priced in before the announcement is made. Consequently, we expect any change in yields in a short window after the announcement to capture the unanticipated component of the monetary policy announcement. We create the measure using the following steps.

As a first step, we obtain the monetary policy announcement dates from the website of the RBI.[22] The dates of policy announcements are available starting from the year 1998. Let the monetary policy announcement dates be represented by t. In the second step, we obtain data related to bond yields from the Database on Indian Economy (DBIE) maintained by the RBI.[23] In the third step, we estimate the net change in yield between day t and day $t+7$. The above step gives the cumulative change in yield in the one-week (7-day) period after each monetary policy announcement date. In the fourth step, we add up the 7-day cumulative change in yields after each monetary policy announcement dates within a year. This step provides us with the measure of monetary policy shock aggregated at a year level. We call the above variable MP_shock. The following equation represents the final two steps discussed above.

$$MP_shock_y = \sum_{t=1}^{t=n} (yield_{t+7} - yield_t) \tag{13}$$

Here y represents a year, t represents a monetary policy announcement date, and n is the number of announcements within the year y.

[22] See: `https://www.rbi.org.in/scripts/Annualpolicy.aspx`

[23] See: `https://cimsdbie.rbi.org.in/#/dbie/home`

D Measure of Price Rigidity based on theories of price-stickiness

For constructing an alternate measure of price-rigidity, we rely on four theories of price stickiness to identify the PR firms - 'coordination failure', 'cost-based pricing', 'non-price competition', and 'implicit contracts'. The four theories have been selected on the basis of the findings of a survey conducted by Blinder (1994). Blinder (1994) presented several theories explaining price rigidity to practitioners and asked them to rank them based on how closely they explain the actual price-setting process in their firms. More than 50% of industry practitioners chose these four theories as closely explaining the ground reality of the price-setting process and practical reasons for price rigidity.

We describe the four theories and the proxies based on them below.

1. Coordination failure: Prices can remain sticky if firms in an industry are not able to coordinate price changes (Ball and Romer (1987)). In such situations, it is possible that firms hesitate to affect large price changes. Suppose a firm in such an industry makes the first move and increases prices significantly and other firms do not increase their price in tandem, the firm that has increased prices may end up losing market share. Similarly, if a cut in price is met by a bigger cut in prices by industry peers, a price war may ensue and hurt all firms. Thus, expected coordination failure is likely to influence the pricing behavior of firms ex-ante and make prices sticky.

We devise an empirical proxy that captures the above characteristics of the price-setting process of firms operating in industries suffering from coordination failures with respect to pricing. We hypothesize that extremely large price movements on either side are likely to be rare in such industries. In other words, if we rank industries based on the proportion of firms affecting large price changes in a year, industries with coordination failure are likely to be at the bottom.

Based on the reasoning presented above, we create an indicator variable that identifies firms whose corresponding industries have a low share of firms experiencing a high magnitude of price change in a year. Specifically, we first denote a firm as a 'high price changer' if the absolute value of price change in percentages of the firm lies in the top quartile of absolute values of price changes (in percentage) across all firms in our sample. We then find the proportion of such 'high-price changers' in each industry. For example, consider an industry that has a total of 50 firms, of which five firms appear in the top quartile among all the firms by the magnitude of price change, then the proportion is 10%.

Finally, we divide the firms into quartiles based on the proportion of 'high-price changers' in the corresponding industry of the firm. We designate the firms in the bottom quartile as

PR firms under the 'coordination failure' theory.

2. Cost-based pricing: Here, the idea is that firms wait for their costs to increase before increasing output prices (Gordon (1981); Blanchard (1982); Carlsson and Skans (2012)). In other words, a demand shock is unlikely to move output prices unless the costs of inputs also rise. Therefore, prices remain sticky even when the demand situation changes.

To create a proxy for the above theory, we identify firms whose output prices closely follow the price movement of their inputs. For estimating the change in input prices, we obtain data related to raw material quantities and the rupee value of expense on raw materials from the CMIE database. We then calculate the unit price of raw materials used. Next, we calculate the year-on-year change in the price of each type of raw material used. Finally, we calculate the weighted average change in raw material price at the firm-year level using the quantity of each type of raw material used as weights.

We use the change in output and input prices to create a proxy based on the 'cost-based pricing' theory. First, we calculate the ratio between the change in average output price and the change in raw material price of the firm. Second, we take the deviation of the above ratio from one, which acts as our proxy for 'cost-based pricing' related price-rigidity. The closer the ratio is to one or the lower the deviation is from one, the more closely the change in output price shadows the change in input cost.

We then divide firms into quartiles based on the above-estimated ratio. We designate firms that are in the bottom quartile among all firms as PR firms based on the 'cost-based pricing' theory.

3. Non-price competition: The third theory is 'nonprice competition', which proposes that price rigidity arises because firms respond to supply shocks by varying other non-price elements such as delivery lags, service, quality, etc., instead of changing prices (Carlton (1989)). As per this theory, firms that offset a change in raw material prices by changing expenses on non-price elements in the opposite direction are price rigid. In other words, when faced with a supply shock in the form of increased input prices, firms maintain their margins not by changing output prices but by cutting on other expenditures.

To test the above theory, we create a measure by comparing the change in raw material costs with the change in SG&A expenses for firms. We consider firms whose SG&A expenditure moves in a direction opposite to that of input costs and shield the impact on margins as price rigid. Operationally, we first calculate the raw material cost and SG&A expenses as a percentage of the revenues of firms each year. Next, we compute the year-on-year change in both these measures for each firm-year. The absolute value of the sum of the change in both these expenses serves as a proxy for firms' decision to adjust SG&A expense in response to change in raw material cost. The lower the absolute value of the sum, the higher the price

rigidity as per this measure.

For example, let us consider two firms, A and B, which experience a 15% increase in raw material to sales ratio in a year. If firm A decreases the SG&A to sales ratio by 13%, whereas firm B increases the SG&A to sales ratio by 5%. The proxy for firm A is (15% - 13% = 2%), and for firm B is (15% + 5% = 20%).

We then divide the firms into quartiles based on the above-created proxy. The firms in the bottom quartile are designated as PR firms based on the 'non-price competition' theory.

4. Implicit contracts: The theory of 'implicit contracts' hypothesizes that some firms do not change prices out of a sense of "fairness" to the customers (Okun (2011)). Such firms agree to keep the prices stable even in tight markets. We argue that such firms could have one of the two characteristics. First, despite operating in a low-competition environment, they may not increase prices when their costs go up. To identify the firms with a low response of prices to costs, we first calculate the change in prices divided by the change in raw material costs. We then consider the firms lying in the bottom quartile of the distribution based on the above measure as firms that respond slowly to costs. However, a reader may worry that the slow response of prices to costs could be due to high competition in the industry. Therefore, as alluded to above, we impose a second condition based on the level of competition within the industry to which a firm belongs. To identify non-competitive industries, we calculate the Herfindahl Index (HHI) of the industry as the sum of squares of the share of sales of each firm in the industry. We define non-competitive industries as industries below the median level of the HHI among all industries. Thus, our measure represents firms that do not increase prices in line with their costs and also belong to industries with low levels of competition.

Second, these firms may engage in charitable spending. The proxy for the second characteristic is an indicator that identifies firms that voluntarily spend on corporate social responsibility (CSR)-related activities. The data for CSR spending by firms is obtained from the CMIE database. After creating the two proxies, we define a firm as price-rigid under the 'implicit contracts' theory if it satisfies any one of the two conditions.

Finally, after identifying PR firms based on the above four theories, we define a firm as price-rigid (PR firm) if it is designated as such under any of the four theories. For example, if a firm is identified as price rigid based on 'coordination failure' but not based on the other three theories, the firm is classified as a PR firm. However, if a firm is not identified as price-rigid based on any of the four theories, it will be classified as a non-PR firm. We present the description of the theories and the corresponding empirical proxies in Table D.1.

Using the above definition of PR firms, we redefine our measure of PR banks as in section 4.1.1. We re-estimate our main specifications using the revised definitions and present the

results in Tables D.2 and D.3. We find that the results remain largely unchanged.

Table D.1: Price-rigidity measures using Blinder (1994))

The table presents the description and corresponding empirical measures of the price-rigidity theories from Blinder (1994).

Sl No	Theory	Brief description	Empirical measure
1	Coordination failure	Firms delay price changes, waiting for other firms in the industry to react first.	1. Identify firms that have a higher magnitude of price changes, and denote them as high-price changers. 2. Calculate the proportion of high-price changers in each industry. 3. Identify firms belonging to the industries that lie in the lowest quartile across industries, in terms of the proportion of high-price changers.
2	Cost based pricing	Firms delay price changes, until their cost of production changes.	1. Calculate the ratio of change in price to change in cost of raw materials for each firm. 2. Calculate the deviation of this ratio from one. 3. Identify firms that belong to the lowest quartile in terms of the above deviation.
3	Non-price competition	Firms absorb changes in costs through changes in non-price elements.	1. Calculate the absolute value of the sum of changes in raw material costs and changes in SG\&A expenses. 2. Identify firms that lie in the bottom quartile in terms of the above measure.
4	Implicit contracts	Firms maintain stable prices out of fairness to customers.	1. Calculate the ratio of change in price to change in raw material costs of firms. Also, calculate the HHI of the industries. 2. Identify firms that remain in the lowest quartile in terms of the ratio of change in product prices to change in raw material costs, and that belong to industries with below the median level of HHI. 3. Identify firms that voluntarily spend high on corporate social responsibility-related activities. 4. Firms that satisfy any one of the above two criteria are considered price-rigid firms.

Table D.2: Firm outcomes

The table shows the difference in firm-level outcomes for PR firms compared to non-PR firms in response to monetary policy change. Here PR firms are defined using empirical measures of the price-rigidity theories from Blinder (1994). The data are organized at a firm-year level. The dependent variable is the natural logarithm of addition to gross fixed assets (*Log gfa*) in Columns 1 and 2, and the natural logarithm of addition to property, plant, and equipment (*Log ppe*) in Columns 3 and 4. The indicator variable *Rigid* is as defined in section 4.1.1. The variable *MP_shock* is as defined in section 4.2. We include firm-year level control variables listed in Table 3 in the even-numbered columns. We also include firm and industry × year fixed effects in all the columns. The standard errors in the parentheses are clustered at the industry level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log gfa		Log ppe	
	(1)	(2)	(3)	(4)
Rigid × MP_shock	-0.212***	-0.179***	-0.218***	-0.185***
	(0.056)	(0.056)	(0.056)	(0.056)
Rigid	0.220**	0.057	0.214**	0.055
	(0.085)	(0.087)	(0.086)	(0.088)
Observations	53,275	50,233	53,259	50,219
R-squared	0.469	0.473	0.468	0.473
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Industry × Year F.E.	Yes	Yes	Yes	Yes

Table D.3: Lending

The table shows the difference in lending activities between PR banks and other banks in response to monetary policy changes. PR banks are banks that are more exposed to PR firms as defined using empirical measures of the price-rigidity theories from Blinder (1994). The data are organized at a bank-firm-year level and span the years 2003 to 2011. The dependent variable in columns 1 and 2 is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. The dependent variable in columns 3 and 4 is *New loan*, which is an indicator variable set to one if the firm obtains a new loan from the bank in the year, zero otherwise. The variable *rigid exposure* is set to one (zero) if the bank has above (below) the median value of the proportion of its total outstanding loans owed by PR firms in the previous year. The variable *MP_shock* is as defined in section 4.2. We include the control variables listed in Table 4 in the even-numbered columns. We also include firm × year and bank fixed effects in all columns. The standard errors in the parentheses are clustered at the industry level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.254***	-0.296***	-0.012***	-0.015***
	(0.048)	(0.055)	(0.002)	(0.003)
Rigid exposure	-0.361***	-0.426***	-0.017***	-0.021***
	(0.072)	(0.074)	(0.004)	(0.004)
Observations	106,560	88,349	106,560	88,349
R-squared	0.399	0.415	0.402	0.418
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

E Alternative measure of monetary policy shock

As elaborated in section 4.2, the interest rate futures market was non-existent in India during the initial years of our sample period, and the interest rate futures were not actively traded in the later years (Lakdawala and Sengupta (2021)). Therefore, the underlying assumption in creating the measure of monetary policy shock based on bond yields is that the price discovery about the future expectations about the macroeconomy happens in the spot market.

To address any residual concerns about the measure of monetary policy shocks, we create an alternative measure of monetary policy shock using Overnight Index Swap (OIS) returns. OIS contracts are derivative contracts in which parties exchange fixed and floating rates. The floating rates are tied to the Mumbai Interbank Overnight Rate (MIBOR). We expect the future expected trajectory of central bank interest rates to be priced into such contracts. Hence, any change in the OIS rates around the monetary policy announcements captures the exogenous component of the announcements. We follow the methodology elaborated in section 4.2 to estimate MP_shock, except that we replace bond yields with OIS rates.

We re-estimate equations 2, 4, 5, 7, and 10 using the above measure of monetary policy shock. We present the results corresponding to the specifications in Tables E.1, E.2, E.3, and E.4 of the online appendix, respectively. The results are qualitatively similar to Tables 3, 4, 5, and 7, respectively.

Table E.1: Price-rigidity and firm outcomes: OIS

The table shows the difference in firm-level outcomes for PR firms compared to non-PR firms in response to monetary policy change. PR firms are as defined in section 4.1.1. The data are organized at a firm-year level. The dependent variable is the natural logarithm of addition to gross fixed assets (*Log gfa*) in Columns 1 and 2, and the natural logarithm of addition to property, plant, and equipment (*Log ppe*) in Columns 3 and 4. In Columns 5 and 6, the dependent variable is *Default* that takes a value of one if the firm is delinquent on any of its borrowing liabilities in the year, and zero otherwise. The indicator variable *Rigid* is as defined in section 4.1.1. The variable *MP_shock* is the measure of monetary policy shock based on seven day OIS return around monetary policy announcement. We include firm-year level control variables - total assets, ROA, leverage ratio, and market share of the firms in their respective industry - and their interactions with *MP_shock* in the even-numbered columns. We also include firm and year fixed effects in all the columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log gfa		Log ppe		Default	
	(1)	(2)	(3)	(4)	(5)	(6)
Rigid × MP_shock	-0.154***	-0.151***	-0.164***	-0.161***	0.003**	0.003**
	(0.034)	(0.039)	(0.033)	(0.039)	(0.001)	(0.001)
Observations	51,842	51,340	51,789	51,294	53,189	52,503
R-squared	0.644	0.641	0.640	0.637	0.523	0.523
Control variables	No	Yes	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes

Table E.2: Price-rigidity of borrowers and bank performance: OIS

The table shows the difference in sensitivity of banks' performance to monetary policy change between price rigid banks (PR banks) and other banks. PR banks are identified as banks with high exposure to PR firms. PR firms are as defined in section 4.1.1. The data are organized at a bank-year-quarter level and span the years 2011 to 2020. The dependent variable in Columns 1 and 2 (3 and 4) is the fresh GNPA added during the quarter as a proportion of advances (Capital adequacy ratio), which we denote as *GNPA slippage* (*Capital adequacy ratio*). The measures are defined in detail in Table A1 of the online appendix. The indicator variable *rigid exposure* is one if the bank has an above the median value of the proportion of its total outstanding loans owed by PR firms among all the banks in the previous year and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock based on seven day OIS return around monetary policy announcement. We include the bank-year level control variables - cash to asset ratio, the ratio between the weighted number of days of deposit and the weighted number of days of advances, the proportion of banks' outstanding loan in districts in which it has more than 75% market share, and deposit to asset ratio - and their interactions with *MP_shock* in the even-numbered columns. We also include bank and year fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the bank and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	GNPA slippage		Capital adequacy ratio	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	0.614***	0.610***	-0.329*	-0.410
	(0.180)	(0.183)	(0.167)	(0.242)
Rigid exposure	-0.856***	-0.805***	0.738*	0.865*
	(0.159)	(0.160)	(0.367)	(0.406)
Observations	1,572	1,572	1,572	1,572
R-squared	0.582	0.589	0.725	0.739
Control variables	No	Yes	No	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes

Table E.3: Lending by PR banks to PR firms: OIS

The table shows the estimates for the differential effect on lending to PR (non-PR) firms by PR banks and non-PR banks in panel A (B), following monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2020. The sample is limited to PR firms (non-PR firms) in panel A (B). In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* and the indicator variable *rigid exposure* are as defined in Table 4. We include the bank-year level control variables from Table 4 in the even-numbered columns. We also include firm × year and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Lending to PR firms				
	Log loan		New loan	
	(1)	(2)	(3)	(4)
Rigid exposure × MP_shock	-0.452*	-0.633**	-0.022*	-0.032**
	(0.203)	(0.270)	(0.010)	(0.014)
Rigid exposure	0.435	0.516	0.023	0.027
	(0.298)	(0.318)	(0.015)	(0.015)
Observations	27,146	23,099	27,146	23,099
R-squared	0.388	0.408	0.393	0.413
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Panel B: Lending to non-PR firms				
Rigid exposure × MP_shock	-0.355**	-0.316	-0.019**	-0.017
	(0.118)	(0.190)	(0.006)	(0.009)
Rigid exposure	0.335	0.256	0.018	0.014
	(0.283)	(0.275)	(0.014)	(0.014)
Observations	72,962	63,261	72,962	63,261
R-squared	0.448	0.465	0.449	0.465
Control variables	No	Yes	No	Yes
Firm × Year F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes

Table E.4: Financial Accelerator Channels: OIS

The table disentangles the financial accelerator effects on borrowings of firms owing to the firm net worth and bank net worth channels, in response to monetary policy shocks. The data are organized at a bank-firm-year level from 2011 to 2021 and are limited to PR firms. In columns 1 and 2, the dependent variable is *Log loan* which is the natural logarithm of the loan amount given by a bank to a firm in a year. In columns 3 and 4, the dependent variable is the indicator variable *new loan* that takes a value of one if a bank extends a loan to the respective firm, and zero otherwise. The variable *MP_shock* is the measure of monetary policy shock based on seven day OIS return around monetary policy announcement. The variable *rigid_bank_nonbg* identifies firm-bank pairs where banks have high exposure to PR firms (PR banks) and the firm doesn't belong to a business group. The variable *non_rigid_bank_nonbg* identifies firm-bank pairs where banks have low exposure to PR firms (non-PR banks) and the firm doesn't belong to a business group. The firms belonging to business groups are in the base as control group. We also remove the business group firms whose groups have more than 50% PR firms from the base. We include the firm-year level control variables from Table 3 and bank-year level control variables from Table 4 in the even-numbered columns. We also include firm, year, and bank level fixed effects in all columns. The standard errors in the parentheses are two-way clustered at the industry and year level and adjusted for heteroskedasticity. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log loan		New loan	
	(1)	(2)	(3)	(4)
MP_shock × Rigid_bank_non_bg	-0.414*	-0.603*	-0.020*	-0.030*
	(0.194)	(0.289)	(0.011)	(0.016)
MP_shock × Non_rigid_bank_non_bg	-0.349***	-0.452*	-0.017**	-0.022
	(0.054)	(0.226)	(0.006)	(0.013)
Rigid_bank_non_bg	0.197	0.337	0.012	0.019
	(0.297)	(0.369)	(0.015)	(0.019)
Observations	28,283	21,050	28,283	21,050
R-squared	0.185	0.196	0.190	0.200
Control variables	No	Yes	No	Yes
Firm F.E.	Yes	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes