Financial Constraints and Factor Substitution: Evidence from India

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Abstract

The paper examines whether financial constraints lead to disproportionate changes in firms' input composition (labour and capital) in response to the monetary policy shock. Using a panel of Indian manufacturing firms from 2003 -2023, combined with monetary policy surprises around the Reserve Bank of India announcements, we decompose these surprises into target and path components and match them with firm balance sheet data to construct a predetermined measure of firms' exposure to financial constraints. This approach allows us to utilise differences in firms' financial exposure to identify heterogeneous responses to policy shocks. The empirical results across model specifications reveal that contractionary monetary shocks are associated with higher financing pressure and lower labour intensity, with stronger effects among more financially constrained firms. These results are consistent with a credit-channel mechanism operating through collateral and working capital effects, in which labour adjustment has been easier than that of capital under tighter financing conditions in India. We also find that path shocks appear to have more persistent effects than target shocks, meaning that monetary tightening affects employment-related firm adjustment more through financial constraints than others.

Keywords: Financial Constraints, Labour Intensity, Factor Substitution, Monetary Policy Surprises

JEL Classification: E52, G30, J20

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1. Introduction

Understanding how firms adjust employment and capital investment when financing conditions tighten is central to both macroeconomics and corporate finance. The global financial crisis (GFC) of 2008 provided significant insights, especially in the context of European firms that predominantly safeguarded their capital expenditures by disproportionately reducing labour costs when faced with financial constraints[1]. This adjustment led to a substantial reduction in their labour-to-capital ratios (ElFayoumi, 2024). Calvo et al. (2012) and Jermann and Quadrini (2012) offer an influential argument linking the observed decline in Europe's aggregate labour share during the 2008 crisis to financial constraints that require firms to increase their reliance on fixed capital. According to this hypothesis, fixed capital serves as collateralizable assets that alleviate financial constraints when financing conditions tighten. ElFayoumi (2024) further supports this, demonstrating empirically that financially constrained firms facing the rising financing costs tend to substitute capital for labour due to the superior collateral value of capital. This substitution effect is particularly pronounced in firms with higher-collateralised assets (e.g., those with lower depreciation rates), whereas firms with fewer collateralizable assets exhibit weaker substitution effects[2]. Conversely, Galindo Gil (2025), in a more recent study, introduces an alternative perspective, emphasising the role of working capital in monetary policy transmission[3]. Under this channel, interest rate shocks intensify financial constraints by increasing firms' marginal costs, thereby reducing labour demand, production, and profitability (Bergin et al., 2018). Firms with substantial internal liquidity are better positioned to smooth these shocks, whereas financially constrained firms face sharper employment reductions (Gilchrist et al., 2017; Ottonello & Winberry, 2020). Despite these insights, a crucial research question remains insufficiently explored: do tighter financing

[1] A firm is considered financially constrained if it cannot secure external funding, even when it is willing to pay an interest rate above the prevailing market rate (Love, 2003; Whited & Wu, 2006). An alternative definition, drawing on Fazzari et al. (1988), views financial constraints as a situation in which firms can still finance investment, but only at progressively higher costs. However, this notion of increasing marginal financing costs is more consistent with the assumption of a well-developed capital market (Jin et al., 2019). In India, where capital markets are not as well developed, even firms willing to pay higher interest rates may still be unable to obtain loans from banks or other financial institutions.

[2] This interpretation aligns with broader theoretical frameworks in which financial frictions distort factor allocation and amplify real effects of monetary shocks (Bernanke & Gertler, 1995; Gertler & Karadi, 2011).

[3] The flow of monetary policy decisions into the real economy or into the real aggregate activities is known as Monetary Policy Transmission (Ghate et al., 2025).

conditions, induced by monetary policy shocks, alter firms labour to capital mix and are these effects stronger for financially constrained firms? Addressing this question is crucial for understanding the microeconomic channels through which monetary policy affects firm employment decisions.

In the Indian context, this issue is particularly relevant. A notable decrease in the labour-to-capital ratio has also been observed in India across both capital-intensive and labour-intensive industries (Kapoor, 2015; Sen & Das, 2015; Sinha, 2025). While this rise in capital intensity is frequently attributed to rigid labour regulations that elevate hiring and firing costs, Sen and Das (2015) argued that such regulations alone cannot fully explain the rising trend. Instead, they suggest that increasing capital intensity may come from financial constraints driving firms towards greater capital investment, as capital becomes relatively cheaper compared to labour due to trade liberalisation, as well as ease of borrowing in capital markets (Maiti, 2019; Veeramani & Basu, 2025). But these explanations do not fully address whether financing conditions themselves contribute to the shift in firms' factor mix. The Indian setting, therefore, provides a useful context for studying whether tighter monetary and credit conditions push financially exposed firms toward lower measured labour intensity.

The mechanism we study connects two related ideas in the literature. The first is the credit (financial) channel of monetary transmission (Bernanke & Gertler, 1995). According to this channel, a contractionary policy raises borrowing costs and tightens external financing conditions, especially for firms with weaker balance sheets. The second is more specific to the collateral and working capital mechanism (Christiano et al., 2014; Kiyotaki & Moore, 1997). Under this, the labour often requires upfront financing through working capital, whereas capital may both generate output and support borrowing capacity by expanding the stock of collateralizable assets. Under tighter financing conditions, these asymmetries imply that labour may become relatively more costly than capital. The firm-level evidence for Europe shows that increases in financing costs can reduce firms' relative demand for labour and induce substitution toward capital. On the other hand, structural work on the working capital channel shows that interest rate shocks can affect labour demand through the financing of wage bills. This could be more pronounced in India due to the presence of flexible and contract workers. The relative strength of these two forces would determine the factor composition in response to the monetary policy shock. These insights motivate the central question of this paper.

Identifying this relationship empirically is challenging because financing conditions are endogenous to firm performance, profitability and investment opportunities, as both financing costs and firm decisions are jointly determined by underlying fundamentals (Bernanke & Gertler, 1995; Hennessy & Whited, 2005). Firms that appear financially constrained may differ systematically from less constrained firms in ways that also affect labour and capital choices. To address this issue, the following ElFayoumi (2024)We combine firm-level balance sheet data with monetary policy shocks. The monetary policy shocks are decomposed into target and path components. The target component captures unexpected changes in the current policy stance, while the path component captures revisions to the expected future path of policy rates. This decomposition is insightful because the target and path factors may operate through different margins of adjustment. Unexpected changes in the current policy rate are likely to affect short-term funding costs, liquidity conditions and working capital financing more immediately. Revisions to the expected future path of policy rates, by contrast, may matter more for investment planning and the expected value of collateral over a longer horizon. Distinguishing between these two components, therefore, helps clarify whether monetary tightening affects firms' input mix mainly through immediate funding pressure or through more persistent changes in expected financing conditions.

Using a panel of Indian manufacturing firms over 2003-2023, the paper shows that contractionary monetary policy shocks are associated with higher financing pressure and lower measured labour intensity, with stronger effects among more financially constrained firms. The results are consistent with a financial transmission mechanism in which tighter borrowing conditions weigh more heavily on labour than on capital. The evidence also suggests that path shocks have more persistent effects than target shocks. Taken together, these findings indicate that monetary tightening may affect employment-related firm adjustment not only by reducing overall activity, but also by changing the composition of production inputs within firms.

By linking monetary policy shocks to firm-level adjustments in labour and capital inputs, this study contributes to the related literature in the following ways. First, while extensive literature has examined monetary policy transmission at the aggregate level, disaggregate-level evidence on how monetary policy shocks shape firms' input choices remains limited, especially in emerging markets[4]. The present study provides new firm-level evidence from India, an

[4] The aggregate effects of monetary policy shocks have been extensively studied (Bernanke & Blinder, 1992; Gallo et al., 2016; Gertler & Karadi, 2015; Kinnerud, 2025; Miranda-Agrippino & Ricco, 2021). In contrast, a growing but still limited literature examines firm-level heterogeneity in monetary transmission, emphasising

economy where financing frictions are pervasive and structurally distinct from those in advanced economies that dominate the existing literature. Second, the paper connects the monetary transmission literature with the literature on within-firm input adjustment by using monetary policy surprises to identify heterogeneous firm-level responses in labour intensity and to distinguish between the effects of target and path shocks. Third, by decomposing monetary shocks into target and path components, the paper distinguishes between immediate and more persistent financing effects and offers an in-depth analysis of how policy affects firms' real decisions. Finally, our study diverges from and extends the existing literature in two substantive ways. First, the finding that labour intensity declines disproportionately, especially in highly leveraged and financially exposed firms, highlights a micro-level channel of monetary policy transmission that has been largely overlooked in the existing literature. Second, while most studies take the monetary policy shock as a single object, in our study, we show that the composition of the shock matters. The path factor generates more persistent financing pressure and sustained labour capital rebalancing, whereas the target factor does not. To the best of our knowledge, this distinction has not been documented for India and adds a new dimension to the understanding of monetary policy transmission in emerging market economies.

The rest of the paper proceeds as follows. Section 2 discusses the background and motivation in the Indian context. Section 3 describes the construction of monetary policy shocks. Section 4 presents the conceptual framework and develops the main hypotheses. Section 5 describes the data and empirical strategy. Section 6 presents the results and discussion. Section 7 concludes.

2. Background of the Study

India's experience over the past four decades offers a rich backdrop for testing whether tighter financial constraints push firms toward 'more capital relative to labour'. Long-run evidence for organised Indian manufacturing using ASI data[5] shows that output growth has substantially expanded faster than employment. Between 1983 and 2017, employment roughly doubled,

differences in balance-sheet strength, credit access, and investment responses (Cloyne et al., 2023; Kashyap & Stein, 1997; Ottonello & Winberry, 2020; Raghuvanshi & Ahmad, 2026). Evidence on how monetary policy affects within-firm input choices remains comparatively scarce, with a few notable exceptions highlighting the role of financial frictions in shaping factor allocation (Albrizio et al., 2026; Caggese & Cuñat, 2013; ElFayoumi, 2024; Junicke et al., 2025).

[5] ASI data refers to the Annual Survey of Industries (ASI), conducted by the Ministry of Statistics and Programme Implementation (MoSPI). It is the primary source of industrial statistics for the organized manufacturing sector in India.

while output increased nearly fifteenfold (Basole & Narayan, 2020). Over the same period, capital intensity rose steadily, leading to a persistent decline in the labour-to-capital ratio. Decomposition analysis indicates that this shift is predominantly attributable to within-industry changes, rather than to shifts in industrial composition. This pattern is consistent with a broad literature documenting weak employment responsiveness in Indian manufacturing and a declining labour share over time (Gupta & Helble, 2022; Jayadev & Narayan, 2020; Veeramani & Basu, 2025). At the same time, India's labour market is highly dualistic, with informality remaining pervasive (Djidonou & Foster-McGregor, 2022). Macro-labour models calibrated to India emphasise that contractionary monetary shocks can reduce employment in both formal and informal segments, implying that financing shocks transmit strongly through the employment margin (Das et al., 2025).

This structural context intersects with two well-identified policy experiments that pull firm behaviour in opposite directions. On the enforcement side, the SARFAESI Act (2002)[6] strengthened secured creditors' ability to seize collateral after notice. The RBI assessments at the time linked the introduction of stronger recovery strategies to significant reductions in banks' NPAs in the early 2000s. Based on ASI microdata, firms with more tangible, collateralizable assets were more exposed to heightened ex ante liquidation risk following the SARFAESI Act. In response, they reduced fixed capital investment and increased employment, substituting away from owned, easily seizable capital toward labour (Alok et al., 2022). On the credit supply side, the RBI's 2005 branch-expansion policy generated an exogenous increase in banking outreach by allocating additional branch licences to districts classified as 'under banked' (those falling below the national population-to-branch cutoff). These treated districts received 21% more branch licences following the reform and had 19% more operating branches by 2010, relative to control districts above the cutoff, leading to sizable increases in both deposits and credit (Cramer, 2025). Looking at the real effects of expanded banking access on bank-borrower relationships, firm-level evidence shows increases in capital accumulation and employment concentrated among incumbents in the manufacturing sector (Chandar et al., 2023). Complementing these domestic credit channels, liberalisation introduced access to foreign capital at the industry level in the early 2000s, reduced capital misallocation and raised capital stocks and wage bills, with especially strong gains observed among previously constrained firms (Bau & Matray, 2023). Taken together, the Indian experiences in this context

[6] The Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest Act 2002 (SARFAESI Act) strengthened creditor rights by allowing banks to seize and sell secured collateral without prior court approval, but only after the loan is classified as an NPA and a 60-day notice is issued (Vig, 2013).

sharpen the empirical question for monetary tightening: does measured capital deepening rise because either firms actively accumulate to own fixed assets (a collateral-accumulation mechanism) or employment falls faster than the capital stocks adjust (a balance-sheet liquidity mechanism)?

Empirical tests of the implications of external financing costs in explaining variations in firms' labour-to-capital ratios involve estimating the causal effect of financing conditions on firms' input choices. However, financing costs are themselves influenced by several firm-specific fundamentals that determine the labour-to-capital ratio, leading to simultaneity bias in which a firm's labour-to-capital ratio and its financing costs are jointly determined, potentially resulting in endogeneity (Hennessy & Whited, 2005). Using firm leverage or liquidity as proxies may not be feasible, as these are endogenous outcomes of a firm's prospects, including unobservable growth expectations. For instance, high leverage may signal strong growth potential rather than financial distress. Therefore, a credible identification strategy must isolate exogenous changes in financing costs that are independent of firm characteristics and jointly affect both financing conditions and the input mix.

3. Monetary Policy Shocks

Following ElFayoumi (2024), in our study, we consider the within-firm variations in the pass-through of aggregate monetary policy surprises to the financing costs of firms (the credit channel), as a function of their liquidity and solvency positions; changes in the aggregate monetary conditions have a disproportionately larger impact on the external financing costs of less liquid and solvent firms. We construct the firm-level shocks by interacting an exogenous, monetary-policy surprise series with lagged firm-level measures of creditworthiness (e.g., leverage, liquidity, and short-term debt share), thereby capturing heterogeneous pass-through working via the credit channel[7]. The monetary policy surprise is plausibly exogenous to concurrent firm fundamentals as it is identified from intra-day market reactions around central-bank announcements, whereas the firm exposure is pre-determined and included as a control to remove direct level effects and mitigate reverse causality. This construction isolates variation

[7] Monetary policy transmits through several complementary channels: (i) Demand channel, whereby changes in policy rates alter aggregate consumption and investment, shifting firms' current and expected sales (ii) Interest-rate/investment channel, where real rates move user cost and discount rates, affecting hurdle rates and capex (iii) Credit (financial-accelerator/bank-lending) channel, in which asset prices, collateral, net worth, and bank balance sheets shift external finance premia and loan supply, with stronger effects on riskier, less liquid firms (iv) Expectations/signalling channel, through which guidance about future rates and inflation feeds into pricing and planning; and, in open economies (v) Asset-price/wealth and exchange-rate channels that influence demand and imported input costs. Our empirical strategy focuses on the credit channel's heterogeneous pass-through.

that is unlikely to reflect contemporaneous demand or supply shocks, focuses identification on differential responses across otherwise similar firms, and makes the exclusion restriction more credible: the instrument affects firm outcomes only through its effect on external financing costs. For monetary policy shocks, we follow the dataset of Lakdawala and Sengupta (2025), who develop a high-frequency measure of Indian monetary policy surprises by extracting two orthogonal factors (target and path) from intraday changes in Overnight Index Swap (OIS) rates[8] across maturities using principal components[9]. The *target factor* captures unanticipated changes in the RBI's short-term policy rate at the announcement, while the *path factor* summarises unexpected news about forward guidance, i.e., shocks that shift the expected future path of policy rates. The two factors are constructed to be orthogonal, ensuring that the path factor captures news about future rates that is uncorrelated with surprise changes in the contemporaneous policy target rate. Orthogonality is obtained via a factor-rotation procedure detailed in Lakdawala and Sengupta (2025)[10].

Decomposing monetary policy surprises into target and path factor matters because they map into different firm-level adjustment mechanisms. The target factor captures unexpected changes in the current policy stance and should primarily tighten near-term credit and liquidity conditions[11], implying a relatively immediate contraction in labour and variable inputs, consistent with a working-capital credit channel. A negative target factor means the decision was more accommodative than expected (e.g., an unexpected rate cut or a smaller than expected hike) and therefore represents an expansionary monetary policy surprise. The path factor captures revisions to the expected future path of policy rates induced by communication or forward guidance, holding the immediate decision fixed. A positive path factor indicates markets revised the expected future policy rate path, i.e., contractionary forward guidance upward; whereas a negative path factor indicates a downward revision, i.e., expansionary forward guidance. The path factor changes longer-horizon discount rates and the expected marginal cost of capital; therefore, it affects the investment planning and the capital-labour

[8] OIS rates are the fixed rates in swaps tied to overnight benchmark rates and represent the market's expectation of the average overnight interest rate over the maturity of the contract (Lloyd, 2021).
[9] Details of target and path factor construction are given in Appendix A1
[10] Lakdawala and Sengupta (2025) use a narrative cross-check to validate that OIS-based target and path factors capture revisions in market expectations around RBI policy decisions. Specifically, authors consider the RBI's official policy statements and also reviewed contemporaneous coverage in India's financial media on announcement days. On dates with large factor movements, they find the factors line up with the policy decision, the language of the statements, and the media's interpretation.
[11] Near-term credit and liquidity conditions captures short-term funding costs, rollover risk, working capital financing conditions, and the state of bank balance sheets.

composition. In the Indian context, this decomposition of monetary policy shocks allows us to test whether monetary tightening raises measured capital intensity mainly because firms actively adjust capital in response to sustained expected tightening (path) or because employment contracts faster, under immediate financing stress (target). **Figure 1** and **Figure 2** plots the resulting target and path series, respectively.

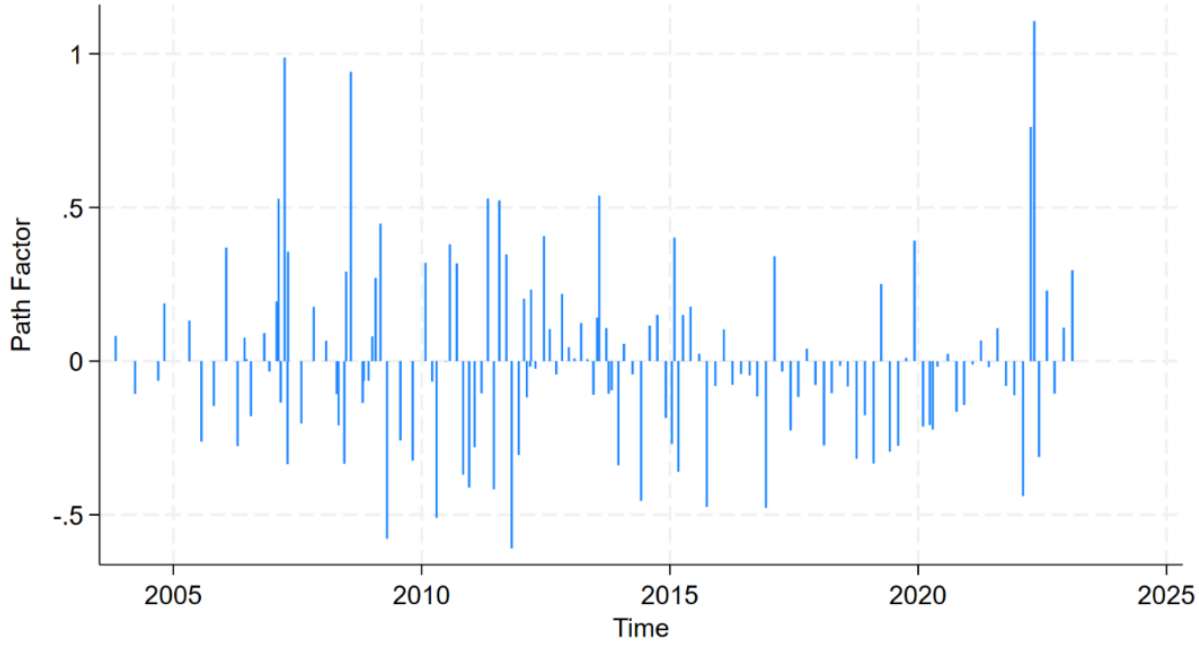


Figure 1: Monetary policy shock - Path Factor

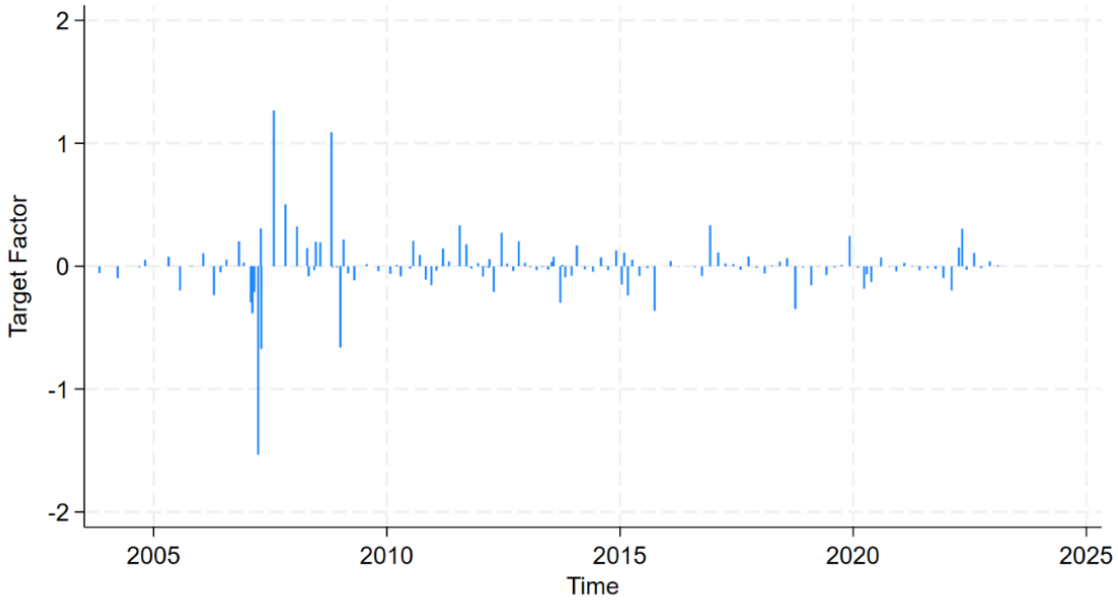


Figure 2: Monetary policy shock - Target Factor

In our study, we use weekly data series from the week beginning November 3, 2003, through the week beginning February 8, 2023 (132 observations). The path and target factors

have values of zero on non-announcement days. To match the annual frequency of our firm-level panel, we first compute monthly shocks and then sum the monthly shocks within each year.

4. Conceptual Framework

In this section, we develop a simple model framework in which firms choose capital and labour under financial constraints. Our aim is to show how the tighter financial conditions affect the firm's labour-capital substitutions which, in turn, help us derive testable hypotheses for the empirical analysis. The monetary policy shocks in our analysis are decomposed into target and path factors. Monetary policy shocks affect the firms through the cost and availability of long-term and working capital loans. The following model framework explains how these shocks enter into the first-order conditions for capital and labour, and ultimately in the optimal labour to capital ratio.

Our model includes three main agents: households, who supply labour hold financial assets such as bank deposits, bonds and owns firms; firms, which produce a single good using capital and labour while facing working capital and collateral constraints; and financial intermediaries, which provide long-term and short-term loans against collateral and set interest rates that respond to default risk and monetary policy conditions.

4.1 Households

We assume a representative risk-neutral household, supplies labour inelastically, consumes the final good of production and owns the firms. The household holds deposits or bonds that pay risk free interest rate $r_{f,t}$. Let λ_t be the multiplier on the budget, $\frac{\lambda_{t+1}}{\lambda_t}$ is the stochastic discount factor. The household side serves mainly to derive the discount factor:

$$\frac{\lambda_{t+1}}{\lambda_t} = \frac{1}{1 + r_{f,t}} \tag{1}$$

which enters the firm's intertemporal first-order conditions. We abstract from household heterogeneity and labour market frictions and mainly focus on firms' input choice under financial frictions.

4.2 Financial intermediaries

We assume a competitive banking sector in our framework that funds itself at the risk-free rate and extends working-capital and long-term loans to firms. Banks cannot costlessly observe

firms' returns; when a firm defaults, banks incur monitoring/enforcement costs to seize collateral, as in a standard costly-state-verification (CSV) environment. In equilibrium, loan rates and collateral haircuts adjust so that the expected return on loans equals funding costs plus verification expenses. This setting gives rise to an endogenous borrowing limit (summarised by a collateral constraint), and loan rates that depend on firm risk, collateral and monetary policy.

4.2.1 Default and recovery

Let $\Lambda^{\mathrm{R}}_{\mathrm{t+1}}$ denote the value of receivables and $\Lambda^{\mathrm{K}}_{\mathrm{t+1}}$ the liquidation value of capital at t+1. Receivables $\Lambda^{\mathrm{R}}_{\mathrm{t+1}}$ first pay for working capital (WC), WC can also be backed by capital up to $\theta^{M}_{t}\Lambda^{\mathrm{K}}_{\mathrm{t+1}}$, the remaining capital up to $\theta^{D}_{t}\Lambda^{\mathrm{K}}_{\mathrm{t+1}}$ serves long-term debt (D) collateral and $\theta \in (0,1]$. Therefore, collateral attached to WC and collateral left for long-term debts can be expressed as follows:

$$WC^{Cap}_{t+1} = min\left\{\theta^{M}_{t}\Lambda^{\mathrm{K}}_{t+1}, \left((1+r^{WC}_{t})M_{t} - \Lambda^{\mathrm{R}}_{t+1}\right)^{+}\right\} \tag{2}$$

M_t is the working capital loan.

Capital left for long-term debt;

$$D^{Cap}_{t+1} = max\{0, \theta^{D}_{t}\Lambda^{\mathrm{K}}_{t+1} - WC^{Cap}_{t+1}\} \tag{3}$$

Recoveries are then,

$$R^{WC}_{t+1} = min\{(1+r^{WC}_{t})M_{t}, \Lambda^{\mathrm{R}}_{t+1} + \theta^{M}_{t}\Lambda^{\mathrm{K}}_{t+1}\}, \tag{4}$$

$$R^{D}_{t+1} = \min\left\{(1+r^{D}_{t})D_{t+1}, D^{Cap}_{t+1}\right\} \tag{5}$$

Thus, to avoid default, the total value of collateral (comprising receivables and pledged capital) must be sufficient to cover all outstanding obligations.

This requires,

$$\Lambda^{\mathrm{R}}_{\mathrm{t+1}} + \theta^{\mathrm{M}}_{\mathrm{t}}\Lambda^{\mathrm{K}}_{\mathrm{t+1}} \geq \left(1+\mathrm{r}^{\mathrm{WC}}_{\mathrm{t}}\right)\mathrm{M}_{\mathrm{t}} \tag{6}$$

$$\theta^{\mathrm{D}}_{\mathrm{t}}\Lambda^{\mathrm{K}}_{\mathrm{t+1}} - \mathrm{WC}^{\mathrm{Cap}}_{\mathrm{t+1}} \geq (1+\mathrm{r}^{\mathrm{D}}_{\mathrm{t}})\mathrm{D}_{\mathrm{t+1}} \tag{7}$$

4.2.2 Costly state verification (CSV)

Let 1^{Def}_{t+1} be an indicator equal to 1 if the firm defaults at $t+1$, and 0 otherwise. Let μ_{WC} and μ_D denote monitoring costs for WC loans and long-term loans, respectively. r^f is the risk-free rate.

The CSV condition for the working capital loans:

$$\left(1+r^{f}_{t}\right)M_{t} = E_{t}\left[(1+r^{WC}_{t})M_{t}\cdot\left(1-1^{Def}_{t+1}\right) + (1-\mu_{WC})R^{WC}_{t+1}\cdot 1^{Def}_{t+1}\right] \tag{8}$$

Where,

$(1 + r_t^{WC})M_t \cdot \left(1 - 1_{t+1}^{Def}\right)$ is the no default payoff.

$(1 - \mu_{WC})R_{t+1}^{WC} \cdot 1_{t+1}^{Def}$ is the net recovery in default, with monitoring cost μ_{WC}, and R_{t+1}^{WC} is the recovery value.

Similarly for long-term Debt:

$$\left(1 + r_t^f\right)D_{t+1} = E_t\left[(1 + r_t^D)D_{t+1} \cdot \left(1 - 1_{t+1}^{Def}\right) + (1 - \mu_D)R_{t+1}^D \cdot 1_{t+1}^{Def}\right] \quad (9)$$

where

$(1 + r_t^D)D_{t+1} \cdot \left(1 - 1_{t+1}^{Def}\right)$ is the no default payoff.

$(1 - \mu_D)R_{t+1}^D \cdot 1_{t+1}^{Def}$ is the net recovery in default with monitoring cost μ_D and R_{t+1}^D is the recovery value

4.2.3 Reduced form collateral constraint

For the analysis we simplify the constraints by assuming the long-term borrowing and working capital is limited by a single collateral constraint that aggregates collateral-backed and receivables-backed borrowing capacity:

$$D_{t+1} + \eta M_t \leq \theta_K(1 - \delta)E_t[q_{t+1}]K_{t+1} + \theta_R E_t[P_{t+1}Y_{t+1}] \quad (10)$$

Where D_{t+1} is long-term debt issued at t, $\eta \in (0,1]$ scales how much working capital borrowing uses the collateral pool, q_{t+1} is the next period liquidation value of undepreciated capital, and $\theta_K, \theta_R \in (0,1]$ are the pledgeability on capital and receivables, respectively.

4.3 Firms

At the end of period t, firm chooses $K_{t+1}, L_{t+1}, I_t, M_t, D_{t+1}$. At the beginning of $t + 1$ output Y_{t+1} is produced using those capital K_{t+1} and labour L_{t+1}. That is, inputs are decided at t, used in production in $t + 1$.

Output at the beginning of $t + 1$ is produced using a CES production function with efficiency shifters for capital and labour:

$$Y_{t+1} = A_{t+1}\left[\alpha\left(e_{t+1}^k K_{t+1}\right)^\rho + (1 - \alpha)(u_{t+1}^L L_{t+1})^\rho\right]^{1/\rho}, \qquad \rho = \frac{\sigma - 1}{\sigma} \quad (11)$$

Where A_{t+1} is aggregate productivity, e_{t+1}^k and u_{t+1}^L capture capital and labour specific efficiency, $\alpha \in (0,1)$ is the distribution parameter, and σ is the elasticity of substitution between capital and labour.

We can derive[12] the marginal products of capital and labour as follows:

[12] Detailed derivation is given in the Appendix A2

$$MPK_{t+1} = \frac{\partial Y_{t+1}}{\partial K_{t+1}} = A_{t+1}\alpha U_{t+1}^{\frac{1}{\rho}-1}\left(e_{t+1}^{k}K_{t+1}\right)^{\rho-1}e_{t+1}^{k} \tag{12}$$

$$MPL_{t+1} = A_{t+1}U_{t+1}^{\frac{1}{\rho}-1}(1-\alpha)(u_{t+1}^{L}L_{t+1})^{\rho-1}u_{t+1}^{L} \tag{13}$$

Capital accumulates according to

$$K_{t+1} = (1-\delta)K_t + I_t \tag{14}$$

With depreciation rate $\delta \in (0,1)$.

At time t, the firm prepays[13] a fraction $\chi \in (0,1]$ of next period's wage bill, financing it with a working capital loan, M_t and cash on hand (CH_t):

$$\chi w_{t+1}L_{t+1} = M_t + CH_t \tag{15}$$

The remaining $(1-\chi)w_{t+1}L_{t+1}$ is paid at $t+1$, and the working capital loan is prepaid at the gross rate $1 + r_t^{WC}$. Consistent with the pecking-order theory[14], the firm uses internal funds first and resorts to external financing only if these are insufficient.

Owing to financial frictions (such as; default risk, limited enforceability of debt contracts, illiquid collateral, and regulatory loan-to-value limits) firm's borrowing capacity is constrained. Consequently, loans must be secured with collateral (e.g., installed capital and/or receivables), there by facing a collateral constraint;

$$D_{t+1} + \eta M_t \leq \theta_K(1-\delta)E_t[q_{t+1}]K_{t+1} + \theta_R E_t[P_{t+1}Y_{t+1}] \tag{10}$$

In addition, firms are subject to a budget constraint:

$$\begin{aligned} q_t I_t + \chi w_{t+1}L_{t+1} + (1+r_t^D)D_t + (1+r_{t-1}^{WC})M_{t-1} + Div_t + C_t^{\Delta} \\ = P_t Y_t + CH_t + D_{t+1} + M_t \end{aligned} \tag{16}$$

Where, q_t is the price of investment good (capital), r_t^D is the long-term interest rate, C_t^{Δ} denotes adjustment costs in investment and labour, and Div is the dividends

4.3.1 Firm's Optimisation Problem and First Order Conditions

The firm maximises the present value of dividends[15]:

[13] The wage prepayment introduces a working capital constraint, i.e, wages must be financed before revenue, so labour demand depends on interest rates and credit conditions, so that labour demand depends on interest rates and credit conditions, not only on standard w/MP_L condition. The literature on working capital channel on monetary policy assumes that firms must pay their production factors before receiving revenues from sales and must borrow to finance these payments (Arabzadeh et al., 2024; Gil, 2025; Mahmoudzadeh et al., 2018).

[14] According to the pecking order theory, information asymmetry induces a hierarchy of financing preferences: firms prefer internal funds to external finance. When outside funds are necessary, firms prefer debt to equity because of lower information costs associated with debt issues (Myers & Majluf, 1984).

[15] We assume that there are no agency costs between shareholders and managers. There is no difference between the managers' and shareholders' objective functions. In particular, the risk-neutral manager maximises shareholder value, i.e., the expected present value of net payouts to equity holders.

$$\max_{\{Div_t, K_{t+1}, L_{t+1}, M_t, D_{t+1}\} \geq 0} E_0 \sum_{t=0}^{\infty} \beta^t Div_t \tag{17}$$

Subject to capital accumulation, the budget constraint and collateral constraint. Let λ_t be the multiplier on the budget and $\mu_t \geq 0$ on the single collateral constraint. We substitute $I_t = K_{t+1} - (1-\delta)K_t$ into the budget constraint, to avoid a separate multiplier.

The present value Lagrangian is

$$\begin{aligned} \mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \big[& Div_t \\ & + \lambda_t \big(P_t Y_t + CH_t + D_{t+1} + M_t - Div_t - q_t [K_{t+1} - (1-\delta)K_t] \\ & - \chi w_{t+1} L_{t+1} - (1 + r_t^D) D_t - (1 + r_{t-1}^{WC}) M_{t-1} - C_t^{\Delta} \big) \\ & + \mu_t (\theta_K (1-\delta) E_t [q_{t+1} K_{t+1}] + \theta_R E_t [P_{t+1} Y_{t+1}] - D_{t+1} - \eta M_t) \big] \end{aligned} \tag{18}$$

The firm's control variables in t are $\{Div_t, K_{t+1}, L_{t+1}, M_t, D_{t+1}\}$. The state variables are the existing capital stock K_t, outstanding long-term debt D_t, outstanding working capital loans M_{t-1}, cash on hand (CH_t), and exogenous states such as (A_t, P_t, q_t). λ_t is the budget constraint multiplier and μ_t is the multiplier on the collateral constraint based on Equations 10 and 16. The firm maximizes its lifelong dividends to its shareholders, faces the following first order conditions[16] with respect to its optimal choices of capital and labour stocks:

For capital,

$$\mathrm{q_t} = \frac{1}{1 + r_{f,t}} E_t \left[\frac{\partial NW_{t+1}}{\partial K_{t+1}} - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} \right] - \frac{\partial C_t^{\Delta}}{\partial K_{t+1}} \tag{19}$$

where

$$\begin{aligned} \frac{\partial NW_{t+1}}{\partial K_{t+1}} = & (1 + r_{f,t}) \mu_t \theta_k (1-\delta) q_{t+1} + \mu_t \theta_R P_{t+1} MPK_{t+1} + P_{t+1} MPK_{t+1} \\ & + q_{t+1}(1-\delta) - D_{t+1} \frac{\partial r_{t+1}^D}{\partial K_{t+1}} - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \end{aligned} \tag{20}$$

The $\frac{\partial NW_{t+1}}{\partial K_{t+1}}$ captures how much one more unit of capital today affect the next periods collateral and value. $(1 + r_{f,t}) \mu_t \theta_k (1-\delta) q_{t+1}$ captures the pledgeable capital collateral, $\mu_t \theta_R P_{t+1} MPK_{t+1}$ captures pledgeable future revenue from capital, $P_{t+1} MPK_{t+1}$ captures

[16] Detailed derivation is given in Appendix A3

future revenue from capital, $q_{t+1}(1-\delta)$ captures resale value of capital and $\left(D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial K_{t+1}}\right)$ captures rate sensitivities.

For Labour,

$$\chi w_{t+1} = \frac{1}{1+r_{f,t}}E_t\left[\frac{\partial NW_{t+1}}{\partial L_{t+1}} - \frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}}\right] - \frac{\partial C_t^{\Delta}}{\partial L_{t+1}} \tag{21}$$

where

$$\begin{aligned}\frac{\partial NW_{t+1}}{\partial L_{t+1}} = {} & \left(1+r_{f,t}\right)\mu_t\theta_R P_{t+1}MPL_{t+1} + P_{t+1}MPL_{t+1} \\ & - (1-\chi)w_{t+1} - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\end{aligned} \tag{22}$$

The $\frac{\partial NW_{t+1}}{\partial L_{t+1}}$ captures how much one more unit of labour today affect the next periods collateral and value. $\left(1+r_{f,t}\right)\mu_t\theta_R P_{t+1}MPL_{t+1}$ captures the pledgeable receivables from labour, $P_{t+1}MPL_{t+1}$ captures revenue from labour, $(1-\chi)w_{t+1}$ capture the the outflow of wage paid at $t+1$, and $\left(D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\right)$ captures rate sensitivities.

Thus, an additional unit of capital today increases the firm's borrowing capacity by directly contributing to pledgeable collateral. In addition, its marginal product generates additional receivables that can also be collateralised. In contrast, labour does not add any collateral value of its own. Although labour increases future revenues, only receivables arising from its output are pledgeble. Moreover, hiring labour requires wage prepayment which tightens the firm's liquidity position. As a result, labour raises the firms' financing needs but does not provide immediate collateral, making labour demand more sensitive to financial frictions than capital demand.

4.3.2 The labour-capital ratio: frictionless benchmark vs constrained

In a frictionless environment the collateral constraint never binds ($\mu_t = 0$), no working-capital prepayment is required ($\chi = 0$), no financing cost $\frac{\partial r}{\partial .} = 0$, adjustment costs are zero, and full capital depreciation $\delta = 1$. Then the first order conditions (FOCs) of capital and labour reduce to $P_{t+1}MPK_{t+1} = q_t$, and $P_{t+1}MPL_{t+1} = w_{t+1}$.

Taking the ratio $\frac{MPL}{MPK}$ and solving for $\frac{L_{t+1}}{K_{t+1}}$ yields the standard CES demand function for input ratios:

$$\frac{\mathrm{L_{t+1}}}{\mathrm{K_{t+1}}} = E_t\left\{\left(\frac{1-\alpha}{\alpha}\right)^{\sigma}\left(\frac{u^L_{t+1}}{e^k_{t+1}}\right)^{\sigma-1}\left(\frac{q_t}{w_{t+1}}\right)^{\sigma}\right\} \tag{23}$$

In this benchmark, the labour-capital ratio depends only on relative factor prices and technology; financing conditions do not have any role.

Relaxing the simplifying assumptions introduces a role for external financing costs as well as firm capital and labour stock size in explaining observed variations in labour-to-capital ratios across firms and over time.

With financial frictions, we divide the FOC of labour by the FOC of capital and integrate with respect to L_{t+1} and K_{t+1}. This gives the expression for the optimal labour to capital ratio[17]:

$$\frac{\mathrm{L_{t+1}}}{\mathrm{K_{t+1}}} = E_t\left\{\frac{\int\left[(P_{t+1}+\mu_t\theta_R P_{t+1})MPL_{t+1} - \left(D_{t+1}\frac{\partial r^D_{t+1}}{\partial L_{t+1}} + M_t\frac{\partial r^{WC}_t}{\partial L_{t+1}}\right) - \chi w_{t+1}\right]dL_{t+1}}{\int\left[(P_{t+1}+\mu_t\theta_R P_{t+1})MPK_{t+1} + \mu_t\theta_k(1-\delta)q_{t+1} - \left(D_{t+1}\frac{\partial r^D_{t+1}}{\partial K_{t+1}} + M_t\frac{\partial r^{WC}_t}{\partial K_{t+1}}\right)\right]dK_{t+1}}\right\} \tag{24}$$

The numerator represents the expected marginal net gain from increasing labour, i.e, its contribution to revenues and receivables (to collateral) minus the effect on borrowing costs and the working capital prepayment. The denominator captures the corresponding marginal net gain from increasing capital, i.e, its contribution to revenues and collateral, plus the resale value of undepreciated capital, net of its effects on borrowing costs.

When financing conditions tighten, the cost of raising funds to pay wages upfront rises, and the borrowing premia in the working capital and long-term loan market increases. Since to hire labour a fraction of the wage bill must prepay and labour does not directly expand the collateral pool, the deteriorating financing conditions affect more on the labour margin than on the capital margin. By contrast, additional capital both produces output and increases pledgeable collateral, which partly offsets the higher cost of funds. As a result, the numerator, labour's marginal net return falls by more than the denominator, capitals' marginal net return, and the optimal labour-capital ratio declines.

4.4 Testable Hypothesis

From Equation 24 and the discussions in Section 4 we could observe that when external financing conditions deteriorate via high borrowing rate or tighter collateral constraints, the labour margin falls more than the capital margin. Capital both produces output and relaxes

[17] Detailed derivation is given in the Appendix A4

collateral constraints, whereas labour must be partially prepaid and does not add to the collateral. Therefore, deteriorating financial conditions reduces the labour-to-capital ratio, in other words, firms substitute away from labour and toward collateralizable capital. Motivated by this mechanism, we derive the following testable hypothesis for the empirical analysis:

Hypothesis 1: Heterogeneity by balance sheet fragility

The sensitivity of the financing terms in Equation 24 to a given monetary shock is larger for firms with higher leverage. For such firms, a monetary policy tightening increases the borrowing-cost $\left(D_{t+1}\frac{\partial r_D}{\partial .}, M_t\frac{\partial r_{WC}}{\partial .}\right)$ *more, amplifying the decline in* $\frac{L}{K}$*. Therefore, the reductions in labour intensity among financially constrained firms will be higher.*

Hypothesis 2: Employment and Capital Dynamics

As capital adjustment is subject to quasi-irreversibility and adjustment cost, while labour can be adjusted more flexibly (via hiring, layoff), a tightening of finance should lead to a faster decline in employment than in the capital stock. Even if both L and K eventually fall, L falls more than K, so that L/K *declines.*

Hypothesis 3: Target vs Path Factor

The Target factor of monetary policy shock changes current borrowing rates and thereby affects the working-capital and long-term financing terms in Equation 24 immediately, leading to a larger and faster drop in L/K*. The Path factor of monetary policy shock shifts expectations of future rates and collateral values and thus affects the input mix more gradually, with peak effects at medium horizons.*

5. Data and empirical strategy

5.1 Data

The study employs data on 1442 manufacturing firms in India over the period 2003-2023. The firm-level balance sheet data on firms is collected from CMIE prowess. For monetary policy shocks, we use the data set provided by Lakdawala and Sengupta (2025), who use changes in OIS rates of different maturities and apply principal component analysis to decompose monetary policy surprise measures into two orthogonal factors: path and target. We use both path and target data for our empirical analysis and robustness test. We deflate nominal wages and salaries by the Consumer Price Index for Industrial Workers (CPI-IW), and nominal capital by the Wholesale Price Index for Machines and Machinery (WPI-MM). These are obtained

from the RBI Database on the Indian Economy, the RBI Handbook of Statistics on the Indian Economy and the Office of the Economic Advisor. Other firm balance sheet variables (such as sales, total assets) are deflated using the GDP deflator. We exclude micro firms (<10 employees) to ensure a degree of homogeneity across firms in their decision-making regarding labour and capital inputs, as well as capital structure. **Figure 3** illustrates the size distribution of the sample by total assets and number of employees.

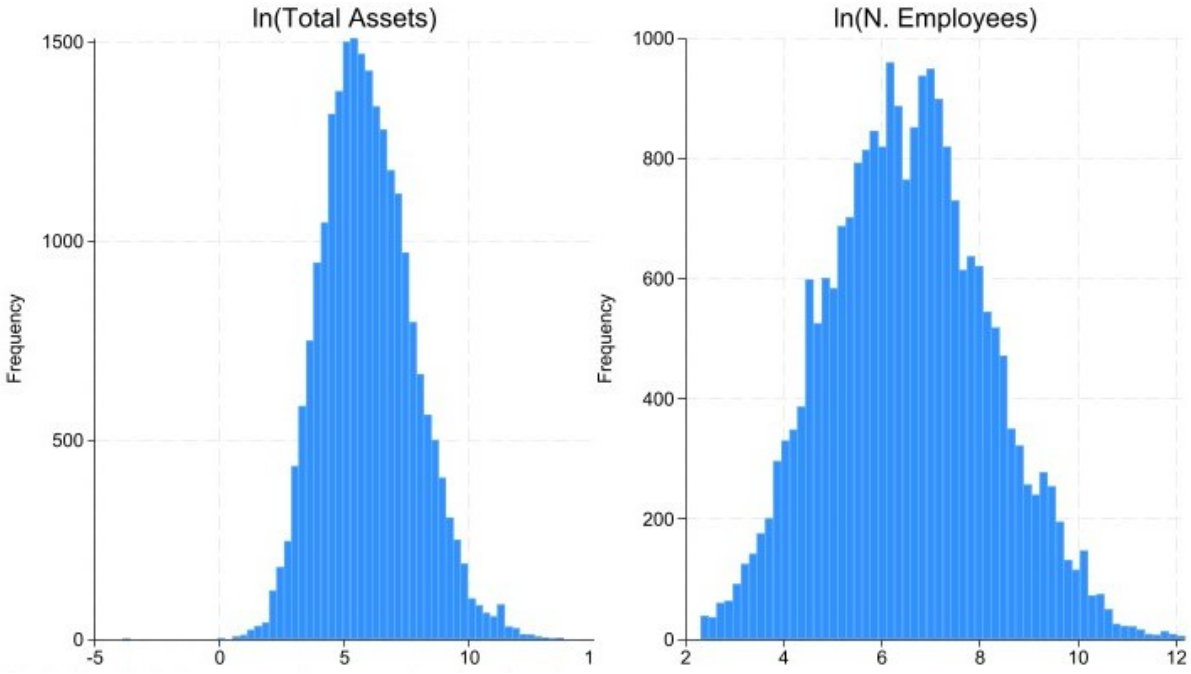


Figure 3: Size distribution w.r.t total assets and number of employees

5.2 Empirical Strategy

The main objective of our study is to empirically examine whether firm labour and capital input decisions are affected by the financial constraint faced by the firms. Following ElFayoumi (2024) we focus on the relative changes between labour and capital shocks, rather than the level effects of each. Based on the theoretical framework in Section 4, when financing conditions worsen, firms face tighter credit constraints and shift production toward more collateralizable assets (capital) and away from labour. Similarly, firms that suffer more from information asymmetry concerns or rely more heavily on external finance may respond to monetary tightening by increasing capital intensity to relax borrowing constraints.

To identify the causal effects of firm financing on its labour-to-capital ratio, we estimate the following regression equation,

$$y_{jit} = \beta_1 y_{jit-1} + \beta_2\{x_{jit-1} \times MPS_t\} + \beta_3 x_{jit-1} + \beta_4 MPS_t + \beta_5 Z_{jit} + \eta_t + \eta_i + \eta_j + u_{jit} \quad (25)$$

Where y_{jit} is the dependent variable of interest capturing the input composition. x_{jit-1} is the firm level financial exposure measured by lagged leverage. MPS_t denotes the monetary policy shock decomposed into target and path factors. Z_{jit} is a vector of lagged firm controls, including current assets to total assets ratio; total debt to total assets ratio; growth rates of wage bill and fixed assets; wage bill to fixed assets ratio. η_t, η_i and η_j represent firm fixed effects, year fixed effects and NIC 2-digit industry fixed effects, respectively. The interaction $x_{jit-1} \times MPS_t$ introduces heterogeneity by allowing firms with greater ex ante financial exposure to respond differently to contractionary monetary shocks. Because x_{jit-1} is predetermined and measures prior to the shock, the interaction is exogenous to contemporaneous firm level adjustment.

A central challenge to our estimation is that the firm's cost of financing may be endogenous to current economic conditions and input choices. To address this, we adopt an instrumental variable (IV) approach utilising the heterogeneity introduced by the monetary policy shocks interacted with lagged leverage. Specifically, we use $x_{jit-1} \times MPS_t$ as an instrument for debt service ratio (DSR), defined as interest expenses scaled by total assets. The first stage projects DSR on the interaction-based monetary shock

$$DSR_{jit} = \gamma_1 x_{jit-1} + \gamma_2 MPS_t + \gamma_3 \{x_{jit-1} \times MPS_t\} + \gamma_4 Z_{jit} + \eta_t + \eta_i + \eta_j + \epsilon_{jit} \quad (26)$$

The interaction is exogenous to contemporaneous firm level adjustment, thus providing a valid instrument for the exogenous variation in cost of borrowing.

The second stage estimates:

$$y_{jit} = \beta_1 y_{jit-1} + \beta_2 \{DSR_{jit}\} + \beta_3 x_{jit-1} + \beta_4 MPS_t + \beta_5 Z_{jit} + \eta_t + \eta_i + \eta_j + u_{jit} \quad (27)$$

$x_{jit-1} \times MPS_t$ is exogenous to firm decisions, and its primary effect takes place through its impact on the price schedule the firm faces in credit markets, which is proxied by interest expenses.

6. Empirical results

This section presents the empirical results on how financial constraints affect firms' input composition. The discussion proceeds in four steps. First, we examine whether the interaction based monetary shock measure predicts firm level borrowing pressure. Second, we study whether tighter financing conditions are associated with changes in debt growth, which helps us to interpret the balance sheet adjustment channel. Third, we look at the core question of our study, that is, whether exogenous tightening in the financing conditions reduces the firm level labour intensity. Finally, we analyse the dynamic responses using IV local projections to assess

whether target and path shocks differ in persistence and timing. Throughout the section, the results are interpreted in light of the firm financing literature focusing on collateral and working capital margins.

6.1 Monetary policy shocks and firm-level borrowing pressure

The first step is to verify the relevance of our selected instrumental variable. That is, the monetary policy shocks when interacted with the firm leverage level have explanatory power for firm-level financing costs. For this purpose, we regress the selected IV on the debt service payments (DSR).

Table 1: Effect of policy shock on debt service payment

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Leverage}_{i,t-1}$	9.536***	9.515***	9.368***	9.513***	9.488***	9.330***
	(0.914)	(0.909)	(0.806)	(0.985)	(0.984)	(0.866)
$\text{Wage Growth}_{i,t-1}$	-0.004*	-0.004	-0.002	-0.004*	-0.004*	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$\text{Capital Growth}_{i,t-1}$	0.002***	0.002***	0.002**	0.002***	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\text{Avg Wage}_{i,t-1}$	-0.128	-0.204	-0.242	-0.112	-0.225	-0.257
	(0.220)	(0.260)	(0.262)	(0.225)	(0.273)	(0.275)
$\text{Revenue}_{i,t-1}$	0.830***	0.797**	0.859***	0.910***	0.858**	0.913**
	(0.315)	(0.323)	(0.331)	(0.347)	(0.369)	(0.377)
$\text{Revenue Growth}_{i,t-1}$	-0.004	-0.004	-0.005	-0.003	-0.003	-0.003
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
$\text{Employment}_{i,t-1}$	-0.220	-0.249	-0.329	-0.267	-0.297	-0.367
	(0.217)	(0.245)	(0.250)	(0.232)	(0.271)	(0.275)
$\text{Total Assets}_{i,t-1}$	-0.123	-0.187	-0.130	-0.105	-0.170	-0.123
	(0.215)	(0.229)	(0.247)	(0.219)	(0.243)	(0.262)
$\text{Sales growth}_{i,t-1}$	0.003	0.003	0.003	0.002	0.002	0.002
	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
$\text{path factor}_{i,t}$	0.237***					
	(0.056)					
path factor_{t}	-1.181***	-1.193***	-1.195***			
$\times \text{Leverage}_{i,t-1}$	(0.165)					
		(0.163)	(0.165)			
target factor_{t}				0.132*		
				(0.070)		
target factor_{t}				-0.588**	-0.594**	-0.630**
$\times \text{Leverage}_{i,t-1}$						
				(0.275)	(0.279)	(0.246)
Num. obs.	11456	11456	11430	11456	11456	11430
Adj. R2	0.916	0.917	0.920	0.913	0.914	0.917
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Year × Industry fixed effects	No	No	Yes	No	No	Yes

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1 presents the findings from a panel regression model on the effects of monetary policy shocks on debt service payments. The results indicate that monetary policy surprises significantly affect firms' interest burden, and that this pass-through is heterogeneous depending on firm leverage (Raghuvanshi & Ahmad, 2026). The main effects (coefficients) of both the path and target factors are positive, indicating that contractionary surprises raise borrowing pressure on average. At the same time, their interactions with lagged leverage are negative and statistically significant, implying that the effect of policy tightening on measured debt-service ratios differs systematically across firms depending on their prior balance-sheet position. Firms having more debt also entail higher debt-service costs, firm leverage matters to assess how a firm is affected by a rise in interest rates. When interest rates rise, for low-debt firms, their debt-service costs increase (Ahmed et al., 2022). However, high-debt firms react differently; they adjust so aggressively (likely by paying down debt or deleveraging) that their costs actually rise less, or even fall (Bhaumik et al., 2018; Prasad & Ghosh, 2005; Salunkhe et al., 2025). While contractionary forward-guidance surprises raise the cost of credit (the price effect), they also induce highly leveraged firms to deleverage aggressively (the quantity effect). Our results indicate that the quantity effect dominates, leading to a net reduction in their interest expense to assets ratio[18].

Table 2 provides additional evidence on the balance sheet channel by examining debt growth. The reported results indicate that lagged leverage predicts slower subsequent debt growth, which is consistent with either tighter borrowing constraints or deliberate deleveraging among already indebted firms. The instrumented interest expense to assets ratio exerts a positive impact on the growth of debts, indicating that with an exogenous rise in financing costs, firms often expand borrowing to meet liquidity needs and refinance obligations[19]. Combining both these effects (the monetary policy shock and leverage), the average response is highly heterogeneous. The coefficient of path factor interacted with lagged leverage appears negative and significant (**Table 2**, model 2), implying that a contractionary forward-guidance shock reduces debt growth more strongly, the higher the pre-existing leverage. In other words, the low-leverage firms may still borrow for precautionary liquidity, whereas high-leverage firms cut or postpone borrowing. Thus, the results show that a tighter policy does not simply reduce borrowing uniformly across firms. Instead, low-leverage firms may continue to borrow for

[18] We also carry out further estimation using the short-run and long-run expenses on interest payments to investigate the role of debt maturity. The findings are presented in Table A2 and Table A3 in the Appendix.
[19] It could indicate an immediate rollover channel rather than a long-run expansion of leverage (Prasad & Ghosh, 2005).

precautionary liquidity purposes, whereas highly leveraged firms cut back more sharply (Akarsu et al., 2025; Anderson & Cesa-Bianchi, 2024).

Table 2: Effect of financing costs on total debt growth

	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Leverage}_{i,t-1}$	-9.799	-9.758	-10.072	-	-	-33.656*
	(7.455)	(7.416)	(6.811)	38.401***	38.750***	(18.614)
				(10.853)	(11.178)	
$\text{Wage Growth}_{i,t-1}$	0.064	0.085	0.094*	0.102*	0.097*	0.095*
	(0.050)	(0.054)	(0.055)	(0.055)	(0.054)	(0.054)
$\text{Capital Growth}_{i,t-1}$	0.014	0.027	0.019	0.014	0.020	0.021
	(0.029)	(0.030)	(0.031)	(0.031)	(0.029)	(0.030)
$\text{Avg Wage}_{i,t-1}$	-0.067	0.038	-0.002	0.749	0.667	0.550
	(3.787)	(4.044)	(4.137)	(4.231)	(4.122)	(4.129)
$\text{Revenue}_{i,t-1}$	7.683***	8.234***	9.334***	6.657**	5.777**	6.232**
	(2.605)	(2.798)	(2.853)	(2.861)	(2.822)	(3.143)
$\text{Revenue Growth}_{i,t-1}$	-0.114***	-0.129***	-0.128***	-0.116***	-0.117***	-0.119***
	(0.038)	(0.038)	(0.038)	(0.044)	(0.044)	(0.041)
$\text{Employment}_{i,t-1}$	1.351	2.425	2.905	3.954	3.205	3.051
	(3.530)	(3.668)	(3.676)	(3.712)	(3.710)	(3.746)
$\text{Total Assets}_{i,t-1}$	-	-	-	-	-	-
	23.017***	24.350***	26.661***	26.282***	23.790***	23.881***
	(4.587)	(4.762)	(4.675)	(4.810)	(4.904)	(4.869)
$\text{Sales growth}_{i,t-1}$	0.016	0.001	0.001	-0.007	-0.008	-0.006
	(0.032)	(0.032)	(0.032)	(0.037)	(0.037)	(0.035)
path factor_t		-2.996*	-1.483			
$\times \text{Leverage}_{i,t-1}$		(1.616)	(1.727)			
path factor_t	1.746*					
	(0.997)					
$\text{Interest expense}_{i,t-1}$				2.999***	3.040***	2.512*
				(0.708)	(0.706)	(1.452)
Num. obs.	11456	11456	11430	11430	11456	11456
Adj. R2	0.034	0.030	0.035	0.025	0.019	0.018
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Year × Industry fixed effects	No	No	Yes	No	No	Yes

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Instrumental variable estimates of labour intensity

The core results of the paper are reported in **Table 3** and **Table 4**, which estimate the effect of exogenous financing-cost variation on labour intensity. The empirical question is whether firms facing tighter financing conditions reduce labour relative to capital, as predicted by the conceptual framework developed in Section 4. The IV evidence supports this hypothesis. Across the reported specifications, tighter financing conditions are associated with a decline in the labour to capital ratio. Therefore, the results align with the view that financial constraints reshape firms' input mix, rather than affecting labour and capital proportionately.

Table 3 presents the empirical findings based on our hypothesis that the path factor of monetary policy shock shifts expectations of future rates and collateral values and thus affects the input mix. **Table 4** presents the estimated results using Target factor as the monetary policy shocks (model 1 and model 2) and using both the monetary policy shock measures as instruments (model 3 and model 4). The findings, presented in **Table 3**, support the hypothesis that firms substitute capital for labour when financing conditions tighten. Findings presented in **Table 4** indicate that models 3 and 4 yield significant results, whereas models 1 and 2 yield insignificant results for the interest expense coefficient. These findings help us explain how tighter external finance reshapes firms' input mix, estimating the effect of financing shocks on labour intensity, measured as the wage bill divided by fixed assets (labour to capital ratio).

Our findings consistent with both the collateral and working-capital views of transmission. If labour requires prefinancing and capital supports borrowing capacity through collateral, then tighter external finance should raise the effective shadow cost of labour relative to capital. Therefore, financing stress is associated with lower labour intensity, especially among firms with greater balance-sheet fragility. This closely parallels the mechanism emphasised by ElFayoumi (2024), who finds that higher financing costs induce firms to hire less relative to investment, and interprets the result as evidence that tighter credit shifts firms toward more collateralizable inputs. However, our results are also consistent with the working-capital channel emphasised in related theory and evidence. The working capital view stresses that interest rate shocks raise the cost of financing variable inputs, especially wages and production-related operating costs, and can therefore depress labour demand even without active capital deepening. The distinction matters because a decline in measured labour intensity can arise either because firms accumulate more capital or because labour adjusts downward faster than capital.

Recent evidence indicates that aggregate fixed investment in the Indian manufacturing sector has remained subdued, and the bulk of new capital expenditure continues to be undertaken by larger, financially stronger firms (Sahoo & Bishnoi, 2023; Vincent et al., 2025). This divergence suggests that, for a substantial share of manufacturing firms, labour demand responds more quickly than capital formation when financing conditions tighten. Accordingly, the observed decline in labour intensity should not be interpreted solely as evidence of deliberate capital deepening; rather, it is also compatible with firms curtailing wage financed operational activity more sharply than long-term investment commitments. Thus, the empirical patterns and the investment behaviour of Indian manufacturing firms indicate that both the

collateral and working-capital channels of monetary transmission operate concurrently. However, the working-capital mechanism appears to exert the more immediate influence on firms' input choices in periods of monetary tightening, with the collateral channel primarily reinforcing these adjustments among firms possessing the balance-sheet strength to maintain capital investment.

Table 3: Effect of financing costs on inputs composition- PathFactor

	(1)	(2)	(3)	(4)
$\text{PathFactor}_t \times \text{Leverage}_{i,t-1}$	0.853**	0.936***		
	(0.370)	(0.326)		
$\text{Interest expense}_{i,t-1}$			-0.721***	-0.654**
			(0.227)	(0.266)
$\text{Leverage}_{i,t-1}$	0.509	0.499	7.409***	6.680**
	(0.936)	(1.098)	(2.221)	(2.666)
$\text{Wage Growth}_{i,t-1}$	-0.052*	-0.059**	-0.063**	-0.054*
	(0.029)	(0.028)	(0.028)	(0.029)
$\text{Capital Growth}_{i,t-1}$	0.121***	0.111***	0.112***	0.122***
	(0.016)	(0.016)	(0.016)	(0.016)
$\text{Avg Wage}_{i,t-1}$	-32.213***	-32.374***	-32.562***	-32.404***
	(2.678)	(2.604)	(2.638)	(2.710)
$\text{Revenue}_{i,t-1}$	6.361***	6.028***	6.552***	6.871***
	(2.174)	(2.165)	(2.205)	(2.224)
$\text{Revenue Growth}_{i,t-1}$	0.006	0.010	0.008	0.004
	(0.025)	(0.025)	(0.026)	(0.026)
$\text{Employment}_{i,t-1}$	-23.130***	-22.575***	-22.817***	-23.394***
	(2.491)	(2.456)	(2.475)	(2.512)
$\text{Total Assets}_{i,t-1}$	9.496***	9.025***	8.994***	9.522***
	(2.074)	(1.962)	(1.951)	(2.069)
$\text{Sales growth}_{i,t-1}$	0.014	0.015	0.016	0.015
	(0.022)	(0.022)	(0.023)	(0.022)
Num. obs.	11430	11456	11456	11430
Adj. R2	0.095	0.084	0.065	0.029
Sanderson-Windmeijer			53.46	50.64
multivariate F			(00.00)	(00.00)
Kleibergen-Paap rk LM (χ^2)			1.65	1.91
			(0.199)	(0.167)
Cragg-Donald Wald F			604.86	588.00
Kleibergen-Paap rk Wald F			53.46	50.64
Anderson-Rubin Wald F			8.22	5.30
			(0.004)	(0.021)
Anderson-Rubin Wald χ^2			8.25	5.52
			(0.004)	(0.019)
Stock-Wright S			6.69	3.39
			(0.009)	(0.066)
Hansen J			0.00	0.00
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Year × Industry fixed effects	Yes	No	No	Yes

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Models 1 and 2 show the first stage of IV regression, and Models 3 and 4 show the second stage.

However, our IV results should also be read with some caution. The weak-instrument diagnostics reported in **Table 4** suggest that the target factor only specifications (Model 1 and

Model 2) are not particularly strong. the Sanderson–Windmeijer multivariate F-statistics for Models 1 and 2 are approximately 1.65 and 1.01, respectively, whereas the specifications that use both target and path interactions (Model 3 and Model 4) yield much stronger first stages, with corresponding values of about 29.41 and 31.50. This means that the most credible causal estimates come from the joint-instrument specifications rather than from target only models.

Table 4: Effect of financing costs on the input composition

	(1)	(2)	(3)	(4)
Interest expense$_{i,t-1}$	2.156	2.041	-0.670**	-0.753***
	(2.698)	(3.035)	(0.266)	(0.228)
Leverage$_{i,t-1}$	-20.247	-19.431	6.832**	7.713***
	(28.310)	(32.344)	(2.668)	(2.224)
Wage Growth$_{i,t-1}$	-0.044	-0.049	-0.054*	-0.063**
	(0.031)	(0.033)	(0.029)	(0.028)
Capital Growth$_{i,t-1}$	0.119***	0.107***	0.122***	0.112***
	(0.017)	(0.017)	(0.016)	(0.016)
Avg Wage$_{i,t-1}$	-31.539***	-31.790***	-32.409***	-32.571***
	(2.847)	(2.769)	(2.711)	(2.640)
Revenue$_{i,t-1}$	4.502	4.351	6.885***	6.577***
	(3.702)	(3.796)	(2.225)	(2.207)
Revenue Growth$_{i,t-1}$	0.011	0.014	0.004	0.008
	(0.030)	(0.029)	(0.026)	(0.027)
Employment$_{i,t-1}$	-22.152***	-21.767***	-23.401***	-22.829***
	(2.921)	(2.850)	(2.512)	(2.476)
Total Assets$_{i,t-1}$	9.391***	9.063***	9.523***	8.993***
	(2.178)	(2.095)	(2.069)	(1.951)
Sales growth$_{i,t-1}$	0.009	0.010	0.015	0.016
	(0.025)	(0.026)	(0.022)	(0.023)
Num. obs.	11430	11456	11430	11456
Adj. R2	-0.005	0.033	0.029	0.064
Sanderson-Windmeijer	1.65	1.01	29.41	31.50
multivariate F	(0.199)	(0.314)	(0.000)	(0.000)
Kleibergen-Paap rk LM (χ^2)	5.70	4.63	6.50	7.39
	(0.017)	(0.031)	(0.039)	(0.025)
Cragg–Donald Wald F	33.95	28.58	294.12	303.17
Kleibergen-Paap rk Wald F	1.65	1.01	29.41	31.50
Anderson-Rubin Wald F	2.75	2.59	3.49	4.11
	(0.098)	(0.108)	(0.031)	(0.017)
Anderson-Rubin Wald χ^2	2.86	2.60	7.26	8.24
	(0.091)	(0.107)	(0.027)	(0.016)
Stock–Wright S	3.08	5.48	4.58	10.47
	(0.079)	(0.019)	(0.101)	(0.005)
Hansen J	0.00	0.00	1.20	1.17
			(0.273)	(0.279)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Year × Industry fixed effects	Yes	No	Yes	No

Notes: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Model 1 and 2 uses TargetFactor$_t$×Leverage$_{i,t-}$ as instrument variable while model 3 and 4 uses both PathFactort×Leverage$_{i,\ t-1}$ and TargetFactort×Leverage$_{i,t-}$ as the instrument variables.

6.3 Dynamic IV local projection

Table 5 and **Figure 4** extend the analysis to a dynamic setting using IV local projections. These results are useful because they help distinguish between the immediate balance-sheet effects of financing shocks and any more persistent reallocation in firms' input mix.

In **Table 5**, the estimated impulse response indicates a statistically significant fall in input growth on impact, with (h=0) around (-0.59), significant at conventional levels for the path factor. Subsequent responses are statistically insignificant, suggesting that the main effect of financing tightening is concentrated in the short run. Path shocks capture news about the expected future path of policy rates rather than only the current policy rate. Lakdawala and Sengupta (2025) show that path shocks have especially large effects on longer-term Indian bond yields, implying that they are informative about financing conditions beyond the very short horizon. In our firm-level setting, this translates into an immediate tightening of the balance-sheet environment that depresses labour intensity on impact, but the effect does not appear to propagate strongly over time. The dynamic response is therefore more consistent with short-run balance-sheet tightening than with a highly persistent capital-deepening process.

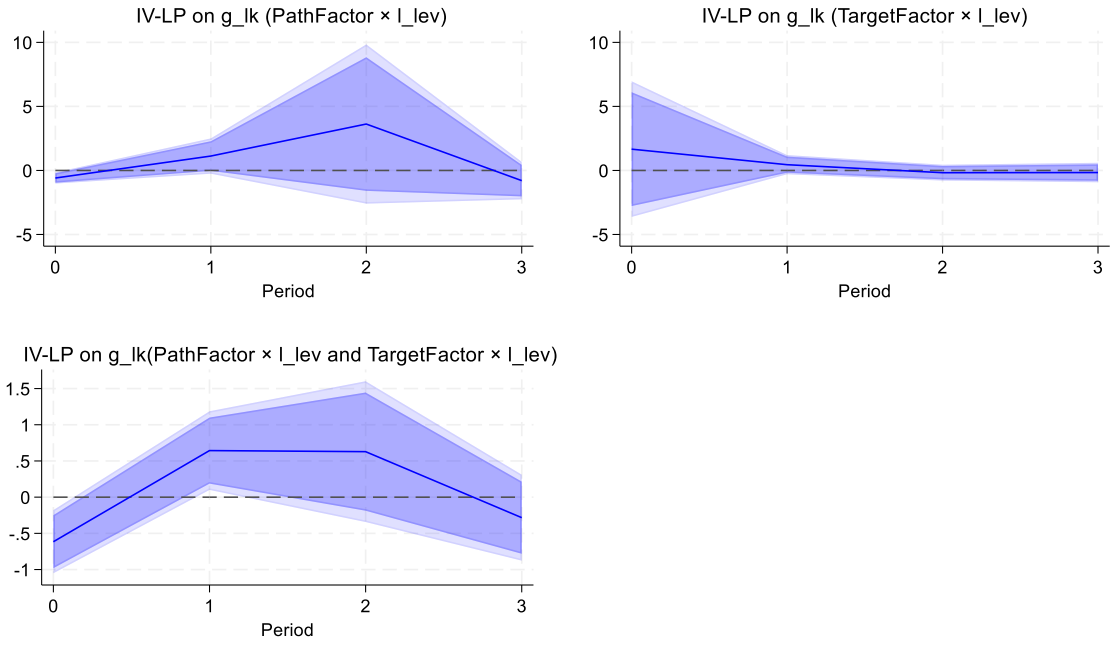
Table 5: Dynamic IV local projection

IRF – path factor						
h	IRF	Std.Err.	IRF LO~90	IRF UP 90	IRF LO~95	IRF UP 95
0	0.590	0.223	-0.956	-0.224	-1.026	-0.153
1	1.124	0.704	-0.034	2.283	-0.256	2.505
2	3.624	3.173	-1.595	8.843	-2.595	9.843
3	0.794	0.749	-2.026	0.437	-2.262	0.673
IRF – target factor						
h	IRF	Std.Err.	IRF LO~90	IRF UP 90	IRF LO~95	IRF UP 95
0	1.665	2.704	-2.782	6.112	-3.634	6.964
1	0.451	0.383	-0.179	1.081	-0.300	1.201
2	-0.173	0.317	-0.695	0.348	-0.795	0.448
3	-0.164	0.389	-0.804	0.476	-0.926	0.598
IRF - Both						
h	IRF	Std.Err.	IRF LO~90	IRF UP 90	IRF LO~95	IRF UP 95
0	-0.616	0.223	-0.982	-0.249	-1.052	-0.179
1	0.643	0.277	0.187	1.099	0.099	1.187
2	0.629	0.496	-0.188	1.445	-0.344	1.601
3	-0.283	0.303	-0.782	0.215	-0.878	0.311

By contrast, the target-leverage shock does not generate statistically significant responses at any horizon when considered in isolation. It suggests that once endogeneity is accounted for, target shocks on their own do not deliver a precisely estimated dynamic response in input adjustment. When both target and path shocks are included jointly, however, the estimates reveal a clearer short-run pattern: input growth falls significantly on impact, with (h=0) around

(-0.62), then shows a one-year rebound, with (h=1) around (+0.64), before dissipating over later horizons. Firms appear to cut labour intensity sharply when financing conditions tighten, then partially reverse those adjustments as rollover pressures ease or liquidity conditions normalise. That dynamic closely matches the idea that labour is the more flexible margin of adjustment, whereas capital adjusts more slowly because of quasi-irreversibility and adjustment costs (Liao, 2021). It also resonates with the broader evidence in the literature that financial shocks can generate immediate and disproportionate employment responses even when capital adjustment remains sluggish (Bäurle et al., 2021; Boeri et al., 2013). At the same time, our local-projection results do not support a strong claim that path shocks dominate target shocks through a long and persistent medium-term mechanism. The findings show immediate effects, but little robust persistence beyond the initial period.

Figure 4: Dynamic IV local projection



7. Conclusion

This paper contributes to the disaggregate literature on monetary transmission by examining whether financial constraints induce systematic shifts in firms' input composition. Using firm-level data from Indian manufacturing, we provide evidence on how financing conditions shape the firm input decisions. By combining monetary policy shocks with detailed firm-level balance-sheet data, the study constructs a predetermined measure of financial constraint that allows for heterogeneous transmission across firms. The decomposition of monetary policy shocks into target and path factors allows us to look at the short-run and long-run impact of the

monetary policy shock. The empirical utilises interactions between monetary surprises and lagged leverage to measure the firm-level measure of financial constraint, thereby capturing how policy tightening affects firms according to their ex-ante balance-sheet vulnerability.

Our findings show that monetary policy shocks significantly affect firms' borrowing pressure, with stronger responses among firms that are more financially exposed. Path shocks, which capture revisions to the expected future path of interest rates, transmit particularly strongly compared to target shocks. The IV estimation results show that tighter financing conditions lead to a decline in firms' labour to capital mix, with larger effects among more financially constrained firms. This pattern is consistent with a financial transmission mechanism operating through collateral and working-capital channels. Labour requires prefinancing and capital supports borrowing capacity through collateral, then tighter external finance should raise the effective shadow cost of labour relative to capital. The dynamic IV local-projection results provide additional validation. A leverage-path shock induces an economically and statistically significant drop in input growth at the time of impact, with limited persistence, reflecting immediate balance-sheet tightening. Target shocks, which primarily move contemporaneous financing costs, generate no independent dynamic effect when examined in isolation. However, both shocks operate jointly, we uncover a sharp initial decline followed by a one year rebound. This suggests that firms adjust inputs aggressively in the short term under financing constraints but partially reverse these adjustments once conditions stabilise. Taken together, the dynamic evidence underscores that financing shocks are transmitted through an immediate liquidity squeeze, followed by partial reversion.

These results contribute to a growing literature on heterogeneous monetary transmission by providing new evidence from an emerging economy, where balance-sheet fragility and working-capital dependence are especially salient. Our findings offer broader insights into the real effects of monetary policy, particularly for employment outcomes, the underlying sources of firm-level heterogeneity, and the mechanisms through which financing frictions influence production decisions. Policies that ease firms' access to short term liquidity, such as working capital lines and collateral enhancement schemes, may help mitigate the contractionary bias in labour demand during the time of monetary tightening. Future studies could extend this analysis by examining sector-level heterogeneity in production technologies, the interaction between financial frictions and labour-market rigidities and the implications of such input substitution for long run growth, productivity and employment dynamics.

Data availability

Data will be made available on request.

Conflict of interest

There is no conflict of interest in this manuscript.

Appendix

A1. Target and Path Factor Construction

Lakdawala and Sengupta (2025) construct target and path monetary policy surprise factors from high-frequency movements in the OIS curve on RBI announcement days as follows. Using 1-day changes in five OIS rates (1, 3, 6, 9 month and 1 year), they first extract the first two principal components, which together explain about 97% of the variation in announcement day OIS changes. Because these PCs load on both the short and long ends of the curve, they follow Gurkaynak et al. (2005) and apply an orthogonal rotation to obtain economically interpretable factors Z_1 (Target) and Z_2 (Path), defined by

$$[Z_1\ Z_2] = [F_1\ F_2]U$$

where,

$$U = \begin{pmatrix} \alpha_1 & \beta_1 \\ \alpha_2 & \beta_2 \end{pmatrix}$$

U matrix has four unique elements and requires four restrictions for identification: first, column normalisations $\alpha_1^2 + \alpha_2^2 = 1$ and $\beta_1^2 + \beta_2^2 = 1$; second, the orthogonality of the two factors $E(Z_1 Z_2) = 0$, which gives $\alpha_1\beta_1 + \alpha_2\beta_2 = 0$; and third, an exclusion restriction that defines the Path factor as orthogonal to contemporaneous short rate surprises by imposing that Z_2 has zero loading on the change in the 1-month OIS rate. Letting the 1-month OIS change be $X(1) = \gamma_1 F_1 + \gamma_2 F_2$, this exclusion implies $\gamma_2\alpha_1 - \gamma_1\alpha_2 = 0$. The resulting rotated factors are interpreted as the Target factor (surprise changes in the short rate) and the Path factor (surprise changes in expected future policy orthogonal to the target surprise), and are normalised by scaling Target to have a unit effect on the 1-month OIS rate and scaling Path to have the same effect as Target on the 1-year OIS rate. Consistent with this construction, Target is highly correlated with the 1-month OIS change, while Path is highly correlated with the residual from regressing the 1-year OIS change on the 1-month OIS change.

A2. Marginal Products Derivation

$$Y_{t+1} = A_{t+1}\left[\alpha\left(e_{t+1}^{k}K_{t+1}\right)^{\rho} + (1-\alpha)(u_{t+1}^{L}L_{t+1})^{\rho}\right]^{1/\rho}, \rho = \frac{\sigma-1}{\sigma} \tag{A1}$$

Take,

$$U_{t+1} = \alpha\left(e_{t+1}^{k}K_{t+1}\right)^{\rho} + (1-\alpha)(u_{t+1}^{L}L_{t+1})^{\rho} \tag{A2}$$

Then $Y_{t+1} = A_{t+1}U_{t+1}^{1/\rho}$

$$MPK_{t+1} = \frac{\partial Y_{t+1}}{\partial K_{t+1}} = A_{t+1} \cdot \frac{\partial (U_{t+1}^{1/\rho})}{\partial K_{t+1}} \tag{A3}$$

Using the chain rule:

$$\frac{\partial (U_{t+1}^{1/\rho})}{\partial K_{t+1}} = \frac{1}{\rho} U_{t+1}^{\left(\frac{1}{\rho}\right)-1} \cdot \frac{\partial U_{t+1}}{\partial K_{t+1}} \tag{A4}$$

$$\frac{\partial U_{t+1}}{\partial K_{t+1}} = \alpha\rho\left(e_{t+1}^{k}K_{t+1}\right)^{\rho-1} \cdot e_{t+1}^{k} \tag{A5}$$

Substituting back

$MPK_{t+1} = A_{t+1}\frac{1}{\rho}U_{t+1}^{\left(\frac{1}{\rho}\right)-1}\alpha\rho\left(e_{t+1}^{k}K_{t+1}\right)^{\rho-1}e_{t+1}^{k}$, ρ term cancel out

$$MPK_{t+1} = \frac{\partial Y_{t+1}}{\partial K_{t+1}} = A_{t+1}\alpha U_{t+1}^{\frac{1}{\rho}-1}\left(e_{t+1}^{k}K_{t+1}\right)^{\rho-1}e_{t+1}^{k} \tag{A6}$$

Similarly, for MPL,

$$MPL_{t+1} = \frac{\partial Y_{t+1}}{\partial L_{t+1}} = A_{t+1} \cdot \frac{\partial (U_{t+1}^{1/\rho})}{\partial L_{t+1}} \tag{A7}$$

Using the chain rule:

$$\frac{\partial (U_{t+1}^{1/\rho})}{\partial L_{t+1}} = \frac{1}{\rho} U_{t+1}^{\left(\frac{1}{\rho}\right)-1} \cdot \frac{\partial U_{t+1}}{\partial L_{t+1}} \tag{A8}$$

$$\frac{\partial U_{t+1}}{\partial L_{t+1}} = (1-\alpha)\rho(u_{t+1}^{L}L_{t+1})^{\rho-1} \cdot u_{t+1}^{L} \tag{A9}$$

Substituting back:

$MPL_{t+1} = A_{t+1}\frac{1}{\rho}U_{t+1}^{\left(\frac{1}{\rho}\right)-1}(1-\alpha)\rho(u_{t+1}^{L}L_{t+1})^{\rho-1}u_{t+1}^{L}$, ρ cancel out

$$MPL_{t+1} = A_{t+1}U_{t+1}^{\left(\frac{1}{\rho}\right)-1}(1-\alpha)(u_{t+1}^{L}L_{t+1})^{\rho-1}u_{t+1}^{L} \tag{A10}$$

A3. Optimization problem - Derivation

$$\max_{\{Div_t, K_{t+1}, L_{t+1}, M_t, D_{t+1}\} \geq 0} E_0 \sum_{t=0}^{\infty} \beta^t Div_t \tag{A11}$$

Subject to capital accumulation, the budget constraint and collateral constraint. Let λ_t be the multiplier on the budget and $\mu_t \geq 0$ on the collateral constraint. We substitute $I_t = K_{t+1} - (1-\delta)K_t$ into the budget constraint.

The present value Lagrangian is

$$\begin{aligned} \mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \big[& Div_t \\ & + \lambda_t \big(P_t Y_t + CH_t + D_{t+1} + M_t - Div_t - q_t[K_{t+1} - (1-\delta)K_t] \\ & - \chi w_{t+1} L_{t+1} - (1 + r_t^D) D_t - (1 + r_{t-1}^{WC}) M_{t-1} - C_t^{\Delta} \big) \\ & + \mu_t (\theta_K (1-\delta) E_t[q_{t+1} K_{t+1}] + \theta_R E_t[P_{t+1} Y_{t+1}] - D_{t+1} - \eta M_t) \big] \end{aligned} \tag{A12}$$

We assume interior solutions for $K_{t+1}, L_{t+1}, M_t, D_{t+1}$ (so no extra nonnegativity multipliers), and allow $Div_t \geq 0$ to impose the standard 'no new equity' Kuhn-Tucker condition on payouts.

First order conditions (FOCs)

i) Dividends D_t

$$\frac{\partial \mathcal{L}}{\partial D_t} = 1 - \lambda_t \leq 0 \tag{A13}$$

$$D_t \geq 0$$

$$(1 - \lambda_t) D_t = 0$$

If the firm pays positive dividends, $\lambda_t = 1$

This makes λ_t the shadow value of internal funds. That is, in optimum condition, the marginal benefit of one extra unit of dividend will equal to the shadow value of that unit inside the constraint[20].

ii) Long-term debt D_{t+1}

Appears as D_{t+1} in the budget at t, and as $-(1 + r_{t+1}^D) D_{t+1}$ in the $t+1$ budget; also in the collateral constraint:

[20] The firm will keep paying out more dividends as long as the marginal benefit of the dividend is greater than its marginal cost.

$$0 = 1 + \mu_t - \frac{1}{1 + r_{f,t}} E_t \left[(1 + r_{t+1}^D) + D_{t+1} \frac{\partial r_{t+1}^D}{\partial D_{t+1}} \right] \quad \text{(A14)}$$

$$1 - \mu_t = \frac{1}{1 + r_{f,t}} E_t \left[(1 + r_{t+1}^D) + D_{t+1} \frac{\partial r_{t+1}^D}{\partial D_{t+1}} \right] \quad \text{(A15)}$$

If r_{t+1}^D does not depend on D_{t+1}, the derivative term drops.

iii) Working capital loan M_t

Appears as M_t in the budget at t , as $-(1 + r_t^{WC})M_t$ in the $t + 1$ budget and as ηM_t in the collateral:

$$0 = 1 + \mu_t \eta - \frac{1}{1 + r_{f,t}} E_t \left[(1 + r_{t+1}^{WC}) + M_t \frac{\partial r_t^{WC}}{\partial M_t} \right] \quad \text{(A16)}$$

$$1 + \mu_t \eta = \frac{1}{1 + r_{f,t}} E_t \left[(1 + r_{t+1}^{WC}) + M_t \frac{\partial r_t^{WC}}{\partial M_t} \right] \quad \text{(A17)}$$

If r_t^{WC} does not depend on M_t, the derivative term drops.

iv) Capital K_{t+1}

At t, from budget constraint via $q_t I_t$: $-\lambda_t q_t$

From collateral constraint $\mu_t \theta_k (1 - \delta) E_t[q_{t+1} K_{t+1}] + \mu_t \theta_R E_t[P_{t+1} Y_{t+1}]$:

$$\mu_t \theta_k (1 - \delta) E_t[q_{t+1}] + \mu_t \theta_R E_t[P_{t+1} MPK_{t+1}]$$

Adjustment cost: $-\lambda_t \frac{\partial C_t^{\Delta}}{\partial K_{t+1}}$

At $t + 1$:

Revenue: $\lambda_{t+1} P_{t+1} MPK_{t+1}$

Investment: $\lambda_{t+1} q_{t+1} (1 - \delta)$

Adjustment cost: $-\lambda_{t+1} \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}}$

And, interest rate sensitivities

Thus, the FOC for K_{t+1} would be

$$0 = \beta^t \left[-\lambda_t q_t - \lambda_t \frac{\partial C_t^{\Delta}}{\partial K_{t+1}} + \mu_t \theta_k (1-\delta) E_t[q_{t+1}] + \mu_t \theta_R E_t[P_{t+1} MPK_{t+1}] \right]$$
$$+ \beta^{t+1} E_t \left[\lambda_{t+1} \left(P_{t+1} MPK_{t+1} + q_{t+1}(1-\delta) \right. \right. \quad \text{(A18)}$$
$$\left. \left. - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \right) \right]$$

Divided by β^t

$$0 = -\lambda_t q_t - \lambda_t \frac{\partial C_t^{\Delta}}{\partial K_{t+1}} + \mu_t \theta_k (1-\delta) E_t[q_{t+1}] + \mu_t \theta_R E_t[P_{t+1} MPK_{t+1}]$$
$$+ \beta E_t \left[\lambda_{t+1} \left(P_{t+1} MPK_{t+1} + q_{t+1}(1-\delta) - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} \right. \right. \quad \text{(A19)}$$
$$\left. \left. - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \right) \right]$$

After re arranging

$$\lambda_t q_t + \lambda_t \frac{\partial C_t^{\Delta}}{\partial K_{t+1}}$$
$$= \mu_t \theta_k (1-\delta) E_t[q_{t+1}] + \mu_t \theta_R E_t[P_{t+1} MPK_{t+1}]$$
$$+ \beta E_t \left[\lambda_{t+1} \left(P_{t+1} MPK_{t+1} + q_{t+1}(1-\delta) - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} \right. \right. \quad \text{(A20)}$$
$$\left. \left. - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \right) \right]$$

Substituting for $\frac{\lambda_{t+1}}{\lambda_t}$, we obtain

$$q_t + \frac{\partial C_t^{\Delta}}{\partial K_{t+1}} = \mu_t \theta_k (1-\delta) E_t[q_{t+1}] + \mu_t \theta_R E_t[P_{t+1} MPK_{t+1}]$$
$$+ \frac{1}{1+r_{f,t}} E_t \left[P_{t+1} MPK_{t+1} + q_{t+1}(1-\delta) - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} \right. \quad \text{(A21)}$$
$$\left. - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \right]$$

$$q_t = \mu_t\theta_k(1-\delta)E_t[q_{t+1}] + \mu_t\theta_R E_t[P_{t+1}MPK_{t+1}] + \frac{1}{1+r_{f,t}}E_t\left[P_{t+1}MPK_{t+1} + q_{t+1}(1-\delta) - \frac{\partial C^{\Delta}_{t+1}}{\partial K_{t+1}} - D_{t+1}\frac{\partial r^{D}_{t+1}}{\partial K_{t+1}} - M_t\frac{\partial r^{WC}_{t}}{\partial K_{t+1}}\right] - \frac{\partial C^{\Delta}_{t}}{\partial K_{t+1}} \quad \text{(A22)}$$

We define $\frac{\partial NW_{t+1}}{\partial K_{t+1}}$ to collect all future balance-sheet effects, and define q_t as

$$\mathrm{q_t} = \frac{1}{1+r_{f,t}}E_t\left[\frac{\partial NW_{t+1}}{\partial K_{t+1}} - \frac{\partial C^{\Delta}_{t+1}}{\partial K_{t+1}}\right] - \frac{\partial C^{\Delta}_{t}}{\partial K_{t+1}} \quad \text{(A23)}$$

Where

$$E_t\left[\frac{\partial NW_{t+1}}{\partial K_{t+1}} - \frac{\partial C^{\Delta}_{t+1}}{\partial K_{t+1}}\right] = (1+r_{f,t})\mu_t\theta_k(1-\delta)E_t[q_{t+1}] + \mu_t\theta_R E_t[P_{t+1}MPK_{t+1}] + E_t\left[P_{t+1}MPK_{t+1} + q_{t+1}(1-\delta) - \frac{\partial C^{\Delta}_{t+1}}{\partial K_{t+1}} - D_{t+1}\frac{\partial r^{D}_{t+1}}{\partial K_{t+1}} - M_t\frac{\partial r^{WC}_{t}}{\partial K_{t+1}}\right] \quad \text{(A24)}$$

$$\frac{\partial NW_{t+1}}{\partial K_{t+1}} = (1+r_{f,t})\mu_t\theta_k(1-\delta)q_{t+1} + \mu_t\theta_R P_{t+1}MPK_{t+1} + P_{t+1}MPK_{t+1} + q_{t+1}(1-\delta) - D_{t+1}\frac{\partial r^{D}_{t+1}}{\partial K_{t+1}} - M_t\frac{\partial r^{WC}_{t}}{\partial K_{t+1}} \quad \text{(A25)}$$

v) Labour L_{t+1}

At t, from budget $-\chi w_{t+1}L_{t+1}$: $-\lambda_t\chi w_{t+1}$

From adjustment cost: $-\lambda_t\frac{\partial C^{\Delta}_{t}}{\partial L_{t+1}}$

from collateral: $\mu_t\theta_R P_{t+1}\frac{\partial Y_{t+1}}{\partial L_{t+1}}$: $\mu_t\theta_R P_{t+1}MPL_{t+1}$

At $t+1$, from budget constraint;

Revenue $P_{t+1}Y_{t+1}$: $\lambda_{t+1}P_{t+1}MPL_{t+1}$

Wage $-(1-\chi)w_{t+1}L_{t+1}$: $-\lambda_{t+1}(1-\chi)w_{t+1}$

Adjustment cost: $\lambda_{t+1}\frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}}$

Long term debt service: $-\lambda_{t+1}D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}}$

WC repayment: $-\lambda_{t+1}M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}$, Now the FOC can be written as

$$0 = \beta^t\left[-\lambda_t\chi w_{t+1} - \lambda_t\frac{\partial C_t^{\Delta}}{\partial L_{t+1}} + \mu_t\theta_R P_{t+1}MPL_{t+1}\right] + \beta^{t+1}E_t\left[\lambda_{t+1}P_{t+1}MPL_{t+1} - \lambda_{t+1}(1-\chi)w_{t+1} - \lambda_{t+1}\frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}} - \lambda_{t+1}D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - \lambda_{t+1}M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\right] \quad \text{(A26)}$$

Dividing both sides by β^t:

$$0 = -\lambda_t\chi w_{t+1} - \lambda_t\frac{\partial C_t^{\Delta}}{\partial L_{t+1}} + \mu_t\theta_R P_{t+1}MPL_{t+1} + \beta E_t\left[\lambda_{t+1}\left(P_{t+1}MPL_{t+1} - (1-\chi)w_{t+1} - \frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}} - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\right)\right] \quad \text{(A27)}$$

Re arranging

$$\lambda_t\chi w_{t+1} + \lambda_t\frac{\partial C_t^{\Delta}}{\partial L_{t+1}} = \mu_t\theta_R P_{t+1}MPL_{t+1} + \beta E_t\left[\lambda_{t+1}\left(P_{t+1}MPL_{t+1} - (1-\chi)w_{t+1} - \frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}} - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\right)\right] \quad \text{(A28)}$$

Taking, $\frac{\lambda_{t+1}}{\lambda_t} = \frac{1}{1+r_{f,t}}$

$$\chi w_{t+1} + \frac{\partial C_t^{\Delta}}{\partial L_{t+1}} = \mu_t \theta_R E[P_{t+1} MPL_{t+1}] + \frac{1}{1+r_{f,t}} E_t \left[P_{t+1} MPL_{t+1} - (1-\chi) w_{t+1} - \frac{\partial C_{t+1}^{\Delta}}{\partial L_{t+1}} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t \frac{\partial r_t^{WC}}{\partial L_{t+1}} \right] \quad \text{(A29)}$$

We define $\frac{\partial NW_{t+1}}{\partial L_{t+1}}$ to collect all future balance-sheet effects, and;

$$\chi \mathrm{w_{t+1}} = \frac{1}{1+\mathrm{r_{f,t}}} \mathrm{E_t} \left[\frac{\partial \mathrm{NW_{t+1}}}{\partial \mathrm{L_{t+1}}} - \frac{\partial \mathrm{C_{t+1}^{\Delta}}}{\partial \mathrm{L_{t+1}}} \right] - \frac{\partial \mathrm{C_t^{\Delta}}}{\partial \mathrm{L_{t+1}}} \quad \text{(A30)}$$

Where

$$\frac{\partial NW_{t+1}}{\partial L_{t+1}} = \left(1+r_{f,t}\right) \mu_t \theta_R P_{t+1} MPL_{t+1} + P_{t+1} MPL_{t+1} - (1-\chi) w_{t+1} - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t \frac{\partial r_t^{WC}}{\partial L_{t+1}} \quad \text{(A31)}$$

A4. Labour-Capital Ratio – Constrained firms

The FOC for Capital

$$\mathrm{q_t} = \frac{1}{1+r_{f,t}} E_t \left[\frac{\partial NW_{t+1}}{\partial K_{t+1}} - \frac{\partial C_{t+1}^{\Delta}}{\partial K_{t+1}} \right] - \frac{\partial C_t^{\Delta}}{\partial K_{t+1}} \quad \text{(A32)}$$

The FOC for Labour

$$\chi \mathrm{w_{t+1}} = \frac{1}{1+\mathrm{r_{f,t}}} \mathrm{E_t} \left[\frac{\partial \mathrm{NW_{t+1}}}{\partial \mathrm{L_{t+1}}} - \frac{\partial \mathrm{C_{t+1}^{\Delta}}}{\partial \mathrm{L_{t+1}}} \right] - \frac{\partial \mathrm{C_t^{\Delta}}}{\partial \mathrm{L_{t+1}}} \quad \text{(A33)}$$

Where $\frac{\partial \mathrm{NW_{t+1}}}{\partial .}$ capture the future balance-sheet effects

For capital

$$\frac{\partial NW_{t+1}}{\partial K_{t+1}} = (1+r_{f,t}) \mu_t \theta_k (1-\delta) q_{t+1} + \mu_t \theta_R P_{t+1} MPK_{t+1} + P_{t+1} MPK_{t+1} + q_{t+1}(1-\delta) - D_{t+1} \frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} - M_t \frac{\partial r_t^{WC}}{\partial K_{t+1}} \quad \text{(A34)}$$

Similarly in labour,

$$\frac{\partial NW_{t+1}}{\partial L_{t+1}} = \left(1 + r_{f,t}\right)\mu_t\theta_R P_{t+1}MPL_{t+1} + P_{t+1}MPL_{t+1} - (1-\chi)w_{t+1} - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}} \quad \text{(A35)}$$

Using the FOCs and dropping the adjustment costs for simplify we define the marginal net return as

$$\mathcal{G}_L(L_{t+1}) = (\mu_t\theta_R P_{t+1} + P_{t+1})MPL_{t+1} - \chi^{21}w_{t+1} - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}} \quad \text{(A36)}$$

$$\mathcal{G}_K(K_{t+1}) = \mu_t\theta_k(1-\delta)q_{t+1} + (\mu_t\theta_R P_{t+1} + P_{t+1})MPK_{t+1} + q_{t+1}(1-\delta) - D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} - M_t\frac{\partial r_t^{WC}}{\partial K_{t+1}} \quad \text{(A37)}$$

$\mathcal{G}_L(L_{t+1})$ and $\mathcal{G}_K(K_{t+1})$ captures the net marginal gain in expected future net worth from employing one more unit of labour and capital respectively.

In a constrained maximization problem, the optimal allocation of inputs will be, net marginal benefit from extra labour equals to Net marginal benefit from extra capital.

So, for the labour to capital ratio,

$$\frac{\mathrm{L_{t+1}}}{\mathrm{K_{t+1}}} = E\left\{\frac{\int \mathcal{G}_L(L_{t+1})dL_{t+1}}{\int \mathcal{G}_K(K_{t+1})dK_{t+1}}\right\} \quad \text{(A38)}$$

$$\frac{\mathrm{L_{t+1}}}{\mathrm{K_{t+1}}} = E_t\left\{\frac{\int\left[(P_{t+1} + \mu_t\theta_R P_{t+1})MPL_{t+1} - \left(D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial L_{t+1}} + M_t\frac{\partial r_t^{WC}}{\partial L_{t+1}}\right) - \chi w_{t+1}\right]dL_{t+1}}{\int\left[(P_{t+1} + \mu_t\theta_R P_{t+1})MPK_{t+1} + \mu_t\theta_k(1-\delta)q_{t+1} - \left(D_{t+1}\frac{\partial r_{t+1}^{D}}{\partial K_{t+1}} + M_t\frac{\partial r_t^{WC}}{\partial K_{t+1}}\right)\right]dK_{t+1}}\right\} \quad \text{(A39)}$$

[21] χw_{t+1} instead of $(1-\chi)w_{t+1}$ to capture how the prepayment of wage at t, tightens working capital now.

Tables

Table A.1 : Variable definition

Variable	Definition	Proxy for
Total assets	Book value of total assets	Firm size /balance sheet scale
Number of employees	Headcount of employees (levels)	Firm size (labour)
Wage bill	Total wage bill, scaled by total assets	Labour input (flow)
Sales	Sales-to-assets ratio (sales ÷ total assets)	Operating scale/turnover
Debt service ratio (Interest service)	Interest expenses ÷ total debt /Interest expenses ÷ total assets	Borrowing cost
Current liabilities	Current liabilities ÷ total assets	Short-term obligations or liquidity pressure
Fixed assets to total assets	Fixed assets ÷ total assets	Asset composition - collateralizable capital share
Wage bill to fixed assets	Wage bill ÷ fixed assets	Labour-to-capital ratio
Wage bill to sales	Wage bill ÷sales	Labour share of revenue or labour intensity
Leverage	Total debt ÷ total assets	Indebtedness or solvency
Profit	Profits ÷ total assets	Profitability (ROA)
Revenues	Revenues ÷ total assets	Scale/asset productivity
Average wage	Wage bill ÷ number of employees	Average real wage
Labour growth rate	Percent change in wage bill (%Δ wage bill)	Hiring growth (flow)
Capital growth rate	Percent change in fixed assets (%Δ fixed assets)	Investment growth (flow)
Growth in total debt	Percent change in total debt	Debt accumulation
Growth in revenues	Percent change in revenues	Sales growth
Growth in profits	Percent change in profits	Profit growth
Labour to capital ratio	Wage bill ÷ fixed assets	Relative demand for labour vs. capital
Short-term debt	Short-term debt ÷ total debt	Maturity structure
Current assets	Current assets ÷ total assets	Liquidity (asset side)
Cash on Hand	Cash and cash equivalents ÷ total assets	Immediate liquidity
Shareholder funds	Shareholder funds ÷ total assets	Equity buffer
Working capital	Current assets − current liabilities (relative to assets)	Liquidity (net working capital)
Wage volatility	Standard deviation of negative real wage growth rates (downward wage volatility)	Wage rigidity (lower volatility; higher rigidity)
Policy shock	Path factor and Target Factor from Lakdawala and Sengupta (2025)	Exogenous change in financing conditions

firm-level shock	Policy shock × lagged firm leverage	Exogenous variation in firm financing costs via credit channel
Average depreciation rate	Firm (or asset) average depreciation rate used as a measure of asset collateralizability.	Collateral value (lower when depreciation is higher)

Table A2: Effect of Path Shocks on Debt-Service Payment by Debt Maturity

	(1)	(2)	(3)	(4)	(5)	(6)
Short $\text{debt}_{i,t-1}$ × $\text{path factor}_{i,t}$	-1.064***	-1.014***	-1.031***			
	(0.170)	(0.253)	(0.310)			
Long $\text{debt}_{i,t-1}$ × $\text{path factor}_{i,t}$				-0.659***	-0.110	0.018
				(0.183)	(0.260)	(0.279)
$\text{Leverage}_{i,t-1}$	0.379	0.349	0.486***	2.185***	2.033***	1.628***
	(0.236)	(0.220)	(0.159)	(0.468)	(0.511)	(0.546)
$\text{Wage Growth}_{i,t-1}$	0.001	0.000	-0.001	0.002	0.000	-0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
$\text{Capital Growth}_{i,t-1}$	-0.001	-0.002**	-0.001*	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\text{Log Avg Wage}_{i,t-1}$	-0.290*	-0.135	-0.017	-0.335*	-0.261	0.018
	(0.175)	(0.190)	(0.190)	(0.185)	(0.205)	(0.195)
$\text{Log Revenue}_{i,t-1}$	-0.141	-0.271*	-0.340*	0.177	0.042	-0.008
	(0.165)	(0.148)	(0.206)	(0.180)	(0.184)	(0.233)
$\text{Revenue Growth}_{i,t-1}$	-0.002	-0.001	-0.000	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
$\text{Log Employment}_{i,t-1}$	-0.369**	-0.167	-0.078	-0.321*	-0.197	0.085
	(0.176)	(0.193)	(0.188)	(0.178)	(0.197)	(0.192)
$\text{Log Total Assets}_{i,t-1}$	0.392***	0.488***	0.434***	0.112	0.126	0.007
	(0.143)	(0.143)	(0.152)	(0.160)	(0.167)	(0.182)
$\text{Sales growth}_{i,t-1}$	0.001	0.001	0.001	0.001	0.002	0.001
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Num. obs.	2995	2995	2921	2093	2093	2023
Adj. R2	0.682	0.698	0.722	0.713	0.727	0.741
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Year × Industry fixed effects	No	No	No	No	No	Yes

Notes: This table reports fixed-effects estimates of the effect of monetary policy path shocks on firms' debt-service burden by debt maturity. The dependent variable is short-term interest payments scaled by total assets in columns (1)-(3) and long-term interest payments scaled by total assets in columns (4)-(6). The variable of interest is the interaction between lagged debt-maturity exposure and the monetary policy path factor. Columns (1)-(3) use the interaction with lagged short-term debt, while columns (4)-(6) use the interaction with lagged long-term debt. Firm fixed effects are included in all columns. Year fixed effects are added in columns (2) and (5), and year-by-industry fixed effects are added in columns (3) and (6). The interaction between lagged short-term debt and the path factor is negative and highly significant across all specifications, whereas the corresponding interaction with long-term debt is not robust once richer fixed effects are included. This suggests that path shocks transmit more strongly through short-term refinancing exposure. Clustered standard errors in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table A3: Effect of Target Shocks on Debt-Service Payment by Debt Maturity

	(1)	(2)	(3)	(4)	(5)	(6)
Short $\text{debt}_{i,t-1}$	7.357***	-2.095	-2.332			
× $\text{target factor}_{i,t}$	(2.106)	(3.072)	(3.195)			
Long $\text{debt}_{i,t-1}$				5.648**	-2.501	0.097
× $\text{target factor}_{i,t}$				(2.574)	(3.468)	(3.723)
$\text{Leverage}_{i,t-1}$	0.467	3.258	2.642	3.111	9.286***	8.639***
	(2.978)	(3.165)	(2.672)	(3.209)	(3.124)	(3.289)
$\text{Wage Growth}_{i,t-1}$	-0.108***	-0.060**	-0.054*	-0.145***	-0.080**	-0.075**
	(0.029)	(0.030)	(0.031)	(0.034)	(0.035)	(0.038)
$\text{Capital Growth}_{i,t-1}$	0.101***	0.120***	0.133***	0.094***	0.114***	0.124***
	(0.018)	(0.018)	(0.017)	(0.017)	(0.016)	(0.016)
$\text{Log Avg Wage}_{i,t-1}$	-31.229***	-33.554***	-33.123***	-31.115***	-34.939***	-34.570***
	(2.761)	(2.885)	(2.913)	(3.382)	(3.568)	(3.549)
$\text{Log Revenue}_{i,t-1}$	2.754	7.302***	7.500***	0.506	5.640**	5.443**
	(2.443)	(2.490)	(2.516)	(2.866)	(2.788)	(2.692)
$\text{Revenue Growth}_{i,t-1}$	0.044	0.027	0.024	0.045	0.021	0.023
	(0.027)	(0.026)	(0.025)	(0.035)	(0.033)	(0.031)
$\text{Log Employment}_{i,t-1}$	-22.381***	-25.298***	-25.516***	-21.018***	-25.053***	-25.449***
	(2.626)	(2.800)	(2.783)	(3.303)	(3.543)	(3.457)
$\text{Log Total Assets}_{i,t-1}$	12.757***	9.884***	10.189***	12.996***	9.760***	10.735***
	(2.333)	(2.341)	(2.421)	(2.581)	(2.412)	(2.541)
$\text{Sales growth}_{i,t-1}$	-0.002	-0.009	-0.007	0.029	0.024	0.022
	(0.020)	(0.021)	(0.021)	(0.028)	(0.028)	(0.026)
Num. obs.	10413	10413	10385	7976	7976	7935
Adj. R2	0.061	0.094	0.108	0.059	0.090	0.105
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Year × Industry fixed effects	No	No	Yes	No	No	Yes

Notes: This table reports fixed-effects estimates of the effect of monetary policy target shocks on firms' debt-service burden by debt maturity. The dependent variable is short-term interest payments scaled by total assets in columns (1)-(3) and long-term interest payments scaled by total assets in columns (4)-(6). The variable of interest is the interaction between lagged debt-maturity exposure and the monetary policy target factor. Columns (1)-(3) use the interaction with lagged short-term debt, while columns (4)-(6) use the interaction with lagged long-term debt. Firm fixed effects are included in all columns. Year fixed effects are added in columns (2) and (5), and year-by-industry fixed effects are added in columns (3) and (6). The interaction terms involving the target factor are significant only in the baseline specifications and lose significance after the inclusion of year and year-by-industry fixed effects. Standard errors in parentheses are clustered at the firm level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

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