Financial Constraints and Price Rigidities

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Slides available at yangliu-95.github.io [Extremely Prelimenary!!!]

Introduction

- Vast micro evidence that finance matters for pricing ...
  - Idea: Lack of financial resources $\Rightarrow$ Unable to compete aggressively
  - Chevalier (1995), Chevalier and Scharfstein (1996), Khanna and Tice (2005), Montero and Urtasun (2014), Balduzzi et al. (2024) ...
- ... with important macro effects on inflation
  - Gilchrist et al. (2017), Kim (2021), Duval et al. (2023) ...

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- This paper: Implications for price stickiness and the slope of NKPC?

Intuition under Minimal Assumptions

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  - Deviating from the optimal sticky price path may raise today's earnings...
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  - The wedge can reach infinity with vertical (or very steep) financial constraints
- The "earnings" channel: Financial constraints weaken nominal rigidities by altering intertemporal trade-offs of earnings
  - Limiting case: Choose optimal flexible prices despite nominal rigidities

Empirical Support for the Earnings Channel

- Annual panel of Indian manufacturing firms
- Financially unconstrained: Both cost pass-through and strategic complementarities are consistent with estimates in the literature
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- ... and show almost zero strategic complementarity
- Thus, financial constraints significantly reduce both nominal and real rigidities

Macroeconomy and the Earnings Channel

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Macroeconomy and the Earnings Channel

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- Example: Large cost increases
  - Large cost increases squeeze internal cash flows and trigger financial constraints
  - More firms become constrained and inflation is amplified
- Monetary policy: Aggressive MP during large cost increases may amplify the earnings channel
  - Firms care less about future negative output gap
  - Likely undermine MP's stabilization effects

Literature

- Granular empirical analysis of finance and pricing
  - Chevalier (1995), Gilchrist et al. (2017), Lenzu et al. (2021), Balduzzi et al. (2024) ...
- New theory of state-dependent price rigidities and non-linear NKPC
  - Benigno and Eggertsson (2023), Blanco et al. (2024a), Blanco et al. (2024b) ...
- Complements the investment channel in NK models with financial heterogeneity
  - Khan and Thomas (2013), Ottonello and Winberry (2020), Caglio et al. (2021) ...

Illustrative Model

- Firm i maximizes $V_{i,t}$ subject to Rotemberg adjustment costs
- $\xi_{i,t}$: shadow value of internal cash flows (EBITDA).
  - Analogous to the wedge definition of financial constraints in Kaplan and Zingales (1997)

$$V_{i,t} = \mathrm{E}_t \sum_{h=0}^{\infty} \Lambda_{t,t+h} \frac{1}{P_{t+h}} \left[\xi_{i,t+h} \underbrace{\left(P_{i,t+h} Y_{i,t+h} - C_{t+h}(Y_{i,t+h}) \right)}_{\text{EBITDA}} - \underbrace{\frac{\tau}{2} \pi_{i,t+h}^2 P_{t+h} Y_{t+h}}_{\text{Adj. cost}} \right]. \quad (1)$$

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- Standard Rotemberg FOC ($\epsilon_{i,t} = -\frac{\partial y_{i,t}}{\partial p_{i,t}}$, $\mathcal{M}_{i,t} = \frac{\epsilon_{i,t}}{\epsilon_{i,t}-1}$):

$$\pi_{i,t} = \xi_{i,t} \frac{\epsilon_{i,t} - 1}{\tau} \frac{P_{i,t} Y_{i,t}}{P_t Y_t} \left[\mathcal{M}_{i,t} MC_{i,t} \frac{P_t}{P_{i,t}} - 1 \right] + \mathrm{E}_t \Lambda_{t,t+1} \frac{Y_{t+1}}{Y_t} \pi_{i,t+1} \quad (2)$$

Limiting Case

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$$P_{i,t} = \mathcal{M}_{i,t} MC_{i,t} P_t. \tag{3}$$

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Proposition (Nominal Rigidities and the Earnings Channel)

The optimal sticky price $P^*_{i,t}$ converges to $P^f_{i,t}$ as $\xi_{i,t} \to \infty$. Hence, the earnings channel weakens nominal rigidities.

$$\lim_{\xi_{i,t} \to \infty} P^*_{i,t} = P^f_{i,t}. \tag{4}$$

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- In the special case of CES + CRS, the limiting case features complete cost pass-through.

Limiting Case

- Recallb that in the limiting case $P_{i,t} = \mathcal{M}_{i,t} MC_{i,t} P_t$
- Strategic complementarities when $\xi_{i,t} \to \infty$ depend on how $P_{-i,t}$ affects $\mathcal{M}_{i,t}$:

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Proposition (Strategic Complementarities and the Earnings Channel)

Holding marginal costs constant,

- *If* $\frac{\partial \epsilon_{i,t}}{\partial p_{-i,t}} > 0$, *strategic complementarities strengthen as* $\xi_{i,t} \to \infty$, *i.e., the earnings channel amplifies strategic complementarities.*
- *If* $\frac{\partial \epsilon_{i,t}}{\partial p_{-i,t}} = 0$, *strategic complementarities (if exist) vanish as* $\xi_{i,t} \to \infty$, *i.e., the earnings channel weakens strategic complementarities.*

Empirical Analysis

- Propositions 1 and 2 are empirically testable predictions.
- Importantly, does the earnings channel matter quantitatively? — Do we see the limiting case in the data?
- ⇒ Pass-through regressions to examine the two propositions
  - à la Amiti et al. (2019) and Gagliardone et al. (2023)

Data

- Indian CMIE Prowess database
  - Details: Goldberg et al. (2010a), Goldberg et al. (2010b), De Loecker et al. (2016) ...
- Annual panel of Indian manufacturing firms:
  - Balance sheet data
  - Product-level prices/quantities for both outputs and material inputs
  - 1992-2011: Include both high- and stable-inflation periods
- Ideal to test how finance interacts with pricing

Specification

- Double-interaction pass-through regressions: Low Past EBITDA $\times$ Marginal costs

$$\begin{aligned}\Delta p_{i,t} = {} & \boldsymbol{\beta^T} \mathbf{1}_{i,t}^{\text{Low EBITDA}} \Delta mc_{i,t} + \boldsymbol{\beta^{NT}} \mathbf{1}_{i,t}^{\text{Not Low}} \Delta mc_{i,t} \quad \cdots\cdots \text{Cost pass-through} \\ & + \boldsymbol{\gamma^T} \mathbf{1}_{i,t}^{\text{Low EBITDA}} \Delta p_{-i,t} + \boldsymbol{\gamma^{NT}} \mathbf{1}_{i,t}^{\text{Not Low}} \Delta p_{-i,t} \quad \cdots\cdots \text{Strategic comp.} \\ & + \zeta \, \mathbf{1}_{i,t}^{\text{Low EBITDA}} + \text{Fixed Effects} + \varepsilon_{i,t}. \end{aligned} \tag{5}$$

- Low EBITDA (25^{th}): Proxy for high $\xi_{i,t}$
  - Lower internal cash flows, more liquidity issues when negative shocks hit
  - Sufficient within-firm variation

Instrumental Variables

- Major intermediate goods: Top 10% 6-digit industries by the # of buyers
  - Assume price changes in major industries are exogenous
- IV:
  - $\Delta mc_{i,t}$: Price changes in major industries $\times$ Cost share
  - $\Delta p_{-i,t}$: Competitors' average Δmc IV
  - and interactions with EBITDA
- Others:
  - Sample restrictions: market share; scope; size; scope; int'l trade exposure
  - Residualized IVs: Only use the idiosyncratic variation (remove industry-time FE)

Effects of the Earnings Channel on Current Prices

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable: $\Delta p_{i,t}$		Full Spec.			Resi. IV	
Low EBITDA $\times$ $\Delta mc_{i,t}$ ($\hat{\beta}^T$)	0.85***	0.84***	0.86***	0.84***	0.83***	0.80***
	(0.06)	(0.05)	(0.06)	(0.05)	(0.04)	(0.04)
High EBITDA $\times$ $\Delta mc_{i,t}$ ($\hat{\beta}^{NT}$)	0.66***	0.66***	0.65***	0.63***	0.71***	0.68***
	(0.05)	(0.06)	(0.05)	(0.05)	(0.04)	(0.04)
Low EBITDA $\times$ $\Delta p_{-i,t}$ ($\hat{\gamma}^T$)	0.10	0.10	0.02	0.09		
	(0.08)	(0.07)	(0.08)	(0.11)		
High EBITDA $\times$ $\Delta p_{-i,t}$ ($\hat{\gamma}^{NT}$)	0.33***	0.33***	0.26***	0.34***		
	(0.08)	(0.09)	(0.09)	(0.13)		
Low EBITDA	0.02***	0.03***	0.02***	0.03***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Firm + Year + Sector FE (+ Industry)	Y	Y				
Firm + Sector-Year FE (+ Industry-Year)			Y	Y	Y	Y
R^2	0.734	0.736	0.692	0.677	0.697	0.686
N	9,564	8,884	9,564	8,884	9,562	8,884
Firms	812	783	812	783	812	783
Two-digit Sectors (Four-digit Industries)	9	25	9	25	9	25
Weak IV F-test (Cragg-Donald)	64.65	59.32	65.63	58.30	244.00	222.98
Hansen J-test — p value	0.907	0.784	0.492	0.673	0.406	0.649
$\hat{\beta}^T - \hat{\beta}^{NT}$	0.194**	0.183**	0.213**	0.212***	0.118**	0.122***
$\hat{\gamma}^T - \hat{\gamma}^{NT}$	-0.226**	-0.228**	-0.246**	-0.255**		

Notes: Weighted by average PPI-deflated sales. Standard errors are clustered by firm and sector/industry-year.

Effects of the Earnings Channel on Current Prices

- The earnings channel weakens both nominal rigidities and strategic complementarities
  - Proportion 1: $\hat{\beta}^T - \hat{\beta}^{NT} \gg 0$; Cost pass-through $\uparrow$; Nominal rigidities $\downarrow$
  - Proportion 2: $\hat{\gamma}^T - \hat{\gamma}^{NT} \ll 0$; Strategic complementarities $\downarrow$; Real rigidities $\downarrow$

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  - Proportion 2: $\hat{\gamma}^T - \hat{\gamma}^{NT} \ll 0$; Strategic complementarities $\downarrow$; Real rigidities $\downarrow$
- Quantitatively important:
  - On average, $\hat{\beta}^T$ is 30% higher than $\hat{\beta}^{NT}$
  - During large cost increases (not reported here), $\hat{\beta}^T \approx 1$, fairly close to the limiting case
  - Recall that the "low EBITDA" dummy covers 25% of firm-year observations
- Robustness checks and others additional results

New Keynesian Model

- Incorporate the earnings channel into a textbook NK model
  - Today: Monopolistic competition
  - Going forward: Strategic complementarities
- Non-linearity of NKPC during large cost increases
- Policy implications

Financial Constraints

- Firms borrow to smooth cash flows (no investment):
  - Debt financing: Earnings-based borrowing constraint (EBC)

$$D_{i,t} \leq \phi_i \text{EBITDA}_{i,t}, \tag{6}$$

  - subject to debt adj. costs — so that EBC is occasionally binding

$$\mathcal{L}_{i,t} = \frac{\tau_d}{2}(D_{i,t} - \bar{D})^2 P_t Y_t, \tag{7}$$

- No equity financing:
  - Unless firms have exhausted internal cash flows and debt financing (pecking order)
- Liquidity constraint:

$$\text{Dividend}_{i,t} = \text{Profit}_{i,t} + \Delta D_{i,t} \geq 0. \tag{8}$$

Monopolistic FOCs

- Let $\kappa_{i,t} = \frac{\epsilon-1}{\tau_p}\frac{P_{i,t}Y_{i,t}}{P_tY_t}$:

$$\pi_{i,t} = (1 + \xi_{i,t}^{div} + \xi_{i,t}^{ebc}\phi_i)\kappa_{i,t}\left[\mathcal{M}MC_{i,t}\frac{P_t}{P_{i,t}} - 1\right] + \mathrm{E}_t\,\Lambda_{t,t+1}\pi_{i,t+1} \tag{9}$$

$$\xi_{i,t}^{ebc} + \tau_d(D_{i,t} - \bar{D}) = (1 + \xi_{i,t}^{div}) - \mathrm{E}_t\,\Lambda_{t,t+1}(1 + r_{i,t+1}^{b,r})(1 + \xi_{i,t+1}^{div}) \tag{10}$$

- High τ_d: Prefer internal cash flows (changing $\pi_{i,t}$) over raising debt
- Low τ_d: Easier to borrow until EBC binds, similar to credit lines
- If no $\{\pi_{i,t}, D_{i,t}\}$ can satisfy all constraints, resort to equity financing ($\text{Dividend}_{i,t} < 0$)

Mechanism: Marginal Cost Shocks in PE

- Idiosyncratic MC shock
- No effect on prices during normal cost increase ...
- ... because firms borrow to smooth cash flows (small τ_d)
- Pass-through: 59% at $t = 4$ ($\kappa = 0.1$)

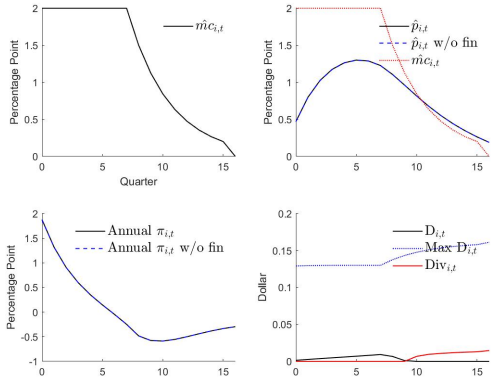
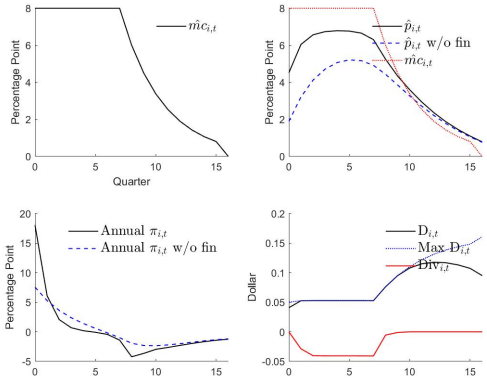


Figure: Normal Cost Increase

Mechanism: Marginal Cost Shocks in PE

- Different pricing during large shocks ...
- ... because firms exhaust both EBITDA and debt financing
- Pass-through: 82% at $t = 4$ (due to DRS)
- $\max \xi = 10$ ($\kappa \approx 0.6$) when liquidity constraint violated: Close enough to the limiting case



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Monetary Policy Dilemma

- In GE, monetary policy reacts to cost-push shocks by lowering $\hat{y}_t$ and real wages
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  - Lower $\hat{y}_t$ only mildly reduces real wages
  - Lower $\hat{y}_t$ further squeezes profit margins and amplifies the earnings channel
  - More generally: When marginal costs not sensitive to the output gap

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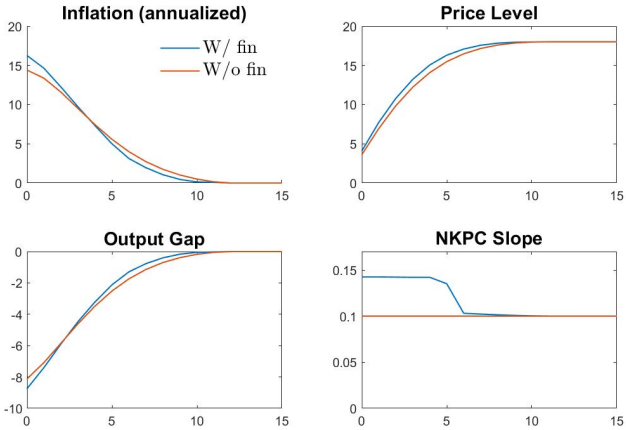
  - More generally: When marginal costs not sensitive to the output gap
- NK + Taylor rule example (next slide)
  - Sticky wages à la Schmitt-Grohé and Uribe (2016)
  - Financial heterogeneity: Different fixed costs; No idiosyncratic shock for simplicity

Standard Taylor Rule ($\phi_\pi = 1.5$, $\phi_{\hat{y}} = 0.125$)

- Large w_t ↑↑
  - $\Delta = +8\%$, $\rho = 0.75$
- Initial $\pi_t = 16.3\%$: $+1.86\%$ due to the earnings channel
  - Nonlinear: Small shocks

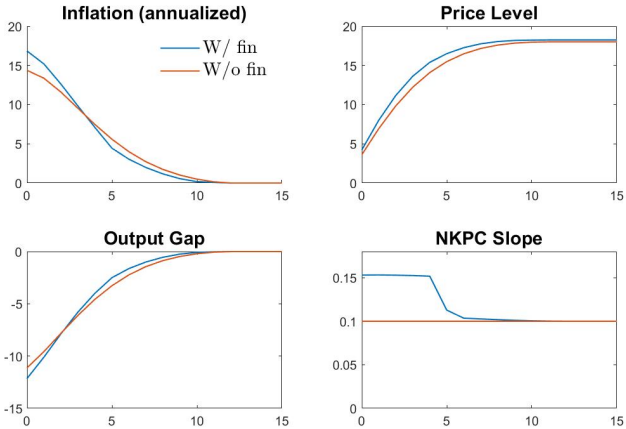
Figure: Standard Taylor Rule



Stronger Taylor Rule ($\phi_\pi = 1.75$, $\phi_{\hat{y}} = 0.125$)

- Initial $\pi_t = 16.9\%$: $+2.47\%$ due to the earnings channel
- Average NKPC slope slightly higher
- Stronger MP has no deflation effect!

Figure: Stronger Taylor Rule



Going Forward

- Strategic complementarities
- Monetary and credit policy
- ...

Appendix

Appendix

Empirical - Robustness Checks

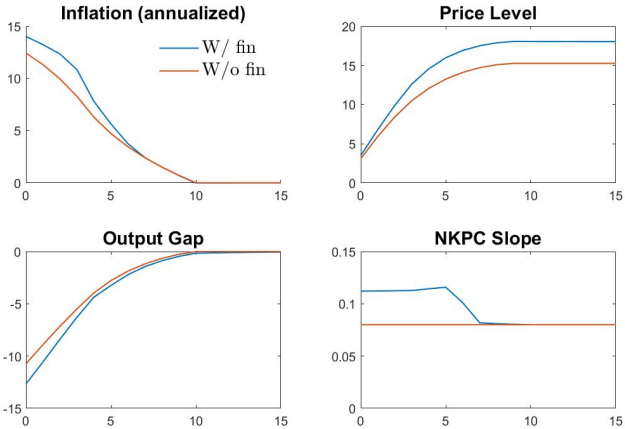
- Additional results are reported in the paper: back
  - Non-binary EBITDA dummy
  - Non-linear effects of $\Delta mc_{i,t}$
  - Effects on future prices
  - Effects on output, margins, and borrowing
  - Additional controls for firm size (fully interacted)
  - Pre-determined variable assumption
  - Predicted input prices by firm type

Flexible Prices

- Standard Taylor rule

back

Figure: Standard Taylor Rule



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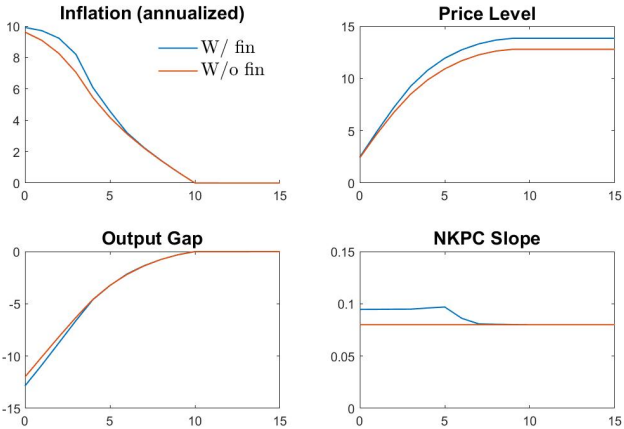

Normal Shocks

- Wage shock: +4%
- The earnings channel muted

back

Figure: Normal Shocks