# Financial Constraints and Price Rigidities

Yang Liu

Boston College

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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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- ... with important macro effects on inflation
  - Gilchrist et al. (2017), Kim (2021), Duval et al. (2023) ...
- 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...
  - ... at the expense of expected earnings in the future

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  - Wedge between internal/external cash flows $\Rightarrow$ Shadow value of today's earnings $\uparrow$
  - 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
  - All sounds cool... But is it empirically relevant?

# 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 complementarities

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  - Almost 100% cost pass-through during large cost increases
  - ... and show almost zero strategic complementarities
- Thus, financial constraints significantly reduce both nominal and real rigidities

# Macroeconomy and the Earnings Channel

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  - Large cost increases squeeze internal cash flows and trigger financial constraints
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# Macroeconomy and the Earnings Channel

- Non-linear NKPC: Steeper when finance-price interactions weaken price rigidities
- Important 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
  - Profit margins further squeezed by lower demand
  - 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), Gagliardone et al. (2024) ...
- 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 FOC ($\epsilon_{i,t} = -\frac{\partial y_{i,t}}{\partial p_{i,t}}$, $\mathcal{M}_{i,t} = \frac{\epsilon_{i,t}}{\epsilon_{i,t}-1}$, $MC_{i,t}$ real marginal costs):

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

## 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 $P_{i,t}^f$ as $\xi_{i,t} \to \infty$. Hence, the earnings channel weakens nominal rigidities.*

$$\lim_{\xi_{i,t} \to \infty} P_{i,t}^* = P_{i,t}^f. \tag{4}$$

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

# Limiting Case

- Recall 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 $\mathcal{M}_{i,t}$:

# Limiting Case

- Recall 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 $\mathcal{M}_{i,t}$:

## 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? — How often do we see the limiting case in the data?
- $\Rightarrow$ Pass-through regressions to examine the two propositions
  - à la Amiti et al. (2019)

# 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 $\Delta mc$ 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 $\downarrow$
- 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 $\tau_d$: Prefer internal cash flows (changing $\pi_{i,t}$) over raising debt
- Low $\tau_d$: 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 $\tau_d$)
- Pass-through: 59% at $t = 4$ ($\kappa = 0.1$)

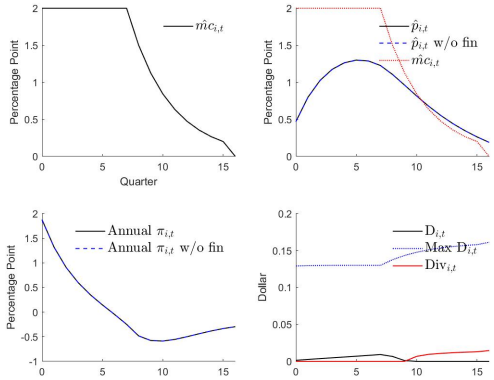


Figure: Normal Cost Increase

# Mechanism: Marginal Cost Shocks in PE

- Different pricing during large shocks ...
- ... because firms exhaust both EBITDA and debt financing
- Pass-through: 82% at $t = 4$ (not 100% due to DRS)
- Set $\xi = 10$ ($\kappa \approx 0.6$) when liquidity constraint violated

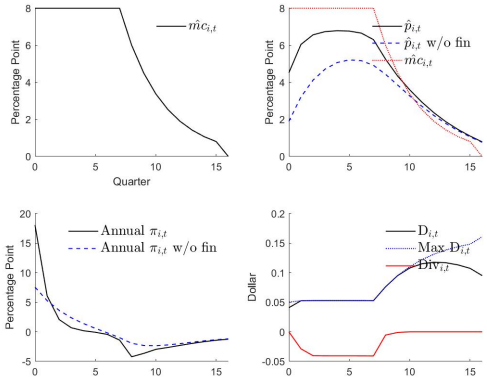


Figure: Large Cost Increase

# Monetary Policy Dilemma During Large Cost Shocks

- In GE, monetary policy reacts to cost-push shocks by lowering $\hat{y}_t$ and real wages
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- Dilemma under sticky wages:
  - 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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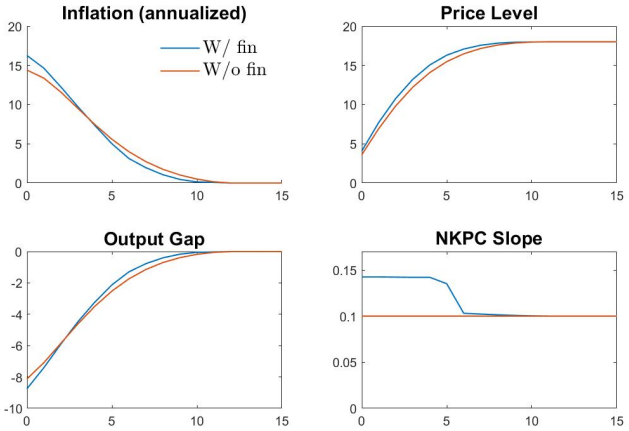
  - More generally: When marginal costs not sensitive to the output gap
- NK + Taylor rule example (next slide)
  - Sticky wages à la Schmitt-Grohé and Uribe (2016)
  - Financial heterogeneity: Different EBC; No idiosyncratic shock for simplicity

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

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

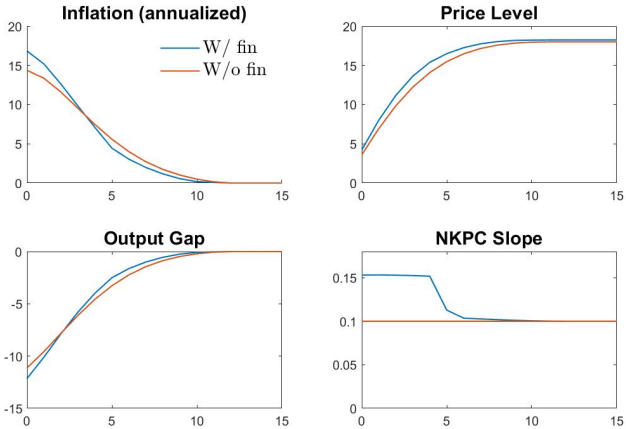
Figure: Standard Taylor Rule



# 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

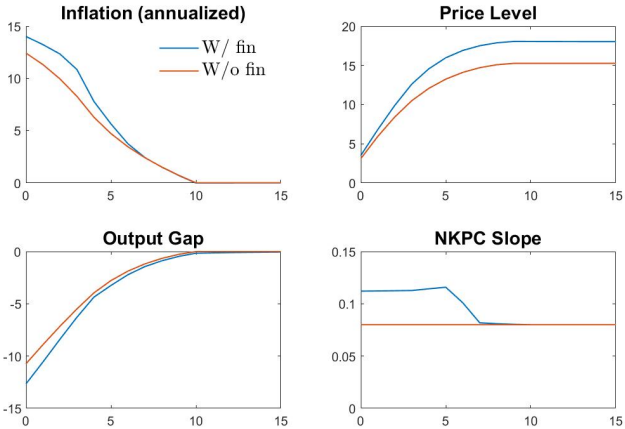
- Additional results are reported in the paper: back
  - Non-binary EBITDA dummy
  - Non-linear effects of $\Delta mc_{i,t}$
  - Effects on future prices
  - Effects on output, margins, and borrowing
  - Additional controls for firm size (fully interacted)
  - Pre-determined variable assumption
  - Predicted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

# Flexible Prices

- Standard Taylor rule

back

Figure: Standard Taylor Rule



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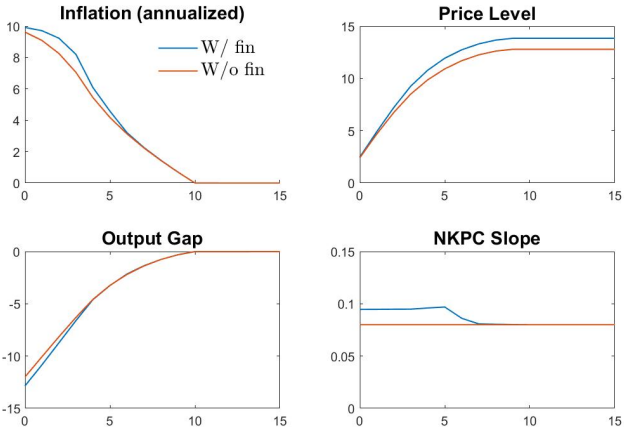

# Normal Shocks

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

back

Figure: Normal Shocks