Monetary Policy, Markup Dispersion, and Aggregate TFP

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Motivation

How does monetary policy affect real economic activity?

Role of heterogeneous price rigidity and markups?

Evidence: Bils/Klenow (04), Nakamura/Steinsson (08), Gorodnichenko/Weber (16), ...

Positive: Carvalho (06), Nakamura/Steinsson (10), Carvalho/Schwartzman (15), Pasten/Schoenle/Weber (19), Hoynck (20), ...

Normative: Aoki (01), Woodford (10), Eusepi/Hobijn/Tambalotti (11), Rubbo (20), ...

New empirical evidence

Using US data, we document:

1. MP shocks increase the markup dispersion across firms
2. MP shocks increase the relative markup of firms that adjust prices less frequently
3. Firms that adjust prices less frequently have higher markups

Data meets theory

An implication of ① higher markup dispersion

- Aggregate total factor productivity falls (through factor misallocation), consistent with empirical evidence

Facts ①–③ consistent with a NK model with heterogeneous rigidity

- Ex-ante, firms with stickier prices have a precautionary motive to set a higher price (markup), and MP shocks raise their rel. markup
- Analyze price-setting frictions: Calvo, Taylor, Rotemberg, Barro

Simple calibrated NK model with heterogeneous price rigidity to study relevance and implications of mechanism

Introduction

Empirical evidence

Analytical results

Quantitative results

Conclusion

Measuring markups and price rigidity

Markups can be estimated as

$$\mu = \frac{\text{output elasticity of } M}{\text{revenue share of } M}$$

assuming cost minimization with flexible factor M Hall (86/88), De Loecker/Warzynski (12)

Measuring markups and price rigidity

Markups can be estimated as

$$\mu = \frac{\text{output elasticity of } M}{\text{revenue share of } M}$$

- Quarterly firm-level Compustat balance sheet data

$$\text{revenue share}_{it} = \frac{\text{Costs of goods sold}_{it}}{\text{Sales}_{it}}$$

  - We assume firms in an industry share the same production function
  - We focus on within-industry log markup differences (Bond et al. (20))
  - Output elasticities: cost shares or De Loecker/Warzynski (12)

Measuring markups and price rigidity

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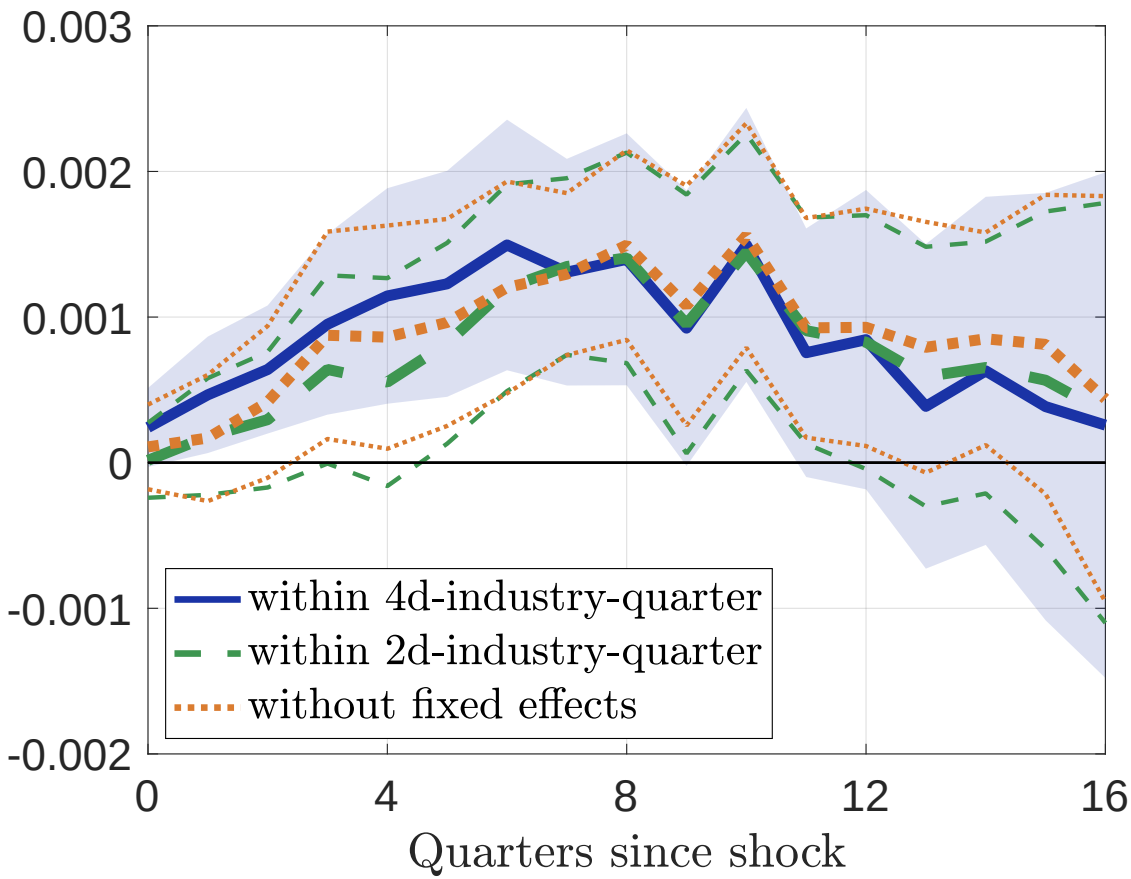
- Quarterly firm-level Compustat balance sheet data

Price adjustment frequency constructed from

- 5-digit sector averages from PPI micro data Pasten/Weber/Schoenle (19)
- Firm-level sales composition across sectors in Compustat segment files

① MP shock raises markup dispersion

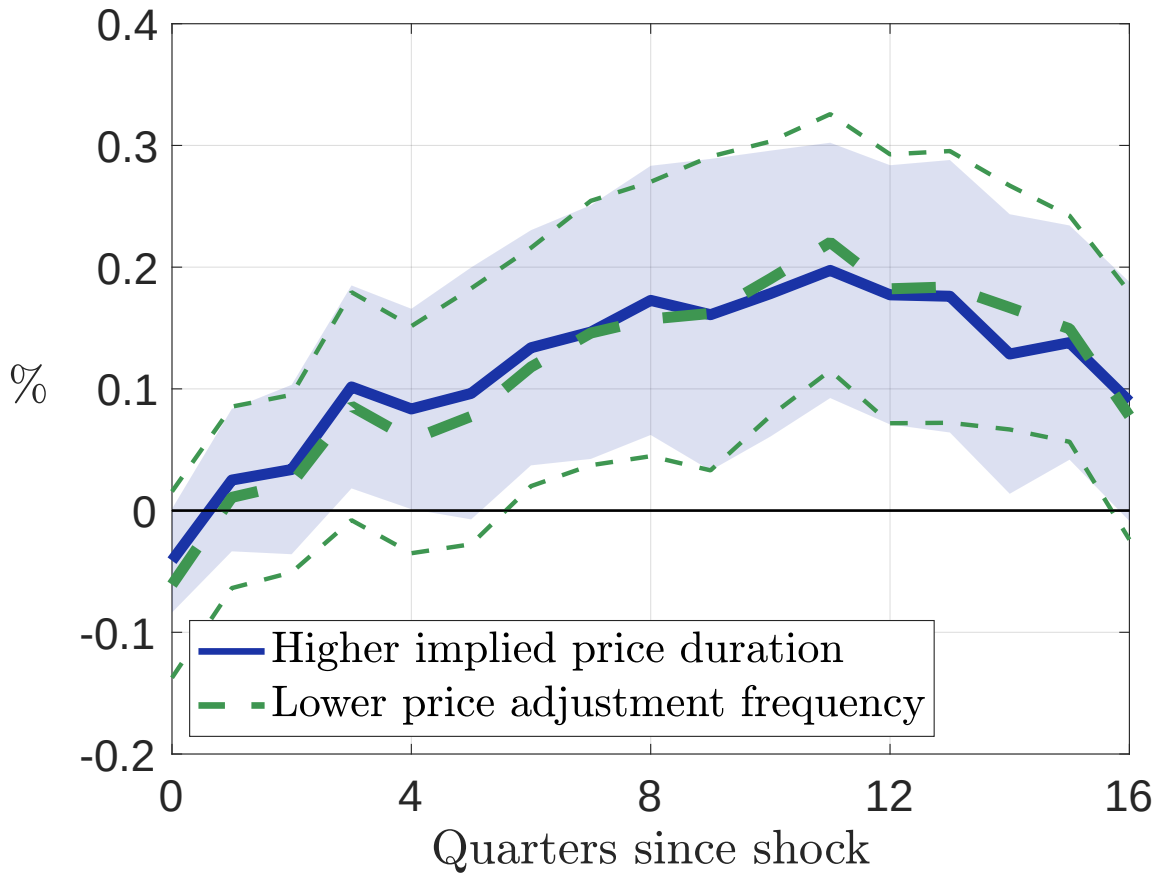
$$y_{t+h} - y_{t-1} = \alpha^h + \beta^h \varepsilon_t^{MP} + \gamma^h Z_{t-1} + u_t^h$$



Solid/dashed line: response to a one standard deviation MP shock (increases FFR by up to 30 bp). Shaded area/dotted line: Newey-West one-standard error bands. ▸ Series

② Markups of rigid-price firms increase by more

$$y_{it+h} - y_{it-1} = \alpha_t^h + B^h Z_{it-1} \varepsilon_t^{MP} + \Gamma^h Z_{it-1} + u_{it}^h$$



③ Firms with more rigid prices have higher markups

	log(Markup)		
Price adjustment frequency	-0.499	-0.347	-0.069
	(0.003)	(0.004)	(0.008)
Implied price duration	0.080	0.054	0.015
	(0.001)	(0.001)	(0.001)
Two-digit industry FE	N	Y	N
Four-digit industry FE	N	N	Y

Separate regressions of log markups on price adjustment frequency and implied price duration from 2005 until 2011. Robust standard errors in parentheses.

Robustness

- Monetary policy shocks
  - Alternative future prices ▷
  - News/information component ▷
  - Unconventional MP ▷
- Great Recession
- LP-IV, additional control variables
- Firm-level data treatment ▷

Implication for aggregate productivity

Aggregate TFP, computed as model-consistent Solow residual in NK models (*monopolistic competition & Dixit–Stiglitz*), yields

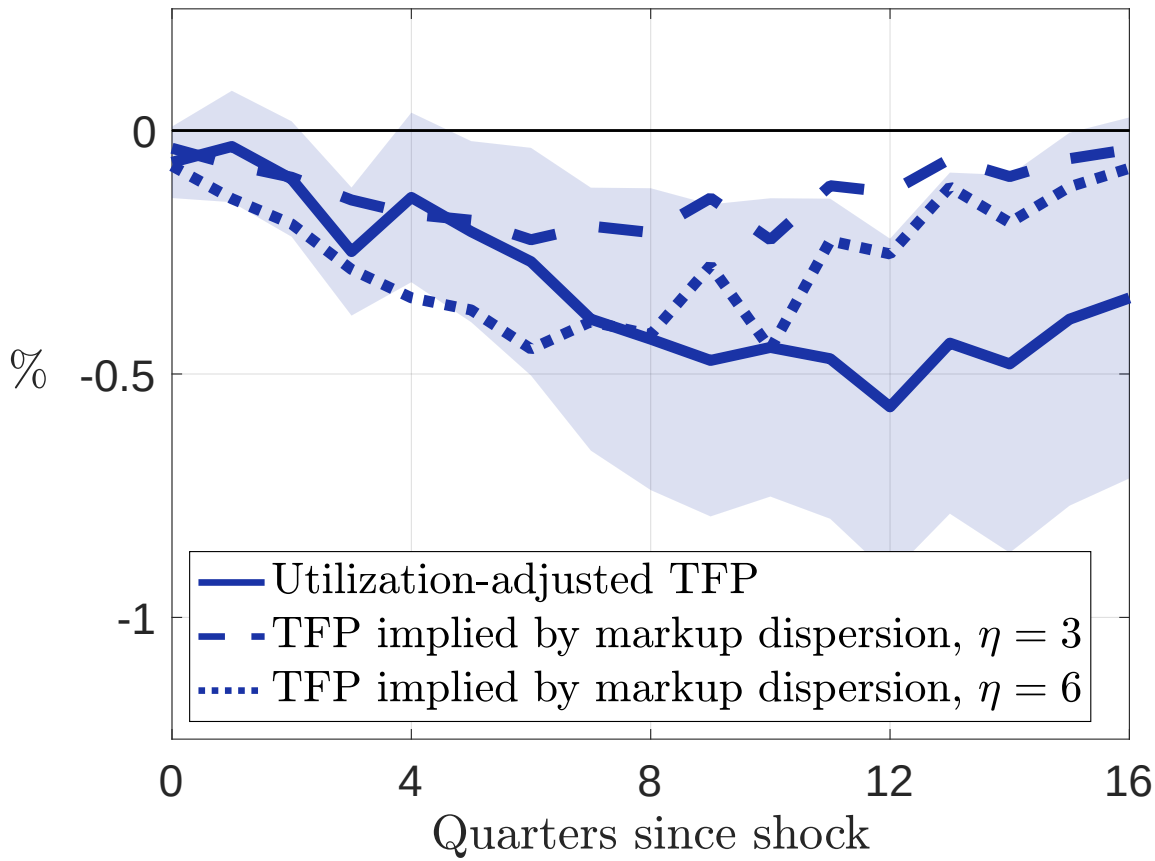
$$\Delta \log \text{TFP}_t = -\frac{\eta}{2}\Delta \mathbb{V}_t(\log \mu_{it}) + \Big[\Delta \text{ exogenous productivity}\Big]$$

Intuition: markup dispersion tightly linked to factor misallocation

Closely related: Hsieh and Klenow (09) and Baqaee and Farhi (20)

- Do MP shocks lower aggregate TFP?
- How much of the response can be explained by higher markup dispersion?

Aggregate TFP response implied by markup dispersion



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Cyclical fluctuations in markup dispersion

Markup: $\mu_{it} \equiv \frac{P_{it}}{X_{it}}$

Pass-through from real marginal costs to price: $\varepsilon_{it} \equiv \frac{\partial \log P_{it}}{\partial \log X_t}$

Proposition

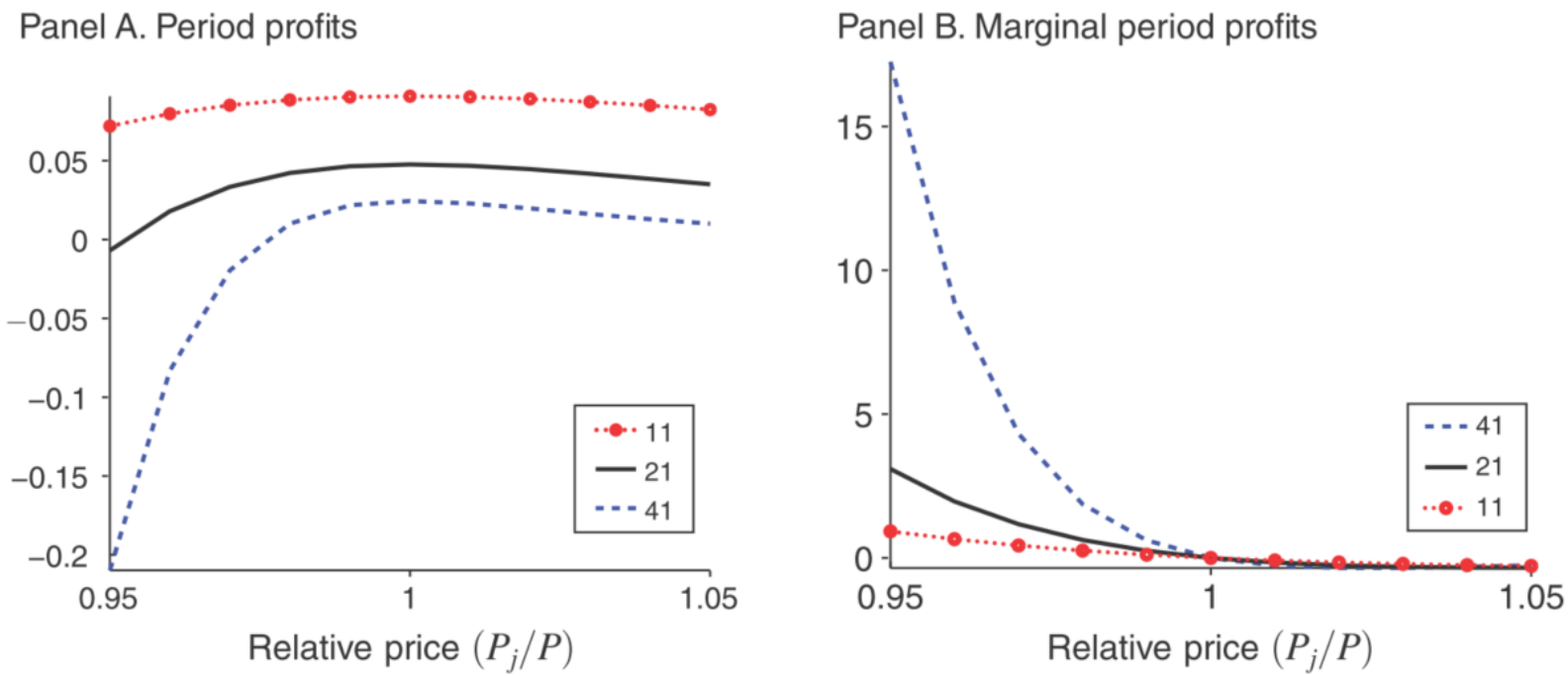
If $\text{Corr}_t(\log \mu_{it}, \varepsilon_{it}) < 0$, then markup dispersion decreases in real marginal costs

$$\frac{\partial \mathbb{V}_t[\log \mu_{it}]}{\partial \log X_t} < 0.$$

$\rightarrow$ MP shocks that lower marginal cost raise markup dispersion

What explains $\text{Corr}_t(\log \mu_{it}, \varepsilon_{it}) < 0$?

- We focus on the role of heterogeneous price stickiness
- Firms with stickier prices have a stronger precautionary motive to raise prices, and thus markups



Source: Fernández-Villaverde, Guerrón-Quintana, Kuester, Rubio-Ramírez (15)

Markups and the severity of price-setting frictions

Calvo price setting

- Firms with lower reset probability optimally set higher markups, as long as a (weak) condition on the covariance matrix of aggregate demand, price, and marginal costs is satisfied

Staggered price setting: similar to Calvo

Rotemberg quadratic price adjustment costs

- Firms with higher cost parameter optimally set higher markups, again under a (weak) parameter condition.

Menu costs

- Numerically, firms with higher menu cost parameter set higher markups

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New Keynesian model with heterogeneous price rigidity

Parsimonious NK model with heter. price rigidity Carvalho (06)

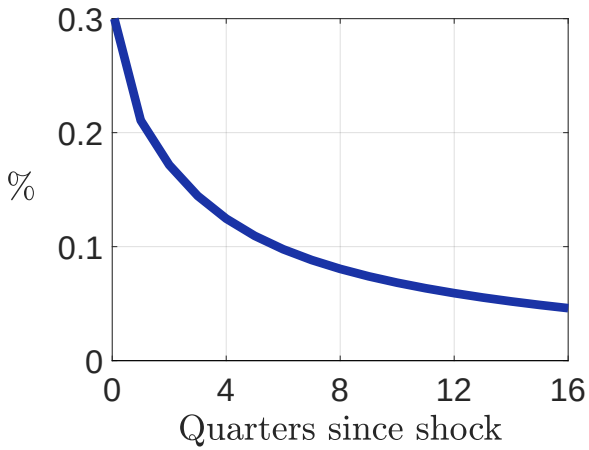
- Price rigidity calibrated to cross-firm differences in price adjustment frequency in Gorodnichenko and Weber (16) ▸ more
- Frisch elasticity calibrated to match ∼50% contribution of employment response to GDP response ▸ more

Model solution

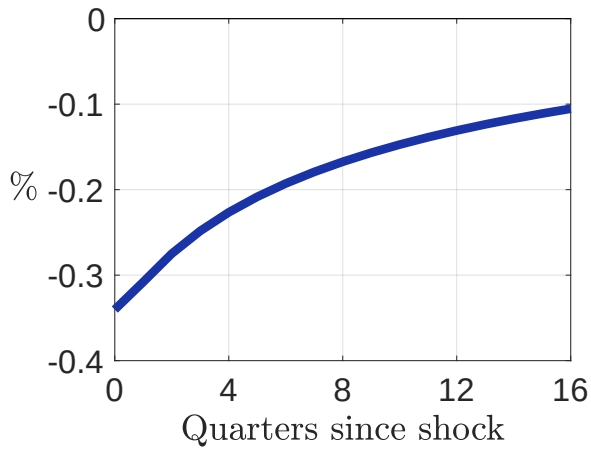
- Solve for linear approximation around the stochastic steady state
- Firms in the stickiest quintile set 6.3% higher markup than firms in the most flexible quintile

MP shock in the model

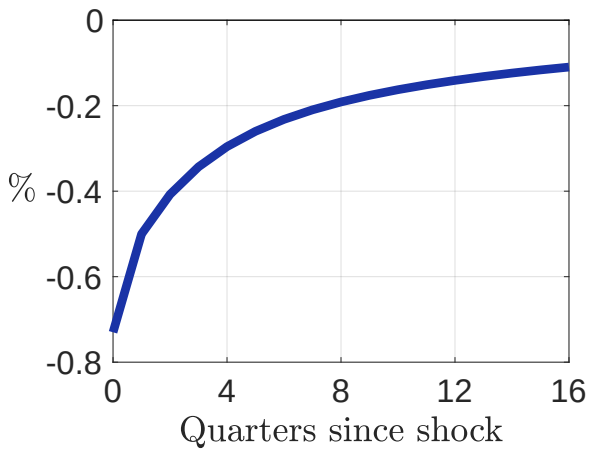
Nominal rate



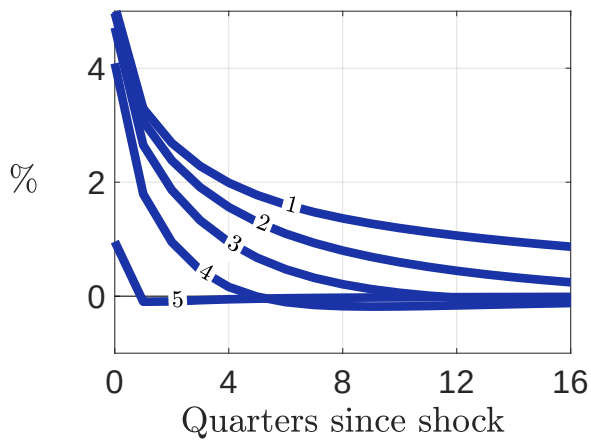
Aggregate TFP



GDP



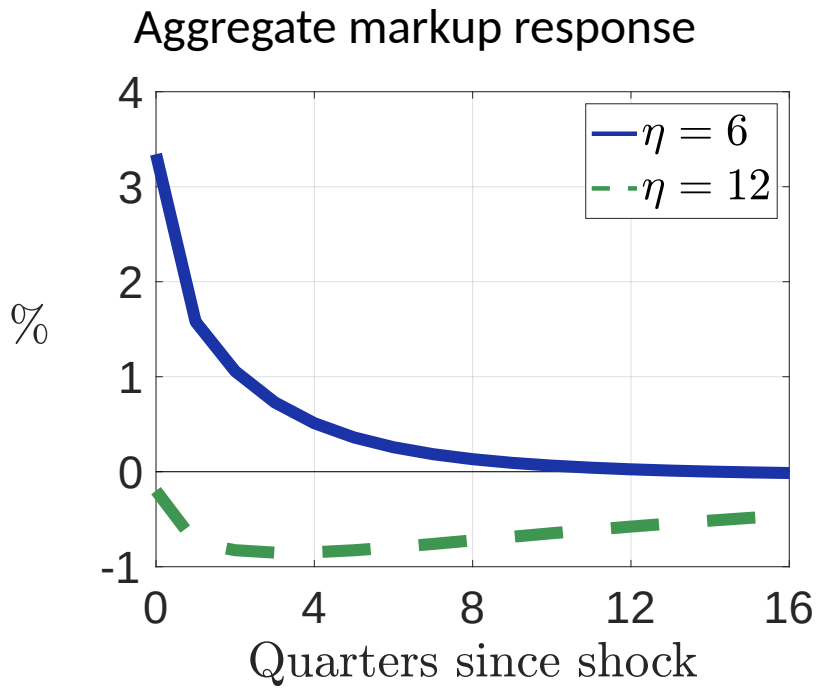
Average markups



Aggregate markup response to MP shocks

Longstanding debate: how do (aggregate) markups fluctuate over the cycle? e.g., Gali/Gertler/Lopez-Salido (07), Nekarda/Ramey (19)

Aggregate markup in the model, TFP_t/X_t, may fall after MP shock

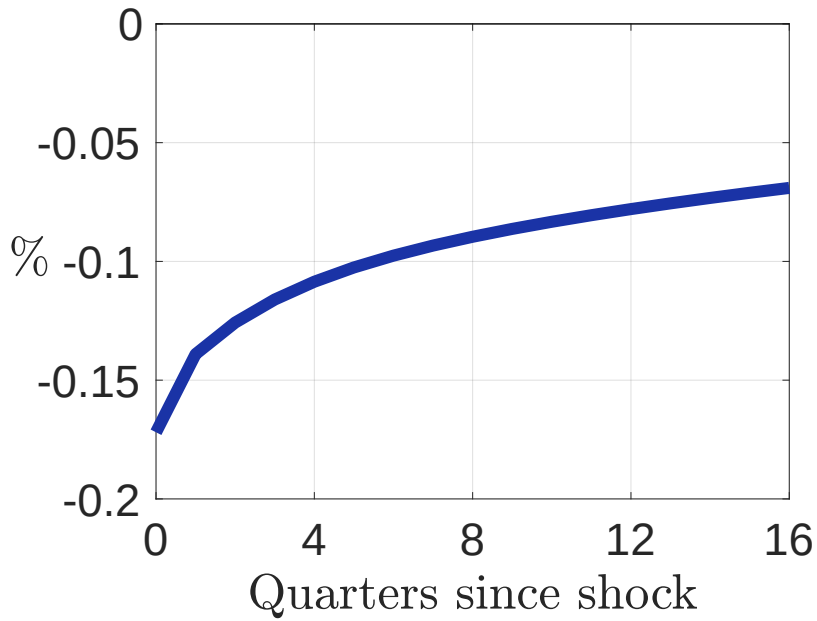


Phantom fluctuations in output gap

Output gap responds to technology shocks, not to MP shocks

If CB mistakes an endogeneous TFP fluctuation as technology shock:

GDP response (counterfactual output gap) – GDP response (baseline)



▸ technology shock

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Main contributions

New empirical evidence

1. MP shocks increase the markup dispersion across firms
   $\hookrightarrow$ can account for large aggregate TFP loss
2. MP shocks increase the relative markup of sticky firms
3. Firms with stickier prices have higher markups

Analytical/quantitative results

- Key moment: correlation between pass-through and markup
- Precautionary price setting generates negative correlation
- Calibrated simple NK model to study quantitative bite, aggregate markups, and policy counterfactuals