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), ...
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 \( \text{higher markup dispersion} \)

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

Facts \( \text{(1) – (3)} \) 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

Markups can be estimated as

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

- 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.

Meier and Reinelt (Mannheim): Monetary Policy, Markup Dispersion, and Aggregate TFP
Markups of rigid-price firms increase by more

\[ y_{it+h} - y_{it-1} = \alpha^h_t + B^h Z_{it-1} \epsilon^\text{MP}_t + \Gamma^h Z_{it-1} + u^h_{it} \]
## Empirical evidence

### Firms with more rigid prices have higher markups

<table>
<thead>
<tr>
<th></th>
<th>log(Markup)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price adjustment frequency</td>
<td>-0.499</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
</tr>
<tr>
<td>Implied price duration</td>
<td>0.080</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
</tr>
<tr>
<td>Two-digit industry FE</td>
<td>N</td>
</tr>
<tr>
<td>Four-digit industry FE</td>
<td>N</td>
</tr>
</tbody>
</table>

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

\[
\Delta \log TFP_t = -\frac{\eta}{2} \Delta V_t(\log \mu_{it}) + \left[ \Delta \text{ exogenous productivity} \right]
\]

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

![Chart showing Aggregate TFP response implied by markup dispersion.](chart.png)
Introduction

Empirical evidence

**Analytical results**

Quantitative results

Conclusion
Cyclical fluctuations in markup dispersion

Markup: \( \mu_{it} \equiv \frac{P_{it}}{X_{it}} \)

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

Proposition

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

\[
\frac{\partial V_t[\log \mu_{it}]}{\partial \log X_t} < 0.
\]

→ 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, Kuster, 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.
Introduction

Empirical evidence

Analytical results

Quantitative results

Conclusion
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)
- Frisch elasticity calibrated to match $\sim 50\%$ contribution of employment response to GDP response

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
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, $\frac{TFP_t}{X_t}$, may fall after MP shock.

Meier and Reinelt (Mannheim): Monetary Policy, Markup Dispersion, and Aggregate TFP
Phantom fluctuations in output gap

Output gap responds to technology shocks, not to MP shocks

If CB mistakes an endogenous TFP fluctuation as technology shock:

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

Empirical evidence

Analytical results

Quantitative results

Conclusion
Main contributions

New empirical evidence

1. MP shocks increase the markup dispersion across firms
   → 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