Market Position and Aggregate Price Dynamics

YSEM

Feb. 16, 2024

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Firm Heterogeneity and Pricing Behavior

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  - This affects their demand schedule and pricing behavior
  - Does this affect aggregate price dynamics?

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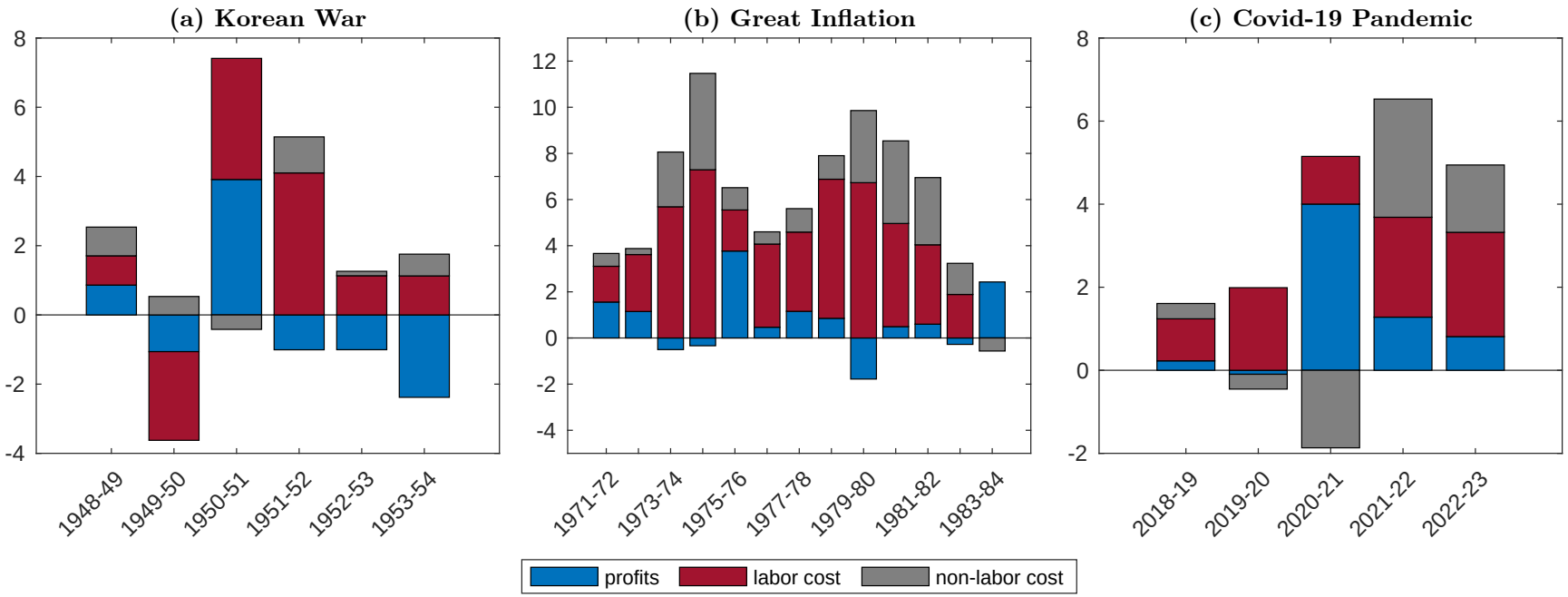
- Many indications leading firms have growing advantage over rivals
  - These firms tend to be efficient, which is good
  - If markets become uncompetitive, then problematic
- Markup dispersion implies households allocate income inefficiently
  - If firms respond differently to shocks, then dispersion may increase/decrease

Comparison of Inflation Episodes

Figure: Contribution to Domestic Price Growth (% YoY)



Source: NIPA Table 1.15

This Paper

- Solves a New Keynesian model where market position influences pricing behavior
  - It adds strategic interaction between firms of different sizes
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  - It adds strategic interaction between firms of different sizes
  - Firms have different sensitivity to shocks
- Establishes a relation between aggregate price dynamics and market concentration
- Evaluates how shocks affect firms of different sizes and the allocative efficiency of the economy
  - Shows strategic complementarity can explain ‘excess’ profits when shocks are firm-specific
  - Helps quantify the output losses from strategic behavior

Contribution to the Literature

- Dynamic oligopoly
  - **Wang and Werning (2022)**: solves for oligopolistic NKPC
  - **Heise et al. (2022)**: relates deflation to import competition and rising concentration
  - **This paper**: concerned with asymmetry between firms and heterogeneity of shocks

- Estimates of cost pass-through
  - **Gödl-Hanisch and Menkhoff (2023)**: pass-through for idiosyncratic 40% lower than aggregate shocks
  - **Bräuning, Fillat, and Joaquim (2022)**: more concentrated industries had a higher pass-through following the Covid shock
  - **Franzoni, Giannetti, and Tubaldi (2023)**: small firms more affected by supply chain backlogs and leading firms increased their markups
  - **This paper**: helps explain these empirical observations

Outline

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What Is the Typical Market Structure?

Fact 1: A Few Firms Control Most Market Share in an Industry

- In both Europe and the US, an HHI over 2000 seems typical for an industry
- A value of 2500 is considered "highly concentrated"
- Benkard et al. (2021) finds 44% of local product markets in the US have an HHI over 2500, based on consumer survey data
- Top two firms usually control around 60% of market share within narrowly defined markets (both EU and US)

Fact 2: Leading Firm in an Industry Has a Large Advantage

- Typically controls 1.5x-2x the market share of the nearest rival
- Hottman et al. (2016) finds the leader's markup is 24% to 100% higher than the sector average (depending on approach)

Evidence on Firm Pricing Behavior

Fact 3: Large Firms Limit Pass-Through of Cost Shocks

- There is strong empirical evidence for this, but most papers are from the trade literature: e.g. Berman et al. (2012), Auer and Schoenle (2016), Amiti et al. (2019)
- Estimates suggest large firms pass through 50-60% of cost shocks, small firms have full pass-through

Fact 4: Large Firms Are Strategic

- Amiti et al. (2019) suggests large firms match around 50% of price increases by rival firms
- Small firms do not appear strategic (ibid.)
- Rival prices typically a top response on research surveys looking at motivation for price changes

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Model Ingredients

- Nested-CES demand system
  - Economy has many industries
  - A small number of firms compete within an industry
  - Each industry has a dominant firm (‘market leader’)
  - Productivity wedge explains differences in firms size
- Firm-specific marginal cost shocks
- Strategic interactions between firms
- Other elements of the model are standard, follow the NK template

Nested-CES Demand System

Output combines goods and varieties of a good

$$(i) \quad Y_t = \left[\int_0^1 y_{jt}^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\sigma}{\sigma-1}} \quad \text{where} \quad (ii) \quad y_{jt} = \left[\sum_{i=1}^{n} y_{ijt}^{\frac{\varphi-1}{\varphi}} \right]^{\frac{\varphi}{\varphi-1}}$$

The corresponding price indices are

$$(i) \quad P_t = \left[\int_0^1 P_{jt}^{1-\sigma} dj \right]^{\frac{1}{1-\sigma}} \quad \text{where} \quad (ii) \quad P_{jt} = \left[\sum_{i=1}^{n} P_{ijt}^{1-\varphi} \right]^{\frac{1}{1-\varphi}}$$

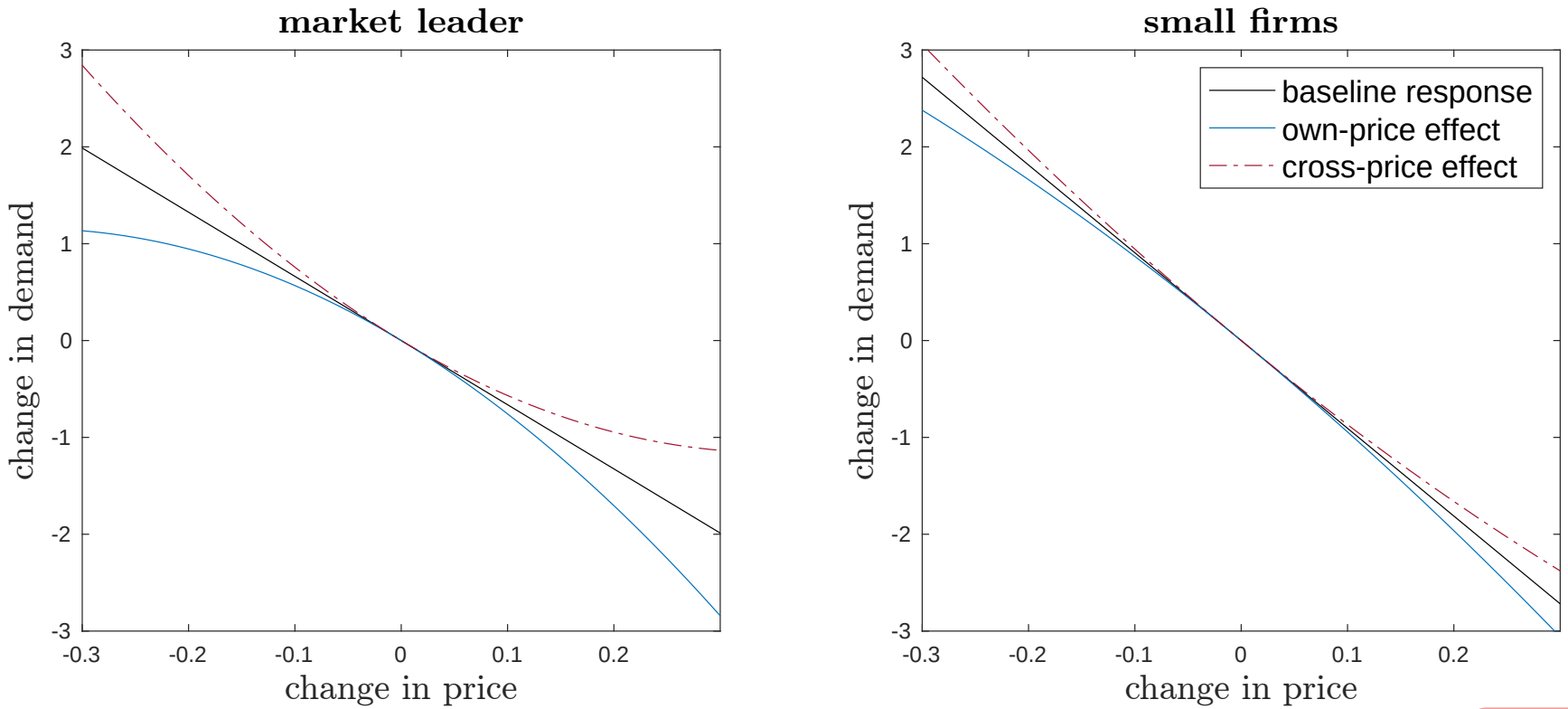
The price elasticity of demand is

$$\Psi_{ijt} \equiv \frac{\partial \log(y_{ijt})}{\partial \log(p_{ijt})} = (\varphi - \sigma) x_{ijt} - \varphi \quad \text{where} \quad x_{ijt} = \left(\frac{p_{ijt}}{p_{jt}} \right)^{1-\varphi}$$

Nested-CES Demand and Firm Size

- Market share of each firm is a function of:
  - Number of firms in the industry
  - Relative productivity

Figure: Price Elasticity of Demand for Large and Small Firms



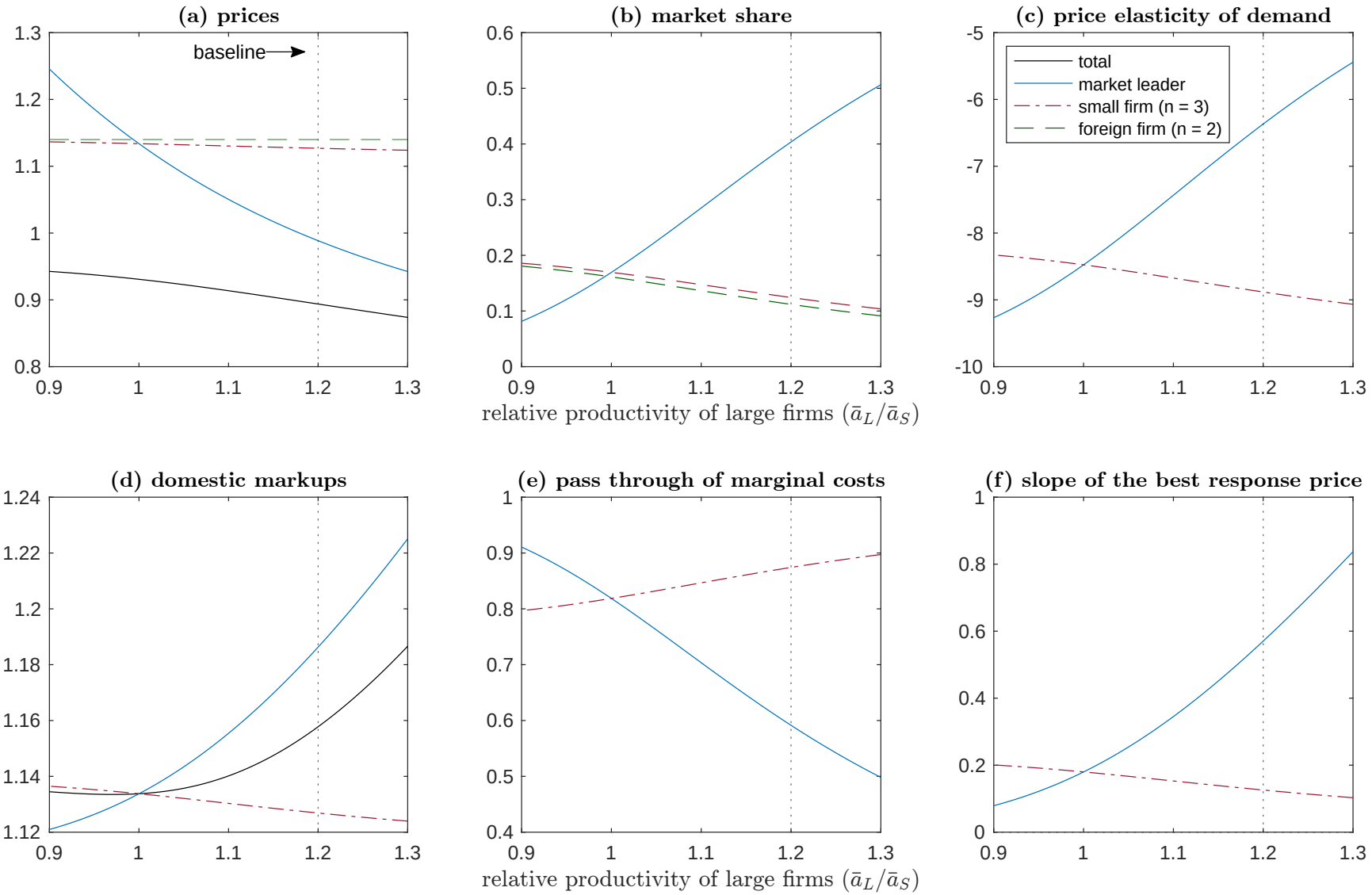
Specification

Parameterization

Table: Baseline Parameter Values

Parameter	Value	Description
β	0.99	Household time discount
$1-\alpha$	0.70	Labor returns to scale
σ	1	Elasticity of substitution across goods
φ	10	Elasticity of substitution across varieties
Θ	125	Rotemberg price adjustment costs
ϕ_π	1.50	Monetary policy inflation reaction
ϕ_y	0.125	Monetary policy output gap reaction
n_L	1	Number of large firms in an industry
n_S	3	Number of small firms in an industry
n_F	2	Number of foreign firms in an industry
$\bar{a}_L/\bar{a}_S$	1.2	Relative productivity of large firms
p_F	1.14	Price of foreign imports (steady state)

Flexible Price Equilibrium (Steady State)



Dynamic Problem with Sticky Prices

- Rotemberg price adjustment costs

$$\frac{\Theta_s}{2}\left(\frac{P^i_{st}}{P^i_{st-1}}-1\right)^2 Y_t \quad \text{where} \quad \Theta_s = x_s\Theta$$

- Adjustment costs (Θ_s) are firm-specific, reflecting market share
- Each firm's objective becomes

$$\mathcal{L} = \mathbb{E}_t \sum_{k=0}^{\infty} \Lambda_{t+k}\left[(p_{st+k}-\mathcal{C}_{st+k})\, y_{st+k} - \frac{\Theta_s}{2}\left(\pi_{t+k}\frac{p_{st+k}}{p_{st+k-1}}-1\right)^2 P_{t+k}\, Y_{t+k}\right]$$

- Stochastic discounting follows from the household Euler equation

$$\Lambda_{t+k} = \beta^k \frac{P_t}{P_{t+k}}\frac{C_t}{C_{t+k}}$$

Solution

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Calibrated Model and Targets

- $\Theta = 125$ implies an average price duration of 8.6 months

Table: Industry-Level Targets

Description	Large firms Target	Large firms Value	Small firms Target	Small firms Value	Source
Targeted					
Market share	0.40	0.40	0.15	0.13	Affeldt et al. (2018)
Pass-through	0.50	0.58	0.80	0.87	Amiti et al. (2019)
Slope of best response price	0.60	0.58	0.12	0.10	Ibid.
Markup ($\mu - 1$)	0.24	0.19	0.16	0.13	Hottman et al. (2016)

Table: Aggregate Targets

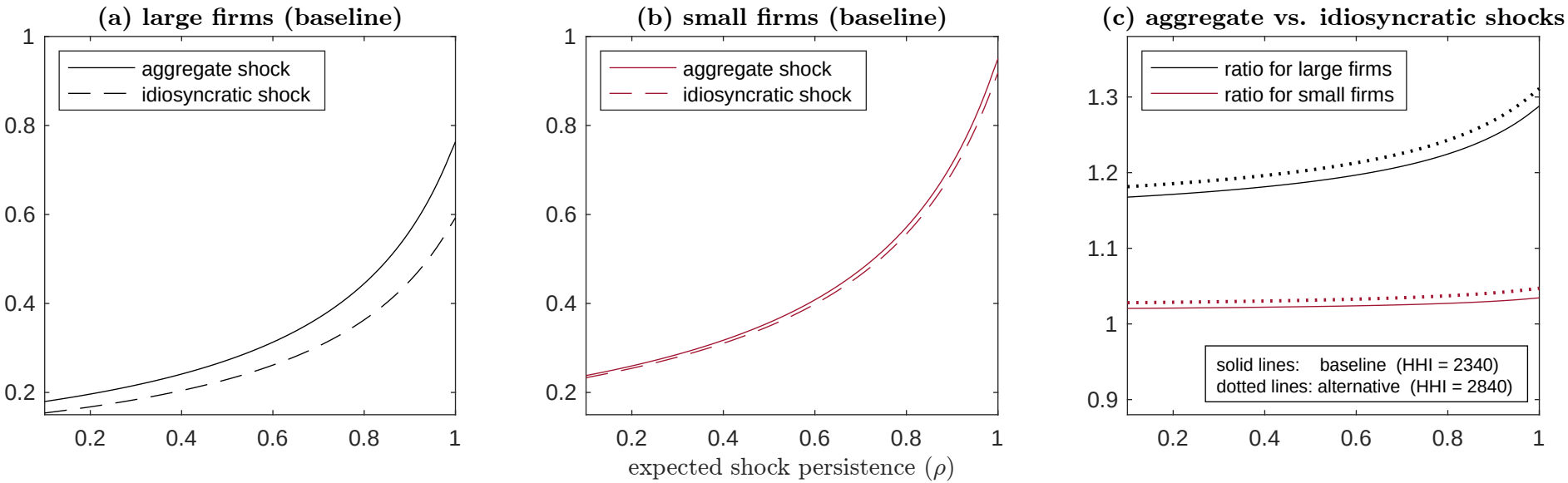
Description	Target (range)	Value	Source
Targeted			
Median industry HHI (incl. foreign firms)	2045 - 2360	2340	Benkard et al. (2021)
Aggregate markup ($\mu - 1$)	0.13 - 0.16	0.16	IRS SOI
Import penetration in manufacturing	0.19 - 0.23	0.21	Hale et al. (2019)
Slope of the Phillips curve	0.20 - 0.33	0.23	Tetlow (2022)
Implied			
Price dispersion (std. dev.)	–	0.07	–
Markup dispersion (std. dev.)	–	0.03	–

NKPC

Pass-Through of Marginal Costs

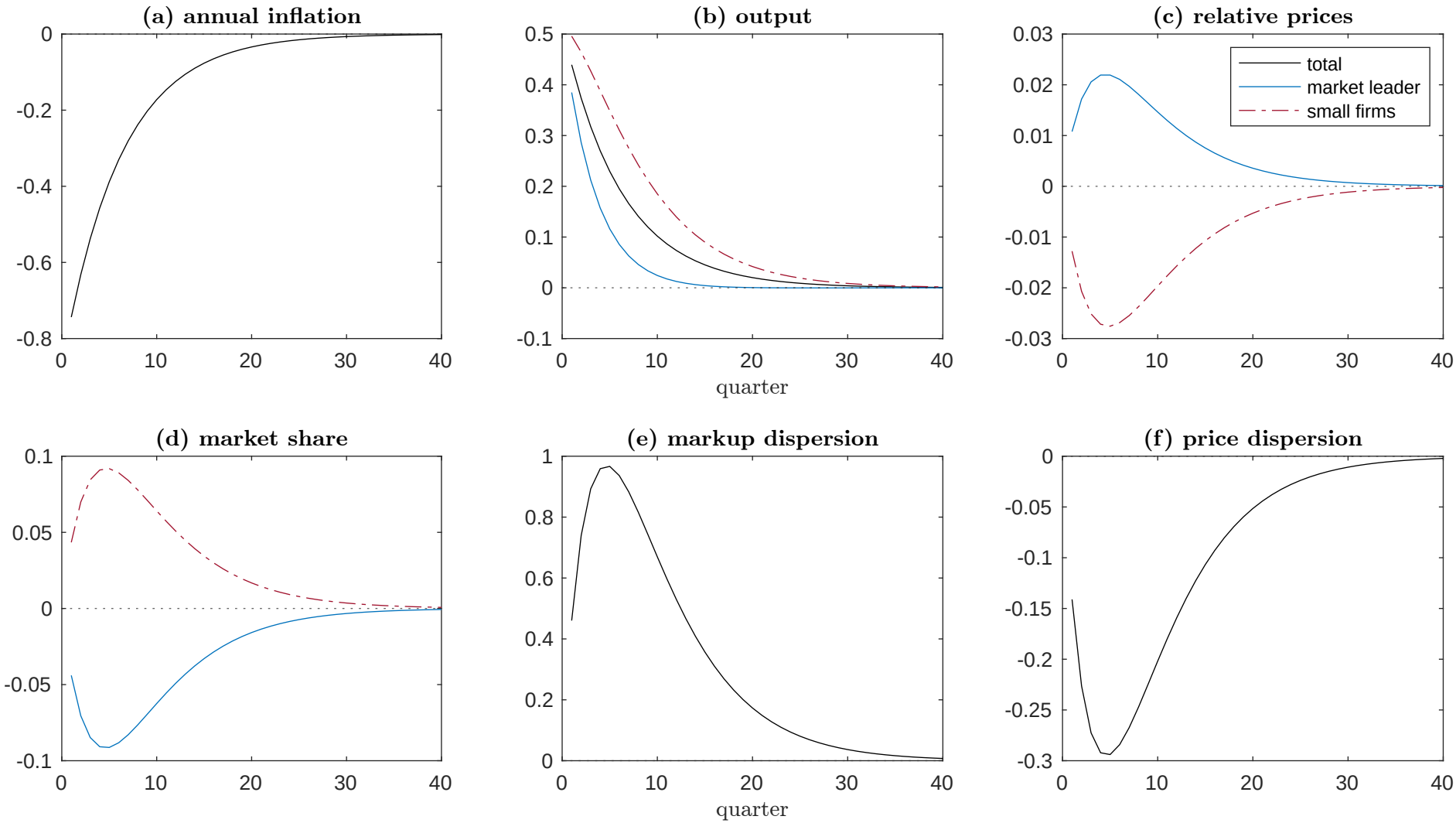
- The model implies a link between the expected persistence of shocks and the pass-through of marginal costs
- The presence of strategic complementarity leads large firms to raise their pass-through when shocks are sector-wide or aggregate

Figure: Pass-Through of Cost Shocks



Response to a Productivity Shock

Figure: Response to a 1% Aggregate Productivity Shock (% dev.)



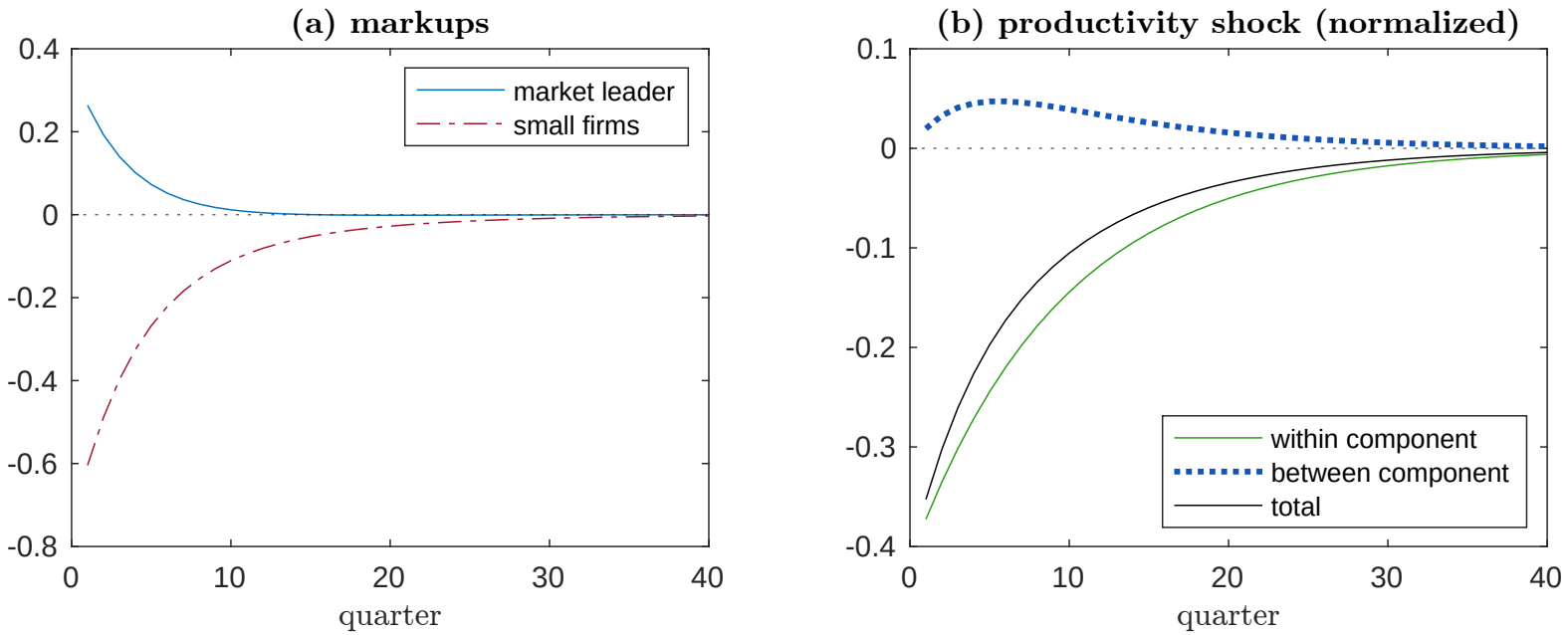
Discussion of Results

- Small firms are more sensitive to the business cycle
  - Consistent with Crouzet and Mehrotra (2020), which finds business cycle fluctuations are around 25 percent larger for small firms
  - The model implies a difference of 35 percent
- There is a positive association between inflation and price dispersion
  - Sheremirov (2020) finds a 1 percentage point increase in inflation results in a 0.026 log point increase in price dispersion
  - The model returns 0.028 using the same measure
    - Sheremirov uses retail data, while model captures producer prices
  - Standard New Keynesian model with price staggering generates much higher level of price dispersion

Firm-Specific Shocks

- A negative productivity shock captures the effect of higher marginal costs for small firms

Figure: Negative 1% Productivity Shock to Small Firms (% dev.)



IRFs

Discussion of Results

- Large firms are more efficient, so the allocation of market share affects aggregate TFP
  - Change in market share is small following aggregate shocks
  - Firm-specific shocks lead to greater reallocation
- Given a shock to small firms, what is the extra 'cost' imposed by strategic behavior?
  - Cumulative productivity loss is 3.2pp of potential output in the baseline where strategic complementarity is present
  - If firms are not strategic, the loss is 2.6pp
  - The difference – 0.6pp – is the cost imposed by strategic behavior
- Strategic behavior makes the initial shock around 25% worse and leads to 'excess' profits

Demand Shock

Adding Competition from Imports

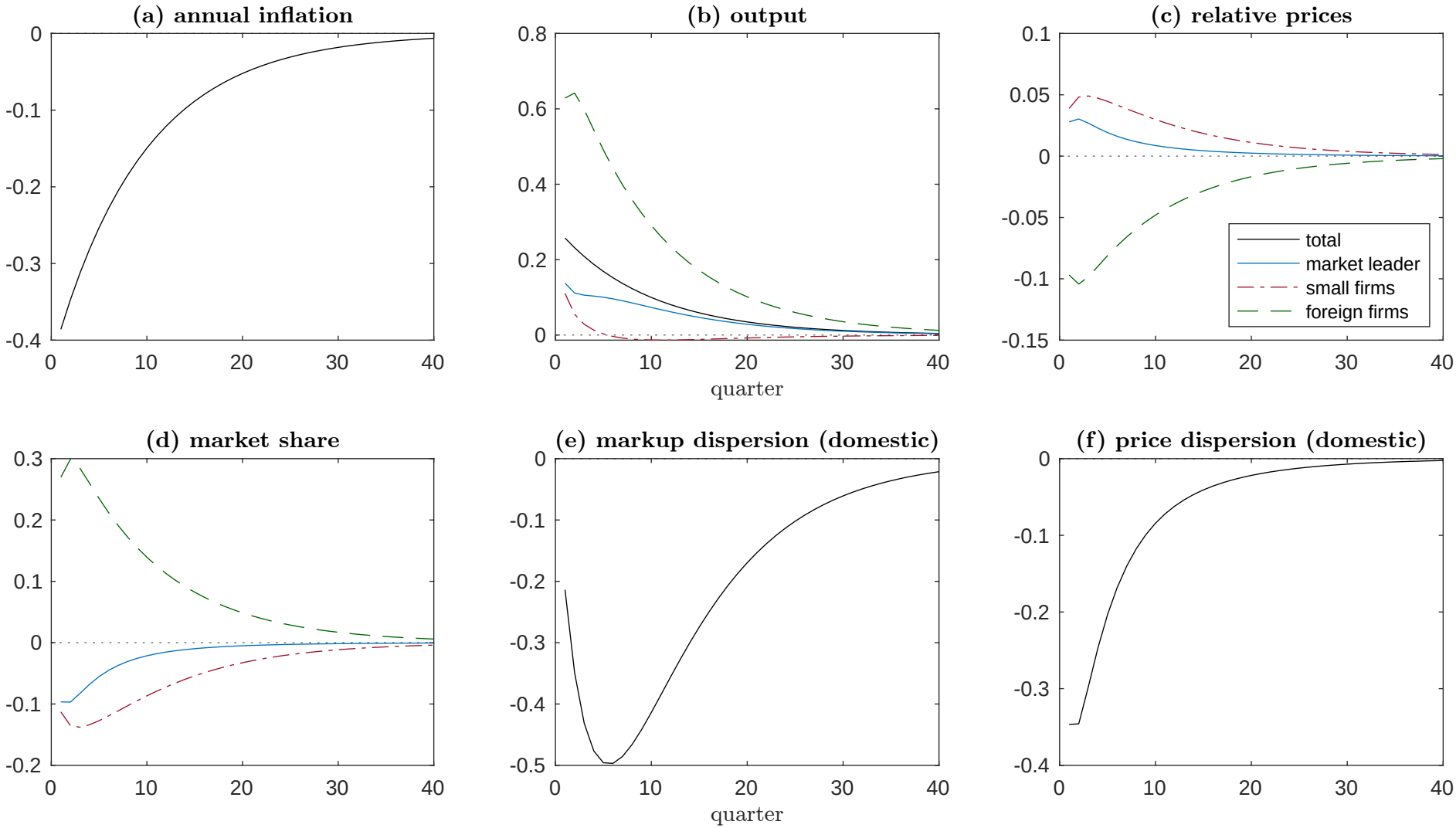
- Import penetration in the U.S. has risen and is now around 35% in the manufacturing sector
- Simple to add imported varieties to the industry structure
- I assume balanced trade
- The industry price is given by

$$p_{jt} = \left[\underbrace{(p_{sjt}^{i})^{1-\varphi}}_{\text{own price}} + \underbrace{(n_s - 1)(p_{sjt}^{-i})^{1-\varphi} + n_{-s}(p_{-sjt}^{-i})^{1-\varphi}}_{\text{rival prices}} + \underbrace{n_F(p_{Fjt})^{1-\varphi}}_{\text{imports}} \right]^{\frac{1}{1-\varphi}}$$

- Lower import prices act like a productivity shock
  - Lower prices raise demand
- Small firms are more sensitive to import shocks

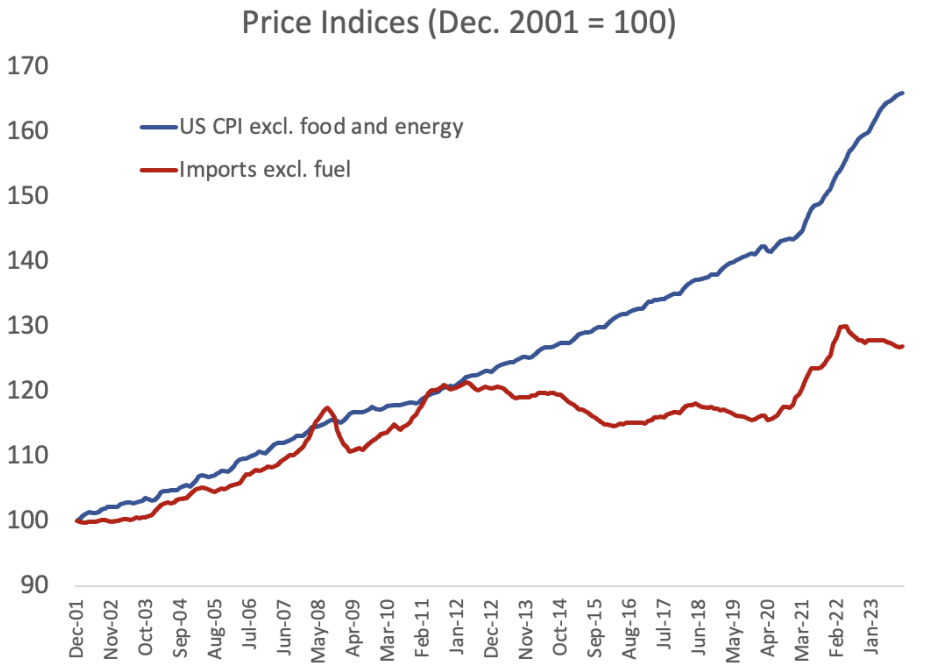
Import Price Shock

Figure: Response to a Negative 1% Import Price Shock (% dev.)

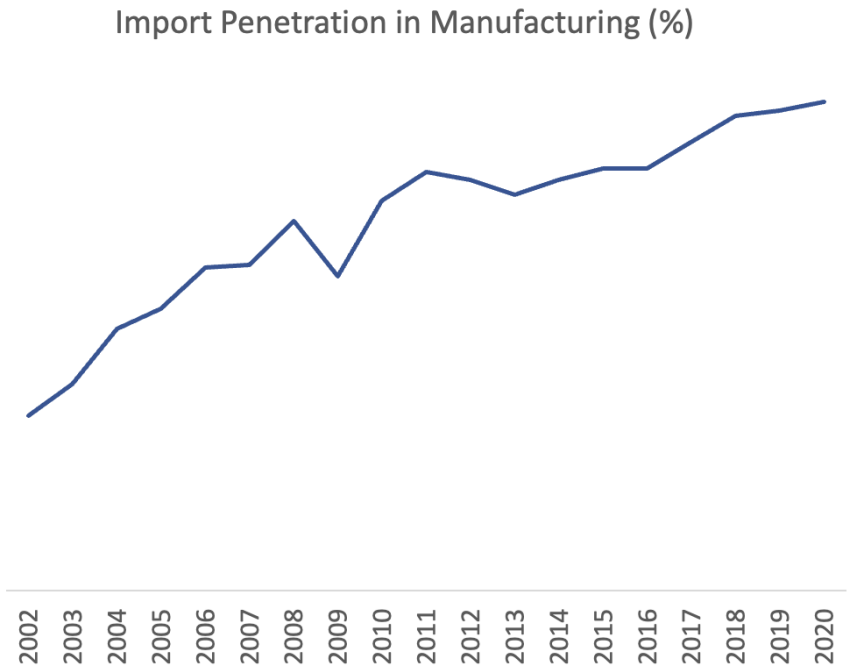


Divergence of Import and Domestic Prices

Figure: Import Prices and Market Penetration in the US



Source: BLS



Source: US Census Bureau and the US ITC

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Main Takeaways

- The 'aggregate' nature of shocks is highly relevant to price dynamics
  - Strategic behavior leads to 'jumps' in the pass-through
  - These jumps get stronger as concentration increases
  - The expected persistence of shocks also relevant
- The reallocation of demand across firms following shocks affects aggregate efficiency
  - Strategic behavior amplifies the losses when shocks are firm specific
- Optimal monetary policy puts more weight on small firms
  - When competitive pressures weaken, market leaders raise prices
  - Not just a long-term concern, short-term dynamics matter!
- Import price shocks have large effects and are amplified through price competition

Thank You!
Questions/Comments?

Working version is available at gregauclair.com

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N-CES Price Index with Asymmetric Firms

$$p_{jt} = \left[\underbrace{(p^{i}_{sjt})^{1-\varphi}}_{\text{own price}} + \underbrace{(n_s - 1)(p^{-i}_{sjt})^{1-\varphi} + n_{-s}(p^{-i}_{-sjt})^{1-\varphi}}_{\text{rival prices}} \right]^{\frac{1}{1-\varphi}}$$

- Here $s \in \{L, S\}$ and i is the firm making the pricing decision
- The own-price superelasticity is

$$\Psi^{i,i}_{st} \equiv \frac{\partial \Psi^{i}_{st}}{\partial \log(p^{i}_{st})}$$

- The cross-price superelasticity is

$$\Psi^{i,-i}_{st} \equiv \frac{\partial \Psi^{i}_{st}}{\partial \log(p^{-i}_{st})}$$

- The pass-through (best-response price) is a function of the firms own-price (cross-price) superelasticity

Back

Solution Method

- The optimal solution to the firm's problem is log-linearized
- The resulting decision rule is given by

$$\tilde{p}^{i}_{st} = \Gamma_s \tilde{p}^{i}_{st-1} + (1 + \Gamma'_s)\widetilde{c}^{i}_{st} + \Gamma^*_s \tilde{p}^{-i}_{-st} + \widehat{\Gamma}_s \tilde{\pi}_t \quad (1)$$

$$\tilde{p}^{-i}_{-st} = \Gamma_{-s} \tilde{p}^{-i}_{-st-1} + (1 + \Gamma'_{-s})\widetilde{c}^{-i}_{-st} + \Gamma^*_{-s} \tilde{p}^{i}_{st} + \widehat{\Gamma}_{-s} \tilde{\pi}_t \quad (2)$$

- The Γ's collect all time-invariant terms
- Small and large firms know each other's rules (Γ's)
- The full solution incorporates the rival's decision rule

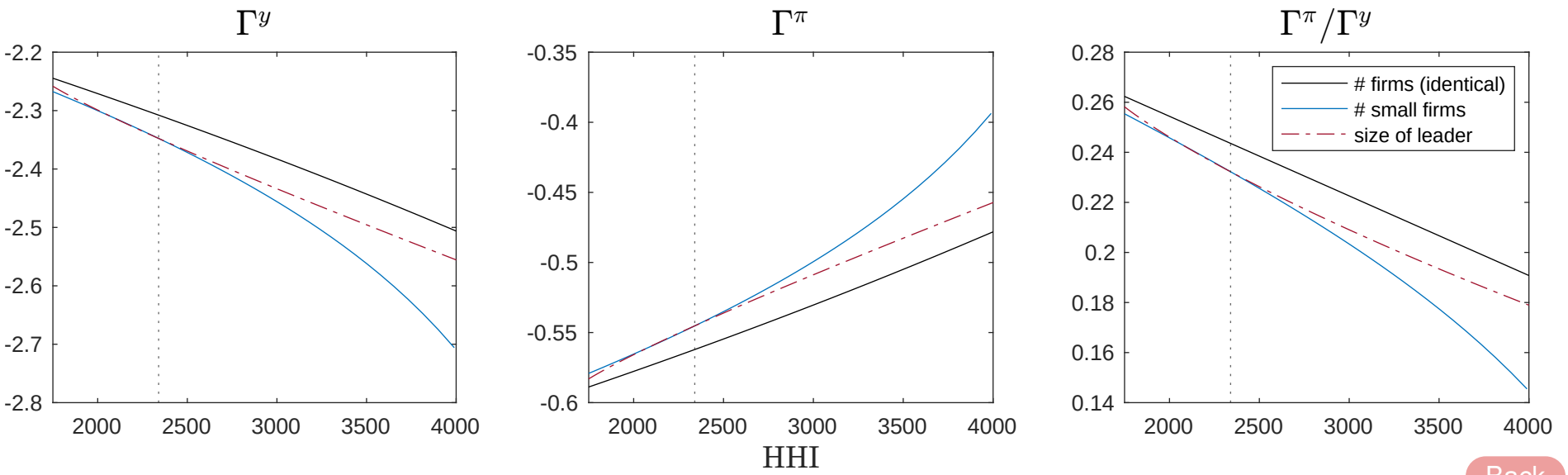
$$\tilde{p}^{i}_{st} = \underbrace{\frac{\Gamma_s}{1 - \Gamma^*_s \Gamma^*_{-s}}}_{\Upsilon_s} \tilde{p}^{i}_{st-1} + \underbrace{\frac{\Gamma^*_s \Gamma_{-s}}{1 - \Gamma^*_s \Gamma^*_{-s}}}_{\Upsilon^*_s} \tilde{p}^{-i}_{-st-1} + \underbrace{\frac{1 + \Gamma'_s}{1 - \Gamma^*_s \Gamma^*_{-s}}}_{\Upsilon'_s} \widetilde{c}^{i}_{st} + \underbrace{\frac{\Gamma^*_s (1 + \Gamma'_{-s})}{1 - \Gamma^*_s \Gamma^*_{-s}}}_{\Upsilon''_s} \widetilde{c}^{-i}_{-st} + \underbrace{\frac{\widehat{\Gamma}_s + \Gamma^*_s \widehat{\Gamma}_{-s}}{1 - \Gamma^*_s \Gamma^*_{-s}}}_{\Upsilon^{\pi}_s} \tilde{\pi}_t$$

Back

Oligopolistic NKPC

- The slope of the Phillips gives the tradeoff between inflation and output
- With higher concentration, inflation becomes less responsive to monetary policy
- Result is consistent with Wang and Werning (2022), but a large increase in HHI needed to explain flattening of the Phillips curve

Figure: Response of Output and Inflation to a Monetary Policy Shock



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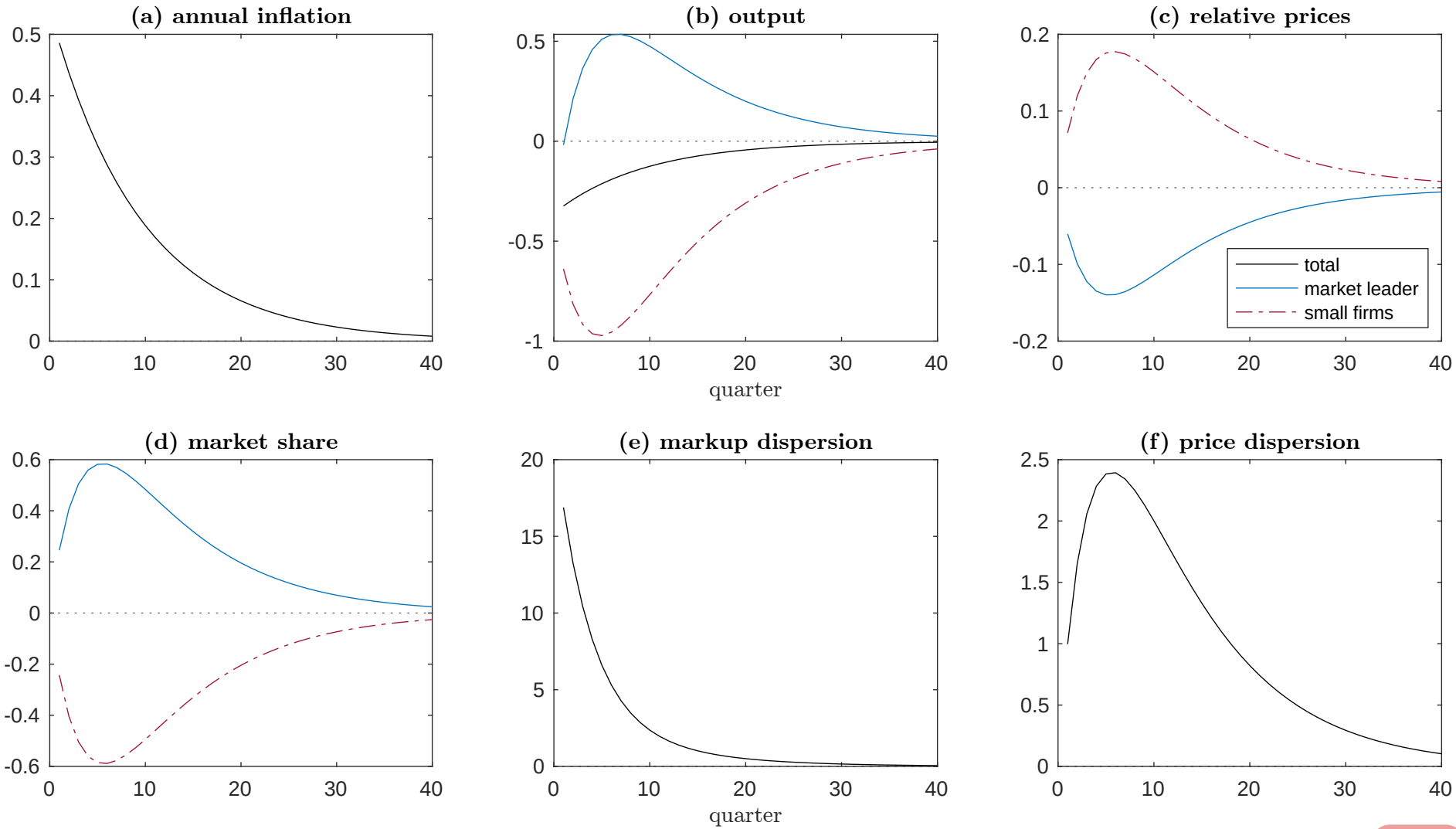
Shock to Small Firms

Figure: Response to a Negative 1% Productivity Shock to Small Firms (% dev.)



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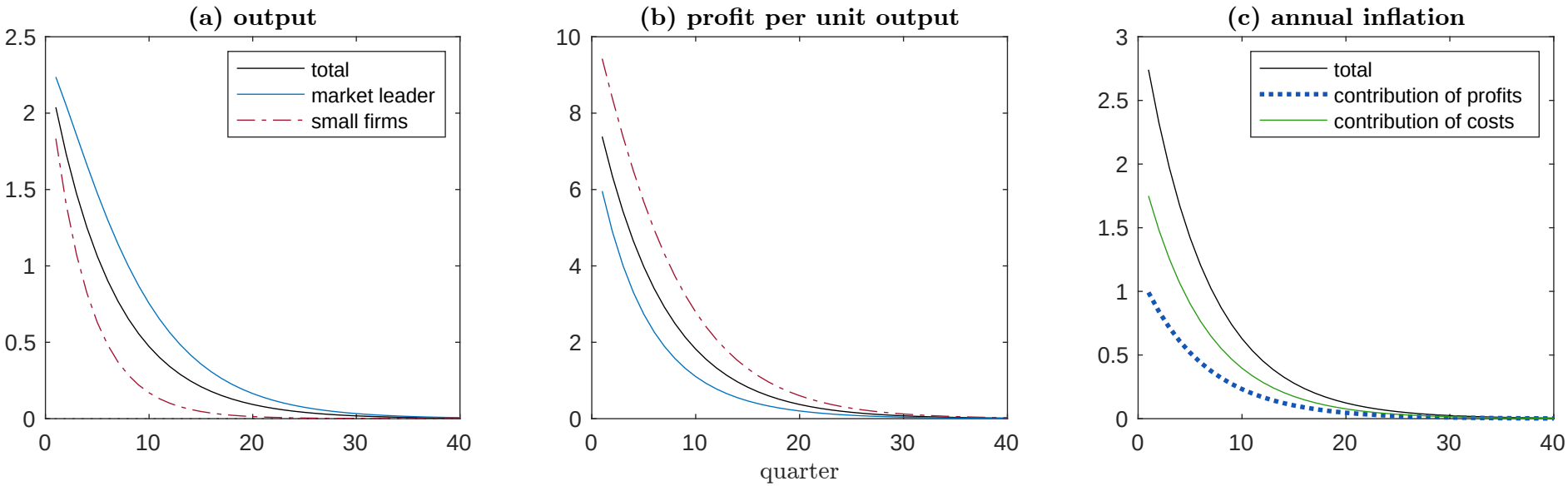
Demand Shock

Figure: Response to a 1.5% Demand Shock (% dev.)



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