Market Power and Macroeconomic Fluctuations

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European Stability Mechanism[1]

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[1] The views expressed here are those of the author and do not necessarily reflect those of the European Stability Mechanism.

Motivation

- Crises do not affect all firms equally
  - Examples: natural disasters, financial crises
- Supply disruptions that affect firms unequally within many industries are jointly referred to as *asymmetric supply shocks*
- This paper investigates the aggregate effects of asymmetric supply shocks
  - Stylized model: analyze transmission & aggregate effects qualitatively
  - Data: document & measure asymmetric supply shocks in firm-level data
  - Quantitative model: quantify aggregate fluctuations due to asymmetric supply shocks

Asymmetric Supply Shocks

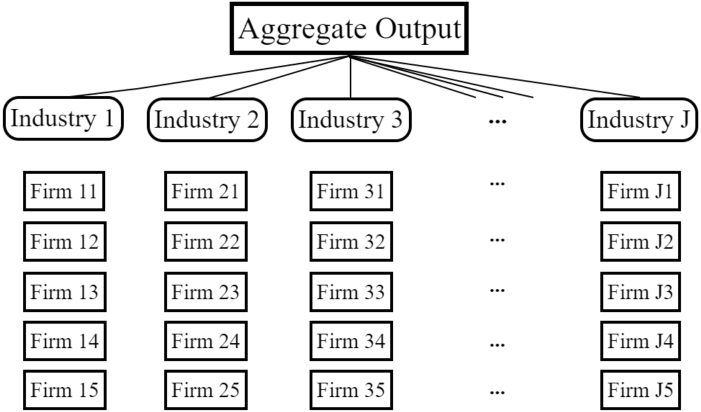
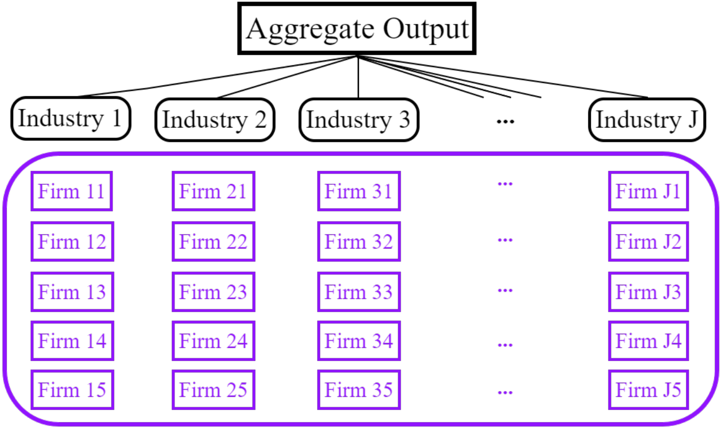


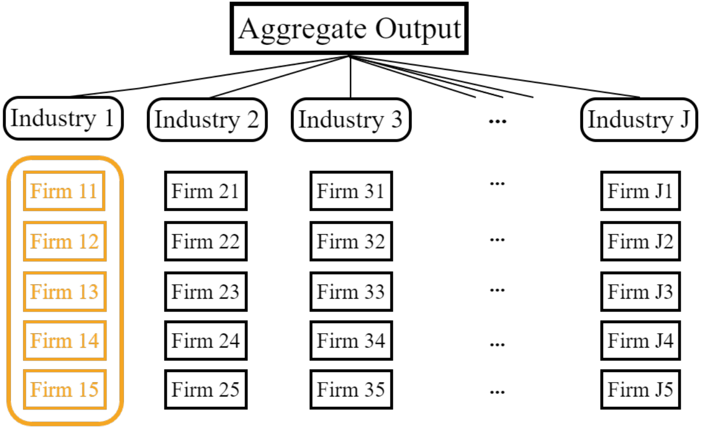
Figure 1: Structure of the Supply Side of the Economy

Asymmetric Supply Shocks



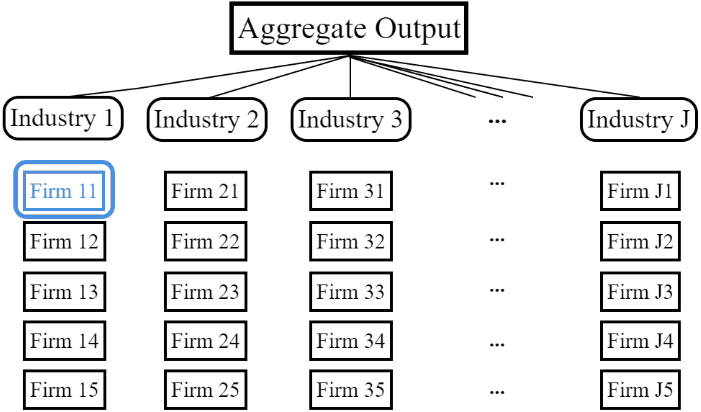
$\rightarrow$ Aggregate (Supply) Shock

Asymmetric Supply Shocks



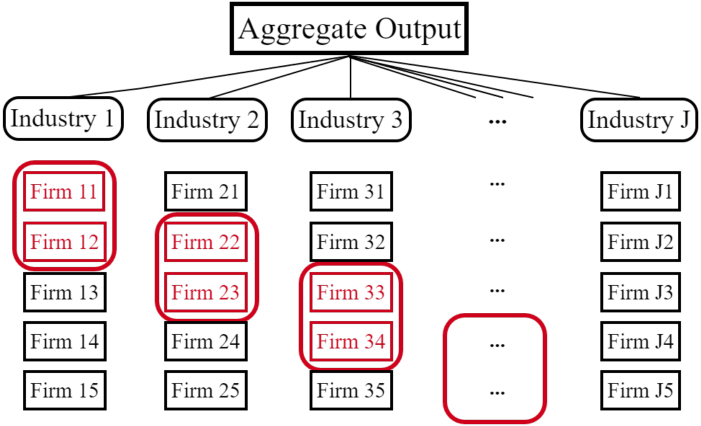
→ Industry-Specific (Supply) Shock

Asymmetric Supply Shocks



→ Firm-Level (Supply) Shock

Asymmetric Supply Shocks



→ Asymmetric Supply Shock

Results Preview

- In a stylized model with imperfect competition and heterogeneous firms, I show that a shock to the productivity of a subset of firms in many industries ...
  - ... affects the decisions of all firms due to strategic competition within industries
  - ... causes fluctuations not only in aggregate productivity but also in the aggregate markup

- In firm-level sales data from Compustat, I show ...
  - ... substantial firm-level volatility in excess of aggregate and industry-specific fluctuations
  - ... this firm-level volatility is still correlated across firms in different industries
  - → In line with the presence of asymmetric supply shocks

- In a calibrated model, asymmetric supply shocks account for close to 30% of fluctuations in aggregate output and around 70% of fluctuations in the labor share
  - A higher intensity of competition reduces the average markup and increases average productivity but also makes the economy more volatile

Literature

- Sources of aggregate fluctuations
  - Aggregate shocks: Kydland & Prescott (1982), Cochrane (1994), Caballero, Engel & Haltiwanger (1997)
  - Sectoral shocks: Long & Plosser (1983), Horvath (1998)
  - Firm-level shocks: Gabaix (2011), Burstein, Carvalho & Grassi (2020)
- Macroeconomic implications of imperfect competition among firms
  - Empirical evidence: De Loecker, Eeckhout & Unger (2020), Covarrubias, Gutiérrez & Philippon (2019), Autor, Dorn, Katz, Patterson & Van Reenen (2020), Burstein, Carvalho & Grassi (2020)
  - Long-run implications: De Loecker, Eeckhout & Mongey (2021), Eggertsson & Mehrotra (2022)
  - Implications for macro fluctuations: Mongey (2021), Wang & Werning (2020), Ferrari & Queirós (2022), Jaimovich & Floetotto (2008), Corhay, Kung & Schmid (2020)
  - Competition policy: Bilbiie, Ghironi & Melitz (2012, 2019), Edmond, Midrigan, Xu (2022), Boar & Midrigan (2022)
- Aggregate implications of firm heterogeneity
  - Khan & Thomas (2008), Bachmann, Caballero & Engel (2013), Khan, Senga & Thomas (2016), Ottonello & Winberry (2020), Koby & Wolf (2020), Winberry (2021)

Model

Model Overview

- Three-layer production structure (Atkeson & Burstein, 2008)
  - Representative producer of the final consumption good
  - Large number of industries
  - In each industry a small number of firms which produce intermediate goods
  - → Firms have market power and compete strategically (Cournot)
- There are four types of supply disruptions: aggregate (A), industry-specific (I), firm-specific (F), and asymmetric (X)
- Representative household which consumes, supplies labor, and owns all firms

▸ Details

Intermediate Good Production

- Intermediate good firms operate a constant-returns-to-scale production technology

$$y_{ijt} = \underbrace{Z_t^A Z_{jt}^I z_{ijt}^F z_{ijt}^X}_{\text{"productivity"}} \; l_{ijt}$$

- Aggregate productivity Z_t^A, industry-specific productivity Z_{jt}^I, and firm-specific productivity z_{ijt}^F follow AR(1) processes in logs

- z_{ijt}^X is the "asymmetric productivity component", where $\log z_{ijt}^X = \alpha_{ij} \times \log z_t^X$
  - $\rightarrow$ z_t^X is the underlying asymmetric productivity (follows AR(1) in logs)
  - $\rightarrow$ α_{ij} is the firm-specific *exposure* to asymmetric supply shocks

  ▸ Microfoundation: Financial Frictions ▸ Microfoundation: Regional Shocks

- Final output, Y_t, is a nested CES aggregate of industry and intermediate output

Firm Behavior

- Due to the finite number of competitors within each industry, firms face a downward-sloping demand curve and have “market power”
  - Firms hire labor (which determines their output and price) in order to maximize profits
  - Take into account productivity & optimal behavior of their competitors

Profit Maximization

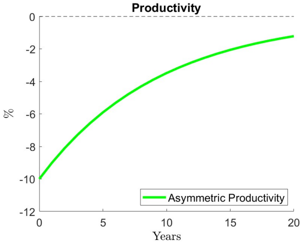
- Within each industry, the distribution of productivity determines ...
  - ... the distribution of firm-level output and prices (markups)
  - ... hence, industry-level productivity, output, and price level (markup)

Industry Aggregates

- Asymmetric supply shocks are special, because ...
  - ... unlike aggregate & industry-specific shocks, they do affect within-industry distributions, hence not only industry productivity but also industry markups
  - ... unlike firm-specific shocks, they affect more than one firm in one industry, hence “average out” to a much smaller degree

Aggregate Effects of Asymmetric Supply Shocks

- Simple example:
  - Negative asymmetric supply shock: $\epsilon_t^X = -10\%$
  - In each industry, there are two exposed ($\alpha_{ij} = 1$), two unexposed ($\alpha_{ij} = 0$) firms



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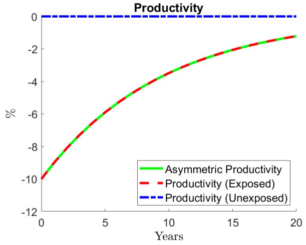

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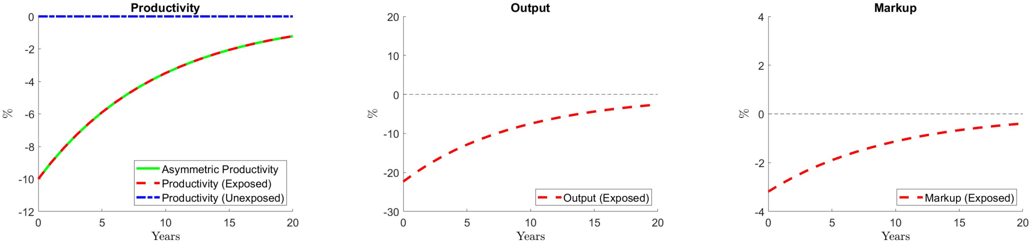

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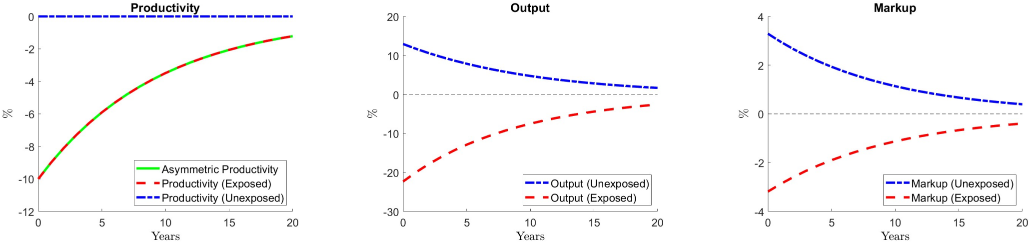

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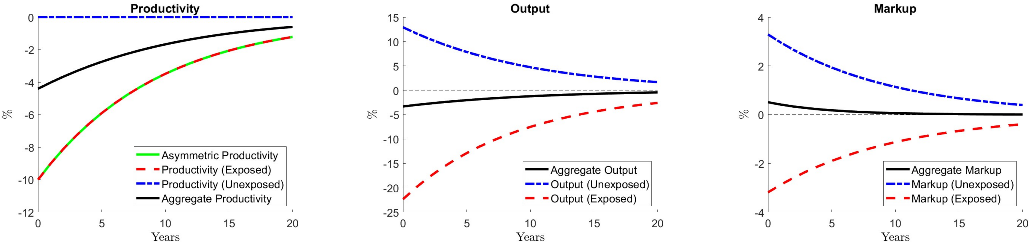

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Data

Asymmetric Supply Shocks in the Data

- Data: Compustat North America, 1990-2019, annual data
- Variable of interest: firm-level sales (in logs)
  - → Fit AR(1): $\log(sales_{ijt}) = \rho \times \log(sales_{ijt-1}) + \epsilon_{ijt}$
  - → Control for firm fixed-effects and industry-by-time fixed-effects (Z_t^A, Z_{jt}^I)
  - → Lots of unexplained volatility in the firm-level residual $\widehat{\epsilon}_{ijt}$ (i.e, residualized sales)
- Firm-level volatility ($\widehat{\epsilon}_{ijt}$) can be explained by
  - firm-level shocks (z_{ijt}^F)
  - asymmetric supply shocks (z_{ijt}^X)

Measuring Asymmetric Supply Shocks

- Exploit that asymmetric supply shocks induce a correlation of firm-level residuals ($\widehat{\epsilon}_{ijt}$) across industries (unlike idiosyncratic shocks)

- Use principal component analysis to find out how much variation in firm-level residuals can be explained by common components

$$\begin{bmatrix} \widehat{\epsilon}_{i=1,t=1} & \cdots & \widehat{\epsilon}_{i=962,t=1} \\ \vdots & \ddots & \\ \widehat{\epsilon}_{i=1,t=29} & & \widehat{\epsilon}_{i=962,t=29} \end{bmatrix} = F \times \Lambda + \nu$$

→ If all firm-level volatility is caused by firm-level shocks, the first principal component (F_1) should explain barely any variation (in a large enough sample)

→ If firm-level volatility also reflects asymmetric supply shocks, the first principal component will explain a relevant share

Results - Principal Component Analysis

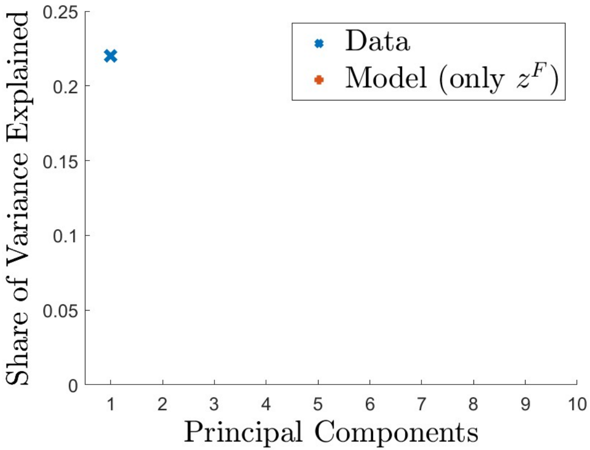

Figure 3: Share of Firm-Level Volatility Explained by Principal Components

Notes: Dataset is a balanced sample from 1990 - 2019 (T=29) with N=962 unique firms in J=179 industries. The model is as described above and as calibrated below with only firm-level shocks.

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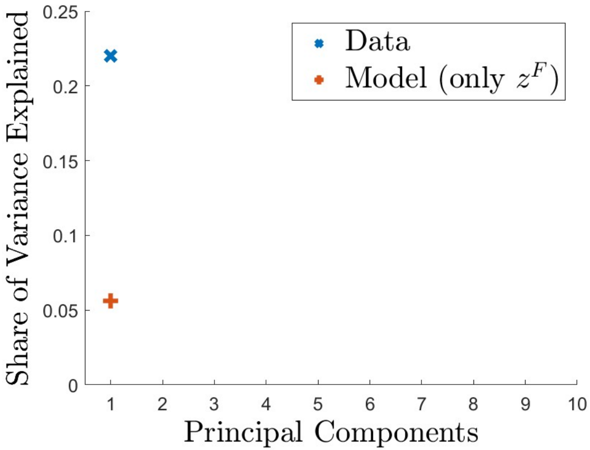

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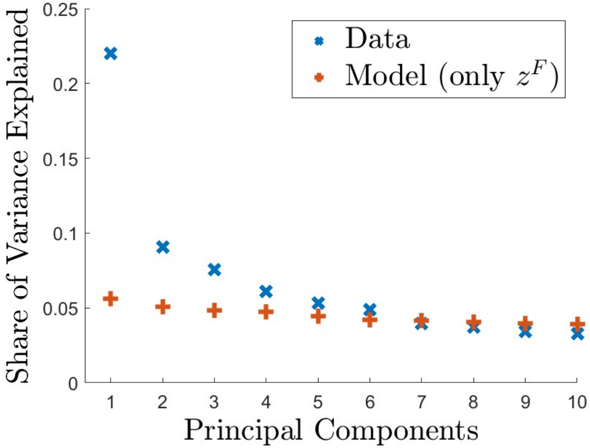

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Quantitative Model Analysis

Calibration – Fixed Parameters

Param.	Description	Value	Target / Source
Household			
ψ	Labor disutility	1.8	$L \approx 1/3$
σ	Curvature of util. w.r.t. C	2	IES $= 0.5$
χ	Curvature of util. w.r.t. L	3	Frisch elasticity $= 2/3$
Firms			
N_J	Number of industries	179	Compustat data (balanced panel)
N_j	Number of firms per industry	5	Compustat data (balanced panel)
ρ	Elast. of subst. within ind.	10	Atkeson and Burstein (2008)
η	Elast. of subst. across ind.	1.4	Avg. markup ≈ 1.3 (Mongey, 2021)
σ^α	Std. dev. of exposure coeff.	1	Normalization
Exogenous Processes			
N_X	Number of asymmetric supply shocks	3	PCA evidence (Compustat)
ρ^X	Persistence of asymmetric supply shocks	0.9	PCA evidence (Compustat)

Table 1: Calibration – Fixed Parameters

Calibration – Fitted Parameters

Param.	Description	Value	Target	Data	Model
Exogenous Processes					
σ^X	Std. dev. of asym. sup. shocks	0.0331	Share of firm volatility explained	38.6%	38.6%
σ^I	Std. dev. of idio. shocks	0.0900	Std. dev. of firm residuals	0.46	0.46
ρ^I	Persistence of idio. shocks	0.5624	Autocorr. of firm residuals	0.72	0.72

Table 2: Calibration – Fitted Parameters

Aggregate Fluctuations

	$\sigma(Y)$	$\sigma(L)$	$\sigma(LaborShare)$	$\sigma(z_{ijt})$
Data	1.41%	1.65%	0.85%	
Model	0.56%	0.47%	0.65%	16.8%
$\rightarrow \sigma^X = 0$	0.16%	0.07%	0.07%	10.8%

Table 3: Aggregate Fluctuations

Notes: Data moments are computed from annual data from 1947-2019. All moments are computed after HP-filtering ($\lambda = 6.25$) the data in logs.

$\rightarrow$ asymmetric supply shocks account for close to 30% of fluctuations in output and around 70% of fluctuations in the labor share

The Intensity of Competition & Competition Policy

Implications of a Higher Intensity of Competition

- A higher intensity of competition (more firms per industry) ...
  - ... reduces steady-state markups
  - ... increases steady-state productivity

- A higher intensity of competition also matters for the implications of macroeconomic fluctuations
  - Markup volatility falls
  - Average productivity increases
  - Volatility of (aggregate) productivity increases

Intensity of Competition & Asymmetric Supply Shocks

- Consider an asymmetric supply shock: $\epsilon_t^X \in (-0.3, 0.3)$
- Half of firms within each industry are exposed ($\alpha_{ij} = 1$), half unexposed ($\alpha_{ij} = 0$)
- Compare economies with low and high number of firms ($N_j = 4$ vs. $N_j = 20$)

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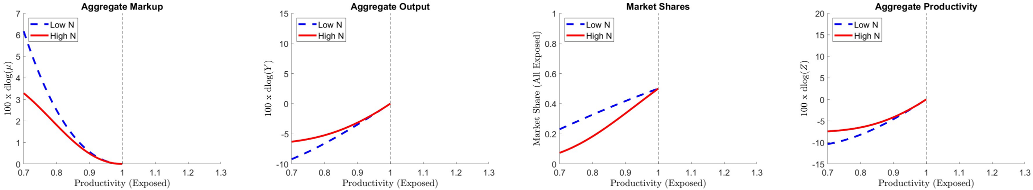

Figure 3: Intensity of Competition & Asymmetric Supply Shocks

→ Strong competition protects against negative shocks and allows to take advantage of positive shocks

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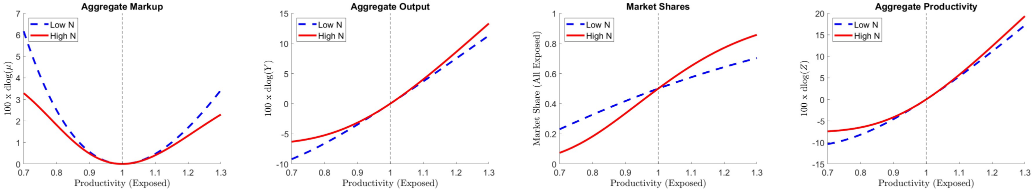

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→ Strong competition protects against negative shocks and allows to take advantage of positive shocks

Conclusion

Conclusion

- Asymmetric supply shocks — shocks that affect firms unequally within many industries — cause meaningful fluctuations in aggregate productivity, output & markups
- Quantitatively, they can account for close to 30% of fluctuations in output and around 70% of fluctuations in the labor share
- A higher intensity of competition increases macroeconomic volatility and may yet improve consumer welfare
  - → Provides an additional reason why the secular increases in market power, markups, and concentration are concerning (De Loecker, Eeckhout & Unger (2020), Covarrubias, Gutiérrez & Philippon (2020))

Thank You!

Appendix

Household

- Representative household chooses consumption C_t and labor L_t to maximize

$$W_t = u(C_t, L_t) + \beta \left(\mathbb{E}_t W_{t+1}^{1-\alpha}\right)^{1/(1-\alpha)}$$

- Period utility function

$$u(C_t, L_t) = \frac{C_t^{1-\sigma}}{1-\sigma} + \psi \frac{(1-L_t)^{1-\chi}}{1-\chi}$$

- Flow budget constraint

$$C_t = w_t L_t + D_t$$

Back

Microfoundation for Asymmetric Supply Shocks: Financial Frictions

- Production requires capital k_{ijt}, which is purchased one period in advance

$$y_{ijt} = Z_t^A Z_{jt}^S z_{ijt}^I \underbrace{k_{ijt}^{\theta}}_{:=z_{ijt}^X} l_{ijt}$$

- Assume two groups of firms in each industry:
  - $\rightarrow$ Financially unconstrained firms can afford optimal level of capital k_{ijt}^*
  - $\rightarrow$ Financially constrained firms cannot afford optimal level, so $k_{ijt} \leq \gamma_t k_{ijt}^*$ with $\gamma_t \in (0, 1]$
  - $\rightarrow$ Financial conditions (γ_t, i.e. "tightness of borrowing constraint") fluctuate over time
- Normalize ${k_{ijt}^*}^{\theta} = 1$
  - $\rightarrow$ Unconstrained firms: $z_{ijt}^X = 1 \quad \forall t$
  - $\rightarrow$ Constrained firms: $z_{ijt}^X = \gamma_t^{\theta}$

Back

Microfoundation for Asymmetric Supply Shocks: Regional Shocks

- Economy consists of R regions, in each of which production is interrupted occasionally (due to adverse weather events, strikes, lockdowns, ...)
- Hence, "regional productivity" z_{rt} in region $r \in R$ is usually 1, but drops below 1 occasionally
- Each firm is only (or primarily) exposed to the region in which it is located, e.g. $z^X_{ijt} = 1 \times z^{r=k}_{rt} + 0 \times z^{r \neq k}_{rt}$ (if firm ij located in region k
- Production function

$$y_{ijt} = Z^A_t Z^S_{jt} z^I_{ijt} z^X_{ijt} \; l_{ijt}$$

Back

Aggregation of Intermediate Goods

- Industry output, Y_{jt}, is a CES aggregate of the intermediate goods y_{ijt} produced by N_j firms in industry j

$$Y_{jt} = \left[\sum_{i=1}^{N_j} y_{ijt}^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}} \quad \text{with} \quad \rho > 1$$

- Aggregate output, Y_t, is a CES aggregate of the industry output, Y_{jt}, of the N_J industries

$$Y_t = \left[\sum_{j=1}^{N_J} Y_{jt}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \quad \text{with} \quad \eta > 1$$

Profit Maximization

The profit-maximizing markup is

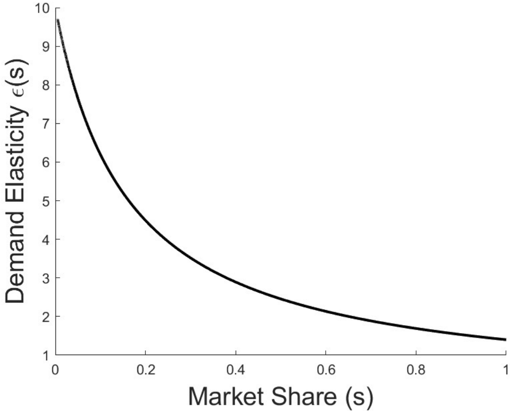
$$\mu(s_{ij}) = \frac{\epsilon(s_{ij})}{\epsilon(s_{ij}) - 1}$$

where $\epsilon(s_{ij})$ is the elasticity of demand faced by firm ij

$$\epsilon(s_{ij}) = \left[\frac{1}{\eta} s_{ij} + \frac{1}{\rho}(1 - s_{ij})\right]^{-1}$$

and where s_{ij} is the firm's sales share within industry j

$$s_{ij} = \frac{p_{ij} y_{ij}}{\sum_{i=1}^{N_j} p_{ij} y_{ij}}$$



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Industry Productivity and Markup

Industry productivity is defined by

$$Z_{jt} = \frac{Y_{jt}}{L_{jt}} = \frac{\left[\sum_{i=1}^{\widetilde{N_{jt}}} \mu_{ijt}^{1-\rho}\right]^{\frac{\rho}{\rho-1}}}{\sum_{i=1}^{\widetilde{N_{jt}}} \mu_{ijt}^{-\rho}}$$

The industry markup, defined by $\mu_{jt} = \frac{(P_{jt}/P_t^C)Y_{jt}}{w_t L_{jt}}$, can be rewritten, as a function of the Herfindahl–Hirschman index (HHI), a measure of industry concentration

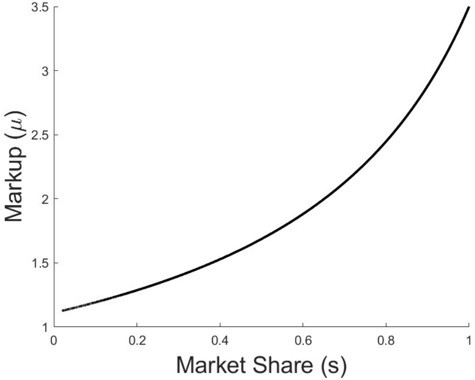
$$\mu_{jt} = \frac{\rho}{\rho-1}\left[1 - \frac{\frac{\rho}{\eta}-1}{\rho-1} HHI_{jt}\right]^{-1}$$

where the HHI is calculated as the sum of squared market shares, $HHI_{jt} = \sum_{i=1}^{\widetilde{N_{jt}}} s_{ijt}^2$.

Back

Competition among Firms & Markup Volatility

- Asymmetric supply shocks redistribute market shares (between exposed and unexposed firms)
- Firm markups depend on market shares nonlinearly
- More competition $\rightarrow$ lower market shares $\rightarrow$ lower markup volatility (due to same shocks)



▸ Limit Case: Monopolistic Competition

Irrelevance Result

When the number of firms in each industry becomes infinitely large, asymmetric supply shocks have no effects on markups (firm-level, industry-level, aggregate) anymore:

$$\lim_{N_j \to \infty} \frac{\text{dlog}(\mu_{ijt})}{\text{dlog}(z_t^X)} = 0$$

- in the limit case of monopolistic competition ($N_j \to \infty$), asymmetric supply shocks are irrelevant for markups
- this result connects to the literature on firm heterogeneity, which has shown that firm heterogeneity becomes less important for aggregate outcomes when profit functions become linear
  - Koby & Wolf (2020), Winberry (2021)

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