Pricing Inequality

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Introduction

Core idea of this paper

Household wealth and income $\rightarrow$ *Sensitivity to differences in prices* $\rightarrow$ *Price setting*

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Motivating example 1 - *Auer Burstein Lein Vogel (2022)*

- Swiss Franc appreciation
- Main result - *Higher income households* $\rightarrow$ *?* $\rightarrow$ *Lower substitution toward French goods*

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Motivating example 2 - *Stroebel Vavra (2018)*

- Increase in local house prices
- Main result - *Areas with more owners* $\rightarrow$ *?* $\rightarrow$ *Larger increases in markups on goods*

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Motivating example 2 - *Stroebel Vavra (2018)*

- Increase in local house prices
- Main result - *Areas with more owners* $\rightarrow$ *?* $\rightarrow$ *Larger increases in markups on goods*

Scenario 1 - Poor households receive large increase in transfers

Scenario 2 - Firms selling to poor households hit with a cost shock

Welfare - How do prices change? How is expenditure reallocated?

Today

1. Theory

- Incomplete markets + Extensive margin demand in general equilibrium
  - Incomplete markets: Bewley, Aiyagari, Hugget
  - Extensive margin demand: Multinomial logit
- Characterize (i) price elasticities of demand, (ii) sorting, (iii) pass-through

2. Numerical example

- Counterfactual 1 - Lump sum transfer financed by an increase in marginal income tax
  - *Reduction in demand elasticities of most elastic households → Higher markups*
- Counterfactual 2 - Marginal cost shock to all / some firms
  - *Rich households' decline in welfare is insulated by trading down to cheaper varieties*

Literature

Environment

Differentiated goods - Goods $g \in \mathcal{G}$. Each good produced by J firms $j \in \{1, \ldots, J\}$

$$y_{jgt} = \overline{Z}_d \, z_{jg} \, n_{jgt} \quad , \quad z_{jg} \sim \Gamma_z(z)$$

Homogeneous goods - Continuum of identical firms

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Households - Continuum of households $i \in [0, 1]$

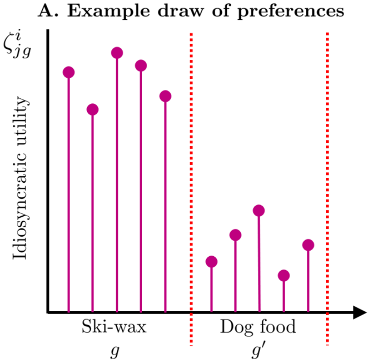
- Stochastic productivity e_t^i: $e_{it+1}^i \sim \Gamma_e(e|e_t^i)$
- Each period choose a good g and producer j, and purchase one unit from them

$$\mathbb{E}_0\left[\sum_{t=0}^{\infty} \beta^t \tilde{u}_{jgt}^i\right] \;,\; \tilde{u}_{jgt}^i = \underbrace{u\left(c_t^i\right)}_{\text{Homog. good}} + \underbrace{\zeta_{jgt}^i}_{\text{Diff. good}} \;,\; \underbrace{\zeta_t^i \sim \Gamma_\zeta\left(\zeta\right)}_{\text{iid each period}}$$

- Savings a_t^i in government debt, interest rate r, borrowing constraint $a_{t+1}^i \geq \underline{a}$.

Environment - Preferences - Nested Gumbel

$$\zeta^i \sim \Gamma_\zeta\left(\zeta^i\right) = \prod_{g\in\mathcal{G}} \exp\left\{-\left(\sum_{j\in g} e^{-\eta\zeta^i_{jg}}\right)^{\theta/\eta}\right\}$$



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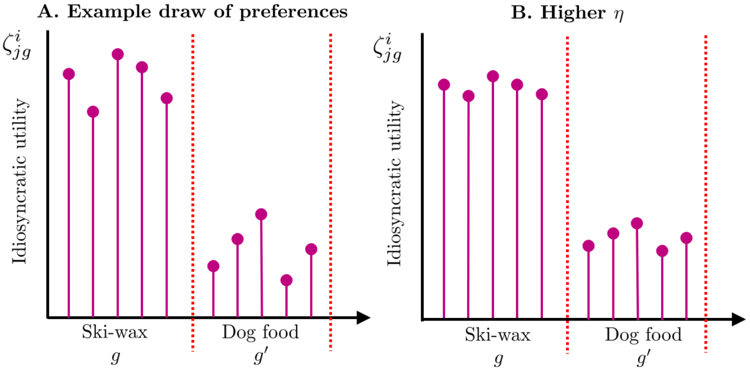

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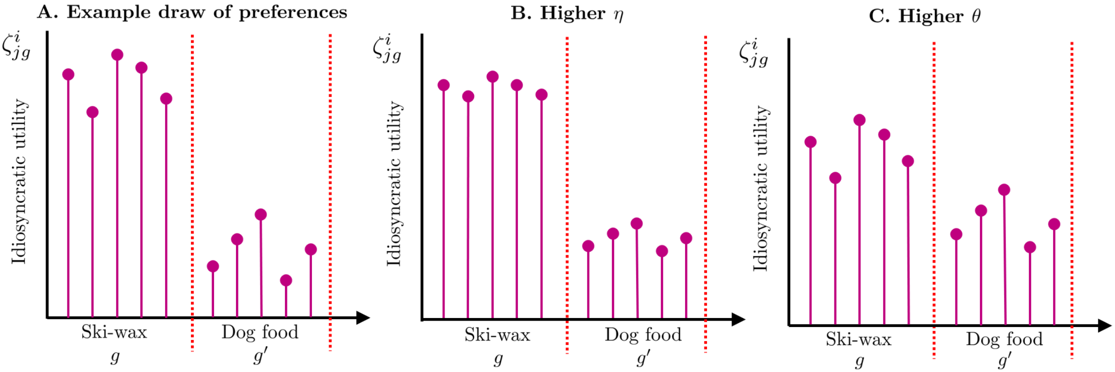

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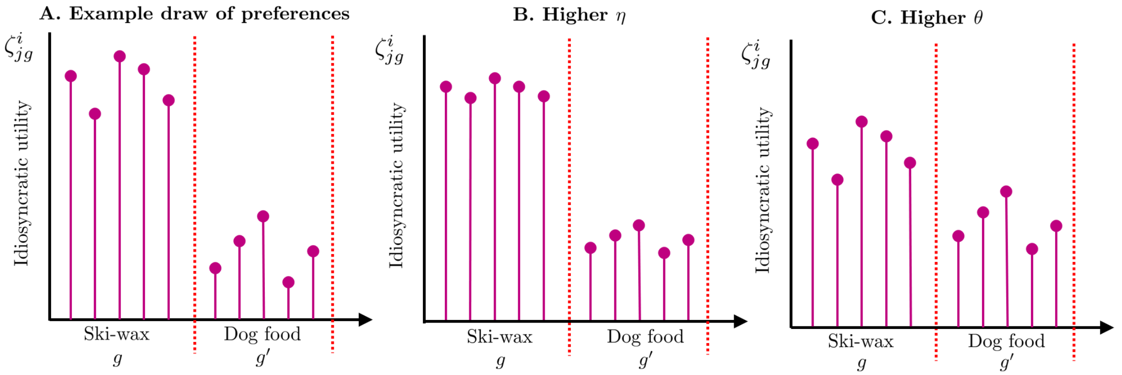
$$\zeta^i \sim \Gamma_\zeta\left(\zeta^i\right) = \underbrace{\prod_{g\in\mathcal{G}}\prod_{j\in g} \exp\left\{-e^{-\eta\zeta^i_{jg}}\right\}}_{\theta=\eta}$$



Household problem

1. Given all prices p_{jg} and preferences ζ_{jg}, choice over goods g and producers j

$$\overline{V}\left(a, e\right) := \mathbb{E}_{\zeta}\left[\max_{j,g}\left\{V\left(a, e, p_{jg}\right) + \zeta_{jg}\right\}\right]$$

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2. Conditional on choosing firm p_{jg}, and given W, r, Π, choose consumption/savings

$$\begin{aligned} V\left(a, e, p_{jg}\right) &= \max_{a', c}\ u\left(c\right) + \beta \int \overline{V}\left(a', e'\right) d\Gamma_e\left(e'|e\right) \\ P_c c + p_{jg} + a' &= \left(1 - \tau\right) We + (1 + r)a + \Pi \\ a' &\geq \underline{a} \end{aligned}$$

▸ Monotonicity, Discounting

Household problem

1. Given all prices p_{jg} and preferences ζ_{jg}, choice over goods g and producers j

$$\overline{V}\left(a,e\right) = \frac{1}{\theta}\log\left[\sum_{g\in\mathcal{G}} e^{\theta\widetilde{V}\left(a,e,\mathbf{p}_g\right)}\right]$$

$$\widetilde{V}\left(a,e,\mathbf{p}_g\right) = \frac{1}{\eta}\log\left[\sum_{j\in g} e^{\eta V\left(a,e,p_{jg}\right)}\right]$$

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$$V\left(a,e,p_{jg}\right) = \max_{a',c}\ u\left(c\right) + \beta\int \overline{V}\left(a',e'\right)\, d\Gamma_e\left(e'|e\right)$$

$$P_c c + p_{jg} + a' = \left(1-\tau\right)We + \left(1+r\right)a + \Pi \quad , \quad \frac{\partial V\left(a,e,p_{jg}\right)}{\partial p_{jg}} = -\Lambda(a,e,p_{jg})$$

$$a' \geq \underline{a}$$

▸ Monotonicity, Discounting

Firm problem

Given *Competitors' Prices* $\mathbf{p}_g$ and *Aggregates*, choose *Price* p_{jg} to maximize profits

$$p_{jg}^{*} = \arg\max_{p_{jg}} \underbrace{x\left(p_{jg}, \mathbf{p}_g, \mathbf{S}\right)}_{\text{Demand}} \underbrace{\left(p_{jg} - \frac{W}{\overline{Z}_d z_{jg}}\right)}_{\text{Per unit profit}}$$

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Demand - The equilibrium quantity sold is

$$x\left(p_{jg}, \mathbf{p}_g, \mathbf{S}\right) = \int_{A\times E} \rho\left(a, e, p_{jg}, \mathbf{p}_g, \mathbf{S}\right) \mathrm{d}\,\Gamma_{a,e}(a, e)$$

$$\rho\left(a, e, p_{jg}, \mathbf{p}_g, \mathbf{S}\right) = \frac{e^{\eta V\left(a,e,p_{jg}\right)}}{e^{\eta \widetilde{V}\left(a,e,p_{jg},\mathbf{p}_g\right)}} \times \frac{e^{\theta \widetilde{V}\left(a,e,p_{jg},\mathbf{p}_g\right)}}{e^{\theta \overline{V}\left(a,e\right)}}$$

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Demand - The equilibrium quantity sold is

$$x_{jg} = \int \rho^i_{jg}\, di$$

$$\rho^i_{jg} = \rho^i_{j|g}\, \rho^i_g = \frac{e^{\eta V^i(p_{jg})}}{e^{\eta \widetilde{V}^i(\mathbf{p}_g)}} \frac{e^{\theta \widetilde{V}^i(\mathbf{p}_g)}}{e^{\theta \overline{V}^i}}$$

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Optimality / Nash - Standard markup condition

$$p_{jg}^* = \underbrace{\frac{\varepsilon_{jg}}{\varepsilon_{jg} - 1}}_{\text{Markup}} \underbrace{\frac{W}{\overline{Z}_d z_{jg}}}_{\text{Marginal cost}}$$

$$\varepsilon_{jg} = -\left.\frac{\partial \log x_{jg}}{\partial \log p_{jg}}\right|_{\mathbf{p}_{-jg}^*}$$

▸ Details - Second order conditions

Next couple of slides

Key objects for welfare effect of a change in marginal cost to firm jg:

1. *How do prices change?*

   Pass-through: $\dfrac{\partial \log p_{jg}}{\partial \log mc_{jg}}$

2. *Who does it affect?*

   Sorting: $\rho^i_{jg} \quad , \quad \dfrac{\partial \log \rho^i_{jg}}{\partial a^i}$

3. *How does spending reallocate?*

   Elasticities: $\varepsilon^i_{jg} = -\dfrac{\partial \log \rho^i_{jg}}{\partial \log p_j} \quad , \quad \varepsilon_{jg} = -\dfrac{\partial \log x_{jg}}{\partial \log p_j}$

1. Elasticity of demand

Recap: $$\underbrace{\rho^i_{jg} = \frac{e^{\eta V^i(p_{jg})}}{e^{\eta \widetilde{V}^i(\mathbf{p}_g)}} \frac{e^{\theta \widetilde{V}^i(\mathbf{p}_g)}}{e^{\theta \overline{V}^i}}}_{\text{Individual demand: } \rho^i_{j|g}\rho^i_g} \quad , \quad \underbrace{\widetilde{V}^i(\mathbf{p}_g) = \frac{1}{\eta}\log\left[\sum_{k\in g} e^{\eta V^i(p_{kg})}\right]}_{\text{Market } g \text{ value}} \quad , \quad \underbrace{x_{jg} = \int \rho^i_{jg}\, di}_{\text{Firm demand}}$$

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Individual: $$\varepsilon^i_{jg} = -\frac{\partial \log \rho^i_{jg}}{\partial \log p_{jg}} = \underbrace{\left[\eta\left(1-\rho^i_{j|g}\right) + \theta\rho^i_{j|g}\right]}_{\text{Market structure}} \underbrace{u'\left(c^i_{jg}\right)\left(\frac{p_{jg}}{P_c}\right)}_{\text{Bewley}}$$

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$$\text{Firm:} \quad \varepsilon_{jg} = -\frac{\partial \log x_{jg}}{\partial \log p_{jg}} = \int \left(\frac{\rho^i_{jg}}{x_{jg}} \right) \varepsilon^i_{jg}\, di$$

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Firm: $$\varepsilon_{jg} = -\frac{\partial \log x_{jg}}{\partial \log p_{jg}} = \int \left(\frac{\rho^i_{jg}}{x_{jg}} \right) \varepsilon^i_{jg} \, di$$

Result 1: Price elasticity decreases in wealth and income

- Poor: Higher $u'(c^i_{jg})$, higher ε^i_{jg}, driven by switching across products
- Bewley: Rich model for the endogenous distribution of $u'(c^i_{jg})$ or, equivalently, V^i_a

Result 2: High price firms sell more to wealthy households

Fix prices $\mathbf{p}_g$, do *conditional* choices probabilities $\rho^i_{j|g}$ increase or decrease in a^i?

$$\log \rho^i_{j|g} = \eta \left\{ V^i\left(p_{jg}\right) - \widetilde{V}^i\left(\mathbf{p}_g\right) \right\} \quad , \quad \frac{\partial \log \rho^i_{j|g}}{\partial a^i} = \eta \left\{ V^i_a\left(p_{jg}\right) - \mathbb{E}_{\rho^i_{k|g}}\left[V^i_a\left(p_{kg}\right)\right] \right\}$$

(+) If j has a high price, then the marginal value of resources is high if buy from j

- For a high price firm, its customer base is *increasing* in assets

(−) If j has a low price, then marginal value of resources is low if buy from j

- For a low price firm, its customer base is *decreasing* in assets

3. Pass-through

Result 3: Off-setting forces shape pass-through

▸ Compare to Nevo (2000) version of BLP (1995)

$$p_{jg} = \frac{\varepsilon_{jg}}{\varepsilon_{jg}-1} mc_{jg} \quad , \quad \frac{\partial \log p_{jg}}{\partial \log mc_{jg}} = \frac{[\varepsilon_{jg}-1]}{[\varepsilon_{jg}-1] + \left\{ \frac{\partial \log \varepsilon_{jg}}{\partial \log p_{jg}} \right\}_{(+)}} \in (0,1)$$

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Recap: $\varepsilon_{jg} = \int \left[\eta (1 - \rho^i_{j|g}) + \theta \rho^i_{j|g} \right] p_{jg} u' (c^i_{jg}) \left(\frac{\rho^i_{jg}}{x_{jg}} \right) di$

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$$\frac{\partial \log \varepsilon_{jg}}{\partial \log p_{jg}} = \underbrace{\mathbb{E}\left[\frac{\eta(\eta-\theta)\rho^i_{j|g}(1-\rho^i_{j|g})}{\eta(1-\rho^i_{j|g}) + \theta\rho^i_{j|g}} p_{jg} u'(c^i_{jg})\right]}_{\text{1. Market share effect}} \underbrace{+ 1 + \sigma\,\mathbb{E}\left[mpc^i_{jg}\left(\frac{p_{jg}}{c^i_{jg}}\right)\right]}_{\text{2. Elasticity effect}} \underbrace{- \mathbb{V}\left[\frac{\varepsilon^i_{jg}}{\varepsilon_{jg}}\right]}_{\text{3. Composition effect}}$$

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- Here pass-through is endogenous . . . and ambiguous:
  - $(+)$ Lose quantity, smaller share, increases elasticity
  - $(+)$ Make all consumers more price elastic. More so if *high MPC*, or *high expenditure share on j*
  - $(-)$ Lose high elasticity buyers first, reduces overall elasticity

Direct evidence on substitution of poor / rich households

Model

$$\text{Budget share:} \quad b_{ijt} = \frac{p_{jt}\,\phi_{jt}\exp\left\{\eta V_i\left(p_{jt}\right)\right\}}{\sum_k p_{kt}\,\phi_{kt}\exp\left\{\eta V_i\left(p_{kt}\right)\right\}}$$

$$\log\left(\frac{b_{ijt}}{b_{ikt}}\right) - \log\left(\frac{b_{mjt}}{b_{mkt}}\right) \approx \underbrace{\left\{\varepsilon_{ikt}\right\}\left\{\sigma\right\}\left\{\frac{\partial \log c_i\left(p_{kt}\right)}{\partial \log e_i}\right\}}_{\text{Coefficient estimated in Auer et al (2022)}} \underbrace{\log\left(\frac{e_i}{e_m}\right)\log\left(\frac{p_{jt}}{p_{kt}}\right)}_{\text{Interaction term}}$$

Data

$$\log\left(\frac{b_{it}^M}{b_{it}^D}\right) = \beta_0 - \beta_1 \log\left(\frac{p_t^M}{p_t^D}\right) + \boldsymbol{\beta}_2 \log e_i \log\left(\frac{p_t^M}{p_t^D}\right) + \varepsilon_{it} \quad , \quad \widehat{\boldsymbol{\beta}}_2 = 2.2$$

Auer et al (2022) - *Unequal Expenditure Switching: Evidence from Switzerland*

▸ Restriction on σ, ε under Auer et al (2022) estimate

NUMERICAL EXAMPLE

Simplifying assumption: $\theta = \eta$

Calibration - Quarterly - 1/2

Key parameters

- η such that average markup is 1.20
- $\overline{Z}_d$ such that 15% of spending on differentiated good
- Close to log preferences $\sigma = 1.50$

Income

- AR(1) in income, only persistent shocks for now

$$\log e_{it+1} = \rho_e \log e_{it} + \varepsilon_{it+1} \quad , \quad \varepsilon_{it+1} \sim \mathcal{N}\left(-\frac{1}{2}\frac{\nu_e^2}{1+\nu_e}, \nu^2\right)$$

- Krueger Perri Mitman (2016) - $\rho_e = 0.99$, $\nu_e = 0.023$

No transitory shocks, same $var(\log y_{it})$

Calibration - Quarterly - 2/2 - Wealth and general equilibrium

- GE version of the 'Liquid wealth' calibration in Kaplan Violante (2022)
- Average liquid wealth to average income $\mathbb{E}[a_i]/\mathbb{E}[y_i] = 0.56$ (SCF)
- Borrowing constraint $\underline{a} = 0$ and baseline annual $r = 0.02$
- Demand for debt:

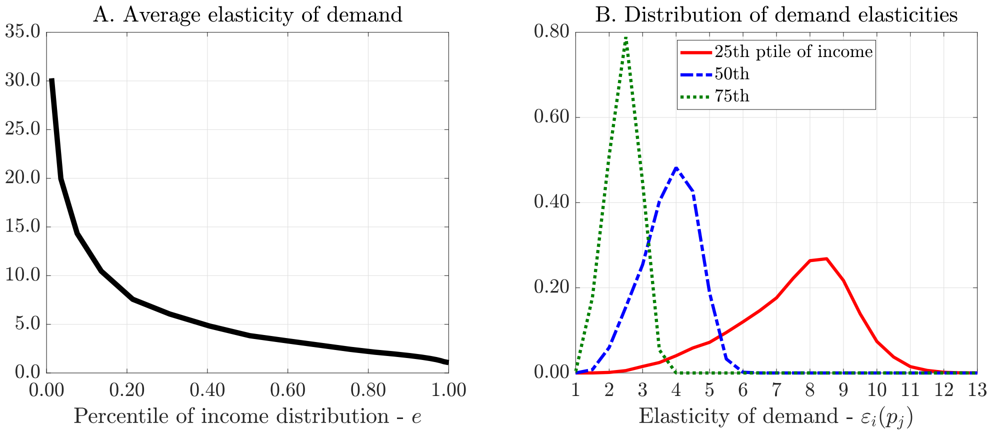
$$B^d(r) = \frac{T - G}{r} \quad , \quad T = \tau \int We_i di \quad , \quad \tau = 0.20$$

- Supply of debt:

$$B^s(r) = \int a \, d\lambda(a, e)$$

- Calibrate $\beta = 0.92$ $(r_{RA} = 38\%)$ to give 0.56. Implies $G/Y = 0.19$. In US ≈ 0.30
- Implies a quarterly MPC out of \$500 of 16.9%

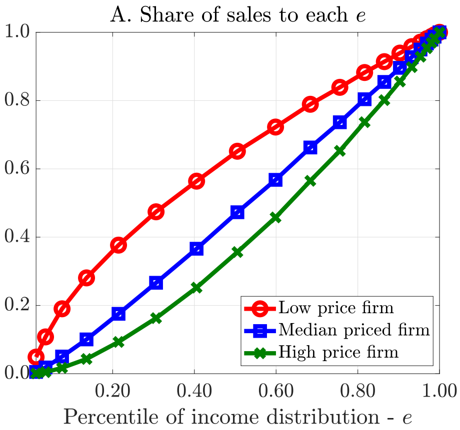
1. Elasticities - $\varepsilon(a, e, p_j)$

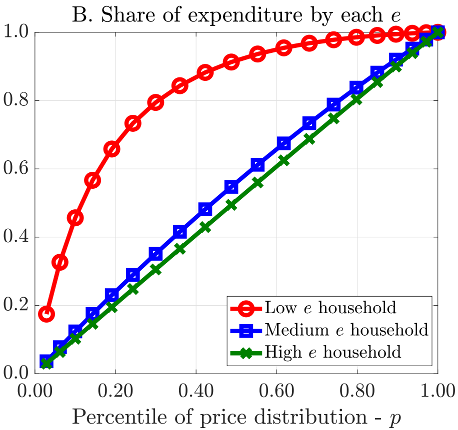


- Cross-sectional regression in same form as interaction terms in Auer et al (2022)

$$\varepsilon_i = \alpha - 6.25 \log Income_i \quad , \quad \text{overstates their estimate of -2.19}$$

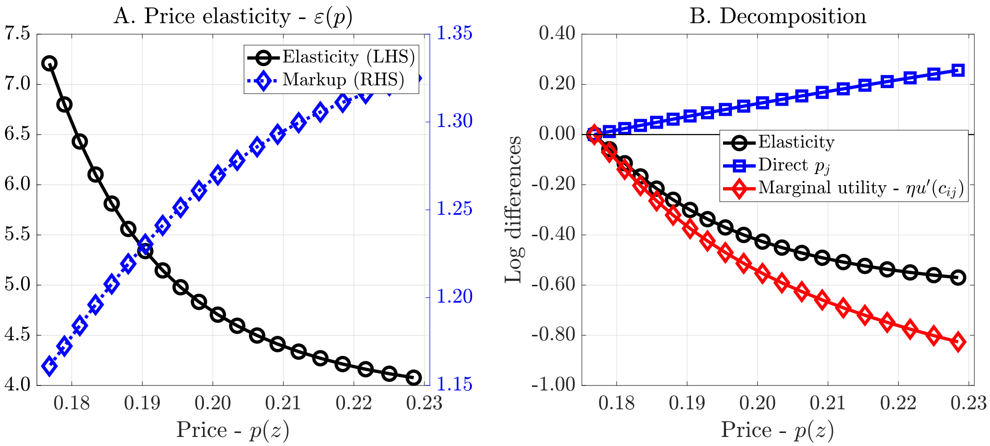
2. Sorting - $\rho(a, e, p_j)$





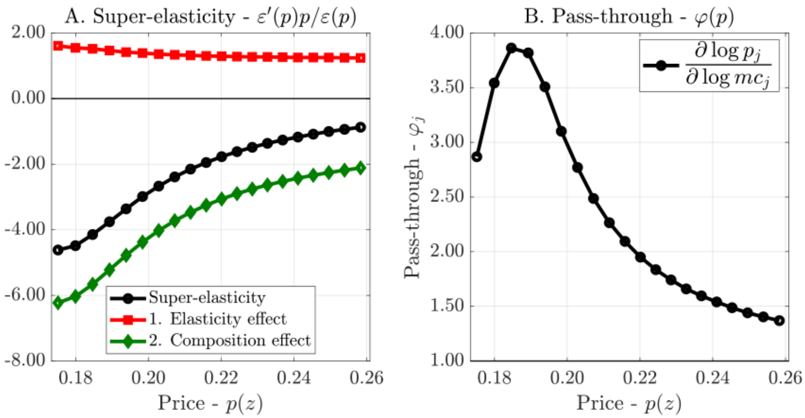
- At low priced firms, more than 60 percent of sales to below median income households
- At high priced firms, less than 40 percent of sales to below median income households

3. Markups - μ_j



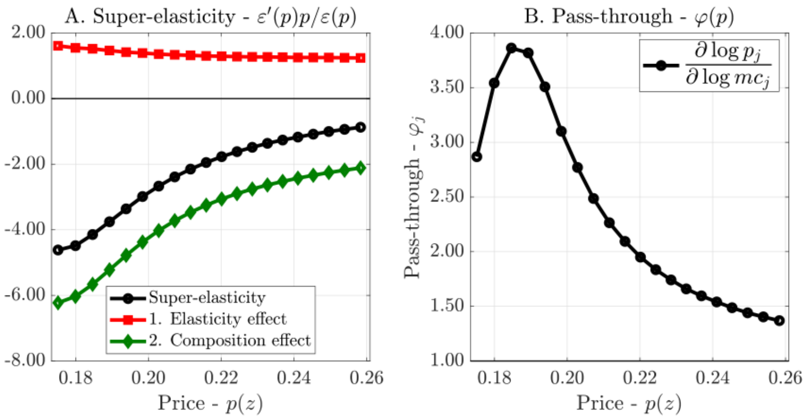
- Low price firms sell to poorer households, operate with lower price-cost margins
- Consistent with Sanghani (2022) - *Markups Across the Income Distribution*

4. Pass-through - $\varphi(p_j)$



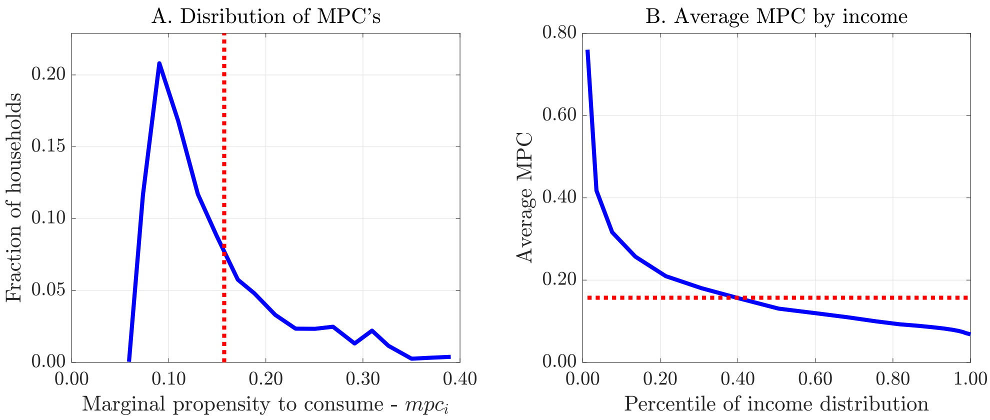
1. Low priced firms sell to higher *MPC* households, and p_j is a larger share of budget
2. More heterogeneity in buyers at low priced firms: $\uparrow \mathbb{CV}[u'(c_{ij})]$

4. Pass-through - $\varphi(p_j)$



- Issue (i) Too much sorting, (ii) Too steep relationship between e_i and ε_i
- Optimistic This is fine, as we also miss the data in these directions too!

4. Pass-through - $\varphi(p_j)$ - Marginal propensities to consume



- Low priced firms sell to higher MPC consumers

Counterfactual 1 - Shock to costs

- Distributional change in prices in partial equilibrium (W, r and Π_d fixed)

  1. Decrease productivity of all differentiated goods. Raise prices by 30%

  2. Decrease productivity of cheap differentiated goods. Raise cheap prices by 30%

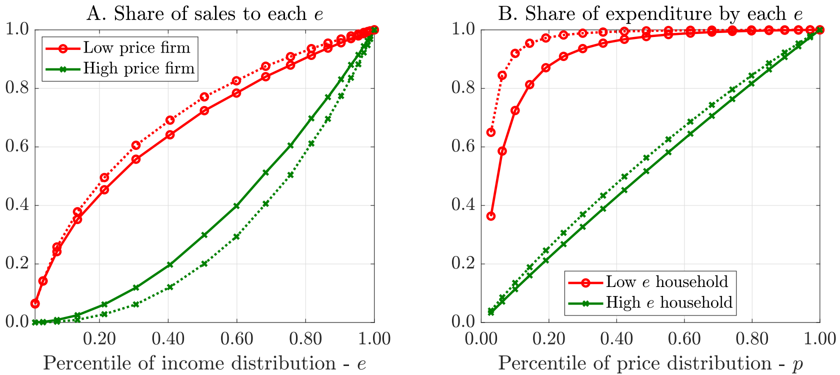
- What does the first order approximation of welfare effects miss?

$$\Delta \log V(a, e) \approx \sum_j b_j(a, e, p_j)\Delta \log p_j \quad \text{v.s.} \quad \Delta \log \overline{V}(a, e)$$

- First order welfare effects used as an empirical benchmark in leading studies

  E.g. Borusyak, Jaravel (2021) - *Distributional Effects of Trade: Theory and Evidence from the United States*

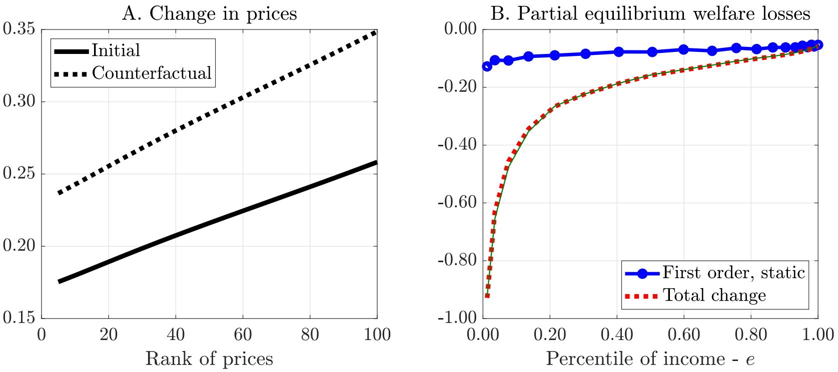
Counterfactual 1 - Shock to costs



- Trading down of high wealth consumers to cheaper products mitigates welfare losses
- Consistent with behavior in the Great Recession documented by Argente Lee (2021)

▸ Figure - Raise cheap goods prices by 30%

Counterfactual 1 - Shock to costs



- Trading down of high wealth consumers to cheaper products mitigates welfare losses
- Consistent with behavior in the Great Recession documented by Argente Lee (2021)

▸ Figure - Raise cheap goods prices by 30%

Combine standard models for pricing, consumption and savings

- Endogenous general equilibrium model for demand and pricing
- Refine, and then use for normative questions

1. Heterogeneity in inflation incidence across households in 2021/2022
   - Are real wages really going up for poor households, or are their price indexes wiping out gains?
   - Inflation in core categories of goods vs. in luxury goods
2. Targeted vs. Non-targeted transfers. What goes into prices? quantities?
   - Transfers to poor, more elastic, more competitive product markets
   - Transfers to rich, more inelastic, lower pass-through
   - E.g. Stroebel Vavra (2019) - How changes in wealth feed into local prices

APPENDIX SLIDES

Previous approaches

1. Consumer demand - Low income households

   (i) Buy at low prices, markups — Faber Fally (2022), Sanghani (2022)

   (ii) Have more elastic demand — Apoorv Gupta (2021)

   (iii) Expenditure switch across goods — Auer, Burstein, Lein, Vogel (2022)

   (iv) Experience larger price changes — Jaravel, Sager (2021)

   Non-homothetic CES: Matsuyama (2019), Handbury (2021), Comin, Lashkari, Mestieri (2021)

2. Firm pricing - The following seem to be correlated across firms:

   (i) Higher markups — Burstein, Carvalho, Grassi (2022), Edmond, Midrigan Xu (2021)

   (ii) Lower pass-through — Amiti, Itskhoki, Konnings (2019), Baqaee, Farhi, Sanghani (2021)

   Homothetic Non-CES: Edmond Midrigan Xu (2021), Baqaee Farhi (2021), Boar Midrigan (2021), Bornstein Peters (2022)

Back - Intro 1 Back - Intro 2

Household problem - When choices are not feasible

- Cases of (a, e) in which setting $a' = \underline{a}$ and buying j implies $c < 0$:

$$(1-\tau)We + (1+r)a + \Pi - \underline{a} - p_j < 0$$

- Let $\mathcal{J}(a, e, \boldsymbol{p})$ be the set of all budget-feasible j
- Then choice is

$$\widetilde{V}\Big(a, e\Big) = \mathbb{E}\left[\max_{j \in \mathcal{J}(a,e,\boldsymbol{p})} \left\{V\Big(a, e, p_j\Big) + \zeta_j\right\}\right] \quad , \quad \zeta \sim G(\zeta; \eta)$$

$$\rho\Big(a, e, p_j\Big) = \frac{e^{\eta V(a,e,p_j)}}{\sum_{k \in \mathcal{J}(a,e,\boldsymbol{p})} e^{\eta V(a,e,p_k)}}$$

1. Love-of-variety is valued:

$$\widetilde{V}(a, e) = \frac{1}{\eta} \log \left(\sum_{j \in \mathcal{J}(a,e,\boldsymbol{p})} \exp\left\{\eta V(a, e, p_j)\right\}\right) = \underbrace{\frac{1}{\eta} \log \left|\mathcal{J}(a, e, \boldsymbol{p})\right| + V\Big(a, e, \overline{p}\Big)}_{\text{If for all } j \in \mathcal{J}(a,e,\boldsymbol{p}) \text{, then } p_j = \overline{p}}$$

2. Everyone buying Gucci can buy Walmart. Some can only buy from Walmart. Competitive: Walmart ignores this.

▸ Back - Household problem

Household problem - Monotonicity and discounting

- Bellman equation

$$V\left(a, e, p_j\right) = \max_{a', c} u(c) + \beta \int \frac{1}{\eta} \log \left[\sum_k \exp\left\{ \eta V\left(a, e, p_k\right) \right\} \right] d\Gamma\left(e' | e\right)$$

$$P_c c + p_j + a' = (1-\tau) We + (1+r)a + \Pi \quad , \quad a' \geq \underline{a}.$$

1. Discounting

$$\beta \int \frac{1}{\eta} \log \left[\sum_k \exp\left\{ \eta \left[V\left(a, e, p_k\right) + a \right] \right\} \right] d\Gamma\left(e' | e\right) = \beta \int \frac{1}{\eta} \log \left[\sum_k \exp\left\{ \eta V\left(a, e, p_k\right) \right\} \right] d\Gamma\left(e' | e\right) + \beta a$$

2. Monotonicity
    - Transformations are monotonic

▸ Back - Household problem

Relationship with Fajgelbaum, Grossman, Helpman (JPE 2011)

Our paper

- Preferences

$$u_{ij} = v(c_{ij}, \phi_j) + \varepsilon_{ij} \quad , \quad v(c_{ij}, \phi_j) = u(c_{ij}) + \eta^{-1} \log \phi_j$$

- Demand elasticity

$$\varepsilon_j = \eta p_j \iint u'\Big(c(a, e, p_j)\Big)\omega_j(a, e)\, da\, de$$

FGH (2011)

- Preferences

$$u_{ij} = v(c_{ij}, \phi_j) + \varepsilon_{ij} \quad , \quad v(c_{ij}, \phi_j) = c_{ij}\phi_j$$

- Demand elasticity

$$\varepsilon_j = \eta p_j \phi_j \quad , \quad p_j = \frac{W}{z_j} + \frac{1}{\eta \phi_j} \quad , \quad \text{Choose } \eta(\phi), \text{ s.t. } \uparrow \phi, \downarrow \eta(\phi)$$

Back - Elasticities

Firm problem - Second order conditions

- Definitions

$$\varepsilon_x(p) = -\frac{x'(p)p}{x(p)} \quad , \quad \varepsilon_{xx}(p) = -\frac{x''(p)p}{x'(p)} \quad , \quad \sigma_x(p) = \frac{\partial \log \varepsilon_x(p)}{\partial \log p}$$

- Second order condition

$$\varepsilon_{xx}(p)\Big/\varepsilon_x(p) \quad < \quad 2$$

$$-\sigma_x(p) \quad < \quad 2\,\varepsilon_x(p) + 1$$

- $\sigma_x(p) > 0$ - Sufficient condition is a *positive* super-elasticity

$$\uparrow p\,,\uparrow \varepsilon_x\,,\downarrow \mu\,,\downarrow p$$

- $\sigma_x(p) < 0$ - If the super-elasticity $\sigma_x(p)$ is *very negative* then

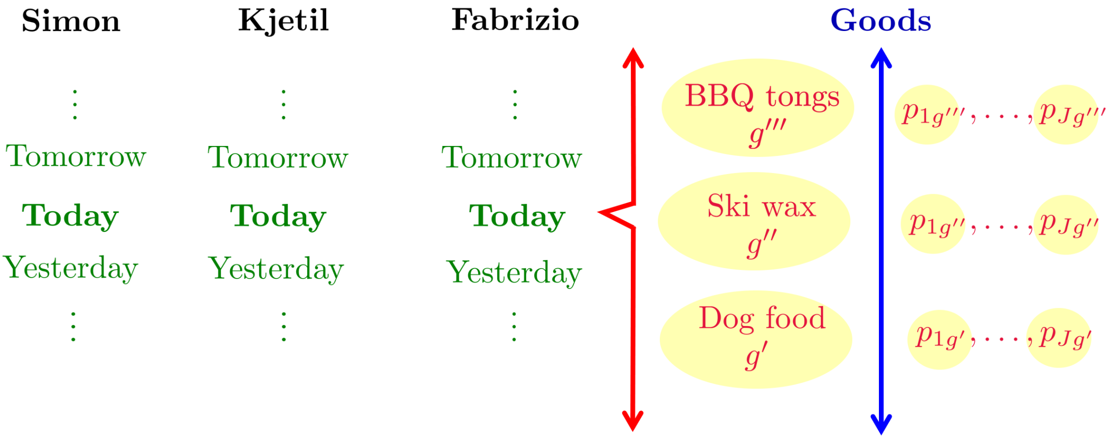
$$\uparrow p\,,\downarrow \varepsilon_x\,,\uparrow \mu\,,\uparrow p$$

- We check second order conditions in quantitative exercise

▸ Back - Firm problem

Key departure - Dynamic budgeting

Key departure - Two-stage budgeting - E.g. Nested CES / Kimball



E.g. Eeckhout, De Loecker, Mongey (2022), EMX (2022), Boar Midrigan (2021)

3. Pass-through - BLP

Nevo's (2000) interpretation of Berry, Levinsohn, Pakes (1995)

$$V\left(e_i, p_j\right) = \phi_j + \alpha_{e_i}\left(e_i - p_j\right) + \zeta_{ij}$$

Then we have:

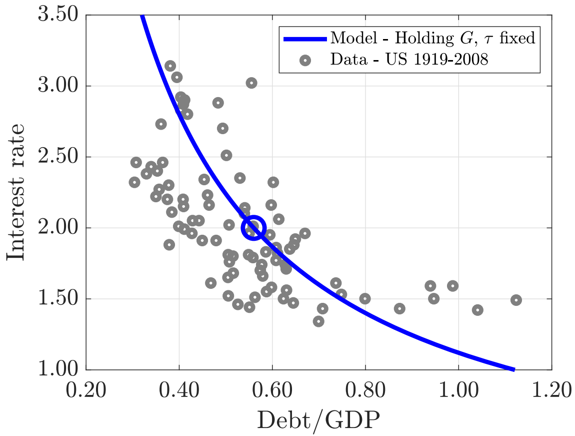
$$\varepsilon_j = \int \varepsilon_{ij}\, s_{ij}\, di \quad , \quad \varepsilon_{ij} = \eta p_j \alpha_e \quad , \quad s_{ij} = \frac{\rho_{ij}}{x_j}$$

$$\frac{\partial \log \varepsilon(p)}{\partial \log p} = \int \underbrace{\frac{\rho_{ij}\alpha_e}{\int \rho_{kj}\alpha_k\, dk}}_{\text{Elasticity weights}} \left[\underbrace{1}_{\text{1. Elasticity effect}} \underbrace{-\left(\alpha_e - \varepsilon_j\right)}_{\text{2. Composition effect}} \right] di$$

- No effect via marginal value of left-over resources
- Distribution of elasticities (mostly) exogenous
- If $\alpha_e = \overline{\alpha}$, then super-elasticity is 1

Back - Pass-through

Debt-to-GDP and interest rates

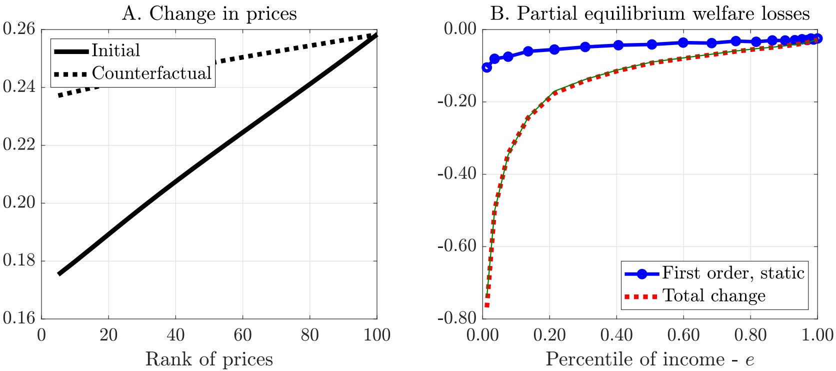


- Krishnamurthy Vissing-Jorgensen (JPE, 2012) - *Aggregate Demand for Treasury Debt*

  x-axis: Data mean of 0.43 adjusted to target $B = 0.56$, y-axis: Data mean spread of 8.1% adjusted to target 2%

Back - Calibration

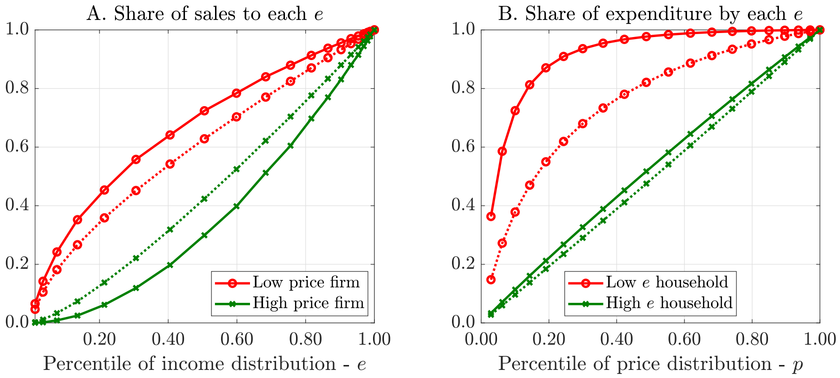
Counterfactual - Distorted productivity shock



- First order approximation still misses expenditure switching

Back - Common price change

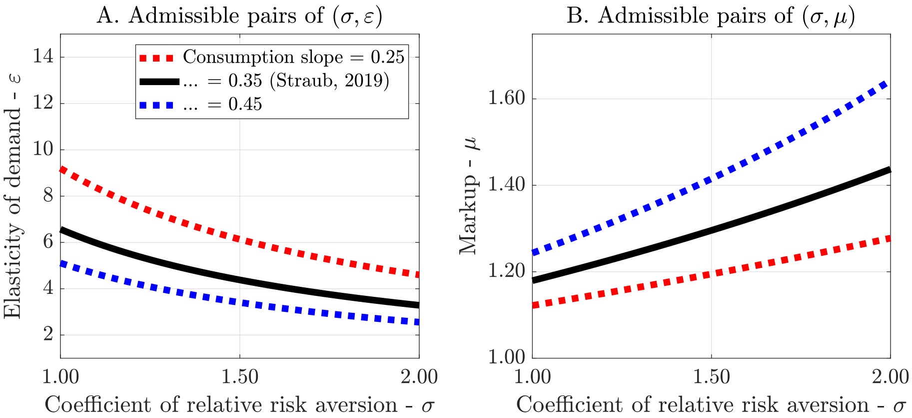
Counterfactual - Distorted productivity shock



- With higher price of cheap goods, both shift to higher priced goods.
- Rich, more so.

Back - Common price change

Implied restriction on parameters



- Plot combinations of (σ, ε) that give $\varepsilon \times \sigma \times \frac{\partial \log c_i}{\partial \log y_i} = 2.2$

Back - Auer et al (2022)

Calibration - Quarterly - 2/3 - Productivity and quality

- Higher marginal cost $\leftrightarrow$ Higher quality

$$\log z_j \sim \left(-\frac{1}{2}\sigma_z^2, \sigma_z \right) \quad , \quad \log \phi_j = -\gamma \log z_j \quad , \quad \gamma = 1$$

- Manova, Zhang (QJE, 2012)
  - *Firms that export more, and charge higher export prices, import more expensive inputs*
- Hottman, Redding, Weinstein (QJE, 2016)
  - *Large role ($\approx$ 70%) for "appeal" differences*
- House of Gucci (2022)
  - *High quality, high cost, high price, selling to less price sensitive consumers*