Pricing Inequality

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The Question

Q: Does household heterogeneity matter for firm pricing and aggregate price dynamics?

- Two facts about households:

    - Poor households are more price elastic (Auer-Burstein-Lein-Vogel'24)

    - Poor households buy low price varieties of the same good (Jaimovich et al'19; Bils-Klenow'01)

- Heterogeneity in income/wealth has direct implications for how firms set prices:

    - Who the firm sells to and how elastic they are determines firms' markups

    - Government policies affecting income/wealth will affect markups and inflation

The Answers

Q: Does household heterogeneity matter for firm pricing and aggregate price dynamics?

- Two facts about households:

    - Poor households are more price elastic (Auer-Burstein-Lein-Vogel'24)

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- Heterogeneity in income/wealth has direct implications for how firms set prices:

    - Who the firm sells to and how elastic they are determines firms' markups
      Result 1 - Household het. accounts for nearly 70% of large vs small firm markups

    - Government policies affecting income/wealth will affect markups and inflation
      Result 2 - 40% less inflation when household heterogeneity is turned off

This Paper

- Simple model for the basic mechanism:

    - Static - Two households - Endowment

    - Extensive margin demand: One good in two varieties

- Quantitative model for quantification:

    - Dynamic - Many households - Bewley

    - Extensive margin demand: G goods in J varieties

- Importance of household heterogeneity:

    - Cross-section of markups

    - Following a fiscal transfer shock

Simple Model

Households' Problem

- Two types, with low, high endowments $i \in \{L, H\}$. A unit measure of each

1. Draw preferences for two varieties $j \in \{1, 2\}$:

$$\left(\zeta_1^i, \zeta_2^i\right) \sim \Gamma(\zeta), \quad \text{where} \quad \log \Gamma(\zeta) = -\sum_j e^{-\eta \zeta_j}$$

2. Choose which variety to consume with: Quality $\phi_1 > \phi_2$

$$\max \left\{ V_1^i + \zeta_1^i + \frac{1}{\eta} \log \phi_1, V_2^i + \zeta_2^i + \frac{1}{\eta} \log \phi_2 \right\}$$

3. Choose how much to consume

$$V_j^i = \max_{c_j^i} u\left(c_j^i\right) \quad \text{subject to} \quad p_j c_j^i = e^i \quad \left[\lambda_j^i\right]$$

Households - Elasticities & Sorting

- Demand - Let $v^i = e^{V^i}$

$$x_1^i = \rho_1^i c_1^i \quad , \quad \rho_1^i = \phi_1 \left(\frac{v_1^i}{\widetilde{v}^i} \right)^{\eta}, \quad \widetilde{v}^i = \left[\phi_1 \left(v_1 \right)^{i\eta} + \phi_2 \left(v_2 \right)^{i\eta} \right]^{\frac{1}{\eta}}$$

- Elasticity

$$-\frac{\partial \log x_1^i}{\partial \log p_1} = \eta \left(1 - \rho_1^i \right) \times c_1^{i,-(\sigma-1)} + 1$$

- Sorting

$$\log \left(\frac{\rho_1^H / \rho_2^H}{\rho_1^L / \rho_2^L} \right) \approx \left(\lambda_1^L - \lambda_2^L \right) \left(e^H - e^L \right) > 0$$

- Data
    1. Elasticity - Higher-income households are less elastic - Auer et al. (2023)

    2. Sorting - Higher-income households pay higher prices - Jaimovich et al. (2019)

Firms - Markups

- Problem

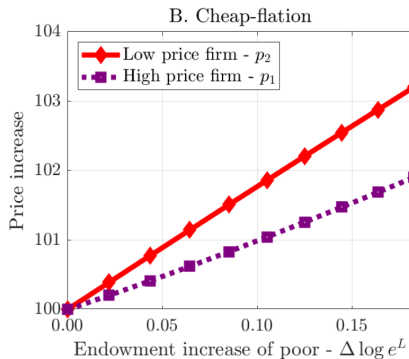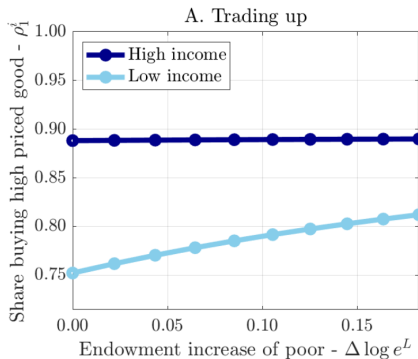$$\pi_1 = \max_{p_1} (p_1 - MC)\, x_1 \quad \text{subject to} \quad x_1 = \sum_i x_1^i$$

- Nash equilibrium

$$p_1^* = \frac{\varepsilon_1}{\varepsilon_1 - 1} MC \quad , \quad \varepsilon_1 = \sum_i \left(\frac{x_1^i}{x_1}\right) \left[\eta\left(1 - \rho_1^i\right) c_1^{i,-(\sigma-1)} + 1\right]$$

- Data - Large firms:

  1. Higher markups - Edmond et al. (2023) via market power and heterogeneity of customers

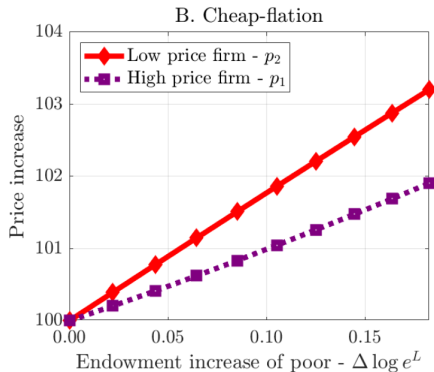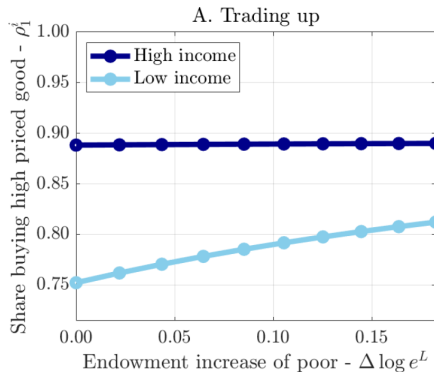 2. Higher sales - more customers, higher quality - Afrouzi et al. (2024)

Comparative static - $e'_L = e_L + T$

A. Trading up

B. Cheap-flation

A. Sorting

- Poor less elastic $\Rightarrow$ Reallocate consumption to higher price, higher quality good
- **Data** - Consistent with 'trading up' - Jaimovich, Rebelo, Wong (2019), & Zhang (2019)

Comparative static - $e'_L = e_L + T$

A. Trading up

Share buying high priced good - $\hat{\rho}_1^i$

- High income
- Low income

Endowment increase of poor - $\Delta \log e^L$

B. Cheap-flation

Price increase

- Low price firm - p_2
- High price firm - p_1

Endowment increase of poor - $\Delta \log e^L$

B. Markups

- Firm 1 - More market power - $\Uparrow p_1$
- Firm 2 - Less choosy customers - $\Uparrow p_2$
- **Data** - Consistent with 'cheapflation' - Cavallo Kryvstov (2024)

Quantitative Model

Nested Logit + Bewley

Differentiated goods

- Goods $g \in \mathcal{G}$, each has J varieties $j \in \{1, \ldots, J\}$ η, θ, J
- Pareto quality ϕ_j (identical draws for each good) ξ
- Decreasing returns: $y_j = n_j^\alpha$ α

Homogeneous good

- Continuum of identical firms: $Y_c = N_c$. Used for government spending, $\overline{G}$.

Households

- Stochastic income We_t^i (AR(1) + Transitory - Krueger Perri Mitman, 2016)
- Taxes τ, transfers T (20% and 5% of GDP - Kaplan Moll Violante, 2020)
- Save in government debt $r = 2\%$, liquid asset calibration   ($B/W = 0.56$ - Kaplan Violante, 2022)
- Preferences only over differentiated good, CRRA σ

Households' Problem

- Today, conditional on choosing good-variety jg

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

$$p_{jg} c_{jg} + a' = \left(1 - \tau\right) We + (1 + r)a + \Pi + T$$

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

- Tomorrow, given prices p_{jg} and preferences ζ'_{jg}

$$\overline{V}\left(a', e'\right) = \int \max_{j,g} \left\{ V\left(a', e', p_{jg}\right) + \frac{1}{\eta} \log \phi_{jg} + \zeta'_{jg} \right\} d\Gamma_\zeta\left(\zeta'\right)$$

Elasticities

- Demand

$$\rho_{jg}^i = \underbrace{\phi_{jg}\left(\frac{v_{jg}^i}{\tilde{v}_g^i}\right)^{\eta}}_{\rho_{j|g}^i}\underbrace{\left(\frac{\tilde{v}_g^i}{\overline{v}^i}\right)^{\theta}}_{\rho_g^i} \quad , \quad \tilde{v}_g^i = \left[\sum_{j\in g}\phi_{jg}\left(v_j^i\right)^{\eta}\right]^{1/\eta} \quad , \quad \overline{v}^i = \left[\sum_{g\in\mathcal{G}}\left(\tilde{v}_g^i\right)^{\theta}\right]^{1/\theta}$$

- Household price elasticity

$$\varepsilon_{jg}^{\rho\,i} = \left[\theta\,\rho_{j|g}^i + \eta\left(1-\rho_{j|g}^i\right)\right]\frac{\partial V\left(a^i, e^i, p_{jg}\right)}{\partial \log p_{jg}} \quad , \quad \varepsilon_{jg}^{c\,i} \in \left[\frac{1}{\sigma}, 1\right]$$

- Firm's price elasticity

$$\varepsilon_{jg} = \int_{A\times E}\left(\frac{\rho_{jg}^i c_{jg}^i}{x_{jg}}\right)\left(\left[\theta\,\rho_{j|g}^i + \eta\left(1-\rho_{jg}^i\right)\right]c_{jg}^{i\,-(\sigma-1)} + \varepsilon_{jg}^{c\,i}\right)dH\left(a^i, e^i\right)$$

Parameters (Validation Omitted Here)

- J - Concentration (Amiti Heise, 2024)

- ζ - Sales share of top firms (Amiti Heise, 2024)

- η - Average markup

- θ - Relationship between market share and markup (Replicate: Edmond et al, 2023)

- σ - How price elasticities decline with income (Replicate: Auer et al, 2022)

- α - How prices paid increase with income (Replicate: Jaimovich et al, 2019)

| Parameter	Value	Moment	Data	Model	
J	25	Sales share HHI	0.051	0.051	
ζ	9.30	Top 4 firms sales share	0.30	0.30	▶
η	10.96	Average cost-weighted markup	1.25	1.25	
θ	0.15	EMX elasticity of markups to shares	0.07	0.07	▶
σ	1.92	$3\times$ higher income, $X \times$ lower elasticity	2.22	2.22	▶
α	0.64	Top vs. Bottom quintile of income households pay $X\%$ higher prices	14.4	14.4	▶

Quantitative Results in the Cross-Section

I.Elasticities
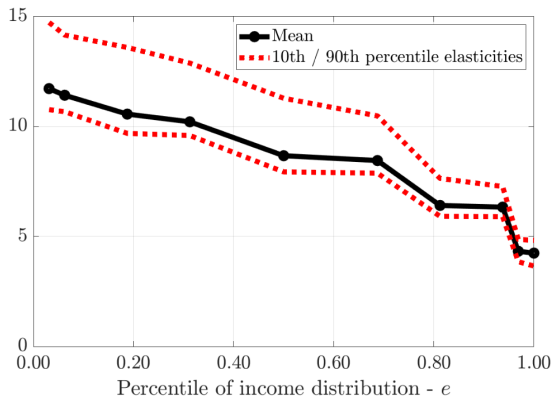
- **Simple regression:** $\mathbb{E}\left[\varepsilon^i | e\right] = \beta_0 - \beta_1 \log e, \quad \widehat{\beta}_1 = 2.23$

- *A household with an income 1 s.d. above the mean has a price elasticity about 20% [22.7%] below the price elasticity of the median consumer [6.23].* - Nakamura, Zerom (2010)

II.Sorting

Share of firm sales to each (a, e)
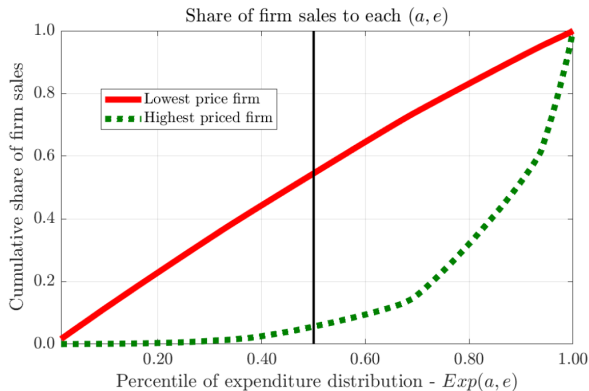
- At the low quality firm, >50 percent of sales to below median expenditure households
- At the high quality firm, <15 percent of sales to below median expenditure households

III.Markups

A. Elasticity of demand
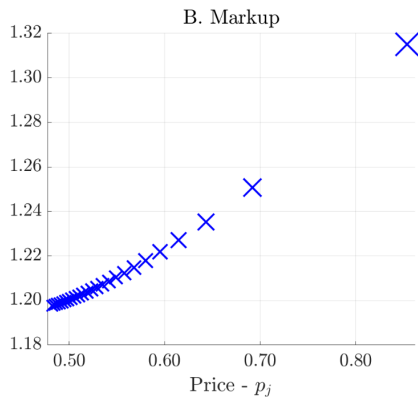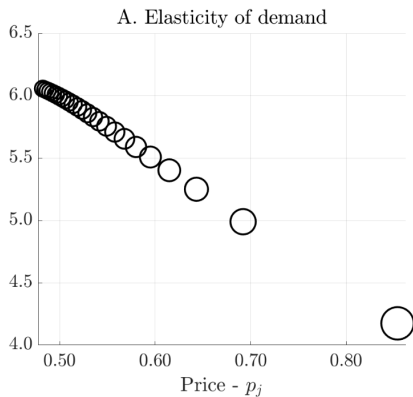
B. Markup

- High quality firms are: Larger, Higher prices, Higher markups

Household Heterogeneity vs Market Power

- Which one is more important: Household heterogeneity and Market power?

Elasticity Decomposition

	Market Power	Household Heterogenaity
Top − Bottom Quintile Firms	32.4	**67.6**
Middle − Bottom Quintile Firms	35.2	64.8

Note: Quintiles formed on the basis of sales.

- Household heterogeneity dominates.
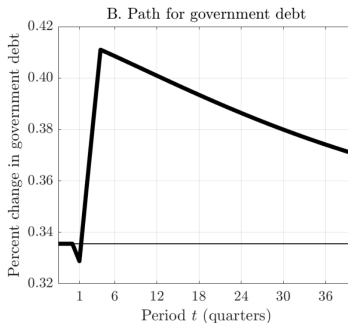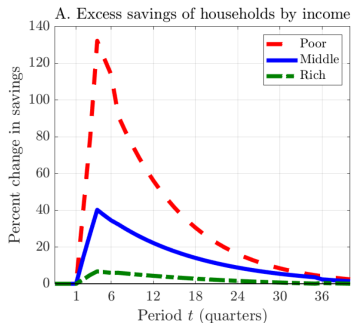
Welfare Effects of Markups

- Monopolistic competition: All firms markup equal to 25%

- Competitive: All firms markup equal to 0%

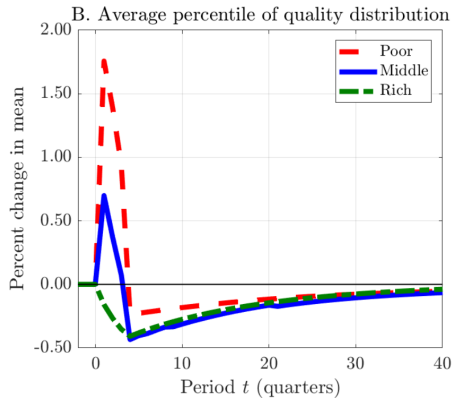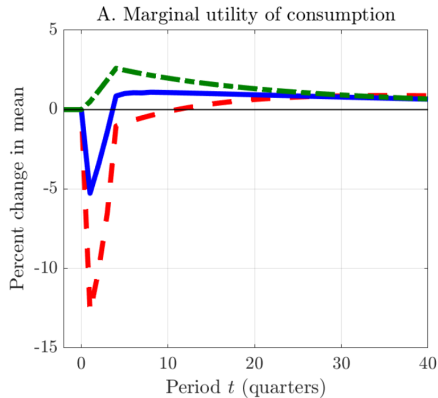|		Baseline	Monop. Comp	Competitive
A. Statistics	Average markup	22%	22%	0
	Interest rate	2.00%	1.99%	1.71%
B. Firms	**Prices**			
	Aggregate		0.52	-19.40
	Low quality goods		0.31	-20.00
	High quality goods		-0.45	-19.62
	Quantities			
	Aggregate		-0.00	-0.00
	Low quality goods		-2.42	-2.58
	High quality goods		6.24	7.54
C. Households	**Quality**			
	Aggregate		35.3	39.2
	Poor		11.6	36.2
	Rich		-3.4	-3.6
	Consumption			
	Aggregate		-0.0	-0.0
	Poor		0.0	-10.9
	Rich		0.1	3.3

Quantitative Results in the Aggregate Dynamics

How does the Economy Respond to a Fiscal Transfer?

- Data - Excess savings peaked at 7.56% of GDP in August 2021

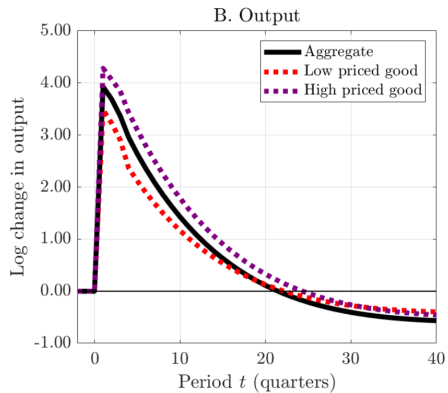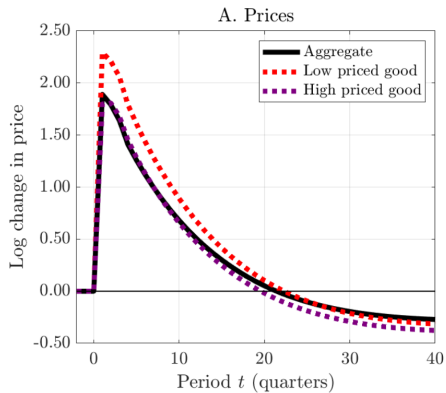- Increase T1, . . . , T6 by 1.26% of GDP

- Result in excess savings:

A. Excess savings of households by income — B. Path for government debt

Elasticities & Sorting

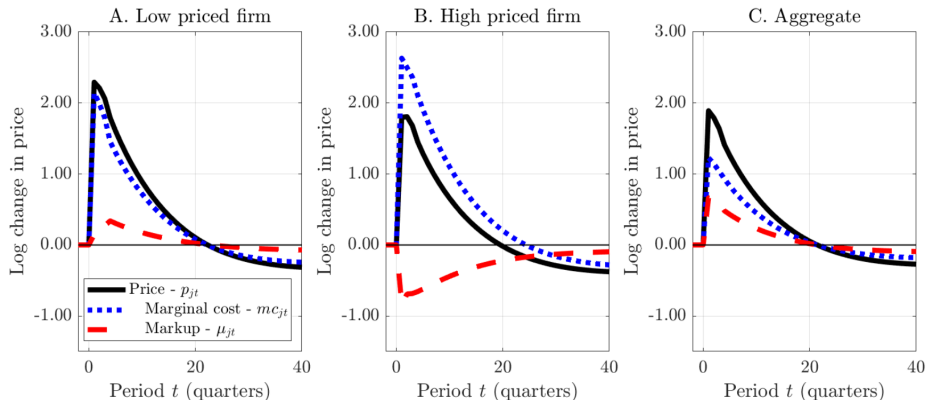A. Marginal utility of consumption

B. Average percentile of quality distribution

- Low income - Transfer: $\uparrow c_t^i$, High income - Face higher prices (next): $\downarrow c_t^i$

Prices & Output

A. Prices

B. Output

- Consistent with *Cheapflation* and *Trading up*

Markups & Marginal Cost

A. Low priced firm — B. High priced firm — C. Aggregate

Log change in price vs Period t (quarters)

Legend: Price - p_{jt} (solid black); Marginal cost - mc_{jt} (dotted blue); Markup - μ_{jt} (dashed red)

- Markup differences account for more than 100% of *cheapflation*, and 35.1% of inflation

Conclusions & Discussions

- A good idea to build a framework for pricing inequality.

- Broadly consistent with many empirical facts (cross-section and time-series).

- Discussions: Not sure where the authors are exactly heading.