Pricing Inequality

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SF Fed - February 2025

The views expressed herein are those of the authors and not those of the Federal Reserve System.

Firm pricing and household inequality

1. **Persistence of pandemic inflation**
   - Late 2022: Inflation 8%, Household real cash-balances 50% higher than pre-pandemic levels
   - McDonalds CEO: *"Low income households resilient, strategic price increases, decrease units"*

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  Result 2 - Large firms have higher markups mostly (**60%**) due to household heterogeneity

  Result 3 - A fiscal transfer of 1% of GDP to h'holds increases aggregate markup **0.3 ppt**

Firms - Markups depend on customers' demand elasticities

- Firm - Selling variety $j \in \{1, \ldots, J\}$ of good $g \in \mathcal{G}$.

$$\pi_{jg} = \max_{p_{jg}} p_{jg} q_{jg} - W n_{jg} \quad \text{subject to} \quad \underbrace{q_{jg} = \int \rho^i_{jg} \, q^i_{jg} \, di}_{\text{Demand}} \quad , \quad \underbrace{q_{jg} = n^{\alpha}_{jg}}_{\text{Technology}}$$

- Optimal price

$$p^*_{jg} = \frac{\varepsilon_{jg}}{\varepsilon_{jg} - 1} \, mc_{jg} \quad , \quad \varepsilon_{jg} = \int \underbrace{\left[\varepsilon^{i,\rho}_{jg} + \varepsilon^{i,q}_{jg} \right]}_{\text{Elasticities}} \underbrace{\left(\frac{\rho^i_{jg} q^i_{jg}}{q_{jg}} \right)}_{\text{Sorting}} di$$

- What do firms want to know?
  - Elasticities - What are the elasticities of demand of different customers?
  - Sorting - What is the sorting of high and low elasticity customers across firms?

Households - Elasticities and sorting depend on wealth and income

- Today, conditional on choosing a single good-variety jg to consume

$$
\begin{aligned}
V\left(a, e, p_{jg}\right) &= \max_{a', c_{jg}} u\left(c_{jg}\right) + \beta \int \overline{V}\left(a', e'\right) d\Gamma_e\left(e'|e\right) \\
p_{jg} c_{jg} + a' &= (1-\tau) We + (1+r) a + \Pi + T \\
a' &\geq \underline{a}
\end{aligned}
$$

- Tomorrow, draw preferences over good-varieties ζ'_{jg} and choose jg to consume

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

Households - Elasticities and sorting depend on wealth and income

- Demand

- Elasticities

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$$\rho^i_{jg} = \underbrace{\phi_{jg}\left(\frac{v\left(a^i, e^i, p_{jg}\right)}{\widetilde{v}\left(a^i, e^i, \boldsymbol{p}_g\right)}\right)^{\eta}}_{\rho^i_{j|g}} \underbrace{\left(\frac{\widetilde{v}\left(a^i, e^i, \boldsymbol{p}_g\right)}{\overline{v}\left(a^i, e^i\right)}\right)^{\theta}}_{\rho^i_g} \quad , \quad \widetilde{v}\left(a^i, e^i, \boldsymbol{p}_g\right) = \left[\sum_{j \in g} \phi_{jg}\, v\left(a^i, e^i, p_{jg}\right)^{\eta}\right]^{1/\eta}$$

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- Elasticities

$$\varepsilon^{\rho\, i}_{jg} = \underbrace{\left[\theta\, \rho^i_{j|g} + \eta\left(1 - \rho^i_{j|g}\right)\right]}_{\text{Size-based market power}} \times \underbrace{\frac{\partial \log v\left(a^i, e^i, p_{jg}\right)}{\partial \log p_{jg}}}_{\text{Consumer heterogeneity}}$$

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$$\log\left(\frac{\rho_1^H/\rho_2^H}{\rho_1^L/\rho_2^L}\right) = \log\left(\frac{v_1^H/v_2^H}{v_1^L/v_2^L}\right)^{\eta} = \eta \int_{\log p_2}^{\log p_1} \left\langle -\frac{\partial \log v^L(p)}{\partial \log p} \right\rangle - \left\langle -\frac{\partial \log v^H(p)}{\partial \log p} \right\rangle d\log p$$

Contrast with alternative approaches

1. Macro

Firm elasticities determined by relative size - $\varepsilon_j = \varepsilon(s_j)$

EMX (2015, 2023), De Loecker Eeckhout Mongey (2022), Baqaee Farhi Sangani (2024, 2024), Boar Midrigan (2023)

New - Household heterogeneity also shapes markups

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Individual elasticities are parametric functions of income - $\varepsilon^i = \varepsilon(e^i)$

BLP (1995), Nevo (2000), Nakamura Zerom (2010), ...

New - Relationship emerges endogenously from a frontier macro model

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3. Public / Spatial / Micro / Trade / Search

Parameterize elasticities or search costs $\varepsilon(e^i)$ and / or tastes $\phi_j^i(e^i)$

Handbury (2021), Auer et al (2024), Faber Fally (2022), Olivi et al (2024), Sangani (2024), Nord (2024)

New - Preferences independent of income, elasticities endogenous

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Parameter		Moment		Data	Model
$\mathbf{J}$	25	Concentration	Sales share HHI	0.052	0.052
ξ	10.9	Concentration	Top 4 firms sales share	30.5	30.5
η	8.9	Markups - Level	Average cost-weighted	1.25	1.25
θ	0.04	Markups - Slope	EMX within-industry elasticity of markups to sales	0.03	0.03

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   - Firms-per-market J, Pareto tail of quality ξ, Preference dispersion η, θ
3. Use novel empirical evidence from Auer, Burstein, Lein, Vogel (2024)
   - CRRA parameter σ
   - Replicate their estimates of declining elasticities of demand by income

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σ	2.57	Elasticities-by-Income	$3\times$ higher income, X lower elasticity	2.42	2.42
α	0.63	Sorting	Top quintile of income households pay $X\%$ higher prices	14.4	14.4

Result 1 - Integrate wide body of empirical facts

- Extensive margin* - ↑ Sales mostly due to ↑ Customers, not ↑ Quantity per customer
  Afrouzi Drenik Kim (2024), Einav Klenow Levin Murciano-Goroff (2021)
- Firm sales - Higher due to quality, lower due to higher marginal cost and higher markups
  Hottman Redding Weinstein (2016)
- Sorting* - Higher income households buy from larger firms
  Faber Fally (2022)
- Income and markups* - Higher income households pay higher markups
  Sangani (2024)
- Wealth and markups* - An increase in local wealth increases local markups
  Stroebel Vavra (2019)

* Quantitatively replicate these statistics in the paper

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	Relative size $\left[\rho^i_{j\|g}\theta + (1-\rho^i_{j\|g})\eta\right]$	Household heterogeneity $\lambda^i_{jg} p_{jg} c^i_{jg}$
Top vs. Bottom quintile sales firms	42.5	**58.5**
Largest vs. Smallest sales firms	45.5	54.5

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- Recalibrate model, match same concentration / markup moments, but under log ($\sigma = 1$)
- Role of household heterogeneity is **zero**
- But *Elasticities-by-Income* and *Sorting* moments are also **zero**
- New framework + New data $\implies$ New result

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Top vs. Bottom quintile sales firms	100	0
Largest vs. Smallest sales firms	100	0

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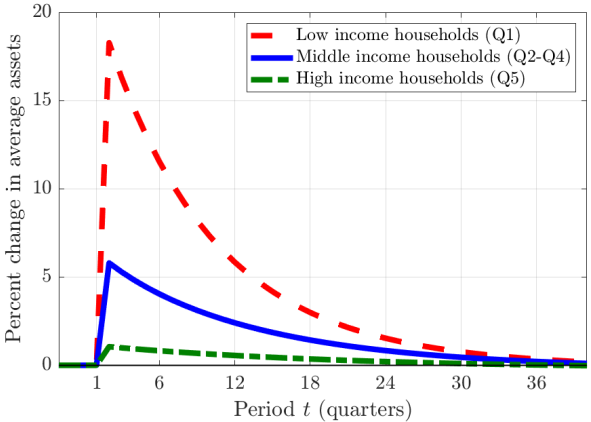
Result 3 - Fiscal transfer increases the aggregate markup



- One-time transfer of 1% of GDP to households

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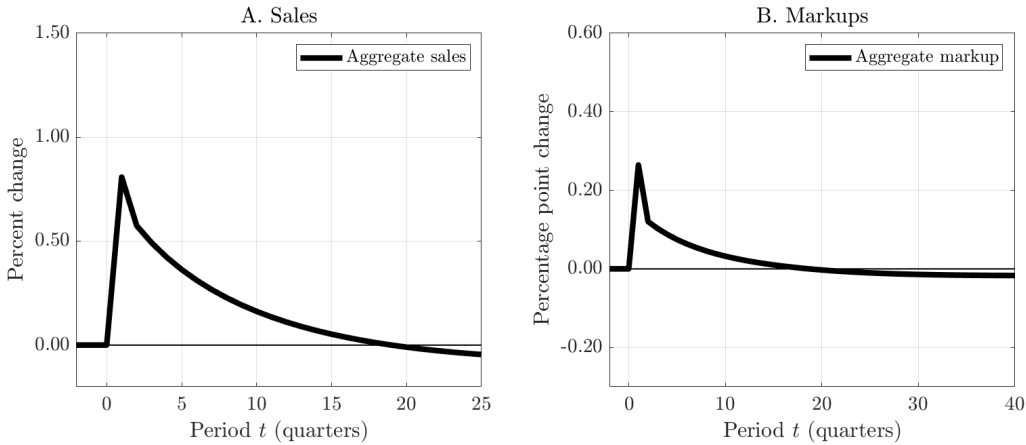

- **Result** - Aggregate markup increases **0.3 ppt**.Shaped by consumer heterogeneity effects.

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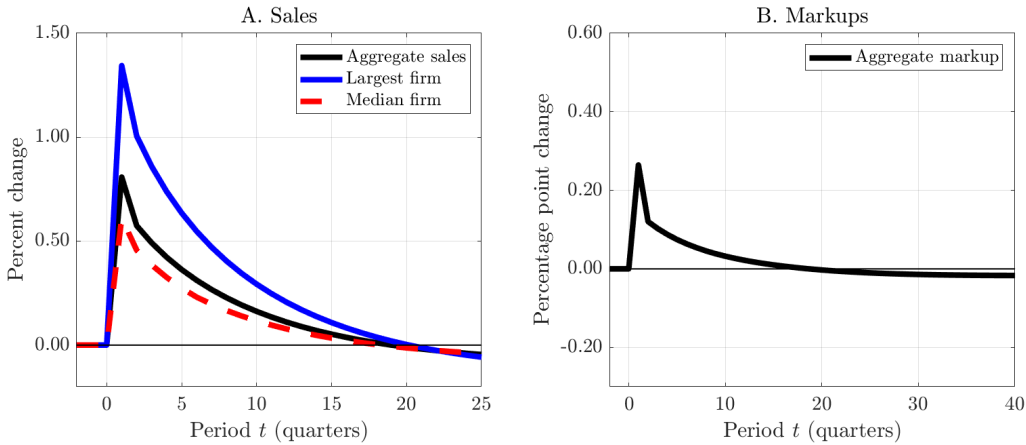

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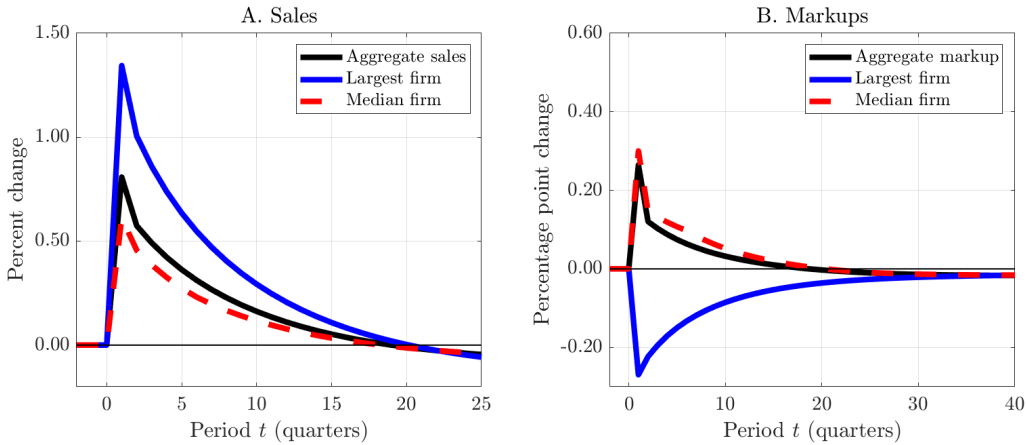

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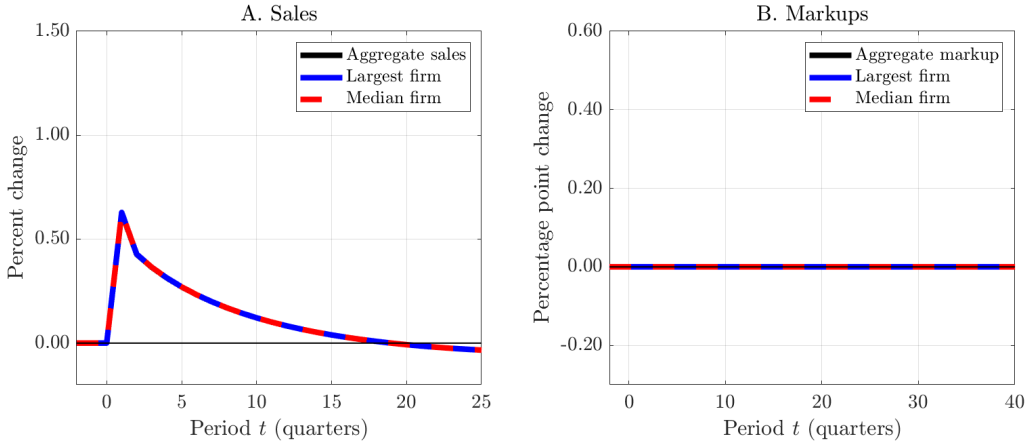

- **Result** - Heterogeneity accounts for 100% of markup response and 49% of inflation

Important questions

1. Is the restriction to a single good each period important?

2. Is the divisibility of the good important? What if $q^i_{jg} = 1$?

3. Why not have quality ϕ_j complementary to consumption $\phi_j u(c^i_j)$?

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- Appendix has important variations that answer this:
  - Continuous time model - Shrink the period length. Keep the basket size
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- Appendix walks through this in context of Fajgelbaum Grossman Helpman (2011)
- Households very price sensitive to high quality goods. Large firms $\rightarrow$ Smaller markups ✗

Conclusion

New theory - Flexible framework that integrates IO and frontier heterogeneous agent macroeconomics. The key link is the endogenous marginal value of wealth. This avoids adding additional parameters to either model.

1. **New perspective on markups**
   - Lesson - *Household heterogeneity / incomplete markets are key*
   - *Counterfactuals* studied in incomplete markets settings have markup implications
   - Income inequality, Income shocks, Financial instruments ... all shape individuals' elasticities

2. **New perspective on policy**
   - Lesson - *Markup responses inhibit counter-cyclical policies that operate via 'high MPC' h'holds*
   - *Policies* studied in incomplete markets settings have markup implications
   - UBI, Medical insurance, Tax progressivity, Debt relief ... all shape individuals' elasticities