Pricing Inequality

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

Fiscal expansions and prices

Standard theory of fiscal expansions and inflation

- Increase in demand requires more labor
- “Hot labor market” drives up wages, marginal cost, prices

Seems unsatisfactory given the pandemic period

- 2021-2022 inflation surge was from a *“shock to prices given wages”* Bernanke Blanchard (2025)

Need a better quantitative theory of fiscal expansions and markups

- Develop a new quantitative theory that links:
- Fiscal expansion $\rightarrow$ Improvement in household balance sheets $\rightarrow$ Higher aggregate markup

What we do

Theory consistent with recent measurement

- Rich households are less price sensitive than poor households, and buy high priced varieties
- Larger firms have higher markups, while selling higher quality goods to more customers

Parsimonious model

- Macro - Heterogeneous agent incomplete markets model
- IO - Additive random utility (discrete choice) model of demand, expanded to many goods

Two results

1. Deficit financed fiscal expansions have a significant effect on the aggregate markup
   - Accounts for more than 40% of the empirical increase in P/W in the pandemic
2. Household heterogeneity is the main determinant of markup differences across firms
   - Accounts for more than 58% of markup differences between large and small firms

Simple choice model - Rich indulge their tastes, Poor respond to prices

- Two types of households $i \in \{1, 2\}$ with wealth $a^i \in \{a^L, a^H\}$
- Consume one of two goods $j \in \{1, 2\}$, $p_1 > p_2$
- Problem
  1. Draw tastes for each good

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

  2. Choose which good to consume

$$\max \left\{ V\left(a^i, p_1\right) + \zeta_1^i \qquad , V\left(a^i, p_2\right) + \zeta_2^i \qquad \right\}$$

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  3. Intensive margin

  $$V\left(a^i, p_j\right) = u\left(q_j^i\right) \quad \text{subject to} \quad p_j q_j^i = a^i$$

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

$$\max\left\{ V\left(a^i, p_1\right) + \zeta_1^i + \frac{1}{\eta}\log\phi_1 \, , \, V\left(a^i, p_2\right) + \zeta_2^i + \frac{1}{\eta}\log\phi_2 \right\}$$

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Key formula

- Extensive margin of demand

$$\rho_1^i = \frac{\phi_1 \exp\left\{\eta V(a^i, p_1)\right\}}{\phi_1 \exp\left\{\eta V(a^i, p_1)\right\} + \phi_2 \exp\left\{\eta V(a^i, p_2)\right\}}$$

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Firm price setting

- Demand

$$x_1 = \rho_1^L q_1^L + \rho_1^H q_1^H$$

- Pricing

$$p_1^* = \frac{\varepsilon_1}{\varepsilon_1 - 1}\overline{mc} \quad , \quad \varepsilon_1 = \sum_i \left(\frac{\rho_1^i q_1^i}{x_1}\right)\varepsilon_j^i$$

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- Large firms
  - ✓ Sell higher quality goods, at higher prices, with higher sales
  - ✓ To more customers
  - ✓ At higher markups

    Size-based market power: Higher quality $\rightarrow$ Higher market share $\rightarrow$ Higher prices

    Household heterogeneity: Higher prices $\rightarrow$ Less elastic customers $\rightarrow$ Higher prices

Quantitative model - ‘Shopping cart’ and Bewley

1. ‘Shopping cart’ discrete choice model

- Many markets $m \in \mathcal{M}_t$, each has J firms $j \in \{1, \ldots, J\}$ J
- Markets $\mathcal{M}_t$ grow at rate $\gamma > 1$
- Pareto distribution of quality ϕ_j ξ
- Decreasing returns to scale α

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2. Bewley model of consumption and savings

- CRRA utility σ
- Stochastic income $WZ_t z_t^i$, quarterly, Z_t grows at rate γ
- Labor income tax τ, receive transfers T and profits lump-sum
- Save in government debt

Quantitative model - Formulas

- For each good m, choose the variety j to consume, $x_{jm} \in \{0,1\}$

$$
\begin{aligned}
V\left(a,z\right) &= \max_{a',q_{jm},x_{jm}} \int_0^1 \sum_{j=1}^{J} x_{jm}\left[u\left(q_{jm}\right) + \frac{1}{\eta}\log\phi_j + \zeta^i_{jm}\right] dm + \beta\gamma \int V\left(a',z'\right) d\Gamma_z(z'|z \\
\int_0^1 \sum_{j=1}^{J} x_{jm} p_{jm} q_{jm} dm &= (1-\tau)Wz + (1+r)a + \Pi + T - \gamma a' \quad , \quad \left[\lambda(a,z)\right] \\
a' &\geq 0
\end{aligned}
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Quantitative model - Formulas

- For each variety j, choose the measure to consume $\rho_j \in [0,1]$

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V\left(a,z\right) &= \max_{a',q_j,\rho_j} \sum_{j=1}^{J} \rho_j \left[u(q_j) + \frac{1}{\eta}\log\phi_j - \frac{1}{\eta}\log\rho_j\right] + \beta\gamma \int V\left(a',e'\right) d\Gamma_z(z'|z) \\
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- Demand - Given expenditure, e^i
- Elasticities
- Sorting

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$$\rho_j^i = \frac{\phi_j \exp\left\{\eta\left[u(q_j^i) - \lambda^i p_j q_j^i\right]\right\}}{\sum_{k=1}^J \phi_k \exp\left\{\eta\left[u(q_k^i) - \lambda^i p_k q_k^i\right]\right\}} \quad , \quad u'\left(q_j^i\right) = \lambda^i p_j \quad , \quad e^i = \sum_{j=1}^J \rho_j^i p_j q_j^i$$

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

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$$\varepsilon^{i,q}_j = \frac{1}{\sigma}$$

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$$\log\left(\frac{\rho^H_1/\rho^H_2}{\rho^L_1/\rho^L_2}\right) = \eta\left[\lambda^{L\,\frac{\sigma-1}{\sigma}} - \lambda^{H\,\frac{\sigma-1}{\sigma}}\right] \times \left[p_1^{\frac{\sigma-1}{\sigma}} - p_2^{\frac{\sigma-1}{\sigma}}\right]$$

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   - Moments: Concentration, Average markup
   - Important: Positive empirical relationship between Firms' share of sales and Markups

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4. Replicate regressions in Jaimovich, Rebelo, Wong, Zhang (2019)
   - Households in top expenditure quintile buy **14%** higher priced varieties of goods
   - Requires $\alpha =$ **0.64**

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Parameter		Moment		Data	Model
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
		Markups - Slope	EMX within-industry elasticity of markups to sales	0.03	0.03
σ	2.57	Elasticities-by-Income	$3\times$ higher income, X lower elasticity	2.42	2.42
α	0.64	Sorting	Top quintile of income households pay $X\%$ higher prices	14.4	14.4

Calibration - Disciplining σ

Auer et al (2024) - *Unequal Expenditure Switching: Evidence from Switzerland*

Data

$$\log\left(\frac{b^i_{Mt}}{b^i_{Dt}}\right) \quad = \quad \beta_0 - \beta_1 \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \boldsymbol{\beta_2} \log y^i \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \varepsilon_{it} \quad , \quad \widehat{\boldsymbol{\beta}}_2 = 2.20$$

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Model

- Compare shares on goods $\{M, D\} \in g$ across low / high income $i \in \{L, H\}$
- To a first order around p_{Dg} then e_L:

$$\log\left(\frac{b^H_{Mg}}{b^H_{Dg}}\right) - \log\left(\frac{b^L_{Mg}}{b^L_{Dg}}\right) = \underbrace{\varepsilon^L_{Dg}\left(\frac{\partial \log q^L_{Dg}}{\partial \log e^L}\right)\left(-\frac{\partial \log \varepsilon^L_{Mg}}{\partial \log q^L_{Mg}}\right)}_{\text{Coefficient estimated in ABLV}} \underbrace{\log\left(\frac{y^H}{y^L}\right)\log\left(\frac{p_{Mg}}{p_{Dg}}\right)}_{\text{Interaction term}}$$

Calibration - Disciplining α

JRWZ (2019) - *Trading Up and the Skill Premium*

Data - Within-market-time, Across-household differences in prices paid

$$\log P^i_{mt} = \lambda_{mt} + \sum_{\mathrm{q}=1}^{Q} \beta_{\mathrm{q}} \mathbb{1}\left[q^i_{dt} = \mathrm{q}\right] + \eta^i_{mt} \quad \text{, where} \quad \log P^i_{mt} = \sum_{u \in \{m,t\}} \omega^i_{umt} \log \overline{P}_{umt}.$$

Refine their approach

- Define markets m as $\mathit{Module} \times \mathit{DMA}$
- Compute average unit prices $\overline{P}_{umt}$ of UPC's u within these markets
- Rank households by *total annual expenditure quantiles* q^i_{dt} within each $\mathit{DMA} \times \mathit{Year}$
- Result - $\widehat{\beta}_5 - \widehat{\beta}_1 = 0.144$

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Quantitatively replicate these studies in the paper

Contrast with alternative approaches

1. Macro

Interpreted empirical size-markup relationship as causal - $\varepsilon_j = \varepsilon(s_j)$

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

New - Household heterogeneity also determines markups

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New - Household heterogeneity also determines markups

2. Industrial Organization

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

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

New - Individual elasticities are endogenous

Contrast with alternative approaches

1. Macro

Interpreted empirical size-markup relationship as causal - $\varepsilon_j = \varepsilon(s_j)$

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

New - Household heterogeneity also determines markups

2. Industrial Organization

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

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

New - Individual elasticities are endogenous

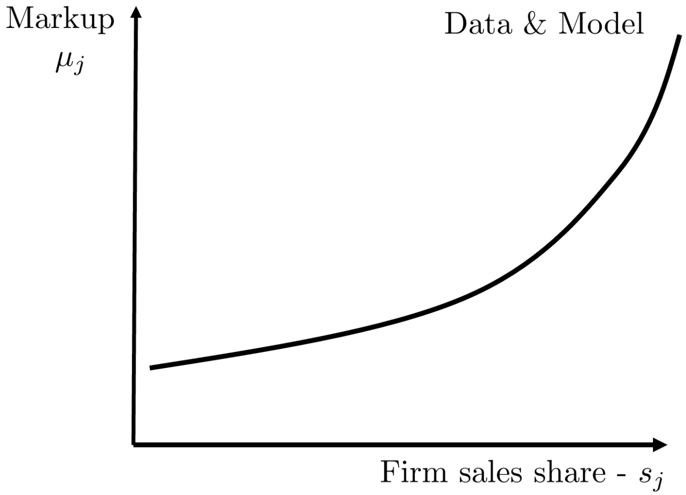
3. Public / Spatial / Micro / Trade / Search

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

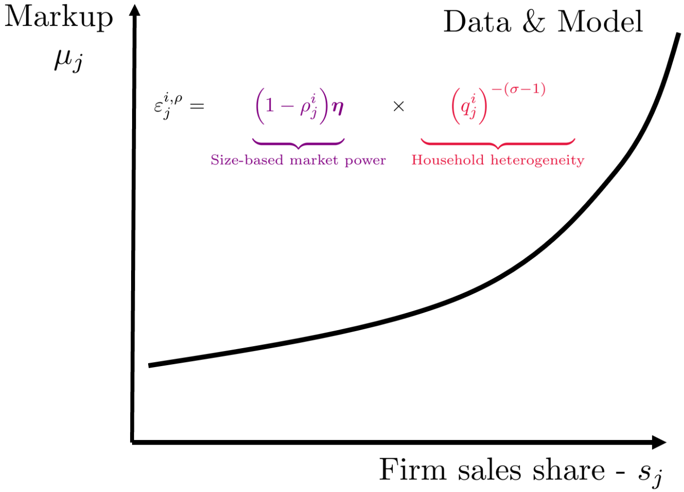
Handbury (2021), Auer et al (2024), Faber Fally (2022), Olivi et al (2024), Sangani (2024), Nord (2024)

New - Preferences separated from income

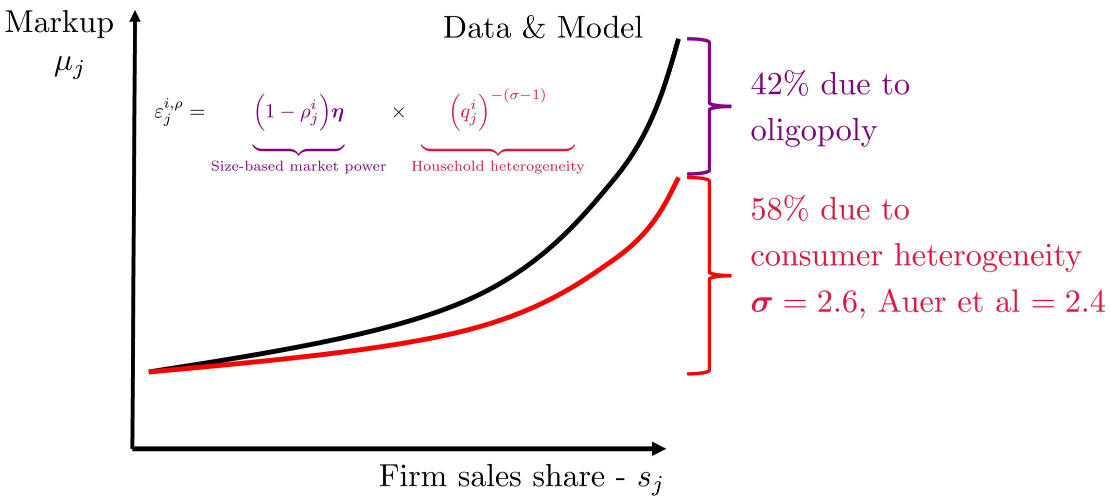
Result 1 - Household heterogeneity accounts for markup differences



Result 1 - Household heterogeneity accounts for markup differences



Result 1 - Household heterogeneity accounts for markup differences



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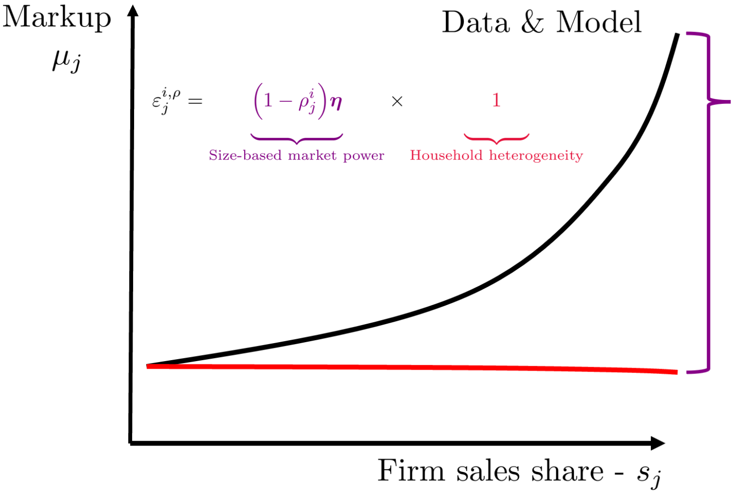
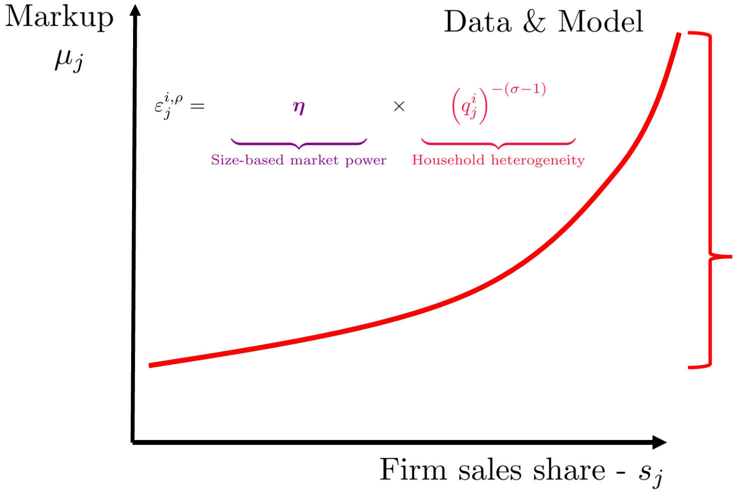


100% due to oligopoly

0% due to consumer heterogeneity

$\boldsymbol{\sigma} = 1$, Auer et al $= 0$

Result 1 - Household heterogeneity accounts for markup differences

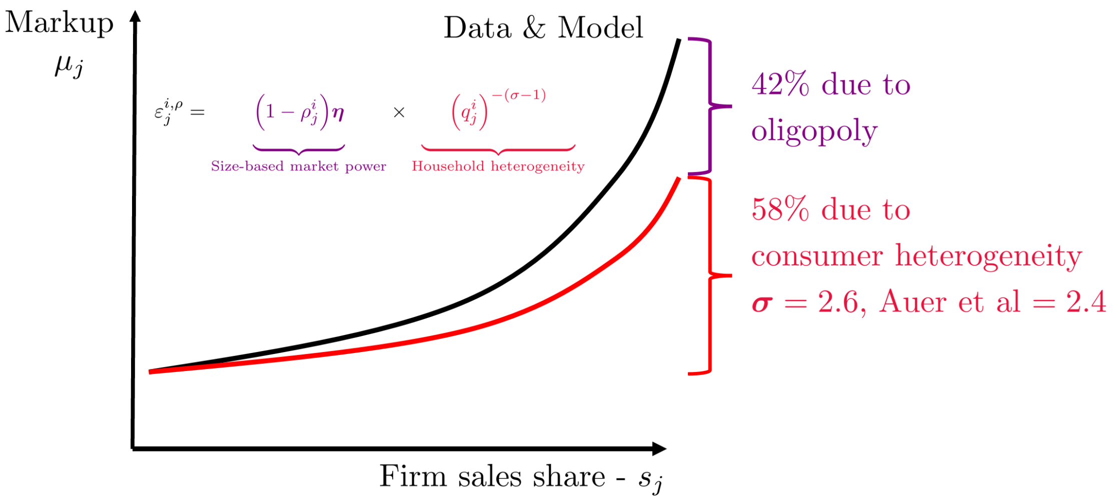


0% due to oligopoly

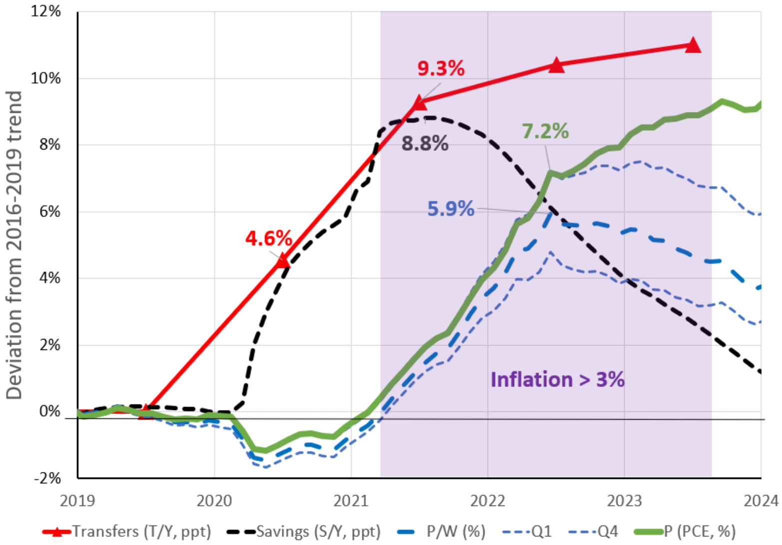
100% due to consumer heterogeneity

$\boldsymbol{\sigma} = 3.4$, Auer et al $= 2.9$

Result 1 - Household heterogeneity accounts for markup differences



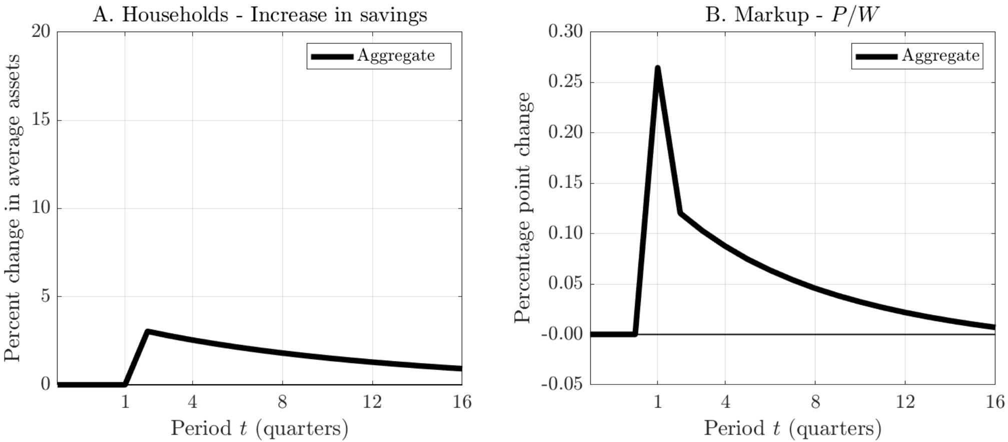
Result 2 - Fiscal Expansion and Aggregate Markup



Result 2 - Fiscal Expansion and Aggregate Markup

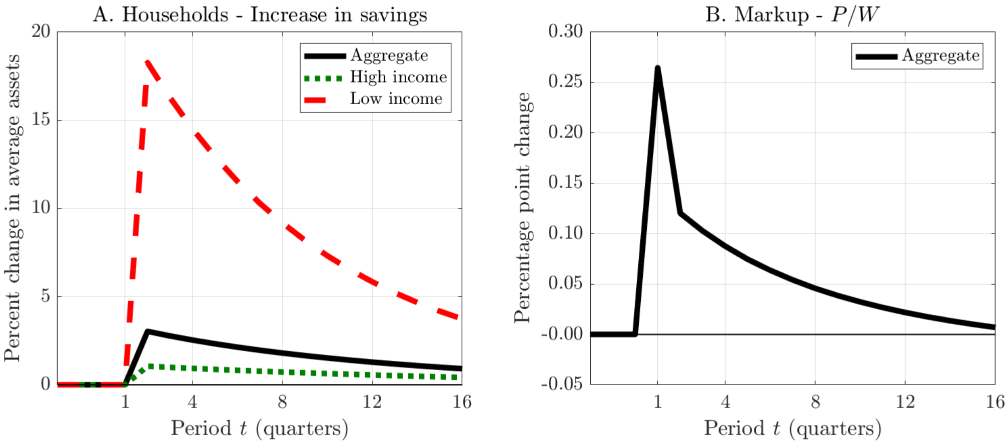
1. Compute the elasticity of the aggregate markup to a fiscal transfer
   - Deficit financed one-time increase in transfers T by 1% of GDP
   - Holding $\overline{G}$ and $\overline{r}$ fixed
   - Increase labor income taxes to smoothly repay debt
2. Apply this to the 9.3% increase in transfers in 2020-2021
3. How the data disciplines this result

Result 2 - Fiscal Expansion and Aggregate Markup



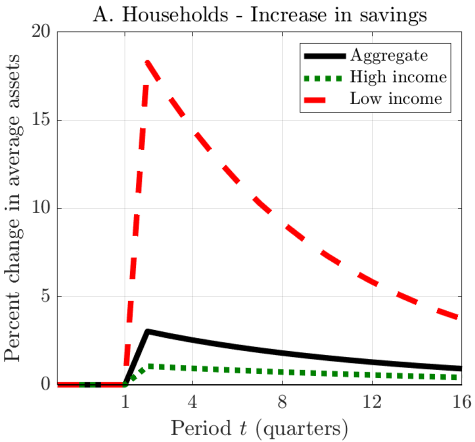
- Elasticity of aggregate markup $P\,/\,W$ is **0.26**.

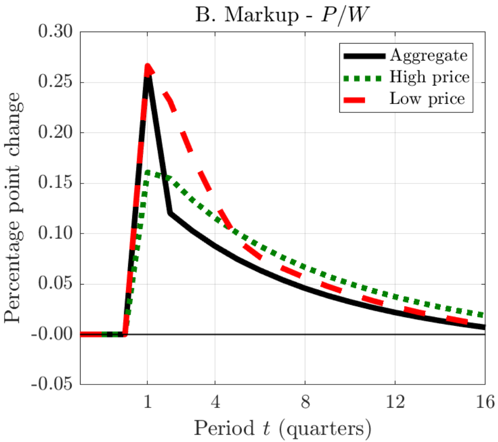
Result 2 - Fiscal Expansion and Aggregate Markup



1. Consistent with excess savings of households in the pandemic (Ganong et al, 2024)

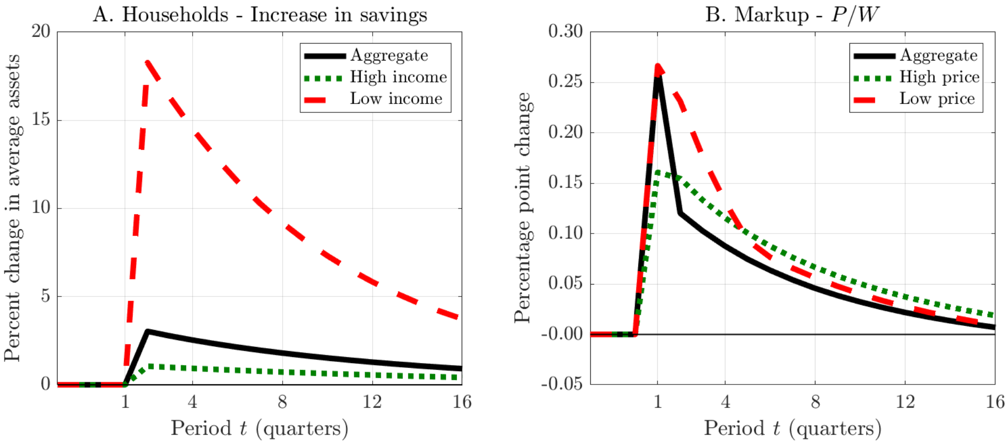
Result 2 - Fiscal Expansion and Aggregate Markup





2. Consistent with 'cheapflation' (Cavallo, Kryvstov, 2024)

Result 2 - Fiscal Expansion and Aggregate Markup



- McDonald's CEO, late 2022 - *"Resilient customers... strategic price increases"*

Result 2 - Fiscal Expansion and Aggregate Markup

- 2020 - 2021
  - Increase in transfers: 9.3% of GDP
  - Increase in savings: 8.8% of GDP
- 2022
  - P/W peaks at 5.9% above trend
  - PCE price level P is 7.2% above trend
- Applying our elasticity
  - Increase in transfers of 9.3% of GDP increases the aggregate markup P/W by 2.5%
  - Accounts for **42%** of the 5.9% increase in P/W

How the data disciplines these results

$$\varepsilon_j^{\rho\, i} = \underbrace{\eta\left(1-\rho_j^i\right)}_{\text{Size based market power}} \underbrace{\left(q_j^i\right)^{-(\sigma-1)}}_{\text{Household heterogeneity}}$$

	Baseline
Moments	
Elasticities by Income - Auer et al (2024)	2.42
Concentration, Average markup, Markups-by-Market-share	
Parameters	
CRRA - σ	2.6
Monopolistic / Oligopsonistic pricing	$\eta,\ \rho_j^i > 0$
Results	
1. Aggregate markup response to fiscal expansion	
Share of empirical increase in P/W	41 %
2. Decomposition of large vs. small firm markups	
Share due to household heterogeneity	58 %

How the data disciplines these results

$$\varepsilon_j^{\rho\, i} = \underbrace{\eta\left(1-\rho_j^i\right)}_{\text{Size based market power}} \underbrace{\left(q_j^i\right)^{-(\sigma-1)}}_{\text{Household heterogeneity}}$$

		Baseline	
Moments			
Elasticities by Income - Auer et al (2024)	0	2.42	2.88
Concentration, Average markup, Markups-by-Market-share	— Same as baseline —		
Parameters			
CRRA - σ	1	2.6	3.4
Monopolistic / Oligopsonistic pricing	$\downarrow \eta,\ \rho_j^i > 0$	$\eta,\ \rho_j^i > 0$	$\uparrow \eta,\ \rho_j^i \approx 0$
Results			
1. Aggregate markup response to fiscal expansion			
Share of empirical increase in P/W	0 %	41 %	66 %
2. Decomposition of large vs. small firm markups			
Share due to household heterogeneity	0 %	58 %	100 %

Answers to important questions

The restriction to a single good each period is not important

- Appendix has important variations with infinitely many purchases per quarter:

  Continuous time model - Shrink the period length. Keep the basket size

  Shopping cart model - Keep the period length. Expand the basket size

The divisibility of the good is not important

- Consider utility over an 'outside' good $u(c^i)$
- Then $u'(c^i)$ shows up in elasticity formula

$$u\left(c^i\right) + \psi_{jm} + \zeta^i_{jm}$$

$$c^i + p_{jm} + a^{i\prime} = \dots$$

Conclusion

New quantitative theory

- Flexible framework that integrates IO into frontier HA macro
- The key link between the two is the endogenous marginal value of wealth

1. New perspective on fiscal policy - Expansionary policies produce 'markup shocks'

- Policies studied in incomplete markets settings have markup implications

  Child Tax Credit expansion, UBI, Medical insurance, Tax progressivity, Debt relief, ...

2. New perspective on markups - Household heterogeneity is central

- Counterfactuals studied in incomplete markets settings have markup implications

  Income inequality, Income shocks, Financial instruments, ...

APPENDIX SLIDES

RELAXING THE ONE-GOOD PER-PERIOD ASSUMPTION

Answers to important questions

The restriction to a single good each period is not important

- Appendix has important variations with infinitely many purchases per quarter:

  Continuous time model - Shrink the period length. Keep the basket size

  Shopping cart model - Keep the period length. Expand the basket size

The divisibility of the good is not important

- Consider utility over an 'outside' good $u(c^i)$
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$$u\left(c^i\right) + \psi_{jm} + \zeta^i_{jm}$$
$$c^i + p_{jm} + a^{i\prime} = \ldots$$

Calibration: ABLV / JRWZ

Parameters - Disciplining σ

Auer et al (2024) - *Unequal Expenditure Switching: Evidence from Switzerland*

Data

$$\log\left(\frac{b^i_{Mt}}{b^i_{Dt}}\right) = \beta_0 - \beta_1 \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \boldsymbol{\beta}_2 \log e^i \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \varepsilon_{it} \quad , \quad \widehat{\boldsymbol{\beta}}_2 = 2.20$$

Parameters - Disciplining σ

Auer et al (2024) - *Unequal Expenditure Switching: Evidence from Switzerland*

Data

$$\log\left(\frac{b^i_{Mt}}{b^i_{Dt}}\right) \quad = \quad \beta_0 - \beta_1 \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \boldsymbol{\beta_2} \log e^i \log\left(\frac{p_{Mt}}{p_{Dt}}\right) + \varepsilon_{it} \quad , \quad \widehat{\boldsymbol{\beta}}_2 = 2.20$$

Model

- Compare shares on goods $\{M, D\} \in g$ across low / high income $i \in \{L, H\}$
- To a first order around p_{Dg} then e_L:

$$\log\left(\frac{b^H_{Mg}}{b^H_{Dg}}\right) - \log\left(\frac{b^L_{Mg}}{b^L_{Dg}}\right) = \underbrace{\varepsilon^L_{Dg}\left(\frac{\partial \log c^L_{Dg}}{\partial \log e^L}\right)\left(-\frac{\partial \log \varepsilon^L_{Mg}}{\partial \log c^L_{Mg}}\right)}_{\text{Coefficient estimated in ABLV}} \underbrace{\log\left(\frac{e^H}{e^L}\right) \log\left(\frac{p_{Mg}}{p_{Dg}}\right)}_{\text{Interaction term}}$$

Parameters - Disciplining α

JRWZ (2019) - *Trading Up and the Skill Premium*

Data - Within-market-time, Across-household differences in prices paid

$$\log P^i_{mt} = \lambda_{mt} + \sum_{\mathrm{q}=1}^{Q} \beta_{\mathrm{q}} \mathbb{1}\left[q^i_{dt} = \mathrm{q}\right] + \eta^i_{mt} \quad \text{, where} \quad \log P^i_{mt} = \sum_{u \in \{m,t\}} \omega^i_{umt} \log \overline{P}_{umt}.$$

Refine their approach

- Define markets m as $Module \times DMA$
- Compute average unit prices $\overline{P}_{umt}$ of UPC's u within these markets
- Rank households by *total annual expenditure quantiles* q^i_{dt} within each $DMA \times Year$
- Result - $\widehat{\beta}_5 - \widehat{\beta}_1 = 0.144$

RESULTS - NESTED CALIBRATIONS

Result 2 - Household heterogeneity accounts for markup differences

		Baseline	Log model $(\sigma = 1)$	Monopolistic competition $(\eta = \theta)$
		(1)	(2)	(3)
A. Household parameters				
Curvature in consumption	σ	2.6	1	
Taste dispersion - Within markets	η	8.9	2.12	
- Across markets	θ	0	0	
B. Firm parameters				
Tail parameter of Pareto	ξ	10.9	4.1	
Decreasing returns	α	0.63	0.66	
C. Moments				
Firms - Top 4 sales share		0.30	0.30	
Firms - Average markup	$\mathbb{E}[\mu_j]$	1.25	1.25	
Firms - Markups and sales shares	β_{EMX}	0.03	0.03	
Households - Elasticities and income	β_{ABLV}	2.20	0	
Households & Firms - Sorting	$\beta^5_{JRWZ} - \beta^1_{JRWZ}$	0.14	0	
Price dispersion	Std.$[\log p_j]$	0.14	0.14	
Share of elasticity variation due to h'hold heterogeneity		58	0	

Note: All economies have the same interest rate (r), with other parameters recalibrated to match the same level of total differentiated goods expenditure $(\overline{Z})$, labor income taxes (τ) and transfers (T) to GDP, average assets to average income (β)

Result 2 - Household heterogeneity accounts for markup differences

		Baseline	Log model $(\sigma = 1)$	Monopolistic competition $(\rho \approx 0)$
		(1)	(2)	(3)
A. Household parameters				
Curvature in consumption	σ	2.6	1	↑ 3.4
Taste dispersion - Within markets	η	8.9	2.12	11.7
B. Firm parameters				
Tail parameter of Pareto	ξ	10.9	4.1	14.7
Decreasing returns	α	0.63	0.66	0.64
C. Moments				
Firms - Top 4 sales share		0.30	0.30	0.30
Firms - Average markup	$\mathbb{E}[\mu_j]$	1.25	1.25	1.25
Firms - Markups and sales shares	β_{EMX}	0.03	0.03	0.03
Households - Elasticities and income	β_{ABLV}	2.20	0	↑ 2.62
Households & Firms - Sorting	$\beta^5_{JRWZ} - \beta^1_{JRWZ}$	0.14	0	↑ 0.17
Price dispersion	Std.$[\log p_j]$	0.14	0.14	0.14
Share of elasticity variation due to h'hold heterogeneity		58	0	100

Note: All economies have the same interest rate (r), with other parameters recalibrated to match the same level of total differentiated goods expenditure $(\overline{Z})$, labor income taxes (τ) and transfers (T) to GDP, average assets to average income (β)

RESULTS - WELFARE EFFECTS OF MARKUPS

Role of consumer heterogeneity - Welfare effects of markups

Who gains from competitive product markets?

- Follow exercise in Edmond, Midrigan, Xu (2023)
- Implement optimal quantity subsidy $S_j = s_j^* y_j$:

$$p_j^* = \frac{\varepsilon_j^*}{\varepsilon_j^* - 1}\left[mc_j^* - s_j^*\right] \quad , \quad s_j^* = \frac{mc_j^*}{\varepsilon_j^*}.$$

- Financed by lump-sum tax on households: $S = \sum_j S_j$

Role of consumer heterogeneity - Welfare effects of markups

Who gains from competitive product markets? **Poor households.**

		Baseline	Optimal Subsidy
A. Statistics	Interest rate	2.00%	1.67%
	Average markup	24%	25%
	EMX slope	0.034	0.078
B. Firms	**Total quantities**		
	Low quality goods		-1.66
	High quality goods		4.31
C. Households	**Average quality -** ϕ_j		
	Poor		2.2
	Rich		-0.9
	Average consumption		
	Poor		-7.9
	Rich		3.5
	Average welfare - $\overline{V}(a, e)$		
	Poor		46.2
	Rich		-21.9

Note: Firms split by top / bottom quintile of sales in baseline. Households split by top / bottom half of cash-on-hand in baseline. All values are log changes expressed in log points.

Role of consumer heterogeneity - Welfare effects of markups

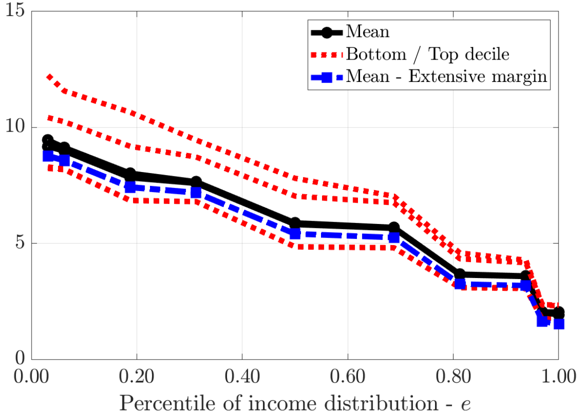
Who gains from competitive product markets? **Poor households.**

		Baseline	Optimal Subsidy
A. Statistics	Interest rate	2.00%	2.00%
	Average markup	24%	25%
	EMX slope	0.034	0.077
B. Firms	**Total quantities**		
	Low quality goods		-1.30
	High quality goods		4.83
C. Households	**Average quality -** ϕ_j		
	Poor		2.3
	Rich		-0.6
	Average consumption		
	Poor		-8.0
	Rich		2.9
	Average welfare - $\overline{V}(a, e)$		
	Poor		46.1
	Rich		-23.0

Note: Firms split by top / bottom quintile of sales in baseline. Households split by top / bottom half of cash-on-hand in baseline. All values are log changes expressed in log points.

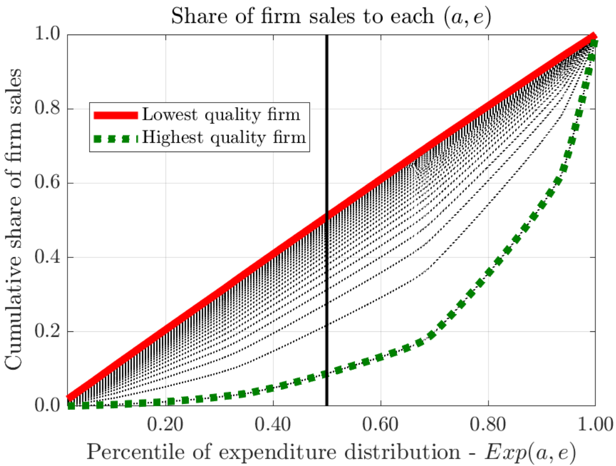
RESULTS - CROSS-SECTION

1. Elasticities



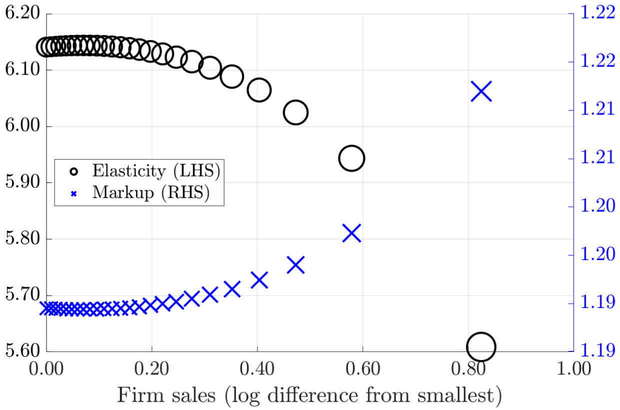
- Simple regression: $\mathbb{E}\left[\varepsilon^i | e\right] = \beta_0 - \beta_1 \log e$, $\widehat{\beta}_1 = 2.19$
- Nakamura Zerom (2010) - 'Coffee paper' - *A household with an income 1 s.d. above the mean has a price elasticity about 20% [18.1%] below the price elasticity of the median consumer [8.34].*

2. Sorting



- 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

3. Markups



- High quality firms have: Higher sales, Higher prices, Lower elasticities, Higher markups