Monopsony Power and the Transmission of Monetary Policy

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Disclaimer

Introduction

- Labor markets in the US are **highly concentrated**
  - 40% of workers employed by firms whose local employment share exceeds 10%[1]
  - Concentration at local labor market has **decreased over the past four decades**

[1] Census LBD 2019; Local labor market defined as subsector-county pair

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- **Q:** How does **labor market power** affect the **transmission of monetary policy**?

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- **Q:** How does **labor market power** affect the **transmission of monetary policy**?
- To answer this question
  - Provide evidence on **heterogeneous response of firms to MP shocks**
  - Construct a **NK model with heterogeneous oligopsonistic firms**

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Preview of Findings

- **Empirical Analysis**
  - Use administrative Census data at quarterly frequency (LEHD)
  - Study **heterogeneous response** firms w/ high vs low monopsony power in labor mkt
  - **Main Finding:** low monopsony power firms more responsive to MP (wage bill, emp.)

Preview of Findings

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  - **Main Finding:** low monopsony power firms more responsive to MP (wage bill, emp.)
- **Quantitative Analysis**
  - Build heterogeneous-firms NK model with **oligopsonistic labor markets**
  - Absent wage stickiness → **homogeneous response** despite heterogeneous markdowns
  - Labor market power implications for the transmission of monetary policy:
    - **Reduces MP efficacy** by 40%
    - **MP is more effective today than in the 1980s** in affecting output by 16%

Empirical Analysis

Data

- **LEHD data**
  - Matched employer-employee data for the population of firms
  - Covers 23 states including California and New York (excl. TX, IL, FL)
  - Period: 1994–2021
  - Contains information on subsector (NAICS 3) and location (county)
  - Construct **quarterly** wage bill and emp. at the firm-level (all estabs. within labor market)
- **Classify firms** into high and low labor market power groups
  - Threshold = 10% of total wage bill in local labor market time-series
- High-frequency monetary policy shocks from Jarocinscki and Karadi (2020)
  - Disentangle *true* monetary policy shock from Fed information

Empirical Strategy

- **Local projection**

$$y_{i,t+h} - y_{i,t-1} = \delta_{t,s,h} + \beta_h \varepsilon_t^{MP} \times \mathbb{1}\left[s_{i,t-1} \leqslant 10\%\right] + \Gamma_h X_{i,t-1} + \epsilon_{i,t+h}, \quad \text{for } h = \{0, \ldots, 15\}$$

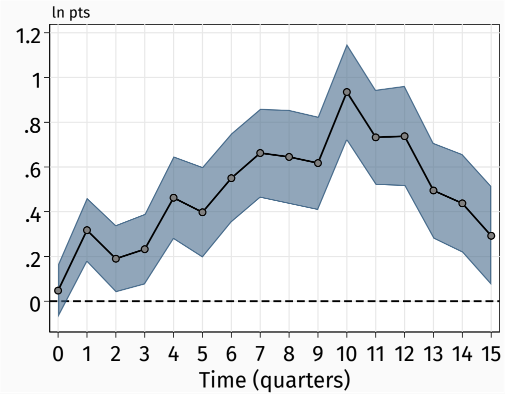
  - $s_{i,t}$: wage bill share of firm i in its local labor market at time t
  - ε_t^{MP}: monetary policy surprise
  - $\delta_{t,s}$: time-subsector fixed effects
  - Controls: four lags of $y_{i,t}$, inflation, unemployment, gdp, state-by-subsector fixed effects

- β_h: response of low labor mkt power relative to high labor mkt power firms

Heterogeneous Response to MP Surprise

difference

Wage bill response difference

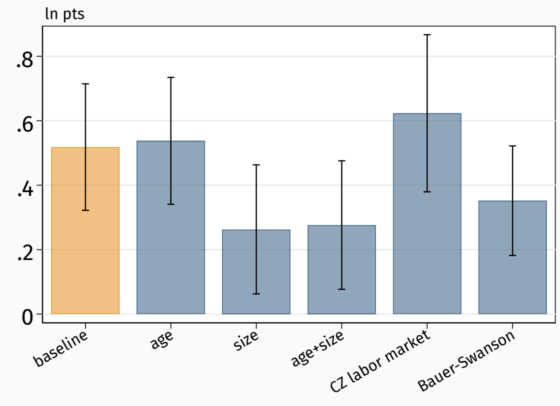


Notes: Relative wage bill response of low monopsony power firms to a 25bp expansionary monetary policy shock. Shaded area represents 95% confidence interval. Clustered at local labor market power level.

- **Low monopsony power → more responsive**
- Relative magnitude:
  - High ms power: year 2 → 100bp increase
  - Low ms power: **52% larger response**

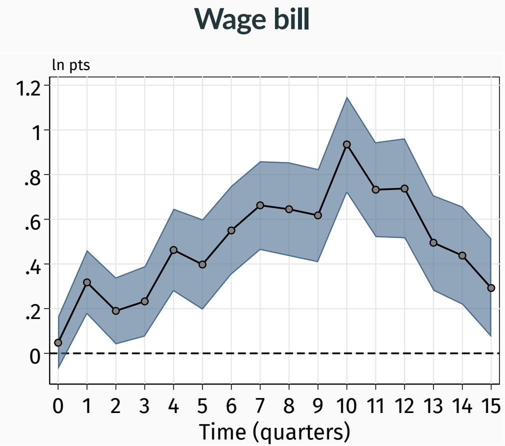
Heterogeneous Response to MP Surprise: Robustness

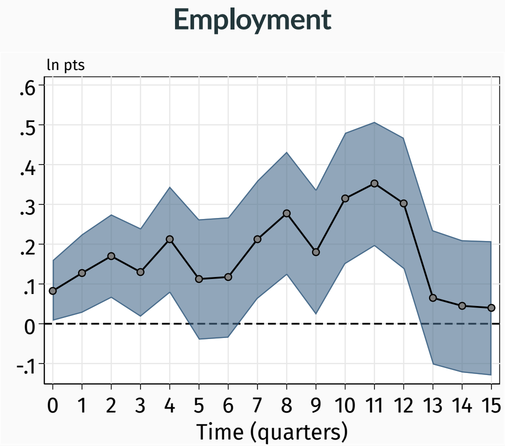
Year 2 response



Notes: Relative wage bill response of low monopsony power firms to a 25bp expansionary monetary policy shock, 4 to 7 quarters after the shock, for different specifications. Bars represent 95% confidence interval. *Age* indicates firm age controls. *Size* indicates firm size controls. *CZ labor market* indicates labor market power defined at commuting zone level. *Bauer-Swanson* indicate BS monetary policy shocks.

Heterogeneous Response to MP Surprise: Employment





Notes: Relative wage bill and employment response of low monopsony power firms to a 25bp expansionary monetary policy shock. Shaded area represents 95% confidence interval. Clustered at local labor market power level.

Model

Environment

- Discrete time, infinite horizon
- Representative household, monopolistically competitive final-good firms
- Continuum of local labor markets $j \in (0, 1)$
  - Each local labor market has a **finite number of firms** $i \in \{1, 2, \dots, M_j\}$
  - Perfect competition in product market (intermediate good)
  - **Bertrand competition** in labor market
- Nominal rigidities à la Calvo
  - **Wage stickiness** for intermediate-good producers
  - Price stickiness for final-good firms (to match average wage bill response)
- Taylor rule: $i_t = i_{ss} + \phi_\pi(\pi_t - 1) + \epsilon_t^{mp}$

Household

$$\max_{\{C_t, N_t, B_t, \{c_{kt}\}, \{N_{jt}\}, \{n_{ijt}\}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\gamma}}{1-\gamma} - \varphi \frac{N_t^{1+\nu}}{1+\nu} \right)$$

$$\text{s.t.} \quad \int_0^1 p_{kt} c_{kt} dk + B_t = (1 + i_{t-1}) B_{t-1} + \int_0^1 \left(\sum_{i=1}^{M_j} W_{ijt} n_{ijt} \right) dj + \Pi_t,$$

$$C_t = \left(\int_0^1 c_{kt}^{\frac{\varepsilon-1}{\varepsilon}} dk \right)^{\frac{\varepsilon}{\varepsilon-1}}, \quad N_t = \left(\int_0^1 N_{jt}^{\frac{\zeta+1}{\zeta}} dj \right)^{\frac{\zeta}{\zeta+1}}, \quad N_{jt} = \left(\sum_{i=1}^{M_j} n_{ijt}^{\frac{\eta+1}{\eta}} \right)^{\frac{\eta}{\eta+1}}$$

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Standard goods demand: $C_t^{-\gamma} = \beta \mathbb{E}_t \left[\frac{1+i_t}{\pi_{t+1}} C_{t+1}^{-\gamma} \right], \quad c_{kt} = \left(\frac{p_{kt}}{P_t} \right)^{-\varepsilon} C_t$

Labor supply: $\frac{W_t}{P_t} = \varphi N_t^{\nu} C_t^{\gamma}, \quad n_{ijt} = \left(\frac{W_{ijt}}{W_{jt}} \right)^{\eta} \left(\frac{W_{jt}}{W_t} \right)^{\zeta} N_t$

Indices: $P_t = \left(\int_0^1 p_{kt}^{1-\varepsilon} dk \right)^{\frac{1}{1-\varepsilon}}, \quad W_t = \left(\int_0^1 W_{jt}^{1+\zeta} dj \right)^{\frac{1}{1+\zeta}}, \quad W_{jt} = \left(\sum_{i=1}^{M_j} W_{ijt}^{1+\eta} \right)^{\frac{1}{1+\eta}}$

Oligopsonistic Wage Setting - Adjuster's Problem

equ def full

- Optimal nominal wage W^*_{ijt} maximizes expected profits

$$\max_{W^*_{ijt},\{n_{ijt+\tau},W_{jt+\tau}\}_{\tau=0}^{\infty}} \mathbb{E}_{\mathcal{S}_{ijt}}\left[\sum_{\tau=0}^{\infty}\theta_w^{\tau}R_{t,t+\tau}\left(M_{t+\tau}z_{ij}n_{ijt+\tau}-W^*_{ijt}n_{ijt+\tau}\right)\right]$$

$$\text{s.t.}\quad n_{ijt+\tau}=\left(\frac{W^*_{ijt}}{W_{jt+\tau}}\right)^{\eta}\left(\frac{W_{jt+\tau}}{W_{t+\tau}}\right)^{\zeta}N_{t+\tau},\qquad W_{jt+\tau}=\left[\left(W^*_{ijt}\right)^{1+\eta}+\sum_{i'\neq i}W_{i'jt+\tau}^{1+\eta}\right]^{\frac{1}{1+\eta}}$$

θ_w — Calvo wage stickiness	M_t — price of intermediate good
z_{ij} — idiosyncratic productivity	N_t — aggregate labor supply
$\mathbb{E}_{\mathcal{S}_{ijt}}$ — expectation conditional on wage spell	$R_{t,t+\tau}$ — nominal discount factor

Markdown

- Firms want to pay wage below marginal revenue product of labor
- Desired **markdown** $\frac{1+\epsilon_{ijt}}{\epsilon_{ijt}}$ *varies* with wage bill share $s_{ijt} \equiv \frac{W_{ijt} n_{ijt}}{\sum_{i'} W_{i'jt} n_{i'jt}}$

$$W^*_{ijt} = \frac{\mathbb{E}_{\mathcal{S}_{ijt}} \sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left[\eta - (\eta - \zeta) s_{ijt+\tau}\right] (M_{t+\tau} z_{ij})}{\mathbb{E}_{\mathcal{S}_{ijt}} \sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left[1 + \eta - (\eta - \zeta) s_{ijt+\tau}\right]}$$

Analytical Results

Special case

- Myopic households ($\beta = 0$) ➔ **static wage setting**
- Local labor market with **three firms**: small, medium, and large
- Wage setting equation becomes

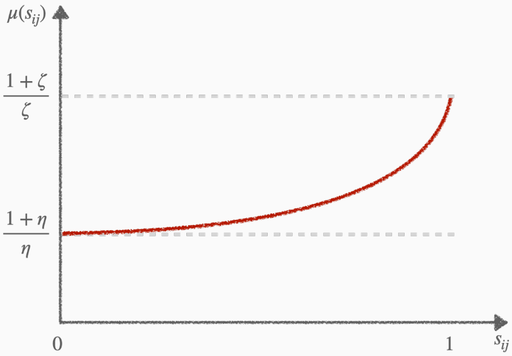
$$w_{ij} = \frac{z_{ij} m}{\mu_{ij}} \qquad \text{where} \qquad \mu_{ij} = \frac{1 + \eta - (\eta - \zeta) s_{ij}}{\eta - (\eta - \zeta) s_{ij}}$$

- so the higher is the wage bill share, μ_{ij} increases and the higher is the markdown
- Passthrough of demand shock m to wage w_{ij}?

Wage Stickiness is Necessary for Heterogeneous Passthrough

- Passthrough is dampened by change in **desired markdown**

$$w_{ij} = \frac{z_{ij} m}{\mu_{ij}} \qquad \Longrightarrow \qquad \frac{\partial \ln w_{ij}}{\partial \ln m} = 1 - \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}} \frac{\partial \ln s_{ij}}{\partial \ln m}$$



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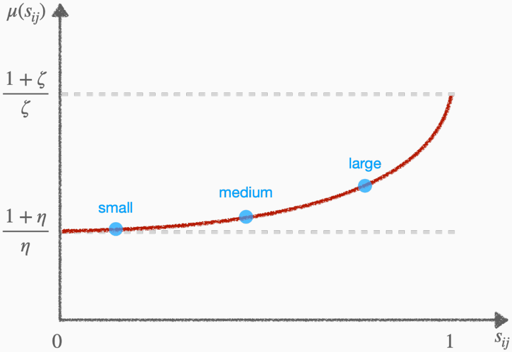
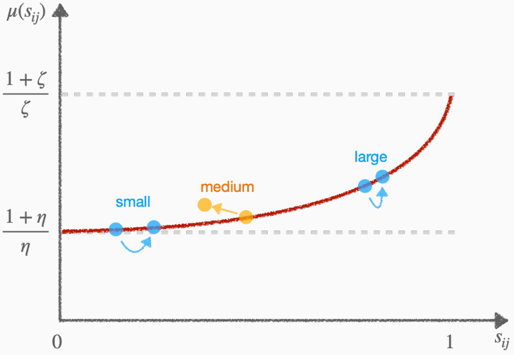


- All firms adjust → full passthrough, **homogenous response**

Wage Stickiness is Necessary for Heterogeneous Passthrough

- Passthrough is dampened by change in **desired markdown**

$$w_{ij} = \frac{z_{ij} m}{\mu_{ij}} \quad \Longrightarrow \quad \frac{\partial \ln w_{ij}}{\partial \ln m} = 1 - \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}} \frac{\partial \ln s_{ij}}{\partial \ln m}$$



- Medium firm stuck → partial passthrough, **heterogeneous response**

Quantitative Results

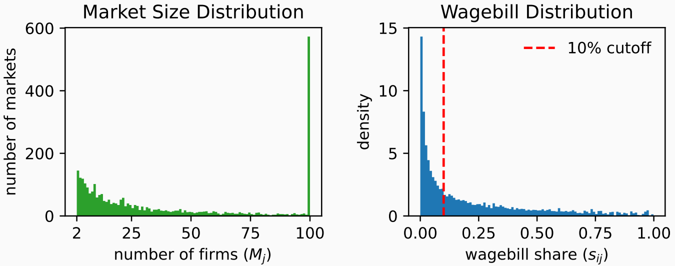
Preliminary Calibration

solution

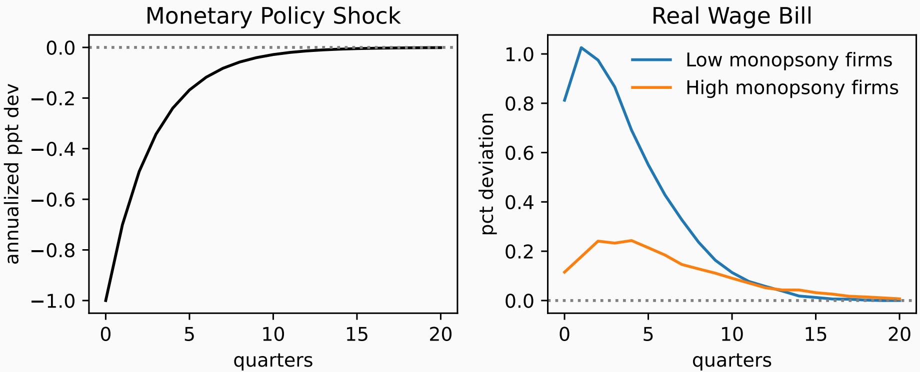
Parameter		Value
A. Fixed parameters		
β	Discount factor	0.99
$1/\gamma$	EIS	0.50
$1/\nu$	Frisch elasticity	0.50
η	Within market elasticity	3.74
ζ	Across market elasticity	0.76
ϵ	Retail goods elasticity	7.00
θ_p	Price stickiness	0.85
θ_w	Wage stickiness	0.75
ϕ_π	Taylor rule coefficient	1.5
ρ_ϵ	Persistence of MP shock	0.7

Parameter		Value
B. Internally calibrated parameters		
a_z	Productivity distribution shape	4.47
ξ_m	Market size distribution shape	[1.55, 1.30]
σ_m	Market size distribution scale	[22.95, 21.03]

Moment	Source	Data	Model
A. High-monopsony firms' share			
Population	LEHD	0.06	0.06
Employment	LEHD	0.32	0.39
B. Local HHI			
Mean	LEHD	0.23	0.21
Standard deviation	LEHD	0.29	0.17

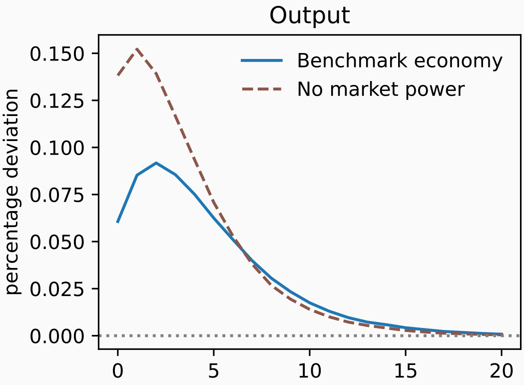


Heterogeneous Response to Monetary Policy Shock



As in data, **high monopsony power firms less responsive to monetary policy**

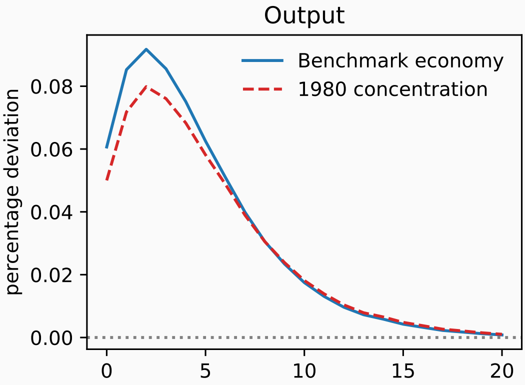
Counterfactual #1: Remove oligopsonistic competition



Oligopsonistic competition **reduces MP effect on output by 44%**

Monopsony Power and the Transmission of Monetary Policy Over Time

Counterfactual #2: Change productivity dispersion to mimic **higher local HHI in 1980** hhi



Decline in labor market power since 1980 **raised MP effect on output by 16%**

Conclusion

Conclusion

- Document **low monopsony firms more responsive to monetary policy**
- Construct a **NK model with heterogeneous oligopsonistic firms**
  - Leverage SSJ method to solve model with *Calvo certainty equivalence*
    - Households and firms interact on many markets ($\approx 120,000$ firms on $3,000$ markets)
  - Model replicates micro data heterogeneous response
- Oligopsonistic wage setting **reduces efficacy of MP**
  - Oligopsonistic competition → MP efficacy **-44%**
  - Decline in local concentration since 1980 → MP efficacy **+16%**

Thank you!

Appendix

Equilibrium

back

Given an initial distribution of wages across oligopsonistic firms $\{W_{ij,-1}\}$, bonds B_{-1}, and price index P_{-1}, an equilibrium is a set of prices, wages, and interest rates $\{P(s^t), W(s^t), m(s^t), i(s^t), \{W_j(s^t), \{W_{ij}(s^t)\}\}\}$, and allocations $\{N(s^t), \{N_j(s^t), \{N_{ij}(s^t)\}\}, C(s^t), B(s^t)\}$, such that

1. Consumption and labor decisions solve HH problem given all prices
2. The final-good firm problem is solved.
3. Given the wage strategy of all other firms, as well as aggregate allocations and price indices, the wage strategy and labor allocation of oligopsonistic firm i in sector j, $\{W_{ij}(s^t)\}$
4. Interest rate evolves according to the Taylor rule
5. Markets clear

Sequence-Space Jacobian Method

back

- Most equilibrium models with perfect foresight of aggregate shocks have form

$$\mathbf{H}(\mathbf{U}|\mathbf{Z}) = 0$$

for **exogenous Z** and **unknowns U** (subset of endogenous variables)

- In dynamic models, **U** and **Z** are both sequences of (multiple) variables.
- Linearized impulse responses are

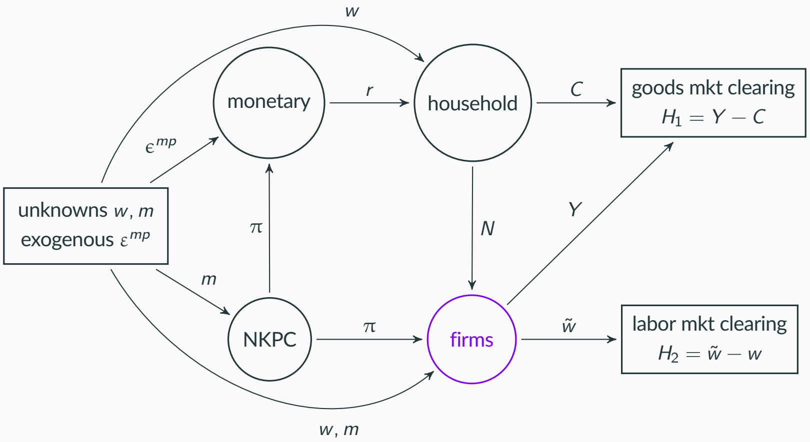
Equivalent to 1st-order perturbation in state space

$$d\mathbf{U} = -\mathbf{H}_{\mathbf{U}}^{-1}\mathbf{H}_{\mathbf{Z}} d\mathbf{Z}$$

where $\mathbf{H}_{\mathbf{U}}$ and $\mathbf{H}_{\mathbf{Z}}$ are the Jacobians of $\mathbf{H}(\bullet|\bullet)$ at steady state

Nested DAG Representation

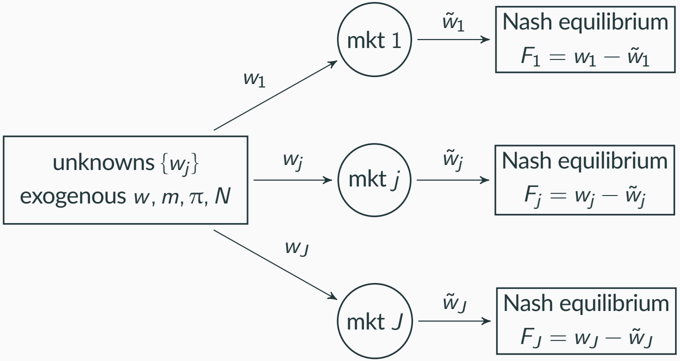
- **Outer layer**: aggregate equilibrium prices satisfy $\mathbf{H}(w, m|\varepsilon^{mp}) = 0$ SSJ overview Jacobians



Nested DAG Representation

- **Outer layer**: aggregate equilibrium prices satisfy $\mathbf{H}(w, m|\varepsilon^{mp}) = 0$
- **Inner layer**: local equilibrium wages satisfy $\mathbf{F}_j(w_j|w, m, \pi, N) = 0$

SSJ overview Jacobians



Challenge #1: Nominal Rigidities with Finite Number of Firms

$$W^*_{ijt} = \frac{\mathbb{E}_{\mathcal{S}_{ijt}} \sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left[\eta - (\eta - \zeta) \frac{(W^*_{ijt})^{1+\eta}}{(W^*_{ijt})^{1+\eta} + \sum_{i' \neq i} W^{1+\eta}_{i'jt+\tau}}\right] (M_{t+\tau} z_{ij})}{\mathbb{E}_{\mathcal{S}_{ijt}} \sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left(1 + \eta - (\eta - \zeta) \frac{(W^*_{ijt})^{1+\eta}}{(W^*_{ijt})^{1+\eta} + \sum_{i' \neq i} W^{1+\eta}_{i'jt+\tau}}\right)}$$

- **Challenge**: Local labor markets have **finitely many firms**
  - Firms have to form expectations of $\sum_{i' \neq i} W^{1+\eta}_{i'jt+\tau}$ for entire wage spell
  - **Realizations of Calvo shocks** affect local outcomes, though not aggregates
  - In a market with 100 firms, that is 2^{99} **possibilities** per period
- **Solution**: solve model ***given* a sequence of Calvo shocks**
  - Firm **uncertain regarding own Calvo shocks**
  - Results independent of Calvo realizations with large number of markets

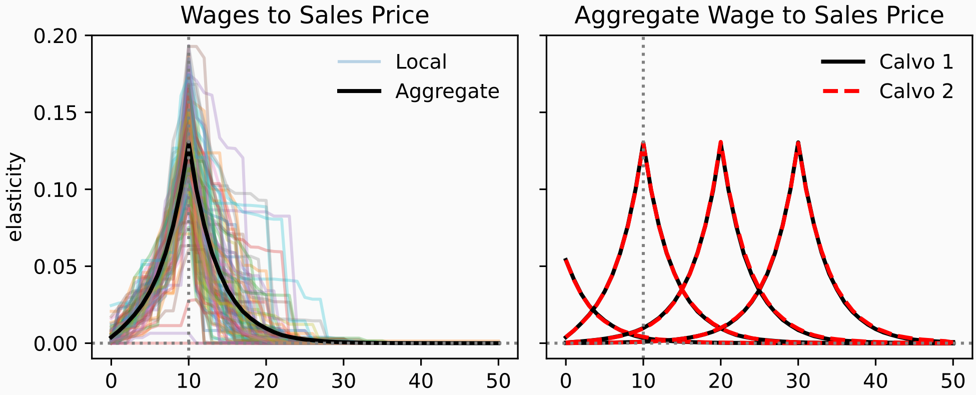
Challenge #2: No Closed Form Solution for Optimal Wage

$$W^*_{ijt} = \frac{\sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left[\eta - (\eta - \zeta) \frac{(W^*_{ijt})^{1+\eta}}{(W^*_{ijt})^{1+\eta} + \sum_{i' \neq i} W_{i'jt+\tau}^{1+\eta}}\right] (M_{t+\tau} z_{ij})}{\sum_{\tau=0}^{\infty} \theta_w^{\tau} R_{t,t+\tau} n_{ijt+\tau} \left(1 + \eta - (\eta - \zeta) \frac{(W^*_{ijt})^{1+\eta}}{(W^*_{ijt})^{1+\eta} + \sum_{i' \neq i} W_{i'jt+\tau}^{1+\eta}}\right)}$$

- **Challenge**: there are **many equilibrium wages** to solve for
  - Each $\{W_{jt}\}$ emerges as fixed point of mutual best responses $\{W_{ijt}\}$
  - **No analytical solution** for $\{W^*_{ijt}\}$ as a function of $\{W_{jt}^{-i}\}$
  - Calibrated model has 3,000 local markets, 120,000 firms, 12 million wages in total
- **Solution**: solve via ***nested* sequence space Jacobians** SSJ overview
  - Local markets interact through aggregate variables only
  - **Inner layer**: Solve local equilibria **independently** of each other, conditional on aggregates
  - **Outer layer**: Solve general equilibrium

Jacobians of Firm Block

- Calvo shocks affect local wages but not the aggregate wage



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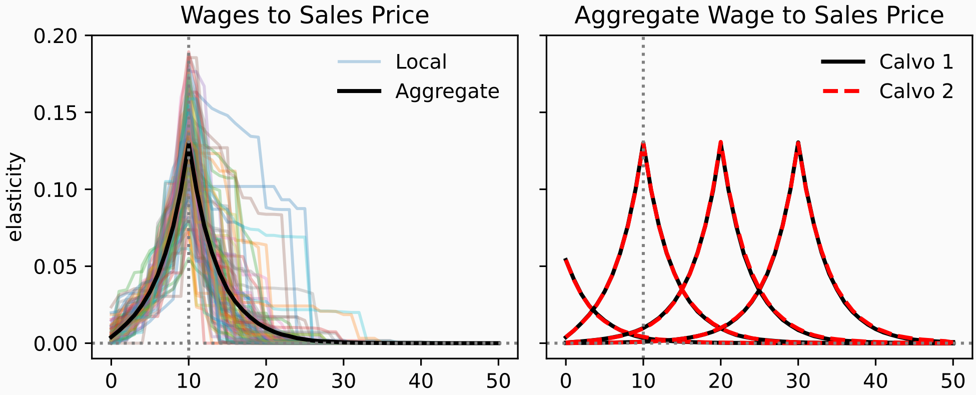


Taking Stock

calibration

- Firms know W^*_{ijt} affects local wage and are uncertain when they can adjust next
- We assume firms **take competitors' current and future wages** as given
  - Firms **commit to wage strategies** that depend on history of exo states s^t
  - Not a Markov perfect equilibrium as in Mongey (2021), Wang & Werning (2022)
  - Assumption allows us to handle **Nash equ with many heterogeneous firms**
- Assumption quantitatively important for IRFs? **likely not**
  - Quantitatively negligible based on Wang & Werning (2022) (oligopoly w symmetric firms)
  - Work-in-progress: solving MPE for small-scale version of our model

Oligopsonistic Wage Setting - Full problem

back

- Aggregate states and Calvo shocks for every firm collected in $s_t = \{\varepsilon_t, \{\Theta_{ijt}\}\}$

$$\max_{W_{ij}(s^t), n_{ij}(s^t), W_j(s^t)} \sum_{t=0}^{\infty} \sum_{s^t} R(s^t) \left[M(s^t) z_{ij} n_{ij}(s^t) - n_{ij}(s^t) W_{ij}(s^t) \right]$$

$$\text{s.t.} \quad n_{ij}(s^t) = \left(\frac{W_{ij}(s^t)}{W_j(s^t)} \right)^{\eta} \left(\frac{W_j(s^t)}{W(s^t)} \right)^{\zeta} N(s^t) \qquad \text{(labor supply)}$$

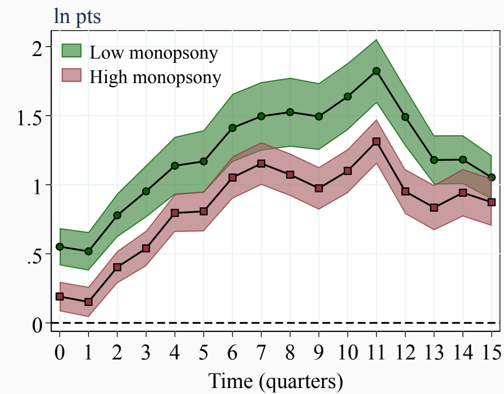
$$W_j(s^t) = \left[W_{ij}(s^t)^{1+\eta} + \sum_{i' \neq i} W_{i'j}(s^t)^{1+\eta} \right]^{\frac{1}{1+\eta}} \qquad \text{(local wage)}$$

$$W_{ij}(s^t) = W_{ij}(s^{t-1}) \quad \text{if } \Theta_{ijt} = 0 \qquad \text{(Calvo shocks)}$$

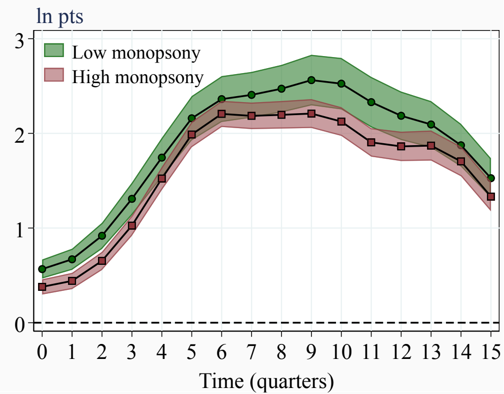
Heterogeneous Response to MP Surprise: Wage bill and Employment

back

Wage bill

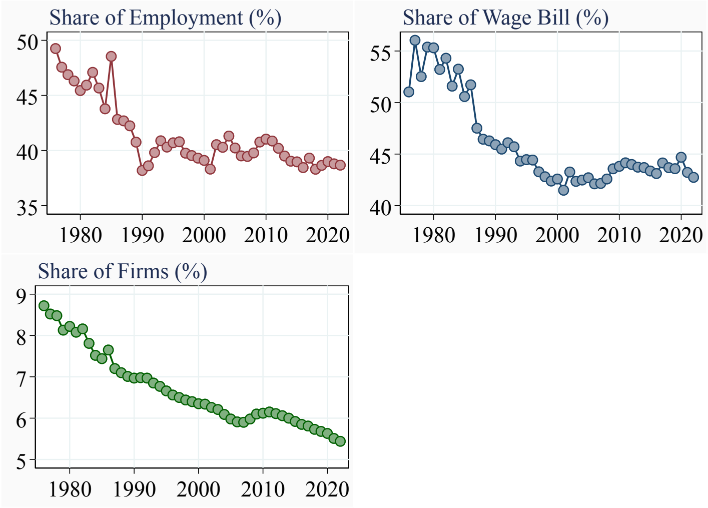


Employment



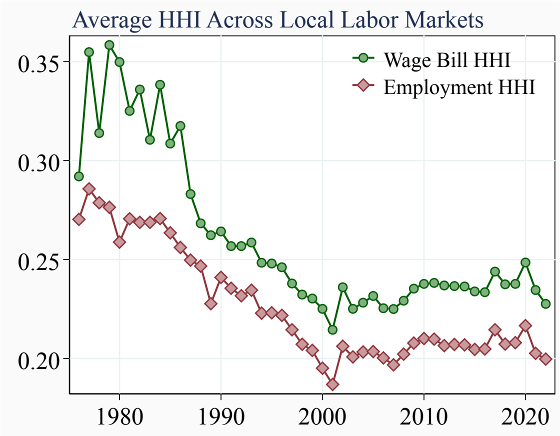
Notes: Wage bill and employment response of low and high monopsony power firms to a 25bp expansionary monetary policy shock. Shaded area represents 95% confidence interval. Clustered at local labor market power level.

Share of Firms, Wage Bill, and Employment of High Labor Mkt Power Firms back



Notes: Share of high market power firms, defined as firms those with 10% of more of the wage bill within labor market. LBD data.

Time Series of HHI back



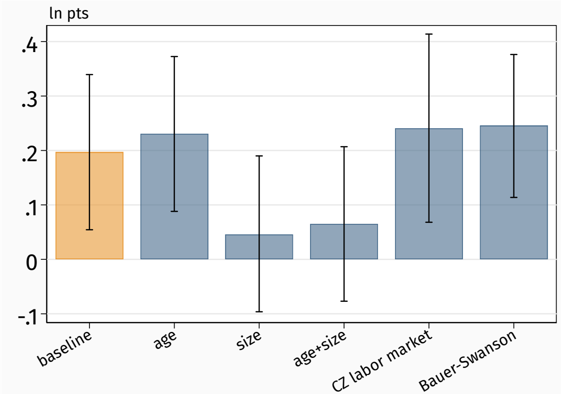
Notes: Share of high market power firms, defined as firms those with 10% of more of the wage bill within labor market. LBD data.

Note: HHI of 0.35 amounts to about 2.8 identical firms; HHI of 0.25 is about 4 identical firms.

Heterogeneous Response to MP Surprise: Robustness - Year 1

year 2

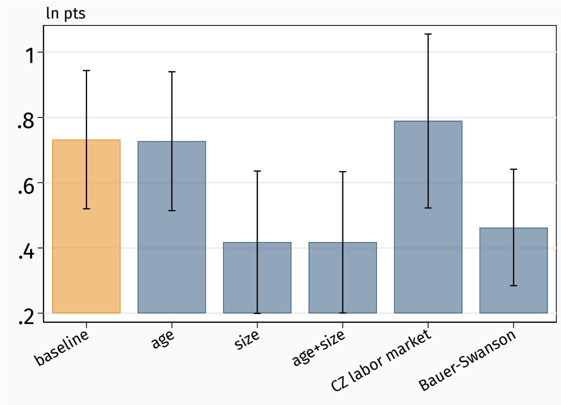
Year 1 response



Notes: Relative wage bill response of low monopsony power firms to a 25bp expansionary monetary policy shock, 0 to 3 quarters after the shock, for different specifications. Bars represent 95% confidence interval. *Age* indicates firm age controls. *Size* indicates firm size controls. *CZ labor market* indicates labor market power defined at commuting zone level. *Bauer-Swanson* indicate BS monetary policy shocks.

Heterogeneous Response to MP Surprise: Robustness - Year 3

Year 3 response

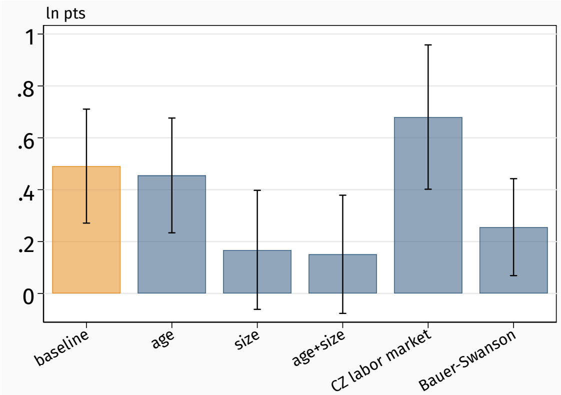


Notes: Relative wage bill response of low monopsony power firms to a 25bp expansionary monetary policy shock, 8 to 11 quarters after the shock, for different specifications. Bars represent 95% confidence interval. *Age* indicates firm age controls. *Size* indicates firm size controls. *CZ labor market* indicates labor market power defined at commuting zone level. *Bauer-Swanson* indicate BS monetary policy shocks.

Heterogeneous Response to MP Surprise: Robustness - Year 4

year 2

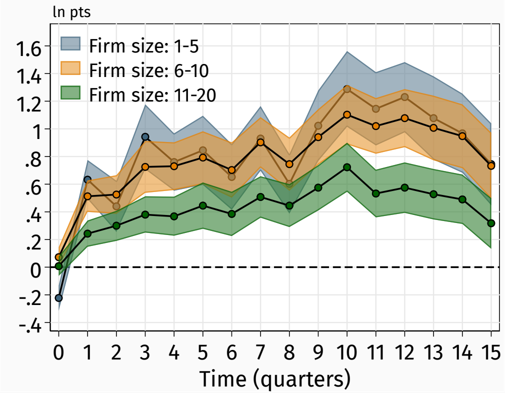
Year 4 response



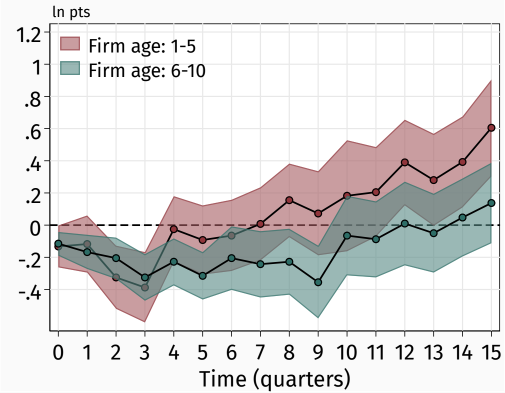
Notes: Relative wage bill response of low monopsony power firms to a 25bp expansionary monetary policy shock, 12 to 15 quarters after the shock, for different specifications. Bars represent 95% confidence interval. *Age* indicates firm age controls. *Size* indicates firm size controls. *CZ labor market* indicates labor market power defined at commuting zone level. *Bauer-Swanson* indicate BS monetary policy shocks.

Heterogeneous Response to MP Surprise: Age and Size back

Firm Size



Firm Age



Notes: Relative wage bill response to a mp surprise for firms of different size (relative to 20+ employee firms) and age (relative 10+ age firms).