What Drives Wage Stagnation: Monopsony or Monopoly?

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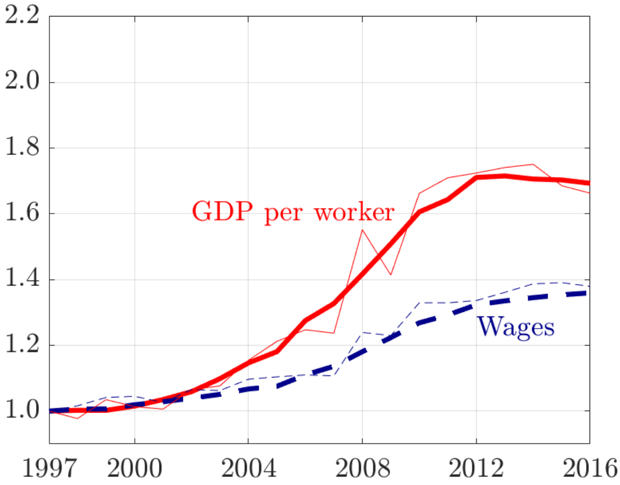
JEEA Supplemental Slides

2022

Wage Stagnation

U.S Census : Tradeable sectors



Mechanisms

- Explore two mechanisms behind wage stagnation:
  1. Monopsony: direct effect from imperfect labor market
     $\rightarrow$ Lower firm-specific wages for own workers
  2. Monopoly: output market power affects labor demand – General Equilibrium effect
     $\rightarrow$ Lowers aggregate, economy-wide wages

Mechanisms

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     $\rightarrow$ Lowers aggregate, economy-wide wages

$\therefore$ Objective:
  1. Explain mechanism behind decoupling of wages and productivity
  2. Decomposition: measure contribution from Monopsony (markdowns) vs. Monopoly (markups)

Motivation

- Evidence on market power:
  1. Monopoly power (markups)

     De Loecker, Eeckhout, Unger (2020); Hall (2018)
  2. Monopsony power: (markdowns)

     Berger, Herkenhoff, Mongey (2020); Hershbein, Macaluso, Yeh (2018)

Motivation

- Evidence on market power:
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  2. Monopsony power: (markdowns)
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- Challenges for measurement:
  1. Marginal cost not directly observable
  2. We don't observe who competes with whom
- Our approach: structurally estimate Strategic Competition in GE:
  1. Jointly Measure Markups and Markdowns
  2. Estimate Market Structure

Findings

1. Competition has decreased over time:
   - Markups increase substantially
   - Markdowns are stable, increase only marginally
2. Wage stagnation: decoupling wages-productivity
3. Decomposition monopoly vs. monopsony: dominant force is monopoly

Model Setup

Markets

- Continuum of markets $j \in [0, J]$
- Finite number of establishments $i = 1, ..., I$
- Finite numbers of firms in each market $n = 1, ..., N$ (set of establishments i in firm n: $\mathcal{I}_{nj}$)

Household Preferences

- maximizes static utility

$$\max_{C_{inj}, L_{inj}} \; U\left(C - \frac{1}{\bar{\phi}^{\frac{1}{\phi}}} \frac{L^{\frac{\phi+1}{\phi}}}{\frac{\phi+1}{\phi}} \right) \quad \text{s.t. } PC = LW + \Pi$$

- CES preferences over Consumption and Labor

$$C = \left(\int_j J^{-\frac{1}{\theta}} C_j^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}} \quad , \quad C_j = \left(\sum_i I^{-\frac{1}{\eta}} C_{inj}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

$$L = \left(\int_j J^{\frac{1}{\hat{\theta}}} L_j^{\frac{\hat{\theta}+1}{\hat{\theta}}} dj \right)^{\frac{\hat{\theta}}{\hat{\theta}+1}} \quad , \quad L_j = \left(\sum_i I^{\frac{1}{\hat{\eta}}} L_{inj}^{\frac{\hat{\eta}+1}{\hat{\eta}}} \right)^{\frac{\hat{\eta}}{\hat{\eta}+1}}$$

Model Setup

Technology

Firm $n \in \{1, \dots, N\}$ in sector $j \in [0, J]$

$$\Pi_{nj} = \max_{\{Y_{inj}\}_{i \in \mathcal{I}_{nj}}} \sum_{i \in \mathcal{I}_{nj}} \Big[\underbrace{P_{inj}(Y_{inj}, Y_{-inj}) Y_{inj}}_{\text{Sales}} - \underbrace{W_{inj}(L_{inj}, L_{-inj}) L_{inj}}_{\text{Variable costs}} \Big]$$

subject to

$$Y_{inj} = A_{inj} L_{inj}$$

Market Structure

The same set of N firms compete in goods and labor market

Prices and Equilibrium

Cournot-Nash Competition in goods markets and labor markets

Equilibrium Solution

Producer Optimality

- The firm's first order condition for establishment i can be written as:

$$P_{inj} \underbrace{\left(1+\varepsilon^{P}_{inj}\right)}_{\mu^{-1}_{inj}} A_{inj} = W_{inj} \underbrace{\left(1+\varepsilon^{W}_{inj}\right)}_{\delta_{inj}}$$

Equilibrium Solution

Producer Optimality

- The firm's first order condition for establishment i can be written as:

$$P_{inj}\underbrace{\left(1+\varepsilon^P_{inj}\right)}_{\mu^{-1}_{inj}}A_{inj} = W_{inj}\underbrace{\left(1+\varepsilon^W_{inj}\right)}_{\delta_{inj}}$$

- Markups and Markdowns

$$\mu_{inj} = \frac{P_{inj}}{MC_{inj}} = \frac{1}{1+\varepsilon^P_{inj}}; \qquad \varepsilon^P_{inj} = -\left[\frac{1}{\theta}s_{nj} + \frac{1}{\eta}(1-s_{nj})\right]$$

$$\delta_{inj} = \frac{MRPL_{inj}}{W_{inj}} = 1+\varepsilon^W_{inj}; \qquad \varepsilon^W_{inj} = \left[\frac{1}{\hat{\theta}}e_{nj} + \frac{1}{\hat{\eta}}(1-e_{nj})\right]$$

Equilibrium Solution

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- Mechanism

$$P_{inj} A_{inj} \times \mu^{-1}_{inj} = W_{inj} \times \delta_{inj} \Rightarrow \underbrace{W_{inj}}_{\text{Wage}} = \underbrace{\frac{R_{inj}}{L_{inj}}}_{\text{Rev/worker}} \times \underbrace{\mu^{-1}_{inj}}_{\text{Markup}} \times \underbrace{\delta^{-1}_{inj}}_{\text{Markdown}}$$

Producer Optimality Mapping Shares

Limit Cases

No Heterogeneity in Productivity

$$\mu_{inj} = \left(1 - \frac{1}{\theta}\frac{1}{N} - \frac{1}{\eta}\left(1 - \frac{1}{N}\right)\right)^{-1}$$

$$\delta_{inj} = \left(1 + \frac{1}{\hat{\theta}}\frac{1}{N} + \frac{1}{\hat{\eta}}\left(1 - \frac{1}{N}\right)\right)$$

Limit Cases

No Heterogeneity in Productivity

$$\mu_{inj} = \left(1 - \frac{1}{\theta}\frac{1}{N} - \frac{1}{\eta}\left(1 - \frac{1}{N}\right)\right)^{-1}$$

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Increasing Competition

1. Perfect Substitutability : $\eta, \theta, \hat{\eta}, \hat{\theta} \to \infty$

$$\mu_{inj} = 1 \; ; \; \delta_{inj} = 1$$

Limit Cases

No Heterogeneity in Productivity

$$\mu_{inj} = \left(1 - \frac{1}{\theta}\frac{1}{N} - \frac{1}{\eta}\left(1 - \frac{1}{N}\right)\right)^{-1}$$
$$\delta_{inj} = \left(1 + \frac{1}{\hat{\theta}}\frac{1}{N} + \frac{1}{\hat{\eta}}\left(1 - \frac{1}{N}\right)\right)$$

Increasing Competition

1. Perfect Substitutability : $\eta, \theta, \hat{\eta}, \hat{\theta} \to \infty$

$$\mu_{inj} = 1 \ ; \ \delta_{inj} = 1$$

2. Number of firms in a market : $N \to \infty \implies s_{inj} \to 0$

$$\mu_{inj} = \frac{\eta}{\eta - 1} \ ; \ \delta_{inj} = \frac{\hat{\eta} + 1}{\hat{\eta}}$$

Monopolistic Competition ($N = 1$)

$$\mu_{inj} = \frac{\theta}{\theta - 1} \ ; \ \delta_{inj} = \frac{\hat{\theta} + 1}{\hat{\theta}}$$

Quantitative Exercise

- U.S. Census Bureau Longitudinal Business Database (LBD): Tradeable Sectors
- In the data we observe
  1. Employment by establishment: L_{inj}
  2. Average Wages by establishment: $W_{inj} = \frac{\text{Wage Bill}_{inj}}{L_{inj}}$
  3. Revenue: R_{inj}
  4. Industry classification NAICS, SIC

Quantitative Exercise

Estimation

1. Market Assignment: Randomly assign I_j establishments from NAICS 6 industry into a market, and I_j establishments into N "firms" of size I_j/N.

2. Elasticity Estimation: Estimate labor elasticities $\hat{\eta}$ and $\hat{\theta}$ using labor supply equation.

3. Backout Productivity: Given establishment-level employment L_{inj}, market assignment, and parameters, back out technology A_{inj} for each establishment, for each N.

4. Estimate Market Structure: Given a distribution of A_{inj} for each N, pick N which minimizes distance between model and data to find the market structure for each year.

Preference Estimates and Parameters

Variable	Value		Source
$\hat{\theta}$	1.89	Input market: Between-market elasticity	estimated
$\hat{\eta}$	3.10	Input market: Within market elasticity	estimated
θ	1.2	Output market: Between-market elasticity	DLEM (2021)
η	5.75	Output market: Within market elasticity	DLEM (2021)
ϕ	0.25	Elast. Aggregate LS	Chetty e.a. (2011)
I	32	Establishments in each market	Externally set
N	$\in [2, 4, 8, 16, 32]$	Firms competing within each market	estimated

Estimating Labor Elasticities

Estimating Within and Between Market Substitutability

Modify the baseline labor supply equation along two dimensions to estimate $\hat{\eta}$ and $\hat{\theta}$:

1. Exploit the panel dimension of the micro-data
2. Account for measurement error in wages: $W^*_{injt} = W_{injt} \times \exp(\varepsilon_{injt})$

$$\ln W^*_{injt} = c_{jt} \; + \; \gamma \ln L_{jt} \; + \; \beta \ln L_{injt} \; + \; \underbrace{\alpha_{inj} \; + \; \epsilon_{injt}}_{\varepsilon_{injt}}$$

where we define $\beta = \frac{1}{\hat{\eta}}$ and $\gamma = \left(\frac{1}{\hat{\theta}} - \beta\right)$

Use Two-Stage Least Squares to estimate β and γ, sequentially.

Rely on Berger, Herkenhoff and Mongey (2021) and Giroud and Rauh (2019)

- Exploit time-series variation in state corporate taxes as instruments for employment

Labor Elasticities Estimates

Exogenous variation from tax differences over time

Parameter	Description	Estimate IV
$\hat{\eta}$	Within-market elasticity	3.10
$\hat{\theta}$	Between-market elasticity	1.89

First Stage Wage Distribution

Backing out $\{A_{inj}, \mu_{inj}, \delta_{inj}\}$

- For given market structure (N) and preferences $\{\eta, \theta, \hat{\eta}, \hat{\theta}\}$, using data on $\{L_{inj}\}$ we can recover $\{A_{inj}, \mu_{inj}, \delta_{inj}\}$.
- System of I equations and I unknowns for all establishments i in each market j

$$P_{inj} \underbrace{\left(1 + \varepsilon^{P}_{inj}\right)}_{\mu^{-1}_{inj}} A_{inj} = W_{inj} \underbrace{\left(1 + \varepsilon^{W}_{inj}\right)}_{\delta_{inj}}$$

Backing out $\{A_{inj}, \mu_{inj}, \delta_{inj}\}$

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- System of I equations and I unknowns for all establishments i in each market j

$$\frac{1}{J}^{\frac{1}{\theta}} \frac{1}{I}^{\frac{1}{\eta}} (A_{inj} L_{inj})^{\frac{1}{\eta}} \left[\left(\frac{1}{I}^{\frac{1}{\eta}} \sum_i (A_{inj} L_{inj})^{\frac{\eta-1}{\eta}} \right)^{\frac{\theta-\eta}{(\eta-1)\theta}} \right] \underbrace{\left[1 - \frac{1}{\theta} \frac{\sum_{i \in \mathcal{I}_{nj}} (A_{inj} L_{inj})^{\frac{\eta-1}{\eta}}}{\sum_i (A_{inj} L_{inj})^{\frac{\eta-1}{\eta}}} - \frac{1}{\eta} \left[1 - \frac{\sum_{i \in \mathcal{I}_{nj}} (A_{inj} L_{inj})^{\frac{\eta-1}{\eta}}}{\sum_i (A_{inj} L_{inj})^{\frac{\eta-1}{\eta}}} \right] \right]}_{\text{Inverse Markup: } \mu_{inj}^{-1}}$$

$$= \frac{1}{Z} \frac{1}{J}^{-\frac{1}{\hat{\theta}}} \frac{1}{I}^{-\frac{1}{\hat{\eta}}} \frac{(L_{inj})^{\frac{1}{\hat{\eta}}}}{A_{inj}} \left[\left(\frac{1}{I}^{-\frac{1}{\hat{\eta}}} \sum_i (L_{inj})^{\frac{\hat{\eta}+1}{\hat{\eta}}} \right)^{\frac{\hat{\eta}-\hat{\theta}}{(\hat{\eta}+1)\hat{\theta}}} \right] \underbrace{\left[1 + \frac{1}{\hat{\theta}} \frac{\sum_{i \in \mathcal{I}_{nj}} (L_{inj})^{\frac{\hat{\eta}+1}{\hat{\eta}}}}{\sum_i (L_{inj})^{\frac{\hat{\eta}+1}{\hat{\eta}}}} + \frac{1}{\hat{\eta}} \left[1 - \frac{\sum_{i \in \mathcal{I}_{nj}} (L_{inj})^{\frac{\hat{\eta}+1}{\hat{\eta}}}}{\sum_i (L_{inj})^{\frac{\hat{\eta}+1}{\hat{\eta}}}} \right] \right]}_{\text{Markdown: } \delta_{inj}}$$

where $Z = W^{-1} L^{\frac{1}{\hat{\theta}}} Y^{\frac{1}{\theta}}$ and the aggregate price P is normalized to 1.

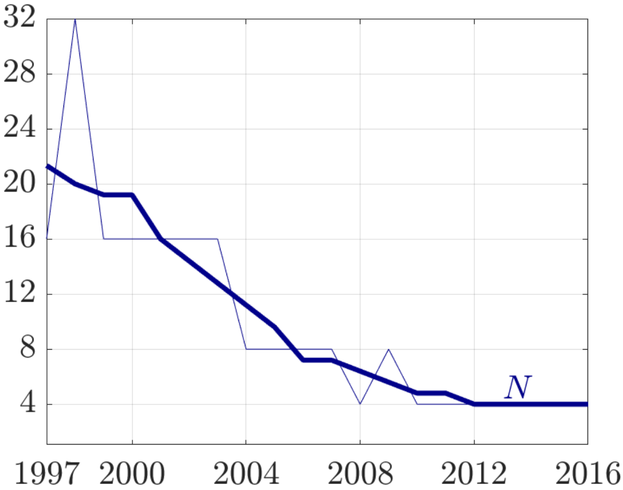
N Estimation

$$N_t^* = \min_{N \in \{2,\ 4,\ 8,\ 16,\ 32\}} \left[\int_j \sum_i m_{injt}^D \psi_{injt}^D dj - \int_j \sum_i m_{injt}^M(N) \psi_{injt}^M(N) dj \right]^2$$

Where $m_{injt}^{D,M} = \frac{R_{injt}}{\int_j \sum_i R_{injt} dj}$ is the sales share of establishment i in the Data and Model

And $\psi_{inj}^{D,M}$ is the revenue over wage bill for establishment i in the Data and Model

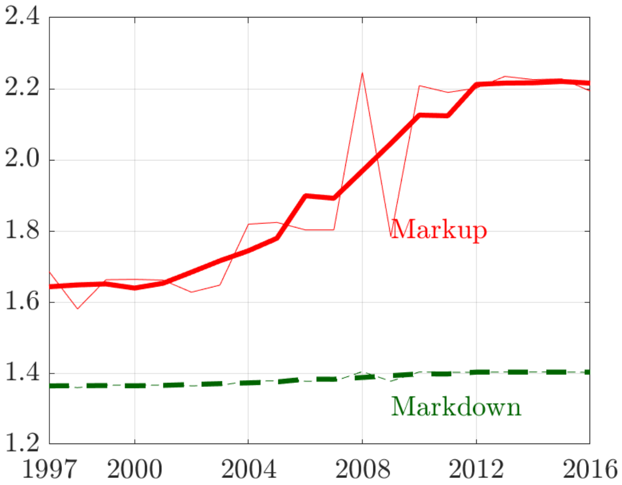
Estimated N



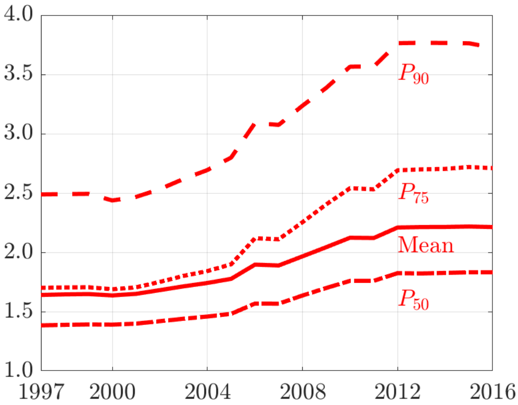
Model Fit

Technology Distribution

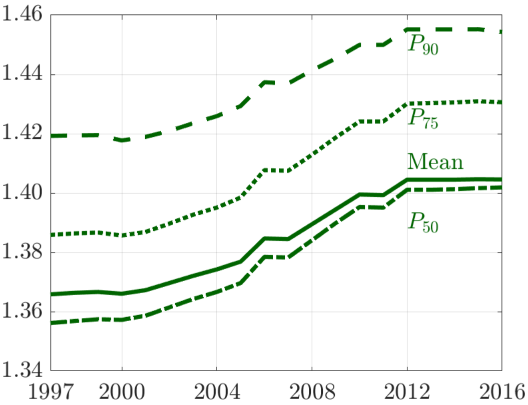
Average Markups and Markdowns



Markup and Markdown Distributions



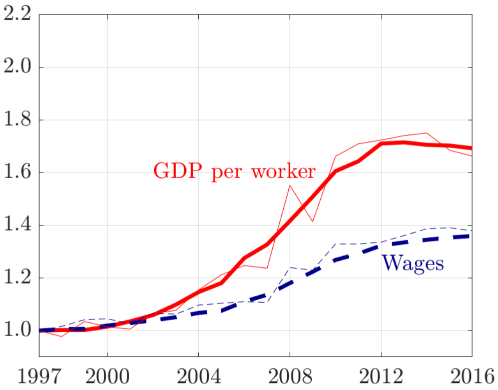
(a) Markups



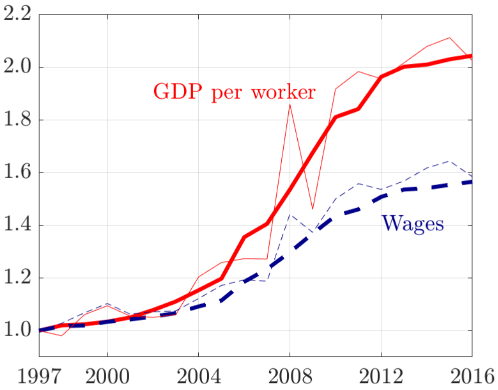
(b) Markdowns

Wage Stagnation

Decoupling Wages-Productivity



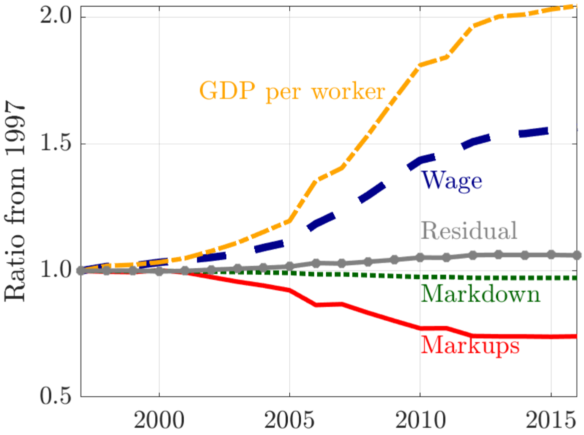
(a) Data



(b) Model

Decoupling Wages-Productivity

$$W = \text{GDP}/\text{Worker} \times \mu^{-1} \times \delta^{-1} \times \Omega$$



Social Planner's Problem

$$V = \max_{\{C_{inj}, L_{inj}\}} U\left(C - \frac{1}{\bar{\phi}^{\frac{1}{\phi}}} \frac{L^{\frac{\phi+1}{\phi}}}{\frac{\phi+1}{\phi}}\right)$$

$$\text{s.t.} \quad C_{inj} = Y_{inj} = A_{inj} L_{inj}$$

Counterfactual Economies

1. DECENTRALIZED EQUILIBRIUM: $L_{inj}^{\mu,\delta}$

$$A_{inj} P_{inj} \ \mu_{inj}^{-1} = W_{inj} \ \delta_{inj}$$

Counterfactual Economies

2. Social Planner's Solution: $L^{1,1}_{inj}$

$$A_{inj} P_{inj} = W_{inj}$$

Counterfactual Economies

3. Monopoly; No Monopsony: $L_{inj}^{\mu,1}$

$$A_{inj} P_{inj} \;\; \mu_{inj}^{-1} \; = \; W_{inj}$$

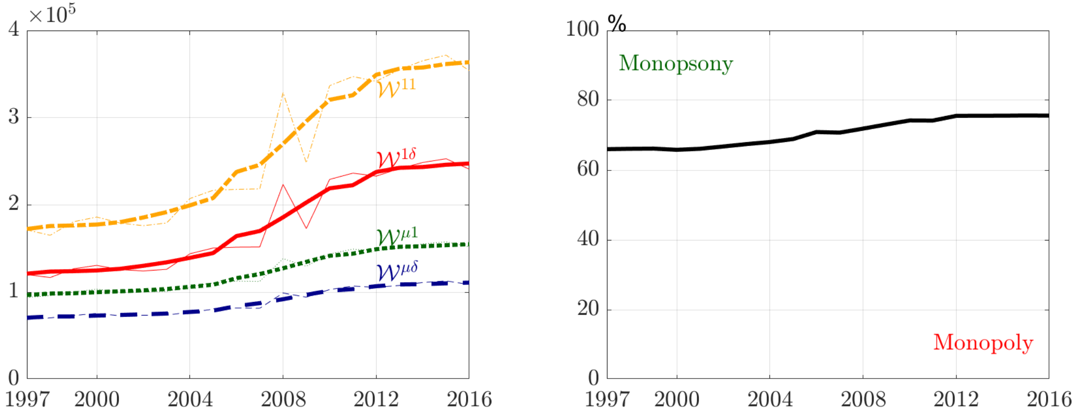
Counterfactual Economies

4. No Monopoly; Monopsony: $L^{1,\delta}_{inj}$

$$A_{inj} P_{inj} = W_{inj} \quad \delta_{inj}$$

Counterfactual Economies

Wage Decomposition



Conclusion

- We propose a novel method to:
  1. Jointly model and measure monopsony and monopoly
  2. Back out market structure
- Our Main Findings:
  1. Market Power has increased over time:
     - Markups increase from 1.69 to 2.2
     - Markdowns are stable, increase only marginally from 1.37 to 1.4
  2. Wage stagnation: decoupling wages-productivity
  3. Decomposition: indirect effect from monopoly dominates direct effect from monopsony

     Monopoly's relative share of the wage decline is 75% in 2016

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Any opinions and conclusions expressed herein are those of the authors and do not represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. Data Management System (DMS) number: P-7083300, Subproject number: 7508369. Disclosure Review Board number: CBDRB-FY22-CED006-0027.

Producer Optimality

$$P_{inj} + \frac{\partial P_{inj}}{\partial Y_{inj}} Y_{inj} + \sum_{i' \in \mathcal{I}_{nj} \setminus i} \left(\frac{\partial P_{i'nj}}{\partial Y_{inj}} Y_{i'nj} \right) = \frac{1}{A_{inj}} \left[W_{inj} + \frac{\partial W_{inj}}{\partial L_{inj}} L_{inj} + \sum_{i' \in \mathcal{I}_{nj} \setminus i} \left(\frac{\partial W_{i'nj}}{\partial L_{inj}} L_{i'nj} \right) \right]$$

$$P_{inj} \Big[1 \underbrace{- \frac{1}{\theta} s_{nj} - \frac{1}{\eta} (1 - s_{nj})}_{\epsilon^P_{inj}} \Big] A_{inj} = W_{inj} \Big[1 + \underbrace{\frac{1}{\hat{\theta}} e_{nj} + \frac{1}{\hat{\eta}} (1 - e_{nj})}_{\epsilon^W_{inj}} \Big]$$

We define our markup $\mu_{inj} = \frac{P_{inj}}{MC_{inj}}$ and markdown $\delta_{inj} = \frac{MRPL_{inj}}{W_{inj}}$

$$\mu_{inj} = \frac{1}{1 + \epsilon^P_{inj}} = \left[1 - \frac{1}{\theta} s_{nj} - \frac{1}{\eta} (1 - s_{nj}) \right]^{-1} \quad \text{and} \quad \delta_{inj} = 1 + \epsilon^W_{inj} = \left[1 + \frac{1}{\hat{\theta}} e_{nj} + \frac{1}{\hat{\eta}} (1 - e_{nj}) \right]$$

Back

Model Solution

Rearranging FOC, we get:

$$P_{inj} = \frac{\left[1 + \frac{1}{\hat{\theta}} e_{nj} + \frac{1}{\hat{\eta}}(1 - e_{nj})\right]}{\left[1 - \frac{1}{\theta} s_{nj} - \frac{1}{\eta}(1 - s_{nj})\right]} \frac{W_{inj}}{A_{inj}}$$

$$s_{inj} = \frac{P_{inj}^{1-\eta}}{\sum_{i'} P_{i'nj}^{1-\eta}} = \frac{\left[\frac{1+\frac{1}{\hat{\theta}}e_{nj}+\frac{1}{\hat{\eta}}(1-e_{nj})}{1-\frac{1}{\theta}s_{nj}-\frac{1}{\eta}(1-s_{nj})} \frac{e_{inj}^{\frac{1}{1+\hat{\eta}}}}{A_{inj}}\right]^{1-\eta}}{\sum_{i'}\left[\frac{1+\frac{1}{\hat{\theta}}e_{n'j}+\frac{1}{\hat{\eta}}(1-e_{n'j})}{1-\frac{1}{\theta}s_{n'j}-\frac{1}{\eta}(1-s_{n'j})} \frac{e_{i'n'j}^{\frac{1}{1+\hat{\eta}}}}{A_{i'n'j}}\right]^{1-\eta}}$$

where

$$e_{inj} = \frac{\left(s_{inj}^{\frac{\eta}{\eta-1}} / A_{inj}\right)^{\frac{\hat{\eta}+1}{\hat{\eta}}}}{\sum_{i'}\left(s_{i'nj}^{\frac{\eta}{\eta-1}} / A_{i'nj}\right)^{\frac{\hat{\eta}+1}{\hat{\eta}}}} = \left[\sum_{i'}\left(\left(\frac{s_{i'nj}}{s_{inj}}\right)^{\frac{\eta}{\eta-1}} \frac{A_{inj}}{A_{i'nj}}\right)^{\frac{\hat{\eta}+1}{\hat{\eta}}}\right]^{-1}$$

Back

Regression Specification

We use Two-Stage Least Squares (2SLS) on the following equations to get the estimate of $\hat{\eta}$ and $\hat{\theta}$.

- $\hat{\eta}$ Estimation

$$\ln W^{*}_{injt} = k_{jt} \; + \; \gamma \ln L_{jt} \; + \; \beta \ln L_{injt} \; + \; \underbrace{\alpha_{inj} \; + \; \epsilon_{injt}}_{\varepsilon_{injt}} \tag{1}$$

- $\hat{\theta}$ Estimation

$$\overline{\Omega}_{Sjt} = k_{jt} + \gamma_S \ln S_{jt} + \overline{\varepsilon}_{Sjt} \tag{2}$$

where we define $\beta = \frac{1}{\hat{\eta}}$ and $\gamma = (\frac{1}{\hat{\theta}} - \beta)$.

Back

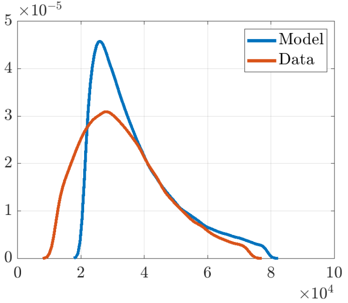
First and Second Stage Results

Table: Estimates of reduced-form parameters: Tradeables

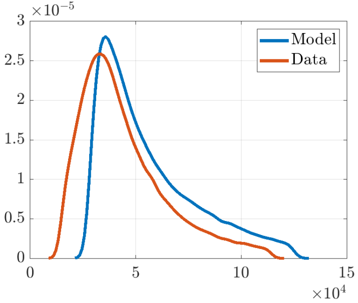
A. OLS and Second-Stage IV Estimates					
	OLS	IV		OLS	IV
	(1)	(2)		(3)	(4)
$\frac{1}{\hat{\eta}}$	-0.197	0.323	$\frac{1}{\hat{\theta}} - \frac{1}{\hat{\eta}}$	0.110	0.207
	(5.0e-4)	(0.051)		(2.0e-4)	(0.006)
Market x Year FE	Yes	Yes	Market FE	Yes	Yes
Establishment FE	Yes	Yes	Year FE	Yes	Yes
B. First-Stage Regressions for the IV					
$\tau_{X(i)t}$	-	-0.003	$\bar{\tau}_{jt}$	-	-0.023
		(2.0e-4)			(3.0e-4)
Market x Year FE	-	Yes	Market FE	-	Yes
Establishment FE	-	Yes	Year FE	-	Yes
No. of obs.	2,559,000	2,559,000	No. of obs.	2,674,000	2,674,000

Back

Wage Distribution



Wage Distribution 1997



Wage Distribution 2016

Back

Estimated Technology Distribution

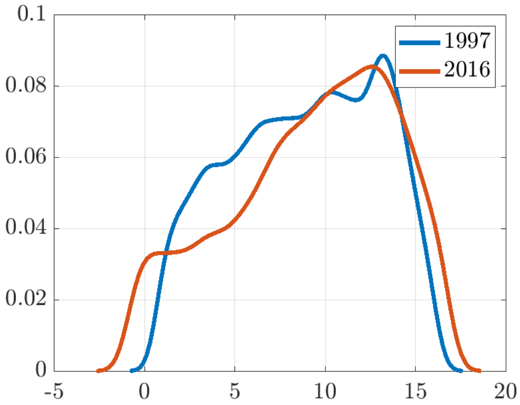


Figure: A_{inj}

Back

N Estimation Fit

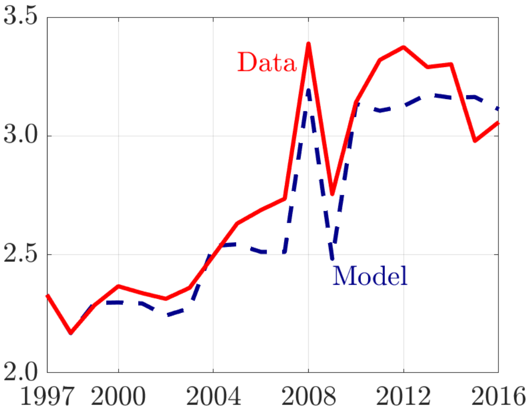


Figure: Model Fit-N estimation

Back