Labor Market Power

David Berger
Northwestern University and NBER

Kyle Herkenhoff
University of Minnesota

Simon Mongey
University of Chicago and NBER

briq Workshop - Firms, Jobs and Inequality

December, 2018

The views expressed herein are those of the authors and not necessarily those of the Census.

This paper

1. What are the welfare implications of labor market power?

- Tractable general equilibrium oligopsony model for the Census LBD
- Calibrate using data on local (i) concentration, (ii) wage / emp. shares
- Quantitative outcomes
    1. Data + Model $\rightarrow$ Market structure
    2. Data + Model + Market structure $\rightarrow$ Welfare implications

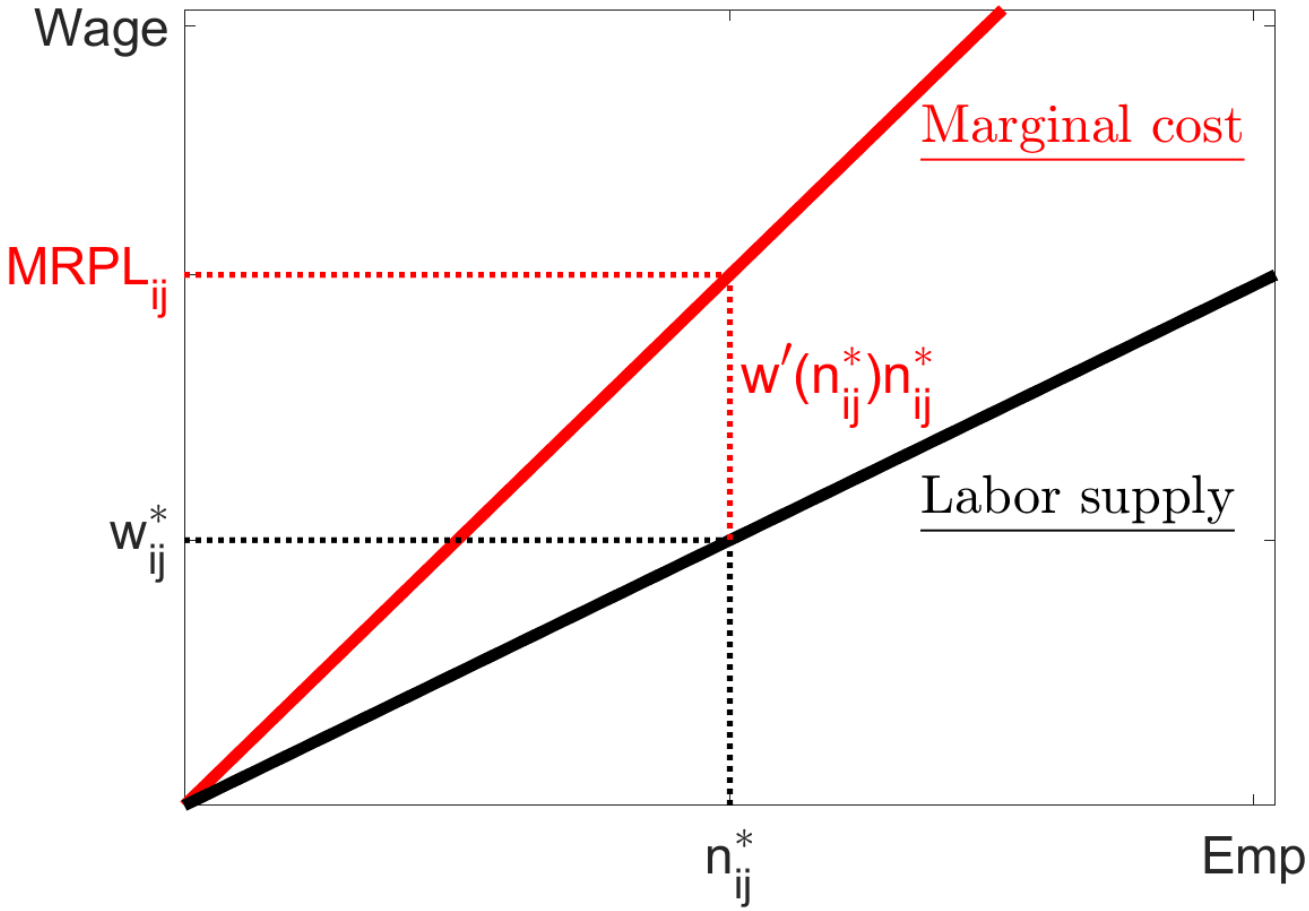
2. Does labor market power help us understand economic events?

   (i) Mergers, (ii) Pass-through, (iii) Minimum wage

   Empirics How do effects vary by market share and concentration?

   Model Validate and interpret empirics

Monopsony 101 - Robinson (1933)



$$\pi_{ij} = \max_{n_{ij}} \; MRPL_{ij} n_{ij} - w\left(n_{ij}\right) n_{ij} \quad , \quad w_{ij} = \mu_{ij} MRPL_{ij}$$

Literature

1. Oligopsonistic competition - *N* firms

   Theory I Bhaskar, Manning & To (2002), Boal & Ransom (1997)

   Theory II Hotelling (1929), Salop (1979)

   New - Quantitative general equilibrium macro model

2. Monopsonistic competition - Continuum of firms

   Frictional Burdett Mortensen (1998), Flinn (2010), Manning (2003, 2006)

   Competitive Robinson (‘33), Card Cardoso Heining Kline (‘18), Lamadon Mogstad Setzler (‘18)

   New - (i) Map discreteness to data, (ii) Strategic interaction

3. Empirics

   Min. wage Card, Krueger (2000), Webber (2015), Lindner Harasztosi (2017)

   Pass-through Staiger, Spetz, Phibbs (2010), Dube, Jacobs, Naidu, Suri (2018)

   Mergers Prager Schmitt (2018)

   Concentration Benmelech... (2018), Azar... (2018), Rinz (2018), Herbshein... (2018), Rossi-...

   New - Leverage the LBD, use within firm, across market variation

MODEL

Model environment

Agents

- Representative family
- Individuals have idiosyncratic disutility of supplying labor across firms
- Continuum of labor markets $j \in [0, 1]$
- Labor market j has a fixed number of firms $M_j \in [1, 2, \ldots, \infty)$
- Firm i in labor market j produces $y_{ij} = z_{ij} n_{ij}^{\alpha} k_{ij}^{1-\alpha}$

Competitive structure of markets

- Within a labor market - Oligopsonistic competition for workers
- Across labor markets - Monopsonistic competition for workers
- Competitive output (y_{ij}) and input (k_{ij}) markets

Household

Preferences

$$
\begin{aligned}
U &= \max_{\{n_{ijt}, c_{ijt}, K_t\}} \sum_{t=0}^{\infty} \beta^t u\left(\widetilde{\mathbf{C}}_t - \frac{1}{\bar{\varphi}^{\frac{1}{\varphi}}} \frac{\widetilde{\mathbf{N}}_t^{1+\frac{1}{\varphi}}}{1+\frac{1}{\varphi}}\right) \\
\widetilde{\mathbf{N}}_t &:= \left[\int_0^1 \widetilde{\mathbf{N}}_{jt}^{\frac{\theta+1}{\theta}}\, dj\right]^{\frac{\theta}{\theta+1}} \\
\widetilde{\mathbf{N}}_{jt} &:= \left[n_{1jt}^{\frac{\eta+1}{\eta}} + \cdots + n_{M_j jt}^{\frac{\eta+1}{\eta}}\right]^{\frac{\eta}{\eta+1}} \quad , \quad \eta > \theta > \varphi > 0 \\
\widetilde{\mathbf{C}}_t &:= \int_0^1 c_{1jt} + \cdots + c_{M_j jt}\, dj
\end{aligned}
$$

Budget constraint

$$
P_t \widetilde{\mathbf{C}}_t + \left[K_{t+1} - (1-\delta) K_t\right] = \int_0^1 \left[w_{1jt} n_{1jt} + \cdots + w_{M_j jt} n_{M_j jt}\right] dj + R_t K_t + \Pi_t
$$

Household - Elasticities and interpretation

1. Across markets

$$\widetilde{\mathbf{N}}_t = \left[\int_0^1 \widetilde{\mathbf{N}}_{jt}^{\frac{\theta+1}{\theta}} \, dj \right]^{\frac{\theta}{\theta+1}}$$

$\theta \to \infty$ All workers to market with highest wage

2. Within markets

$$\widetilde{\mathbf{N}}_{jt} = \left[n_{1jt}^{\frac{\eta+1}{\eta}} + \cdots + n_{M_j jt}^{\frac{\eta+1}{\eta}} \right]^{\frac{\eta}{\eta+1}}$$

$\eta \to \infty$ All workers to firm with highest wage

Micro-foundation - Nested logit individual choice model

- More competitive: $\uparrow \theta \sim \downarrow Var(\varepsilon_{ij})$, $\uparrow \eta \sim \uparrow Corr_j(\varepsilon_{ij})$

▸ Microfounding firm and sector labor supply: Nested logit ↔ Nested CES (Verboven, 1996)

Household - Optimality conditions

Inverse labor supply curve

$$w_{ijt} = \left(\frac{n_{ijt}}{\widetilde{\mathbf{N}}_{jt}}\right)^{1/\eta}\left(\frac{\widetilde{\mathbf{N}}_{jt}}{\widetilde{\mathbf{N}}_{t}}\right)^{1/\theta}\widetilde{\mathbf{W}}_t \quad , \quad \frac{\widetilde{\mathbf{W}}_t}{P_t} = \bar{\varphi}\widetilde{\mathbf{N}}_t^{\varphi}$$

$$\widetilde{\mathbf{W}}_t := \left[\int_0^1 \widetilde{\mathbf{W}}_{jt}^{1+\theta} dj\right]^{\frac{1}{1+\theta}} \qquad \widetilde{\mathbf{W}}_t\widetilde{\mathbf{N}}_t = \int_0^1 \sum_{i\in j} w_{ijt} n_{ijt}\, dj$$

$$\widetilde{\mathbf{W}}_{jt} := \left[\sum_{i\in j} w_{ijt}^{1+\eta}\right]^{\frac{1}{1+\eta}}$$

Goods demand and capital accumulation

$$u'\left(\widetilde{\mathbf{C}}_t - \frac{1}{\bar{\varphi}^{\frac{1}{\varphi}}}\frac{\widetilde{\mathbf{N}}_t^{1+\frac{1}{\varphi}}}{1+\frac{1}{\varphi}}\right) = \Lambda_t P_t \quad , \quad R_t = \frac{\Lambda_{t-1}}{\Lambda_t}\left[r_t + \delta\right] \quad , \quad r_t = \frac{1}{\beta} - 1$$

Firms

Profits

$$\pi_{ijt} = \max_{n_{ijt}} \left(MRPL_{ijt} - w_{ijt} \right) n_{ijt}$$

$$MRPL_{ijt} = \alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}} \left(\frac{P_t z_{ijt}}{R_t} \right)^{\frac{1-\alpha}{\alpha}} P_t z_{ijt}$$

+ household labor supply

$$\pi_{ijt} = \max_{n_{ijt}} \Bigg(MRPL_{ijt} - \underbrace{\bar{\varphi}^{-\frac{1}{\varphi}} \left(\frac{n_{ijt}}{\widetilde{\mathbf{N}}_{jt}} \right)^{1/\eta} \left(\frac{\widetilde{\mathbf{N}}_{jt}}{\widetilde{\mathbf{N}}_t} \right)^{1/\theta} \widetilde{\mathbf{N}}_t^{1/\varphi} P_t}_{w\left(n_{ijt}, n_{-ijt}, \widetilde{\mathbf{N}}_t, P_t\right)} \Bigg) n_{ijt}$$

Firms - Local labor market equilibrium

Result Equilibrium expressed entirely in wage payment shares

$$s_{ijt}^{wn} = \frac{w_{ijt} n_{ijt}}{\sum_{k \in j} w_{kjt} n_{kjt}} \quad , \quad \frac{\partial \log w_{ijt}}{\partial \log n_{ijt}} = \frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta} \right) s_{ijt}^{wn}$$

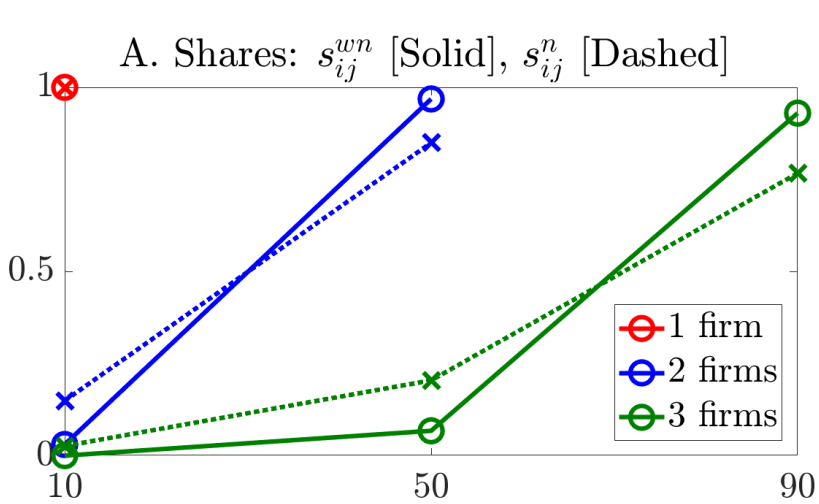
$$(1) \quad w_{ijt} = \mu(s_{ijt}^{wn}) MRPL_{ijt}$$

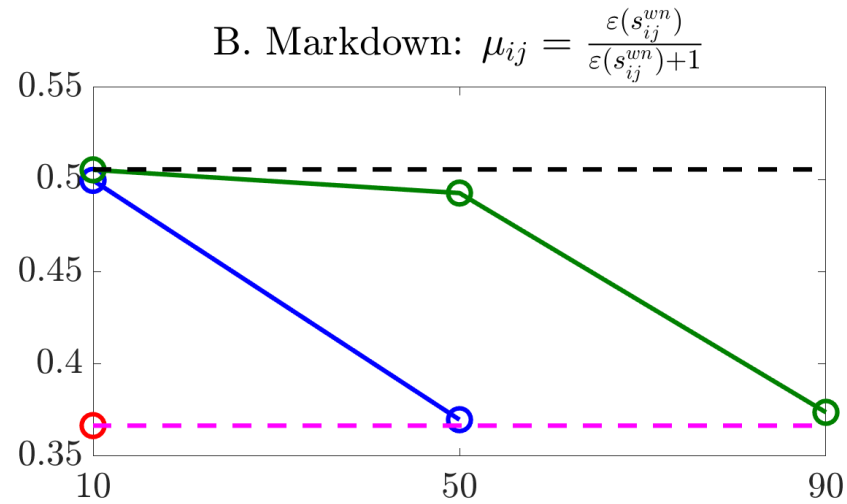
$$\mu\left(s_{ijt}^{wn}\right) = \frac{\varepsilon(s_{ijt}^{wn})}{\varepsilon(s_{ijt}^{wn}) + 1}$$

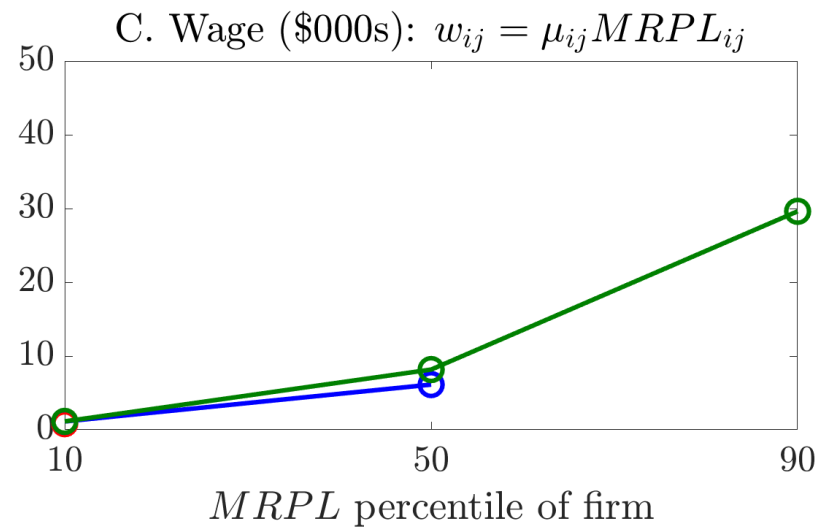
$$\varepsilon(s_{ijt}^{wn}) = \left[\frac{1}{\eta} + \left(\frac{1}{\theta} - \frac{1}{\eta} \right) s_{ijt}^{wn} \right]^{-1}$$

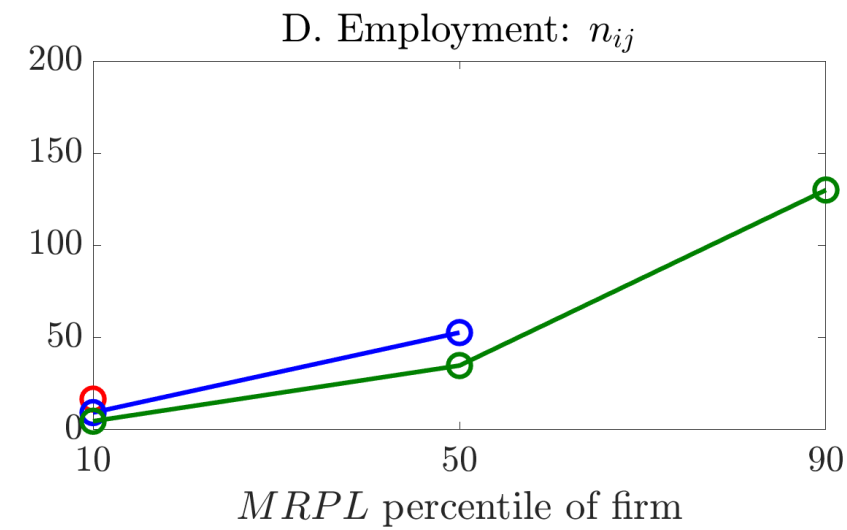
$$(2) \quad s_{ijt}^{wn} = \frac{w_{ijt} n\left(w_{ijt}, \widetilde{\mathbf{W}}_{jt}, \widetilde{\mathbf{W}}_{t}, P_t \right)}{\sum_{k \in j} w_{kjt} n\left(w_{kjt}, \widetilde{\mathbf{W}}_{jt}, \widetilde{\mathbf{W}}_{t}, P_t \right)}$$

Firms - Local labor market equilibrium

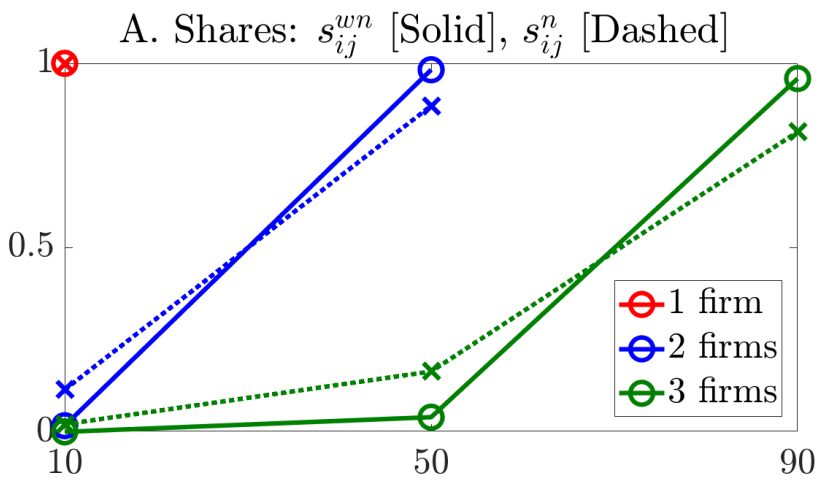


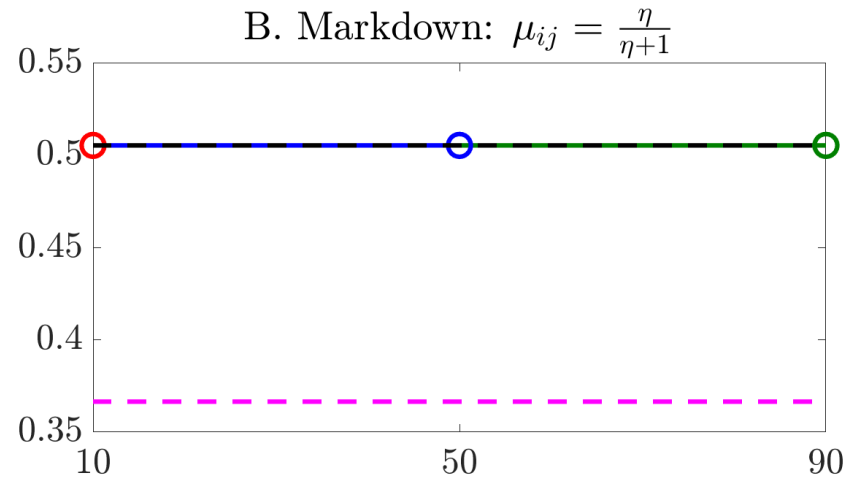


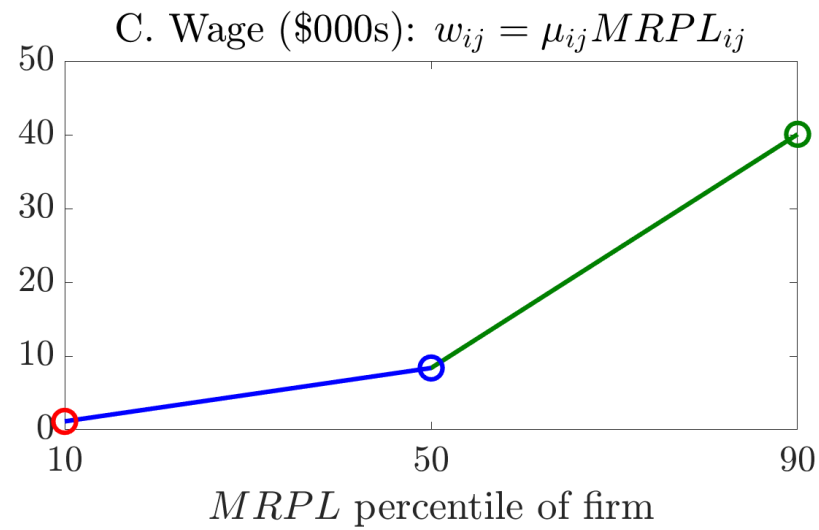


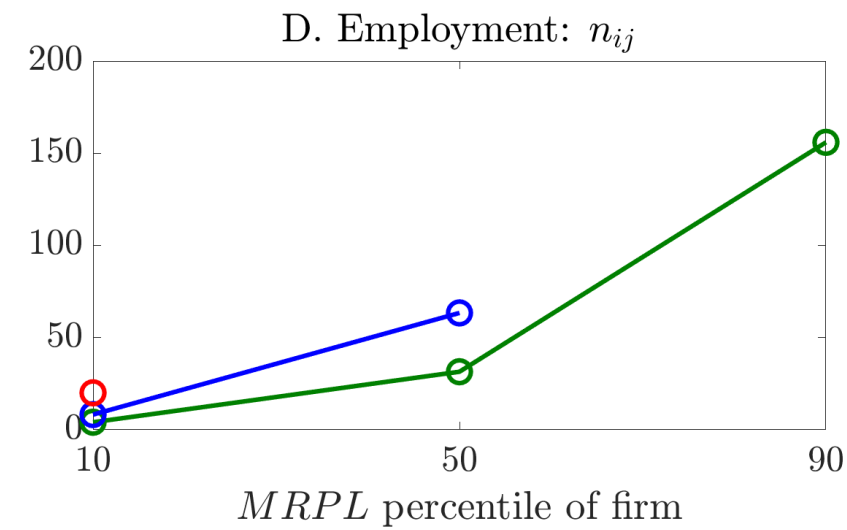


Firms - Local labor market equilibrium









Aggregation 1 - Concentration and labor share

Herfindahl index

$$HHI_j^{wn} \equiv \sum_{i \in j} (s_{ij}^{wn})^2 \ , \ IHI_j^{wn} = \frac{1}{HHI_j^{wn}} \ , \ \widetilde{IHI}^{wn} = \left[\int_0^1 s_j^{wn} \left\{ IHI_j^{wn} \right\}^{-1} dj \right]^{-1}$$

Labor share

$$LS = \alpha \left\{ \frac{\widetilde{IHI}^{wn}}{\left(\frac{\eta+1}{\eta} \right) \widetilde{IHI}^{wn} + \left(\frac{\theta+1}{\theta} - \frac{\eta+1}{\eta} \right)} \right\}$$

Two results

1. If $\theta < \eta$ then labor share is increasing in $\widetilde{IHI}^{wn}$
2. If $\theta = \eta$ then labor share is independent of HHI_j^{wn} distribution

Aggregation 2 - Concentration and output

$$
\begin{aligned}
y_{ijt} &= \alpha^{-1}\, MRPL_{ijt}\, n\left(w_{ijt}, \widetilde{\mathbf{W}}_{jt}, \widetilde{\mathbf{W}}_{t}, P_t\right) \\
Y_t &= \Delta_t \left(\frac{P_t}{\widetilde{\mathbf{W}}_t}\right)^{\theta-\varphi} \\
\Delta_t &= \bar{\varphi} \int_0^1 \sum_{i\in j} MRPL_{ijt}^{1+\eta} \left(\frac{\mu_{ijt}}{\mu_{jt}}\right)^{\eta} \mu_{jt}^{\theta}\, dj \quad , \quad \mu_{jt} := \frac{P_t}{\widetilde{\mathbf{W}}_{jt}}
\end{aligned}
$$

Two results

1. If $\theta < \eta$, negative correlation of $MRPL_{ijt}$ and μ_{ijt} reduces supply $\downarrow \Delta_t$
2. If $\theta = \eta$ then larger firms' market power has no effect on output

Aggregation 2 - Concentration and output

$$
\begin{aligned}
y_{ijt} &= \alpha^{-1} \, MRPL_{ijt} \, n\left(w_{ijt}, \widetilde{\mathbf{W}}_{jt}, \widetilde{\mathbf{W}}_{t}, P_t\right) \\
Y_t &= \Delta_t \left(\frac{P_t}{\widetilde{\mathbf{W}}_t} \right)^{\theta - \varphi} \\
\Delta_t &= \bar{\varphi} \left(\frac{\eta}{\eta + 1} \right)^{\eta} \int_0^1 \sum_{i \in j} MRPL_{ijt}^{1+\eta} \, dj \quad , \quad \mu_{ijt} := \frac{\eta}{\eta + 1}
\end{aligned}
$$

Two results

1. If $\theta < \eta$, negative correlation of $MRPL_{ijt}$ and μ_{ijt} reduces supply $\downarrow \Delta_t$
2. If $\theta = \eta$ then larger firms' market power has no effect on output

▸ Backing out $MRPL_{ij}$ from s_{ij}^{wn}

CALIBRATION

Calibration

Market

- Only tradeable sectors. Approx. $15,000$ markets in Census LBD
- A market j is Commuting Zone$\times$NAICS3. Aggregate estabs in j.

Parameters: $\{\alpha, \theta, \eta, F(z)\}$

- Set $\alpha = 1$
  - $\{\text{Labor, Capital, Profit}\} = \{\alpha\widetilde{LS}, (1-\alpha)\widetilde{LS}, \alpha(1-\widetilde{LS})\}$
- $z \sim Pareto(\underline{z}, \mu_z, \xi)$

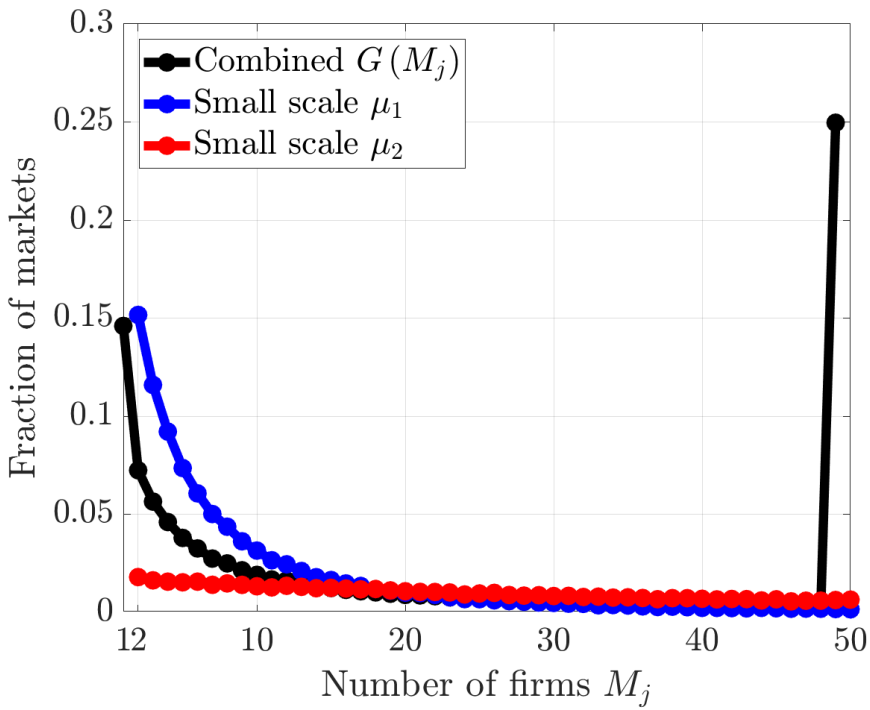
Targets

1. Employment weighted means of within market moments
2. Distribution of HHI_j^{wn}
3. Distribution of employment across markets

Calibration - Number of firms M_j

- 15% of markets have one firm $(M_j = 1)$
- Rest drawn from two paretos, same shape γ, different scales μ_1, μ_2

Distribution of number of firms M_j	**Mean**	**Std.Dev.**	**Skewness**
Data (LBD)	42.6	208.4	22.8
Model	42.7	206.6	27.4



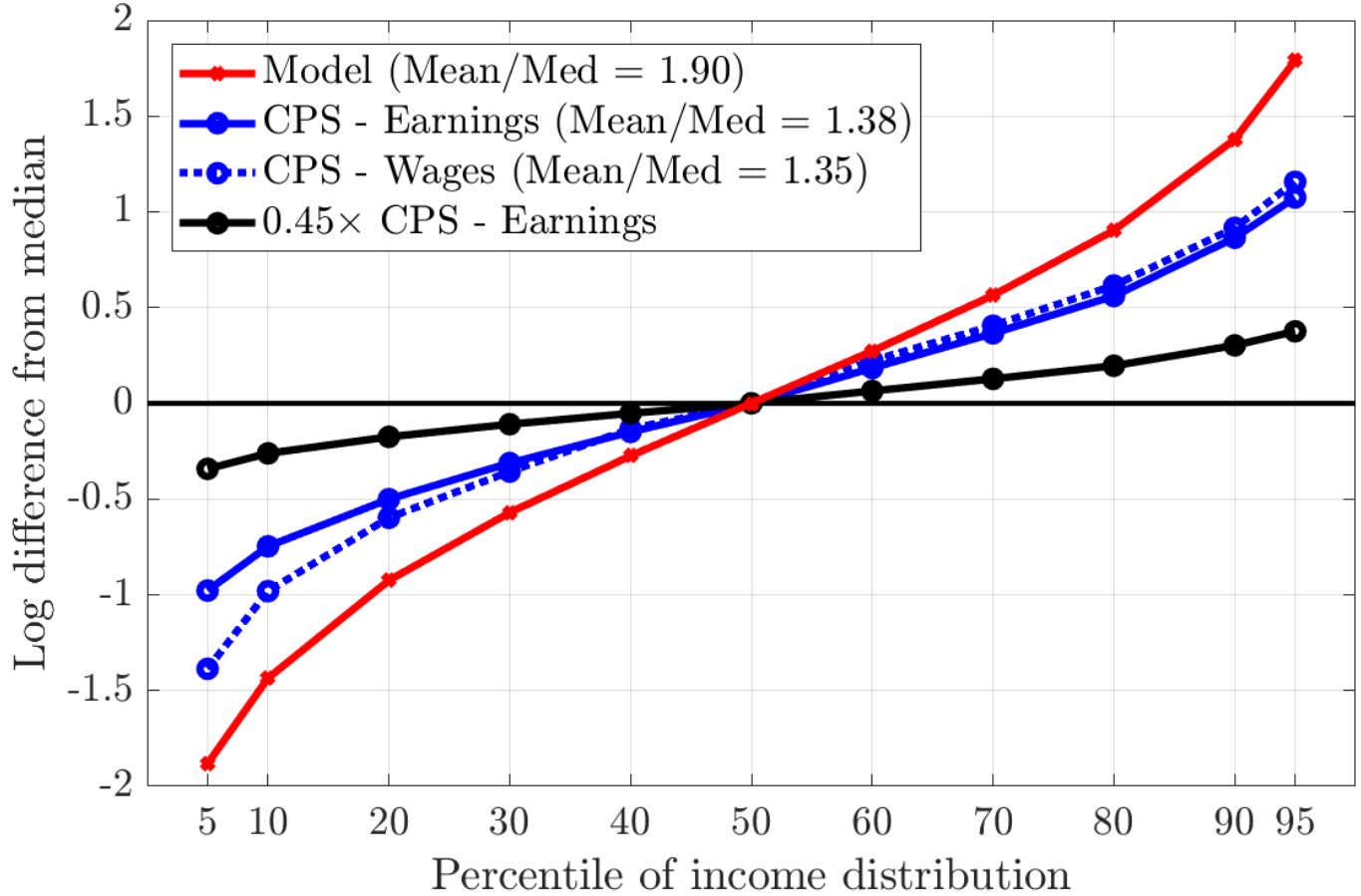
Calibration

Parameter		Value	Target	Model	Data
A. Internally calibrated					
Across sector substitution	θ	0.88	$\mathbb{E}[Corr_j(s_{ij}^{wn}, s_{ij}^{n})]$	0.944	0.890
Within sector substitution	η	1.38	$\mathbb{E}[Std_j(s_{ij}^{n})]$	0.039	0.044
Pareto - Shape parameter	ξ	0.16	$\mathbb{E}[Std_j(w_{ij}/W_j)]$	0.404	0.564
			$\mathbb{E}[HHI_j^{wn}]$	0.460	0.449
			$Std[HHI_j^{wn}]$	0.334	0.334
			$Skew[HHI_j^{wn}]$	0.485	0.477
			$Std[\log N_j]$	1.675	1.887
B. Normalizations					
Labor disutility shifter	$\bar{\varphi}$		Ave. firm size	27.9	27.9
Aggregate productivity	μ_z		Ave. annual earnings ($000's)	65.8	65.8
Frisch elasticity	φ	0.50			
Pareto - Lower bound	$\underline{z}$	0			

- First 3 moments measured only for j with $M_j > 1$ and are employment weighted
- Averages of moments across markets are employment weighted
- HHI_j^{wn} moments unweighted across sectors
- $Std[\log N_j]$ computed across County$\times$NAICS3 from CBP
- W_j is average worker earnings in market: $W_j = \sum_{i \in j} w_{ij} n_{ij} / N_j$

▸ Identification - Parameters vs. moments ▸ Identification - Distribution of parameters

Calibration - Income inequality



- $Var_{s_{ij}^n}\left(\mathbb{E}\left[\log \bar{w}_{ij}\right]\right)$: Model = 1.33, LEHD (Spletzer) = 0.58

Calibration - Alternative moments

Parameter		Value	Target	Model	Data
A. Internally calibrated					
Across sector substitution	θ	0.88	$\mathbb{E}[Corr_j(s_{ij}^{wn}, s_{ij}^{n})]$	0.944	0.890
Within sector substitution	η	1.38	$\mathbb{E}[Std_j(s_{ij}^{n})]$	0.039	0.044
Pareto - Shape parameter	ξ	0.16	$\mathbb{E}[Std_j(w_{ij}/W_j)]$	0.404	0.564
			$\mathbb{E}[HHI_j^{wn}]$	0.460	0.449
			$Std[HHI_j^{wn}]$	0.334	0.334
			$Skew[HHI_j^{wn}]$	0.485	0.477
			$Std[\log N_j]$	1.675	1.887
			Labor share	0.564	0.800
			Across firm size class wage-emp	0.736	0.107
			Across county regression wage-emp	0.513	0.086
B. Normalizations					
Labor disutility shifter	$\bar{\varphi}$		Ave. firm size	27.9	27.9
Aggregate productivity	μ_z		Ave. annual earnings ($000's)	65.8	65.8
Frisch elasticity	φ	0.50			
Pareto - Lower bound	$\underline{z}$	0			

Calibration - Alternative moments

Parameter		Value	Target	Model	Data
A. Internally calibrated					
Across sector substitution	θ	6.98	$\mathbb{E}[Corr_j(s_{ij}^{wn}, s_{ij}^{n})]$	0.997	0.890
Within sector substitution	η	11.89	$\mathbb{E}[Std_j(s_{ij}^{n})]$	0.120	0.044
Pareto - Shape parameter	ξ	0.01	$\mathbb{E}[Std_j(w_{ij}/W_j)]$	0.190	0.564
			$\mathbb{E}[HHI_j^{wn}]$	0.781	0.449
			$Std[HHI_j^{wn}]$	0.251	0.334
			$Skew[HHI_j^{wn}]$	-0.755	0.477
			$Std[\log N_j]$	6.537	1.887
			Labor share	0.867	0.800
			Across firm size class wage-emp	0.115	0.107
			Across county regression wage-emp	0.140	0.086
B. Normalizations					
Labor disutility shifter	$\bar{\varphi}$		Ave. firm size	27.9	27.9
Aggregate productivity	μ_z		Ave. annual earnings ($000's)	65.8	65.8
Frisch elasticity	φ	0.50			
Pareto - Lower bound	$\underline{z}$	0			

Model with constant returns to scale cannot simultaneously match

- Concentration and within market dispersion
- Labor share, size-wage elasticities

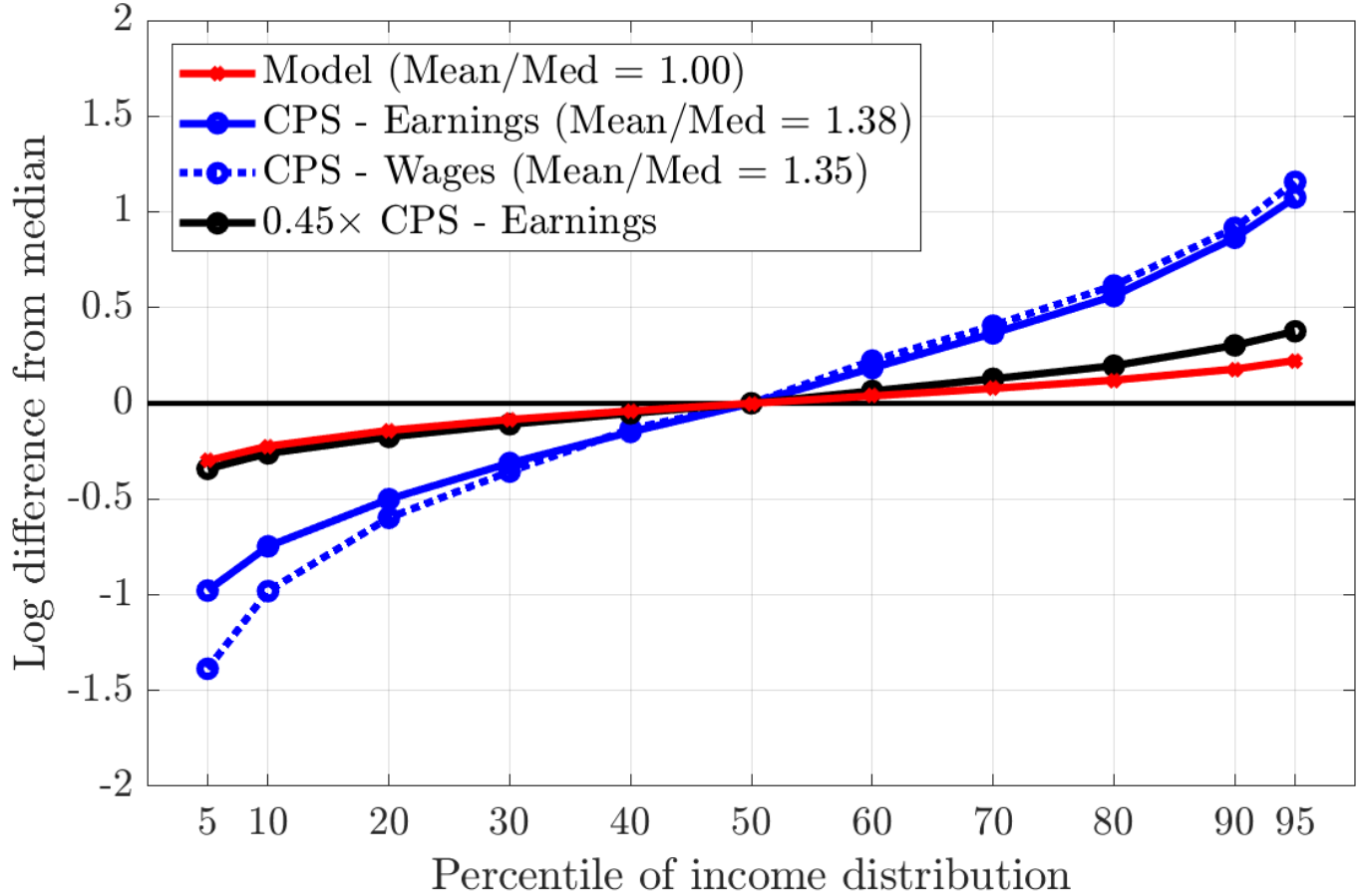
Calibration - Decreasing marginal revenue

Parameter		HHI	Wage	DRS	Target	HHI	Wage	DRS	Data
A. Internally calibrated									
Across sector substitution	θ	0.88	6.98	7.00	$\mathbb{E}[Corr_j(s_{ij}^{wn}, s_{ij}^{n})]$	0.944	0.997	0.994	0.890
Within sector substitution	η	1.38	11.89	8.50	$\mathbb{E}[Std_j(s_{ij}^{n})]$	0.039	0.120	0.043	0.044
Pareto - Shape parameter	ξ	0.16	0.01	0.01	$\mathbb{E}[Std_j(w_{ij}/W_j)]$	0.404	0.190	0.201	0.564
Returns to scale	γ	1	1	0.65	$\mathbb{E}[HHI_j^{wn}]$	0.460	0.781	0.441	0.449
$y_{ij} = z_{ij} n_{ij}^{\gamma}$					$Std[HHI_j^{wn}]$	0.334	0.251	0.346	0.334
					$Skew[HHI_j^{wn}]$	0.485	-0.755	0.502	0.477
					$Std[\log N_j]$	1.675	6.537	2.604	1.887
					Labor share	0.564	0.867	0.752	0.800
					Across firm size	0.736	0.115	0.116	0.107
					Across county	0.513	0.140	0.096	0.086
B. Normalizations									
Labor disutility shifter	$\bar{\varphi}$				Ave. firm size	27.9	27.9	27.9	27.9
Aggregate productivity	μ_z				Ave. earnings	65.8	65.8	65.8	65.8
Frisch elasticity	φ	0.50							
Pareto - Lower bound	$\underline{z}$	0							

Model with decreasing returns to scale can simultaneously match

- Concentration and within market dispersion
- Size-wage elasticities

Calibration - Income inequality



- $Var_{s_{ij}^n}\left(\mathbb{E}\left[\log \bar{w}_{ij}\right]\right)$: Model = 0.54, LEHD (Spletzer) = 0.58

Calibration - Non-targetted moments

Moment	Model	Data
A. Within and across market moments		
$Std_j(s_{ij}^{wn})$	0.047	0.048
$Corr(HHI_j^{wn}, \overline{WN}_j)$	-0.250	-0.150
B. Unweighted HHI distribution		
Mean	0.441	0.449
Standard deviation	0.346	0.334
Skewnewss	0.502	0.477
C. Employment weighted HHI distribution		
Mean	0.129	0.139
Standard deviation	0.027	0.195
Skewnewss	2.976	2.280
D. Markets with 1000+ workers		
Share of markets	0.304	0.312*
Share of employment	0.849	0.916*
Share of earnings	0.859	0.943*

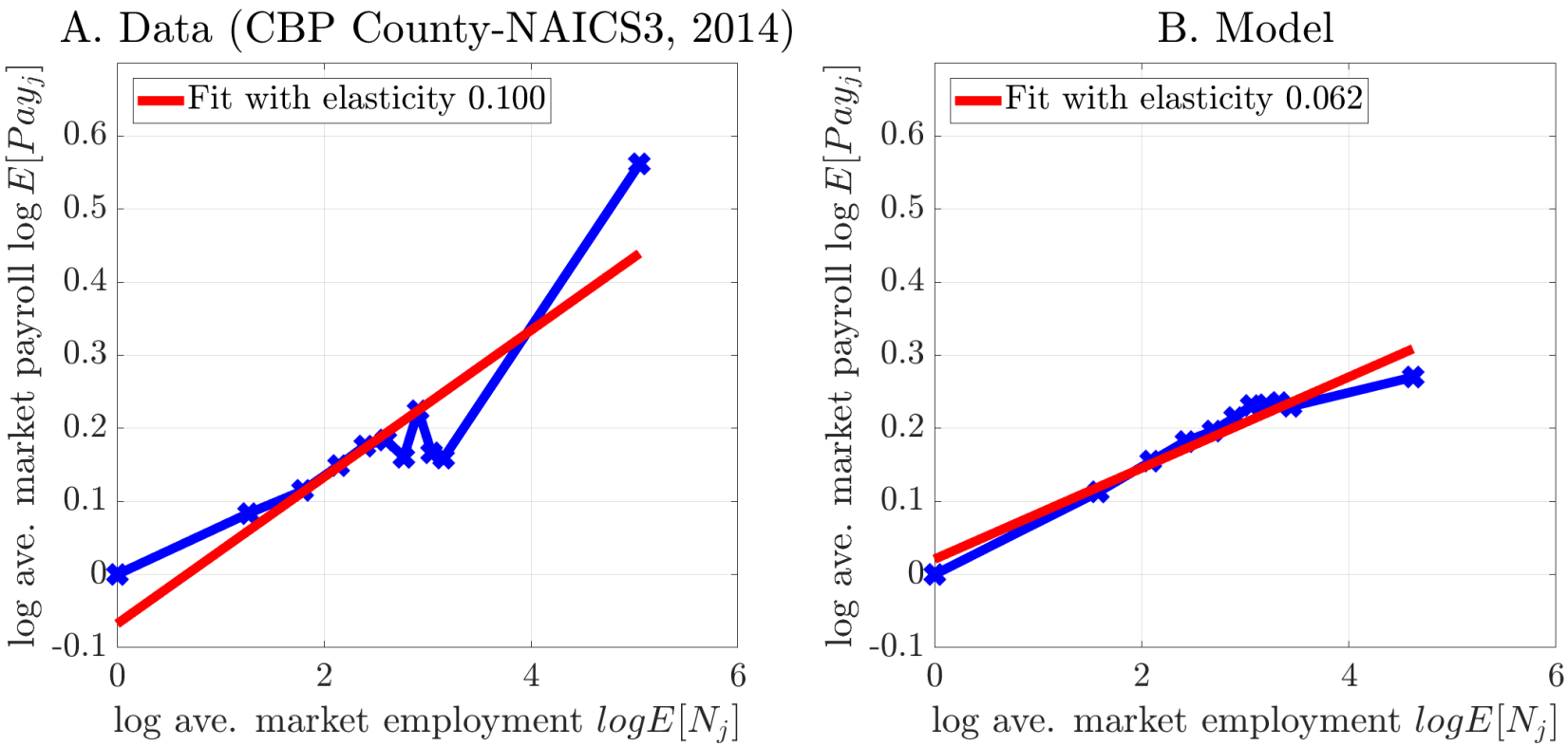
* County Business Patterns data: Market = County $\times$ NAICS3 (non-tradeables)

Calibration - Non-targetted moments

Moment	Model	Data
A. Log market employment		
Mean	5.334	5.973*
Standard deviation	2.604	1.887*
Skewness	-1.325	0.033*
B. Log market payroll		
Mean	16.248	16.706*
Standard deviation	2.857	2.079*
Skewness	-1.438	0.040*
C. Log market average worker pay		
Mean	10.914	10.734*
Standard deviation	0.268	0.386*
Skewness	-2.306	-0.121*

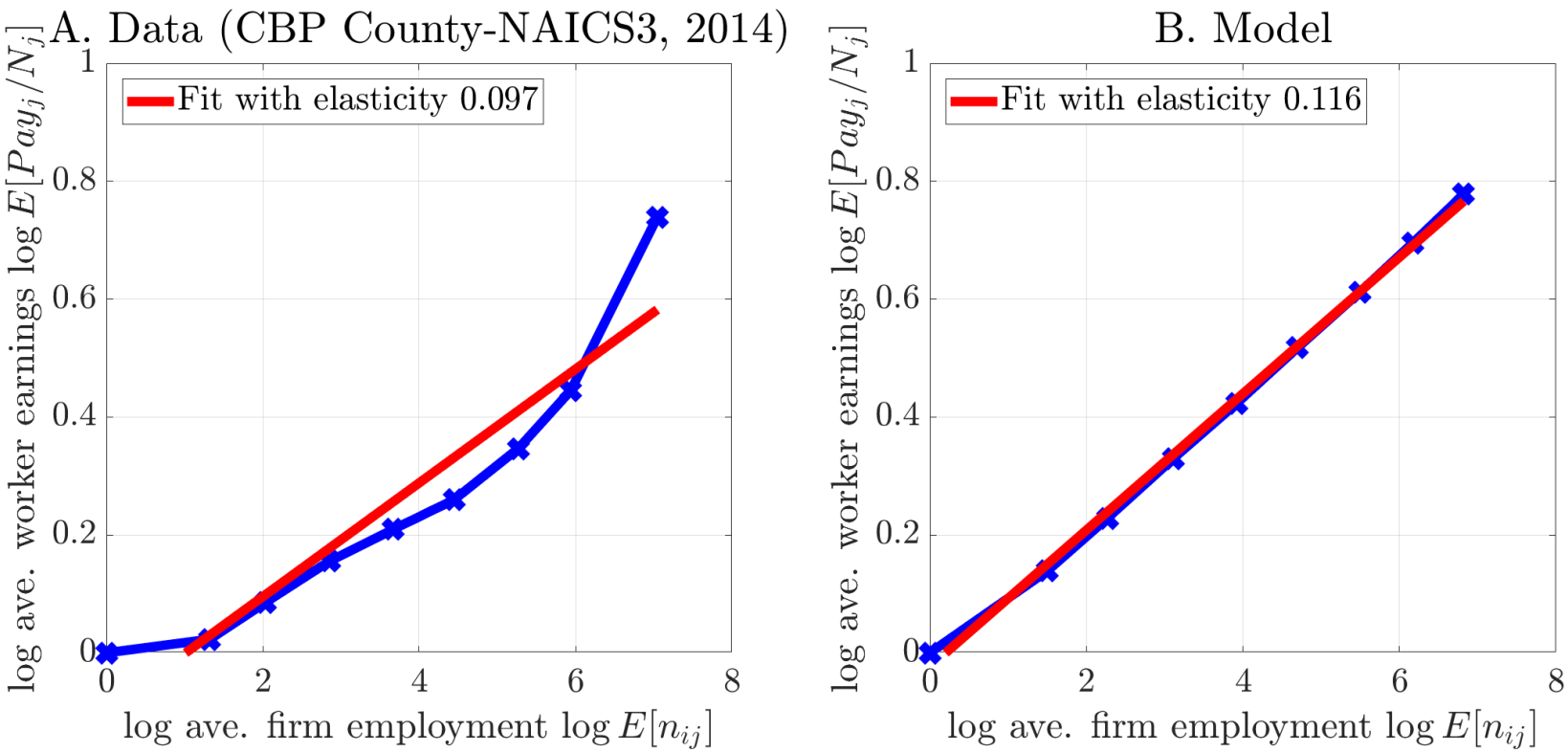
* County Business Patterns data: Market = County $\times$ NAICS3 (non-tradeables)

Calibration - Size and wage - Across markets



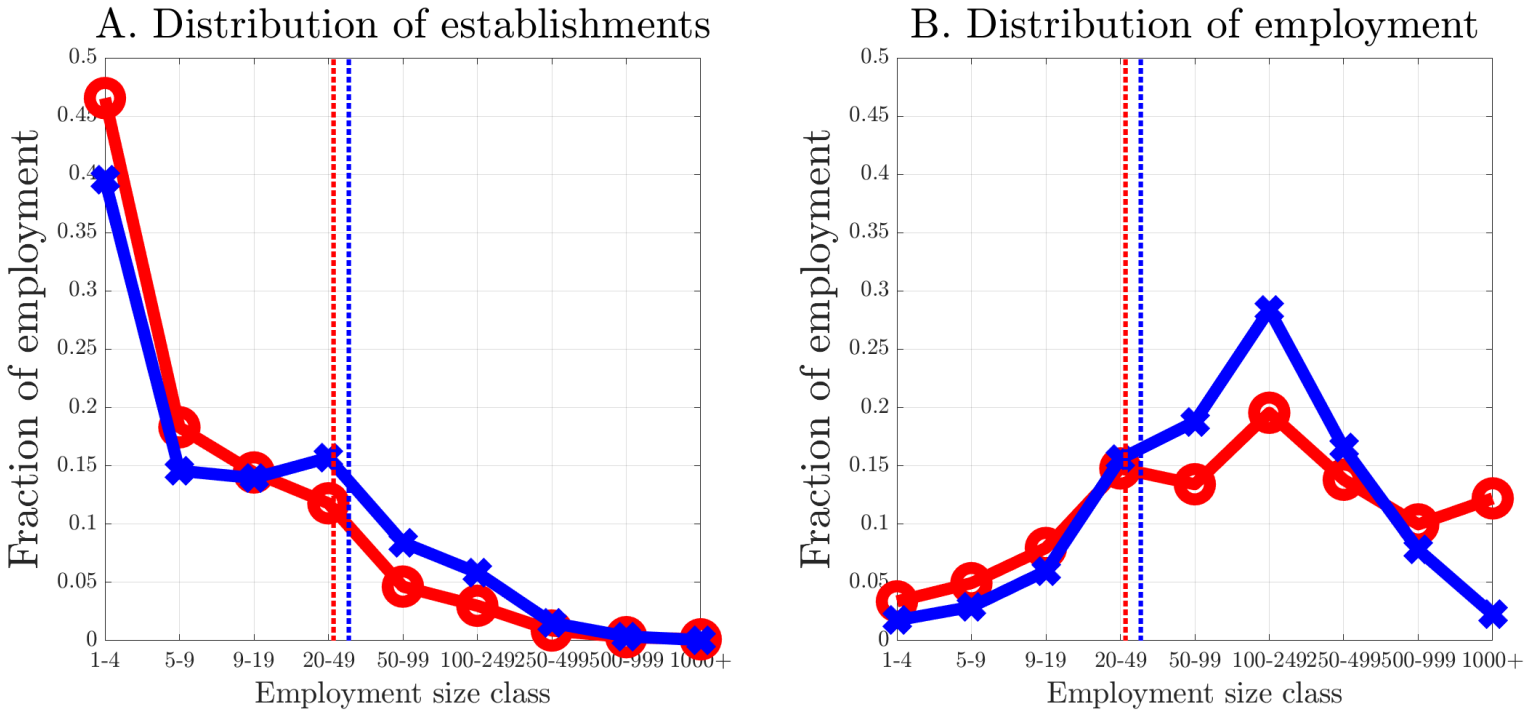
- Bin County-NAICS3 markets into employment classes $N_j \in \{0\text{-}99,\ 100\text{-}199,\ \cdots,\ 900\text{-}999,\ 1000+\}$
- Average employment N_j and total payroll WN_j

Calibration - Size and wage - Across employment sizes



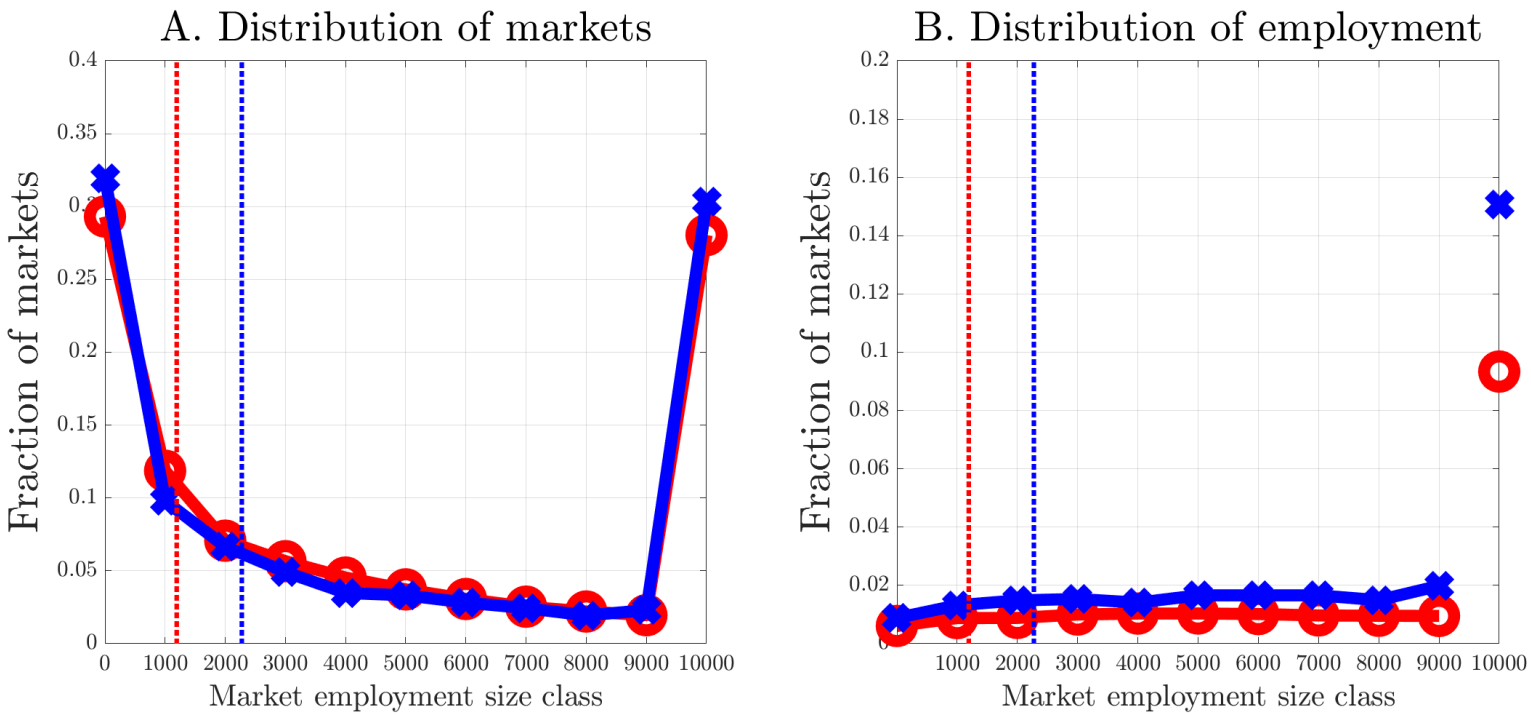
- Bin US establishments into employment classes
  $n_{ij} \in \{0\text{-}4,\ 5\text{-}9,\ \cdots,\ 499\text{-}999,\ 1000+\}$
- Ave. employment n_{ij} and ave. worker earnings $\sum_{ij \in g} w_{ij} n_{ij} \,/\, \sum_{ij \in g} n_{ij}$

Calibration - Across firm employment distribution



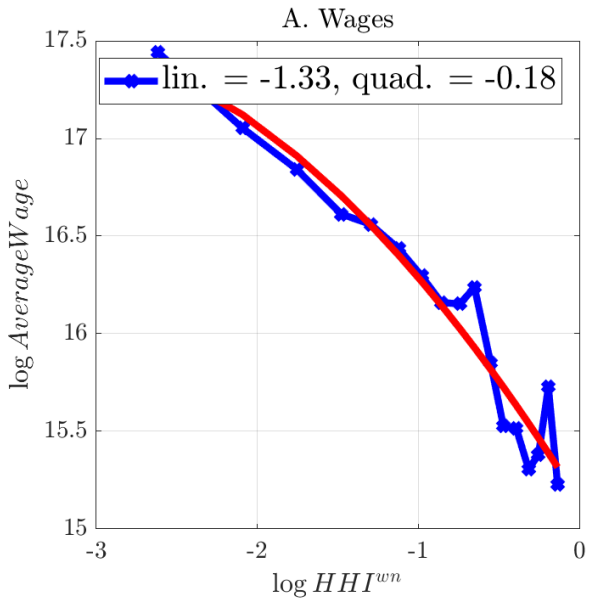
- Data CBP 2014, establishments binned by employment
- Model CZ-NAICS3 firms (ij) binned by employment

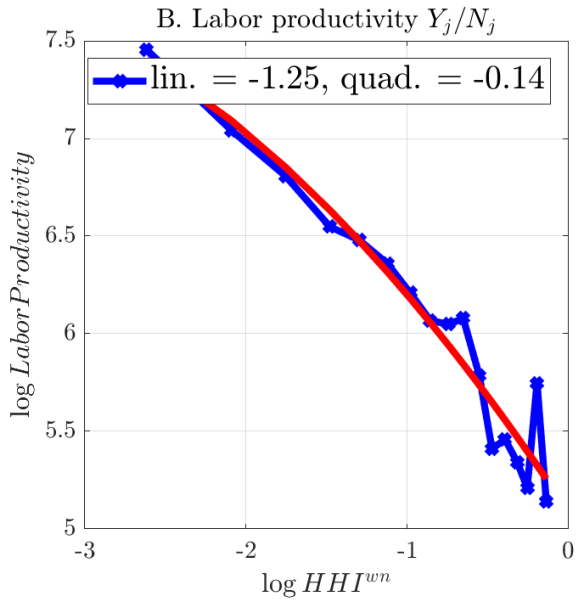
Calibration - Across market employment distribution

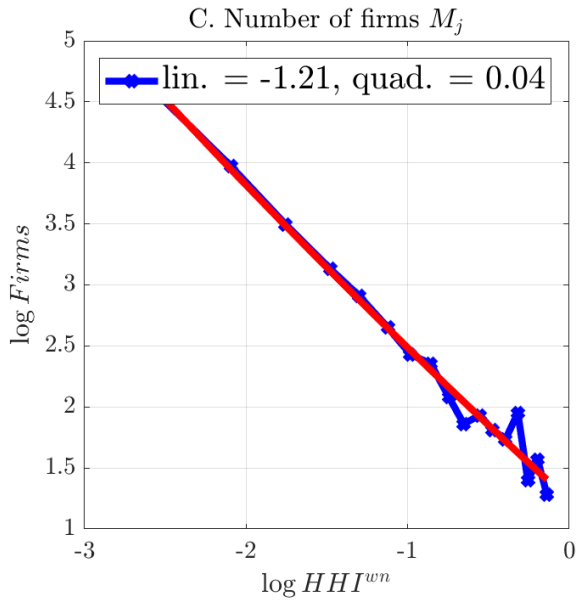


- Data CBP 2014, County-NAICS3 markets binned by employment
- Model CZ-NAICS3 markets (j) binned by employment

Calibration - Concentration, wages, productivity





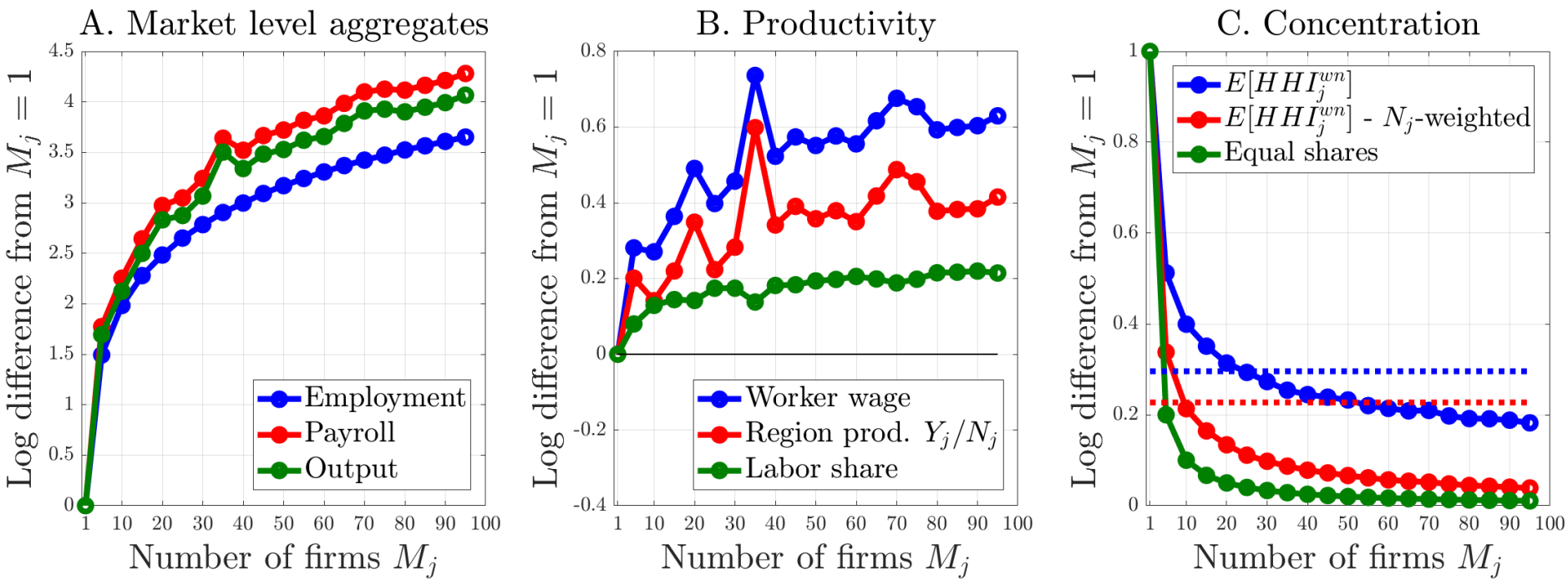


Results

1. Number of firms and measured productivity
2. Concentration and labor share
    - Time series
3. Bias in employment HHI^n
4. Heterogeneity in labor market power
5. Welfare effects of market structure

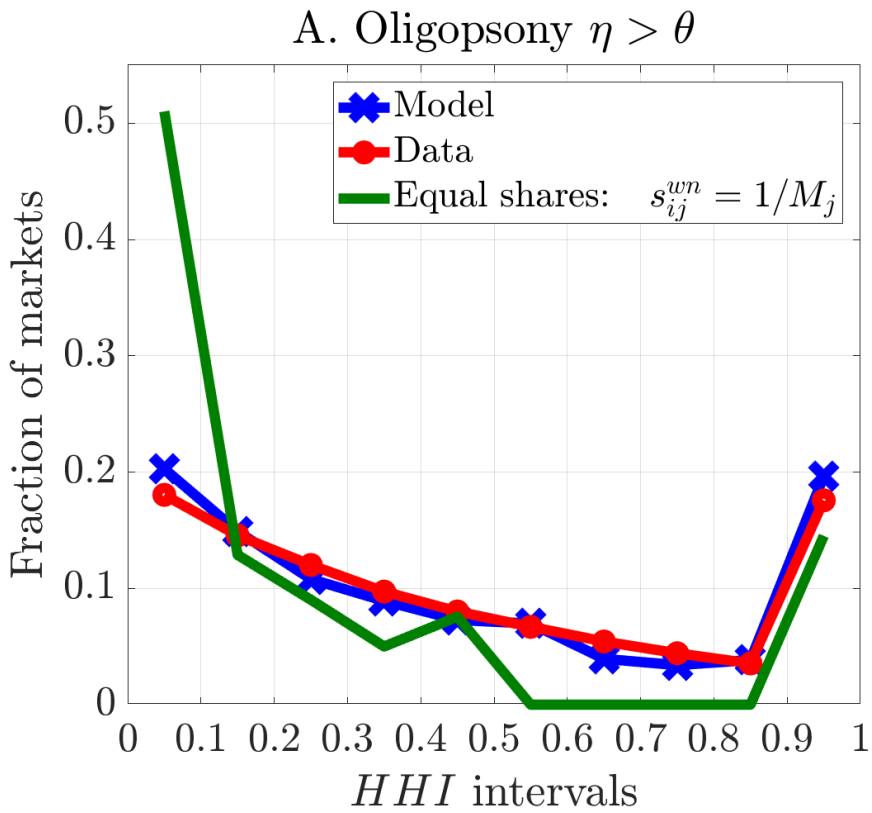
→ Three applications ▸ Skip

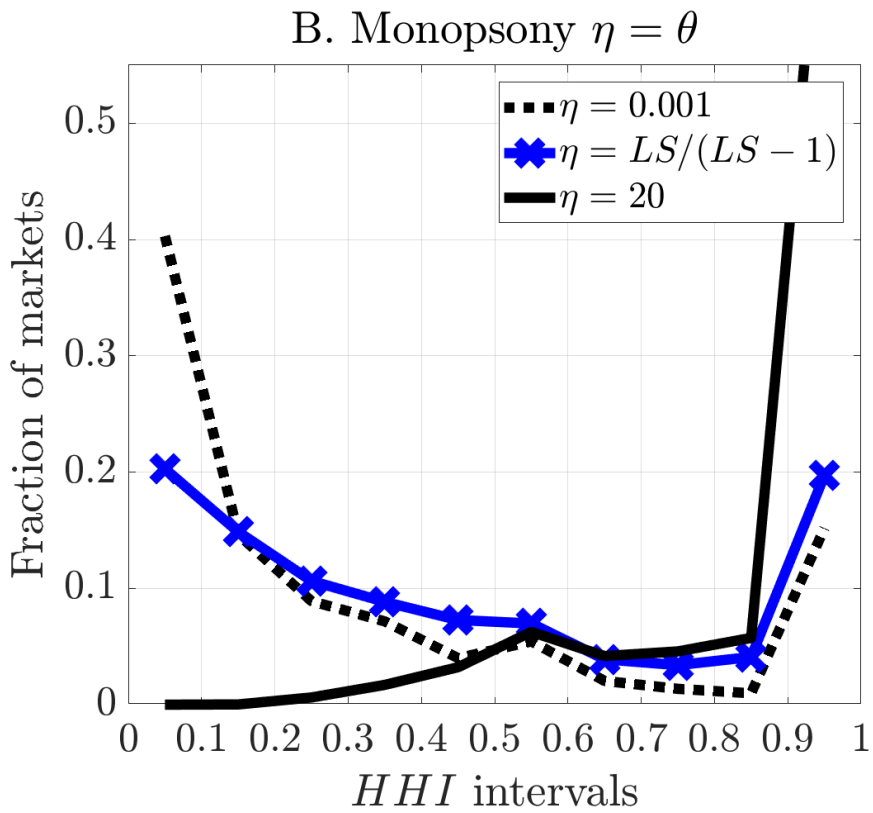
1. Number of firms and measured productivity



- Same total number of markets drawn for each value of M_j. Same productivity distributions.
- Market power effects alone lead markets with more firms to be up to 40% more productive and pay 60% higher wages

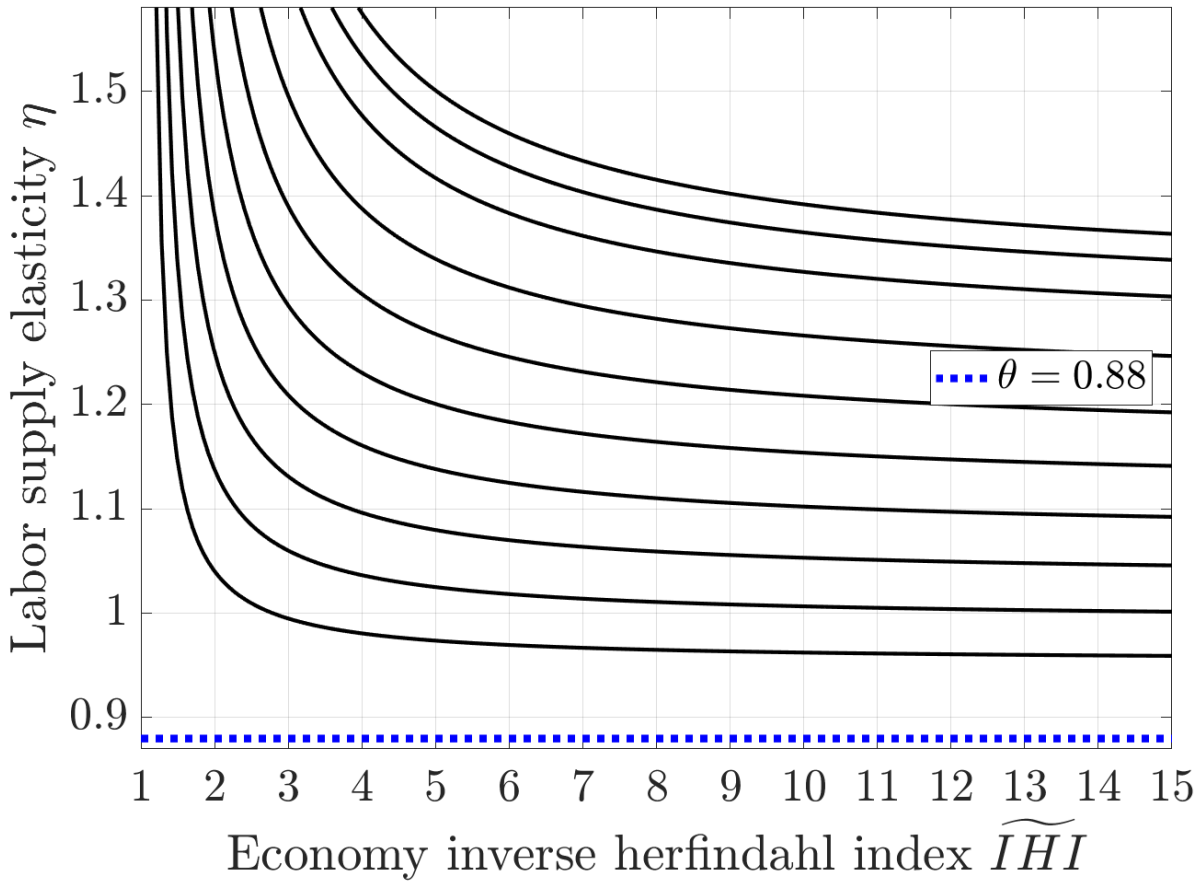
2. Concentration and labor share





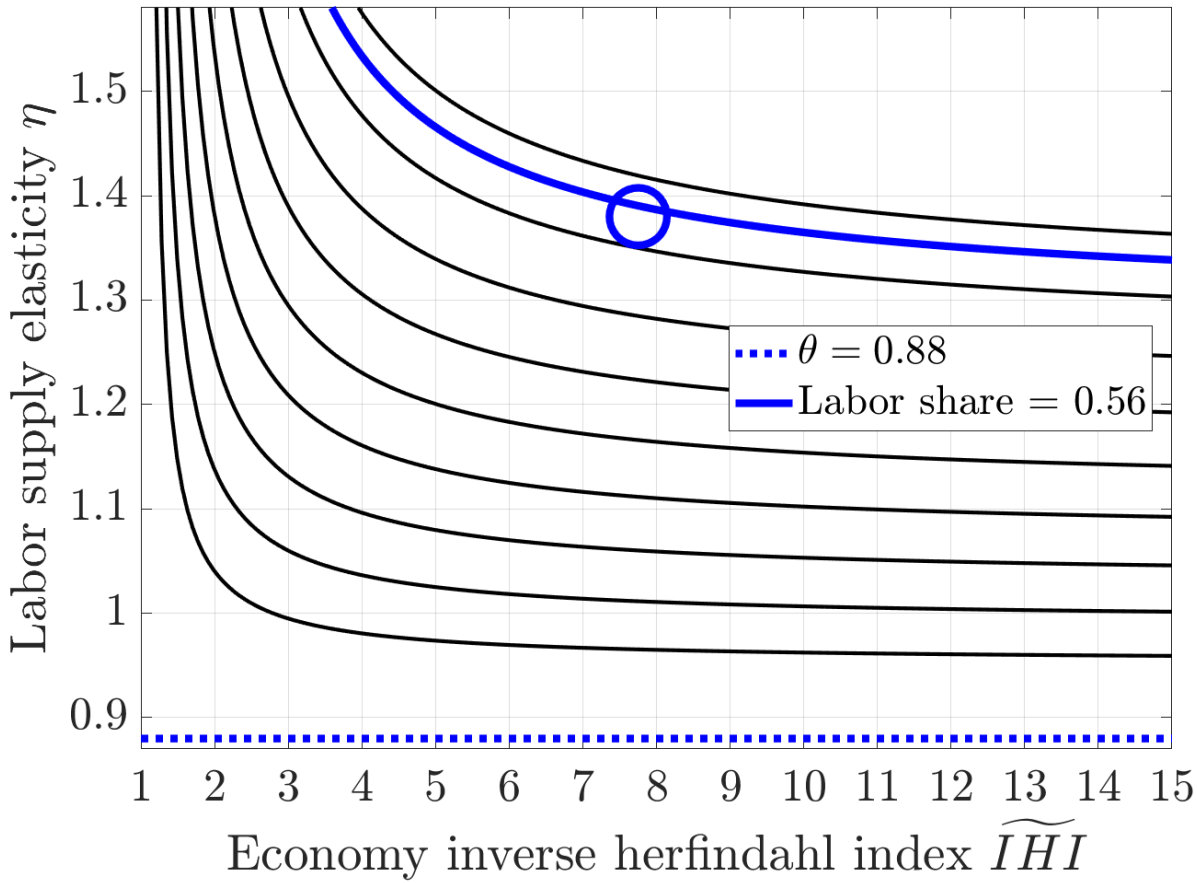
- *HHI* distribution is not informative regarding market structure

2. Concentration and labor share



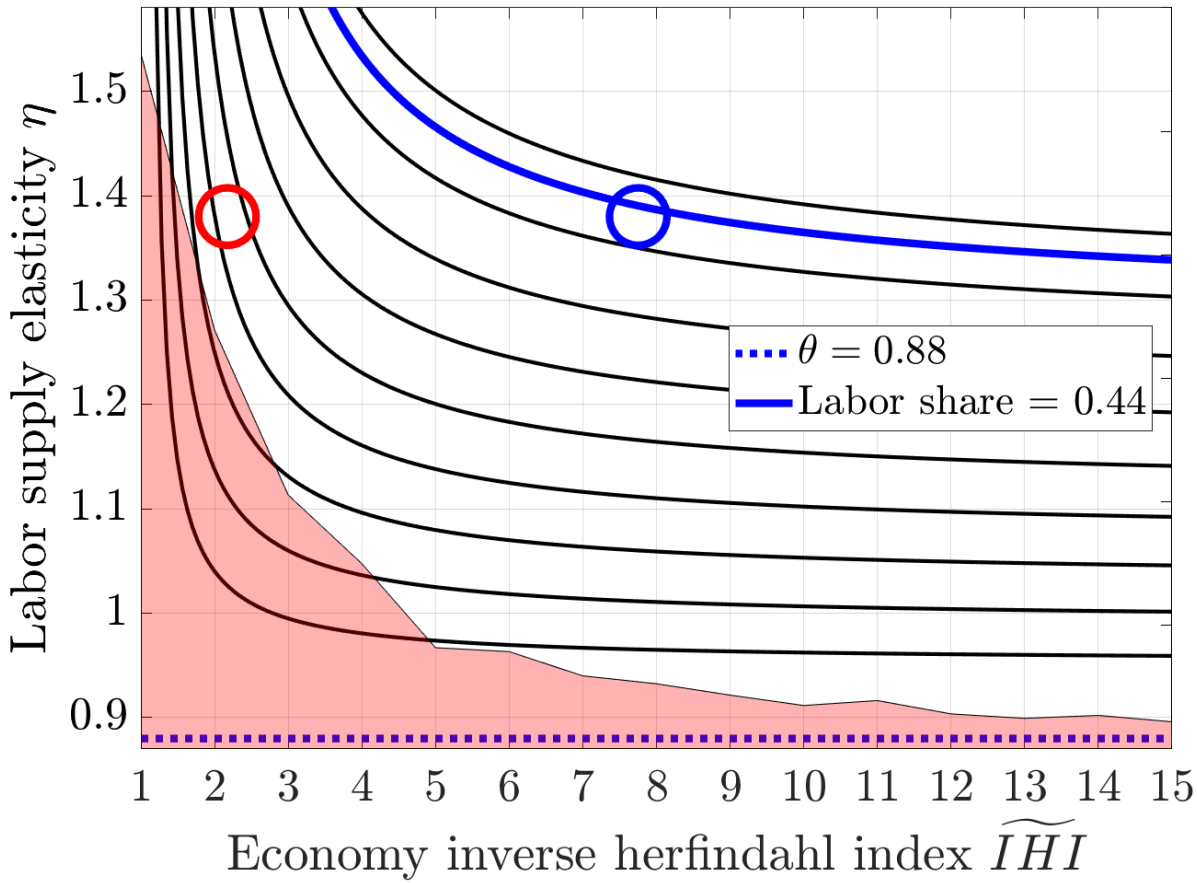
- As $\eta \nearrow \infty$, concentration determines labor share
- As $\eta \searrow \theta$, concentration irrelevant for labor share

2. Concentration and labor share



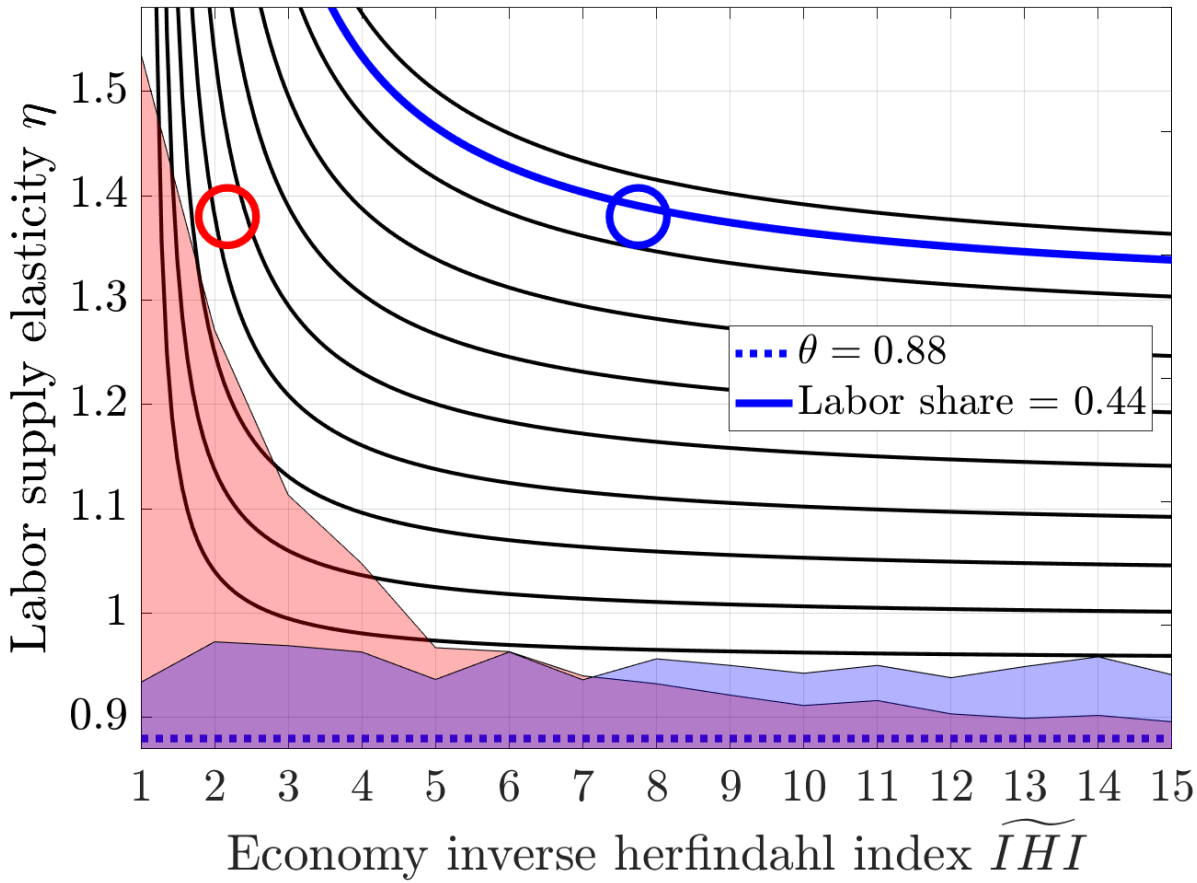
- As $\eta \nearrow \infty$, concentration determines labor share
- As $\eta \searrow \theta$, concentration irrelevant for labor share

2. Concentration and labor share



- Distribution of markets *j*

2. Concentration and labor share

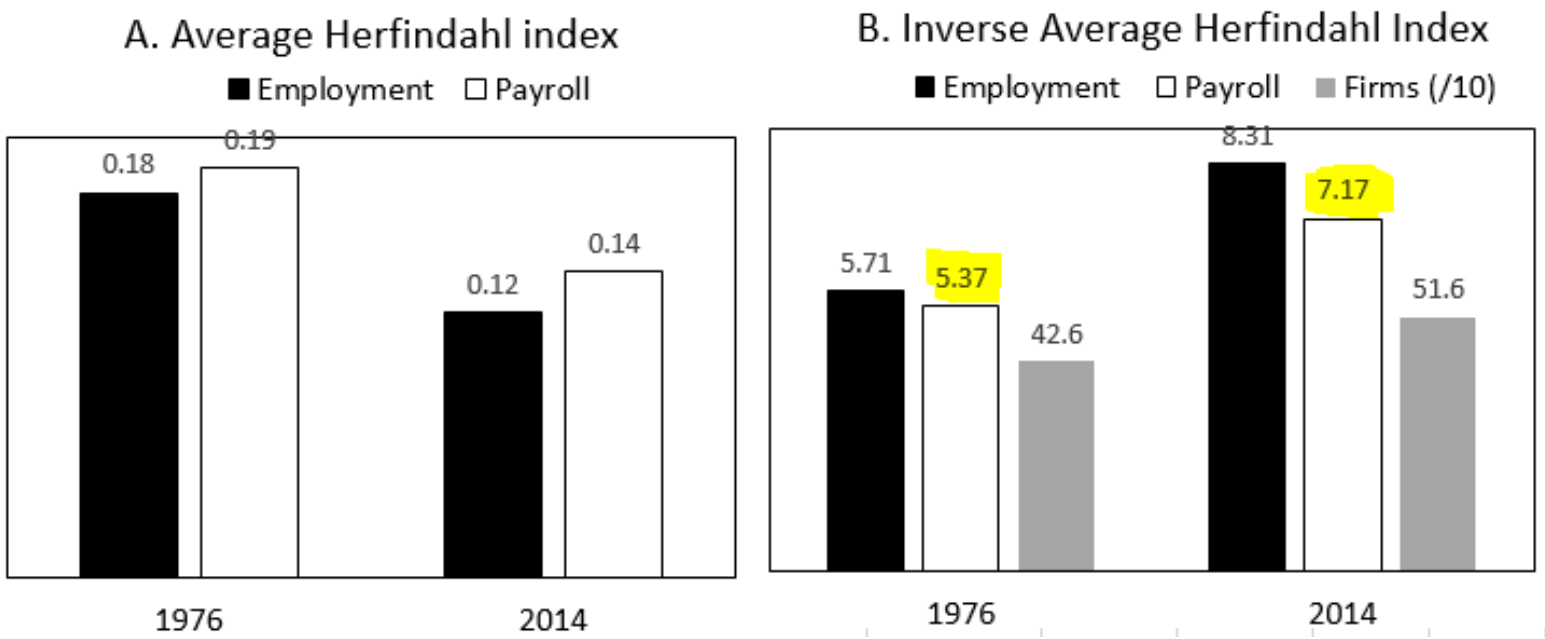


- Distribution of markets j

  ...weighted by wage payments s_j^{wn}

- Under η, θ, changes in concentration have small labor share effects

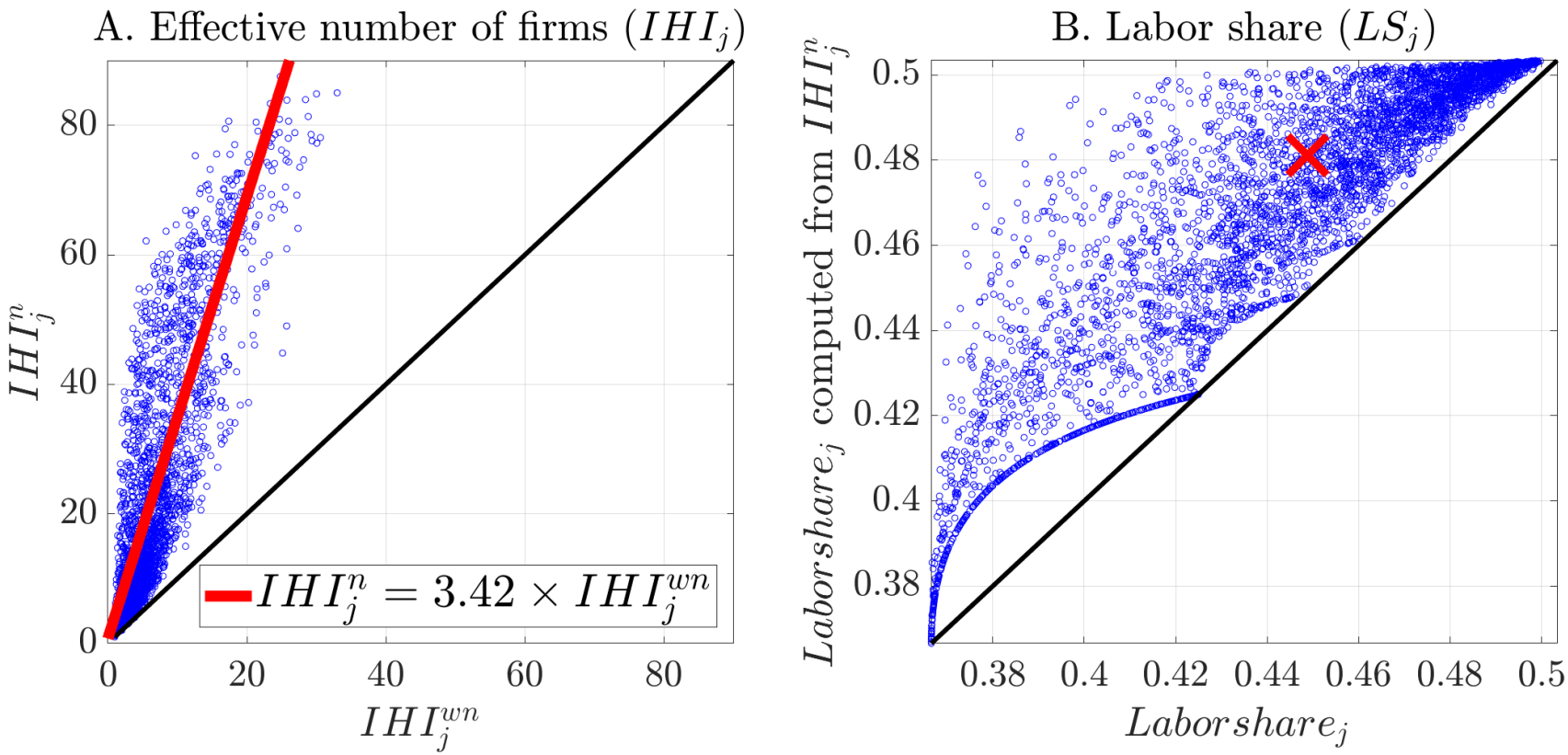
2. Concentration and labor share



- *HHI* decreased by 35% and $\widetilde{IHI}$ increased by 33%. So?

$$LaborShare_{2014} - LaborShare_{1976} = 0.0079 \quad , \quad \text{or} \quad 2 \text{ percent}$$

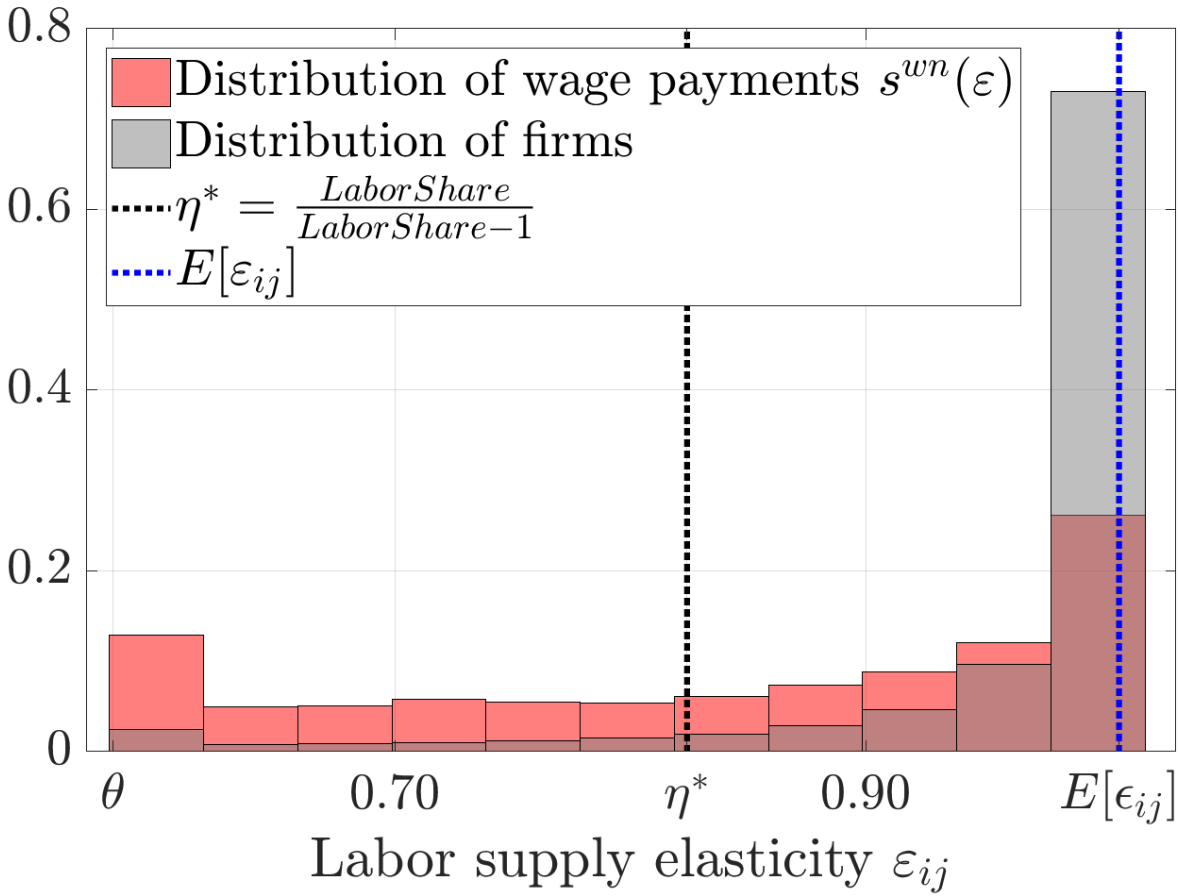
3. Measuring labor market concentration



A. Employment Herfindahls overstate 'competition' by factor of 4

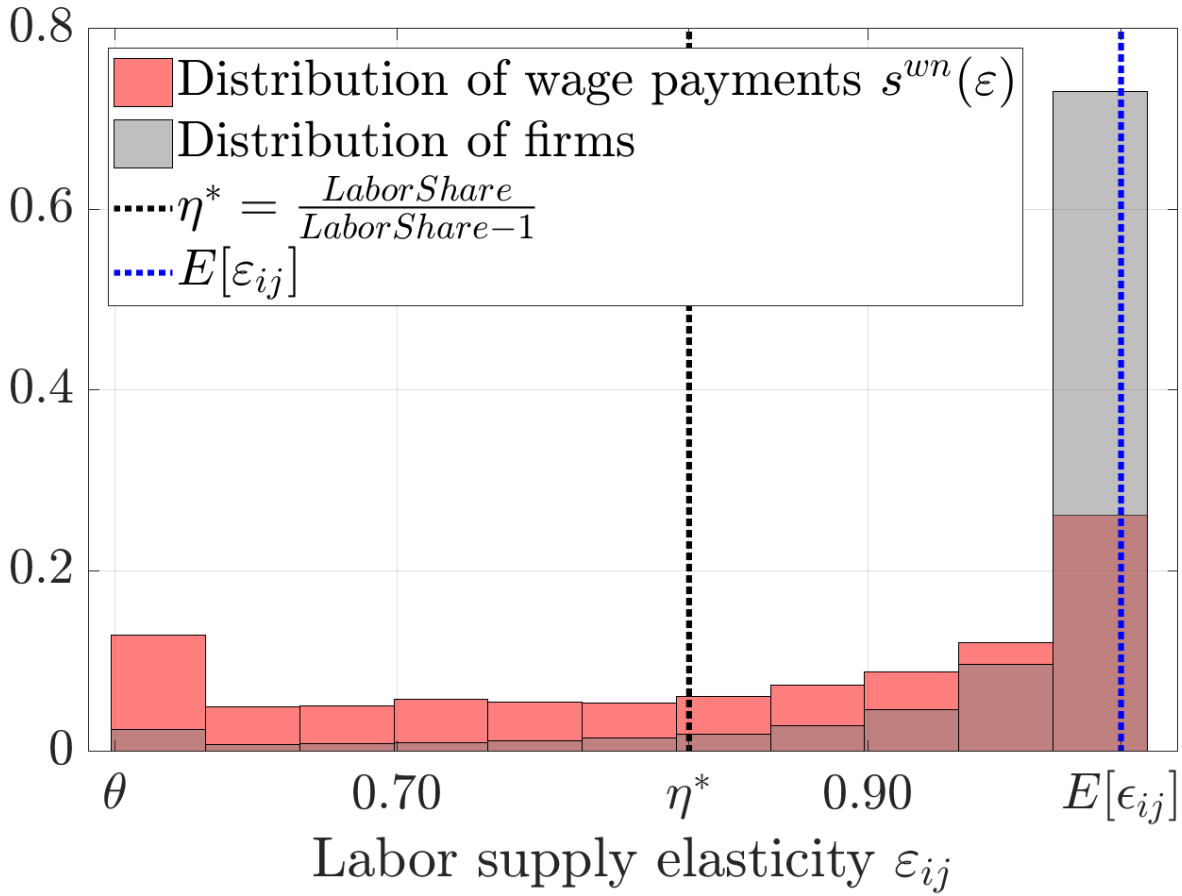
B. And so bias upward the implied labor share by 4ppt

4. Heterogeneity in labor market power



- Most firms face a flat supply curve
- Most payments are steeply below marginal product

4. Heterogeneity in labor market power



$$\textit{Labor Share} = \alpha \left[\int \mu(\varepsilon)^{-1} s^{wn}(\varepsilon) d\varepsilon \right]^{-1}, \quad \mu(\varepsilon) = \frac{\varepsilon}{\varepsilon + 1}$$

4. Heterogeneity in labor market power

From Ashenfelter, Farber, and Ransom (2010)

- Falch (2010): Teachers in Norway: 1.5
- Staiger, Spetz, and Phibbs (2010): Nurses in VA hospitals: 0.1
- Hirsch, et al. (2010): German LEHD. Compare individuals over jobs and employers: 2-4.
- Ransom and Sims (2010): Missouri public school teachers: 3.7
- Ransom and Oaxaca (2010): data on single employer, compare separation rates and wages across different job titles: Men 1.5-2, Women 2.5-3.

APPLICATIONS

Three tests

1. Minimum wage

- Is the model consistent with recent evidence on the effects of minimum wages on (i) employment across firm sizes, (ii) earnings inequality?

2. Mergers

- How do firms behave when they exogenously accrue market share?
- Within a firm-merger, compare behavior in cross-section of markets
- Shock: National merger

3. Pass-through of firm-level shocks

- How do firms with different market shares to shocks?
- Within a firm-state, compare behavior in cross-section of markets
- Shock: State corporate tax change (Giroud Rauh, JPE 2018)

1. Increase in minimum wage

Dustmann, Lindner, Schoenberg, Umkehrer, vom Berge (2018)

- German minimum wage increase in 2016
- Affects 10.4% of workers
- (i) Small firms exit, (ii) Large firms increase employment

Model

- Minimum wage relative to initial equilibrium

$$\begin{aligned} w_1 &< MRPL_1 < \underline{w} \\ w_2 &< \underline{w} < MRPL_2 \\ \underline{w} &< w_3 < MRPL_3 \end{aligned}$$

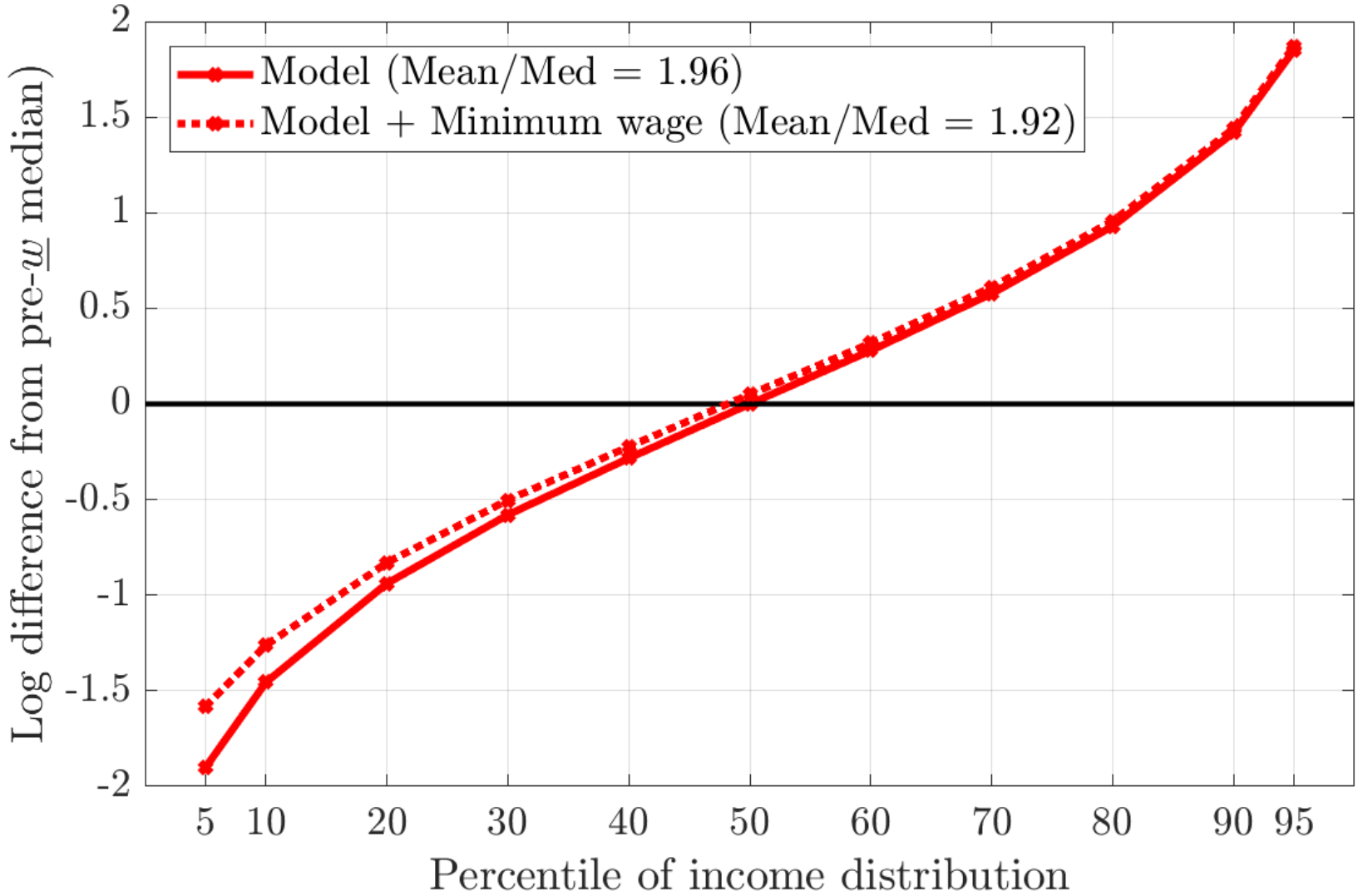
- Firm 1 exits
- Firm 2 narrows markdown, increases wage, increases employment
- Firm 3 increases wage (complementarity). Employment?

1. Increase in minimum wage

- Choose $\underline{w}$ such that 10.4% of workers initially receive $w < \underline{w}$

Moment	**Model**	**Data**
Post experiment median $w_k / \underline{w}$	23%	48%
Δ log Number of firms	-0.24	-0.10
Δ log Ave firm size	0.21	0.12
Δ log Number of firms with $n_{ij} \leq 2$	-5.14	-0.15
Δ log Number of firms with $n_{ij} \geq 50$	0.002	0.120
Δ Share Emp at firms with $n_{ij} \leq 2$	-0.11	-0.03
Δ Share Emp at firms with $n_{ij} \geq 50$	0.05	0.01
Inequality	**Pre**	**Post**
p50	1	1.05
p50-p10 (log diff.)	1.46	1.31
p90-p50 (log diff.)	1.44	1.41

1. Increase in minimum wage



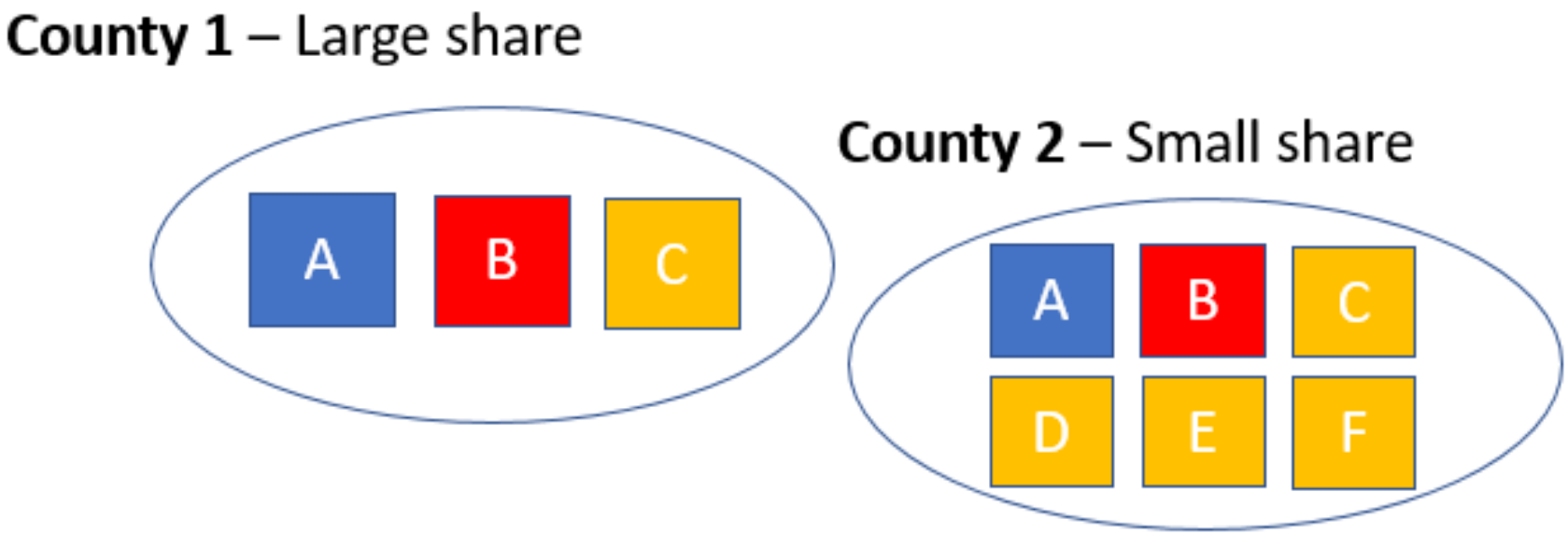
2. Across region mergers

Identify national mergers in LBD

- *Nationally*, two firms **A** and **B** merge

Local changes

- *Locally*, does employment change depend on market share of **A**+**B**?



2. Across region mergers

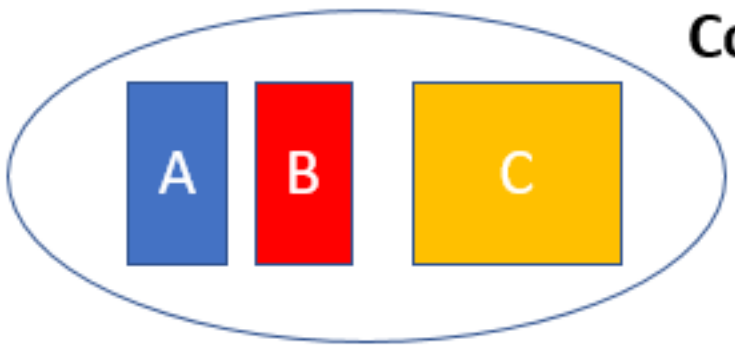
Identify national mergers in LBD

- *Nationally*, two firms **A** and **B** merge

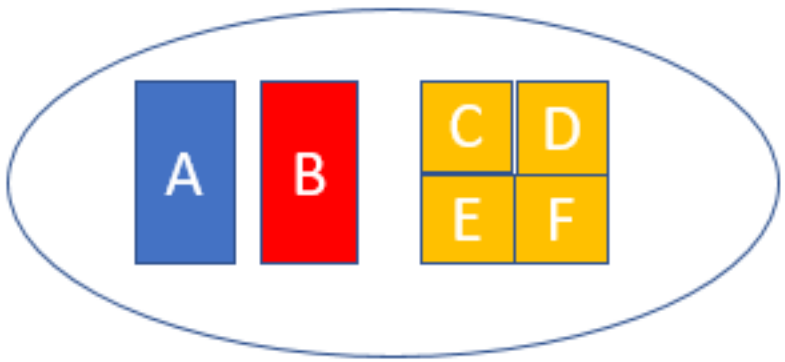
Local changes

- *Locally*, does employment change depend on market share of **A**+**B**?
- *Locally*, does employment change depend on concentration?

County 1 – More concentrated



County 2 – Less concentrated



2. Across region mergers

Set up

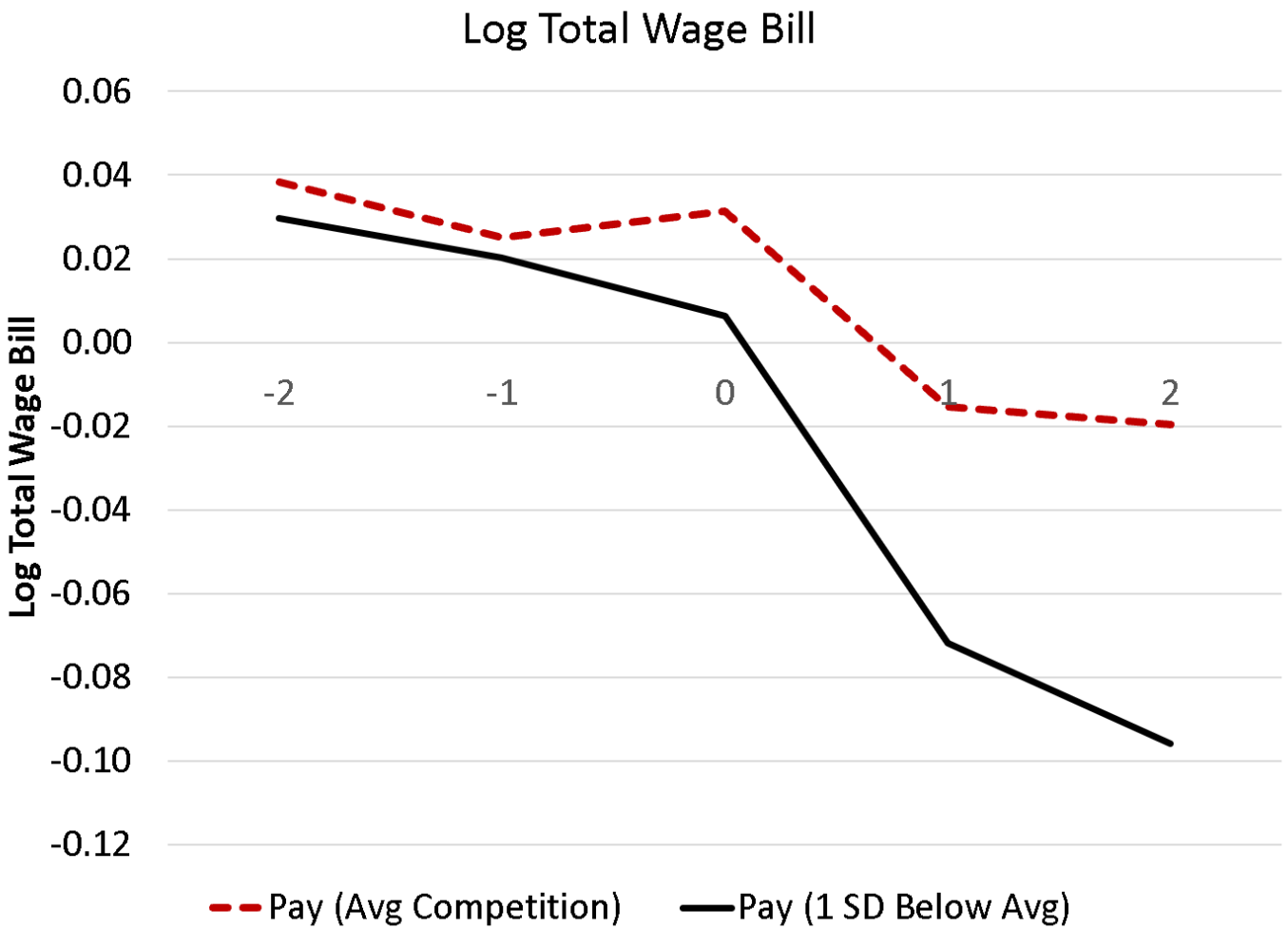
- Multi-county mergers in year t, tradeable sector only
- Panel $\{t-3, \ldots, t+2\}$.
- $\mathcal{D}^M_{it-s}$: Dummies for merger for firm f, s periods ago
- x_{ijt} : Combined aquirer-aquired outcome pre- and post- merger

Event study stratified by labor market share

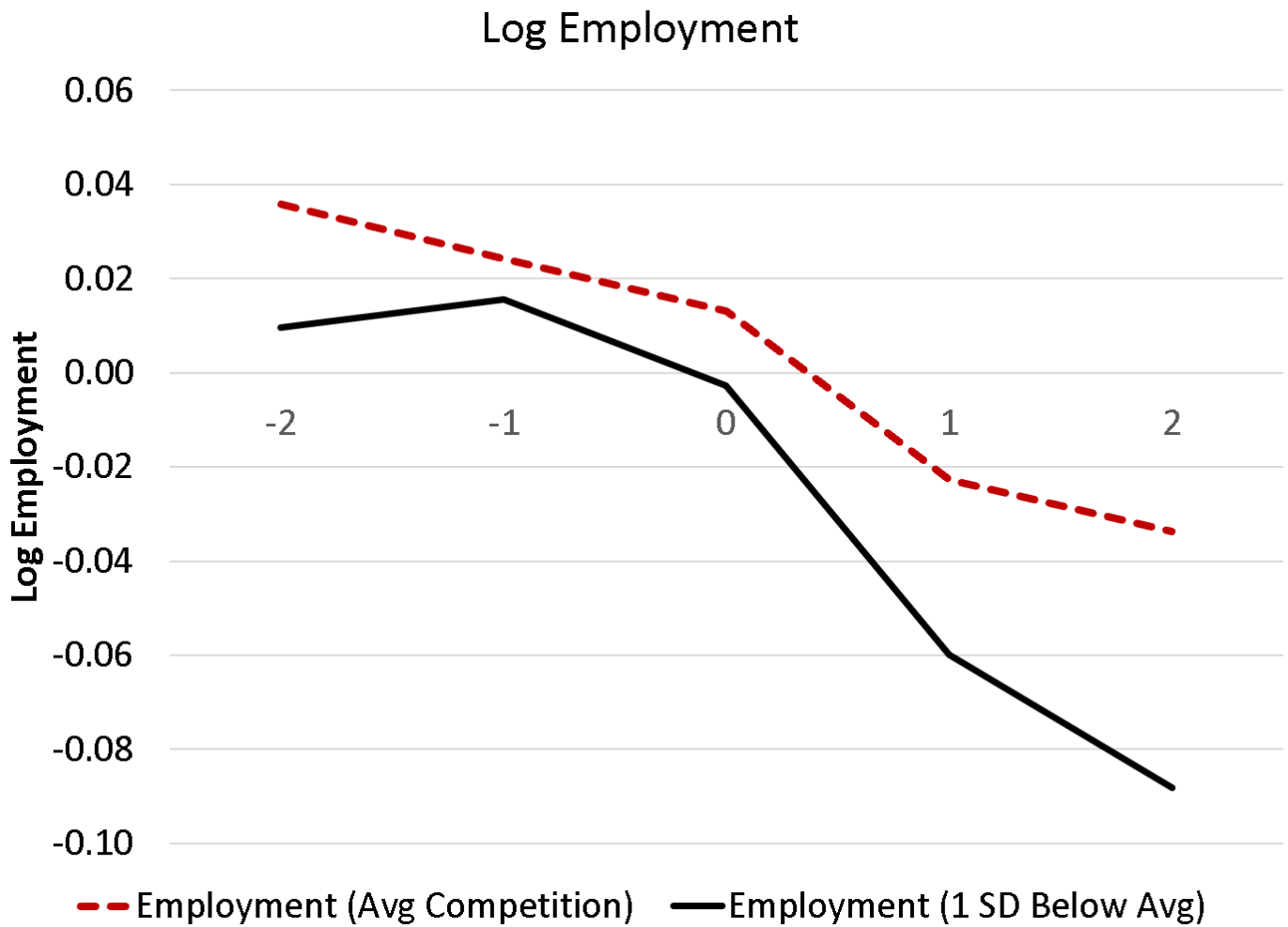
$$\begin{aligned} \log y_{ijt} &= \alpha_i + \delta_j + \mu_t + \\ &\quad + \sum_{s=-2}^{2} \beta_s \mathcal{D}^M_{it-s} + \psi s^{wn}_{ijt-s} + \sum_{s=-2}^{2} \gamma_s \left(\mathcal{D}^M_{it-s} \times s^{wn}_{ijt-s} \right) + \varepsilon_{ijt} \\ \delta_j &= \delta_{ind(j)} + \delta_{CZ(j)} \end{aligned}$$

▸ Measurement, Summary Stats, Regression Table ▸ Solo event graphs

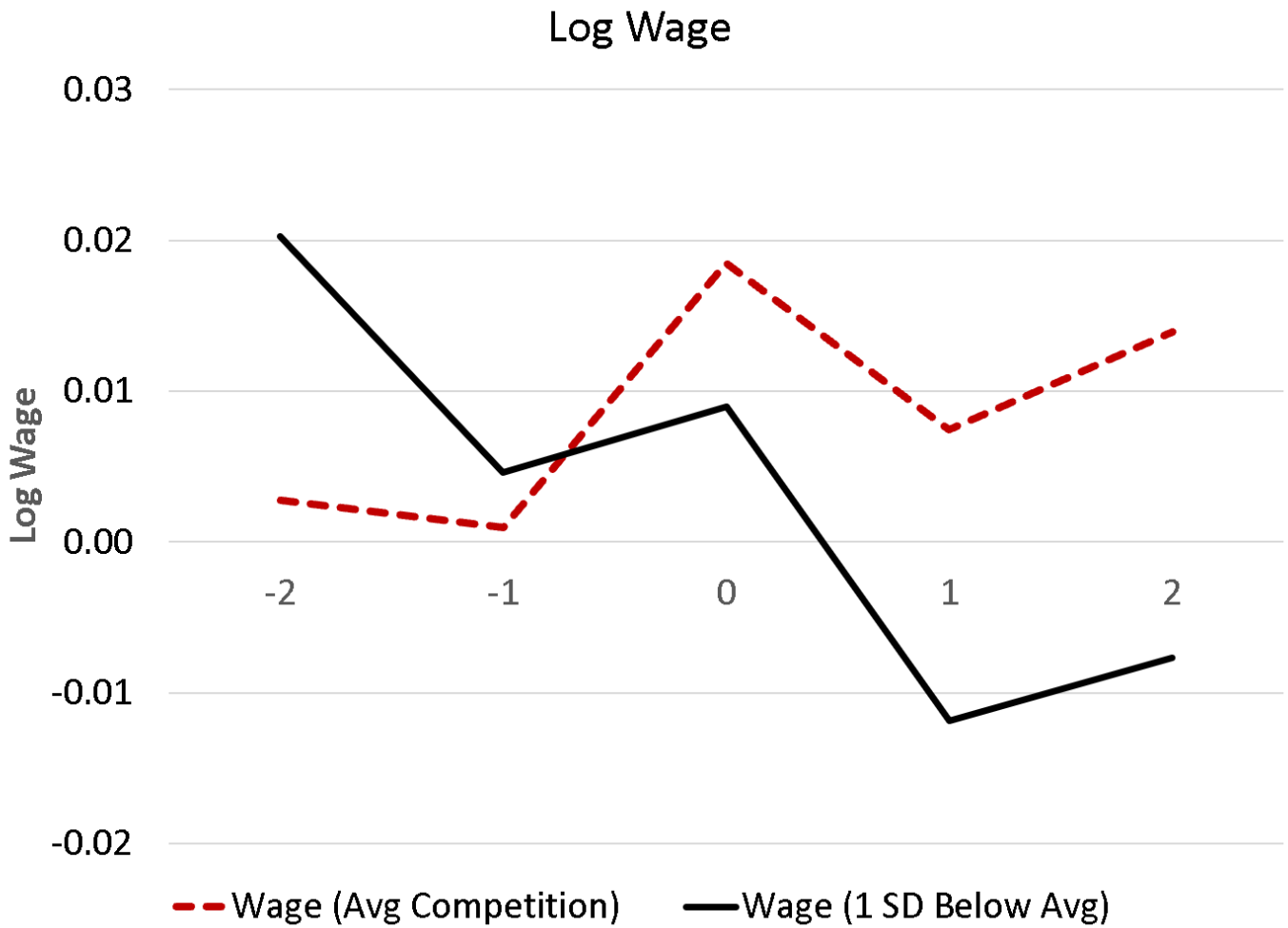
2. Across region mergers



2. Across region mergers



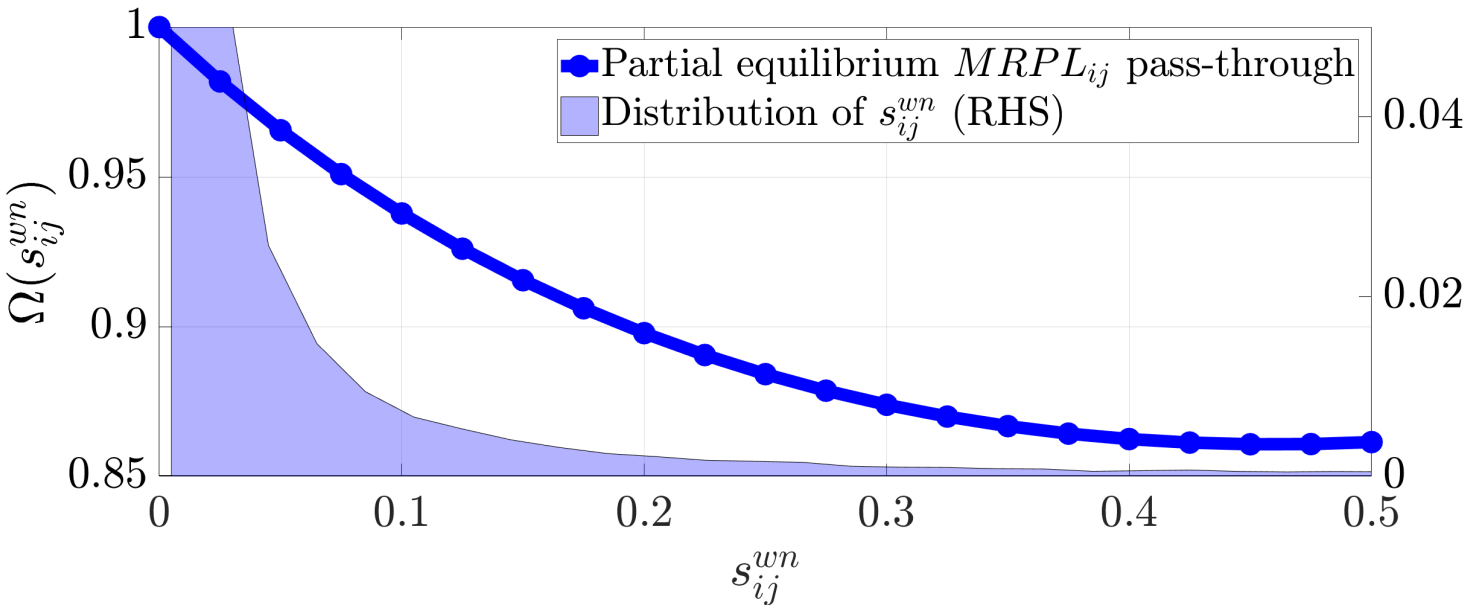
2. Across region mergers



3. Pass-through

$$d \log w_{ij} = \Omega\left(s_{ij}^{wn}\right) d \log MRPL_{ij} + \left(1 - \Omega\left(s_{ij}^{wn}\right)\right) \sum_{k \neq i} \left(\frac{s_{kj}^{wn}}{1 - s_{ij}^{wn}} \right) d \log w_{kj}$$

$$\Omega\left(s_{ij}^{wn}\right) = \frac{\theta\left(\eta + 1\right) + \left(\eta - \theta\right) s_{ij}^{wn}}{\theta\left(\eta + 1\right) + \left(\eta - \theta\right) s_{ij}^{wn} \left[1 + \left(\eta + 1\right)\left(1 - s_{ij}^{wn}\right)\right]}$$



▸ Figure - Supply functions

3. Pass-through

Do employment and wage changes depend on market share?

- Shocks State corporate tax changes (Giroud Rauh, JPE 2018)
- Exposure Effect only C-corps (76% of firm-state observations)
- Variation Within firm-state is, across markets $j \in s$

Specification

$$\begin{aligned} \log n_{ijt} &= \alpha_{is(j)} + \delta_j + \mu_t \\ &\quad + \beta \tau_{s(j)t} + \psi s^{wn}_{ijt} + \gamma \left(\tau_{s(j)t} \times s^{wn}_{ijt} \right) + \varepsilon_{ijt} \end{aligned}$$

Results

- Robust, precise, estimates of $\beta < 0$, $\gamma > 0$

▸ Modelling the effect of a change of corporate taxes on $MRPL_{ij}$: Accounting vs. Economic profits

3. Pass-through - Wages

Dep. Variable	(1) log w_{ijt}	(2) log w_{ijt}	(3) log w_{ijt}	(4) log w_{ijt}
$10 \times \tau_{s(j)t}$	-0.0263***	-0.0181***	-0.0305***	-0.0187***
	(0.00644)	(0.00584)	(0.00782)	(0.00588)
s_{ijt}^{wn}			0.537***	0.214***
			(0.0322)	(0.0724)
$10 \times \tau_{s(j)t} \times s_{ijt}^{wn}$			0.168***	0.0310***
			(0.0496)	(0.0075)
Year FE	Y	Y	Y	Y
CZ FE	Y	Y	Y	Y
Firm×State FE	N	Y	N	Y
R-squared	0.112	0.819	0.122	0.820
Round N	4.42m	4.42m	4.42m	4.42m

*Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at ×year level. Tradeable C-Corps in the LBD from 2002 to 2014. Market j is Fort Klimenk Naics 3 × Commuting Zone.*

- 10ppt increase in τ_C causes a 1.9% change in employment

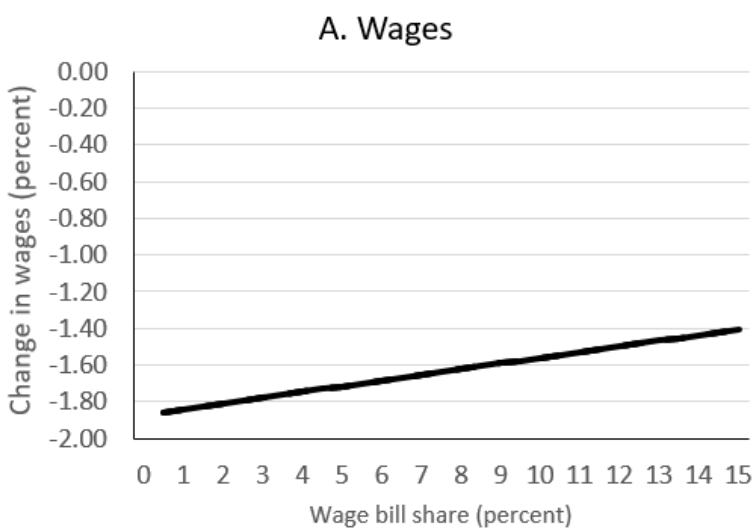
3. Pass-through - Employment

Dep. Variable	(1) $\log n_{ijt}$	(2) $\log n_{ijt}$	(3) $\log n_{ijt}$	(4) $\log n_{ijt}$
$10 \times \tau_{s(j)t}$	-0.0180***	-0.0357***	-0.0367***	-0.0368***
	(0.00618)	(0.00644)	(0.00859)	(0.00757)
s^{wn}_{ijt}			3.263***	2.085***
			(0.0801)	(0.0467)
$10 \times \tau_{s(j)t} \times s^{wn}_{ijt}$			0.810***	0.158***
			(0.112)	(0.0495)
Year FE	Y	Y	Y	Y
CZ FE	Y	Y	Y	Y
Firm$\times$State FE	N	Y	N	Y
R-squared	0.036	0.872	0.132	0.879
Round N	4.425m	4.425m	4.425m	4.425m

*Notes: *** p<0.01, ** p<0.05, * p<0.1 Standard errors clustered at $\times$year level. Tradeable C-Corps in the LBD from 2002 to 2014. Market j is Fort Klimenk Naics 3 $\times$ Commuting Zone.*

- 10ppt increase in τ_C causes a 3.7% change in employment $(\varepsilon_{ij} \approx 2)$

3. Pass-through - Employment



$$\frac{\partial \log y_{ijt}}{\partial \tau_t^C} = \beta + \gamma s_{ijt}^{wn}$$

$$\frac{\partial \log w_{ijt}}{\partial \tau_t^C} = -1.87 + 0.031\, s_{ijt}^{wn\%}$$

$$\frac{\partial \log n_{ijt}}{\partial \tau_t^C} = -3.68 + 0.158\, s_{ijt}^{wn\%}$$

Conclusion

Three contributions:

1. Develop simple general equilibrium oligopsony model
2. Calibrate on Census data, replicates size/wage distribution
    1. Quantify heterogeneity in extent of market power
    2. Provide sufficient statistics for welfare / counterfactuals
3. New well-identified empirical exercises. + Used to validate model

THANK YOU!

APPENDIX

Decreasing labor market concentration

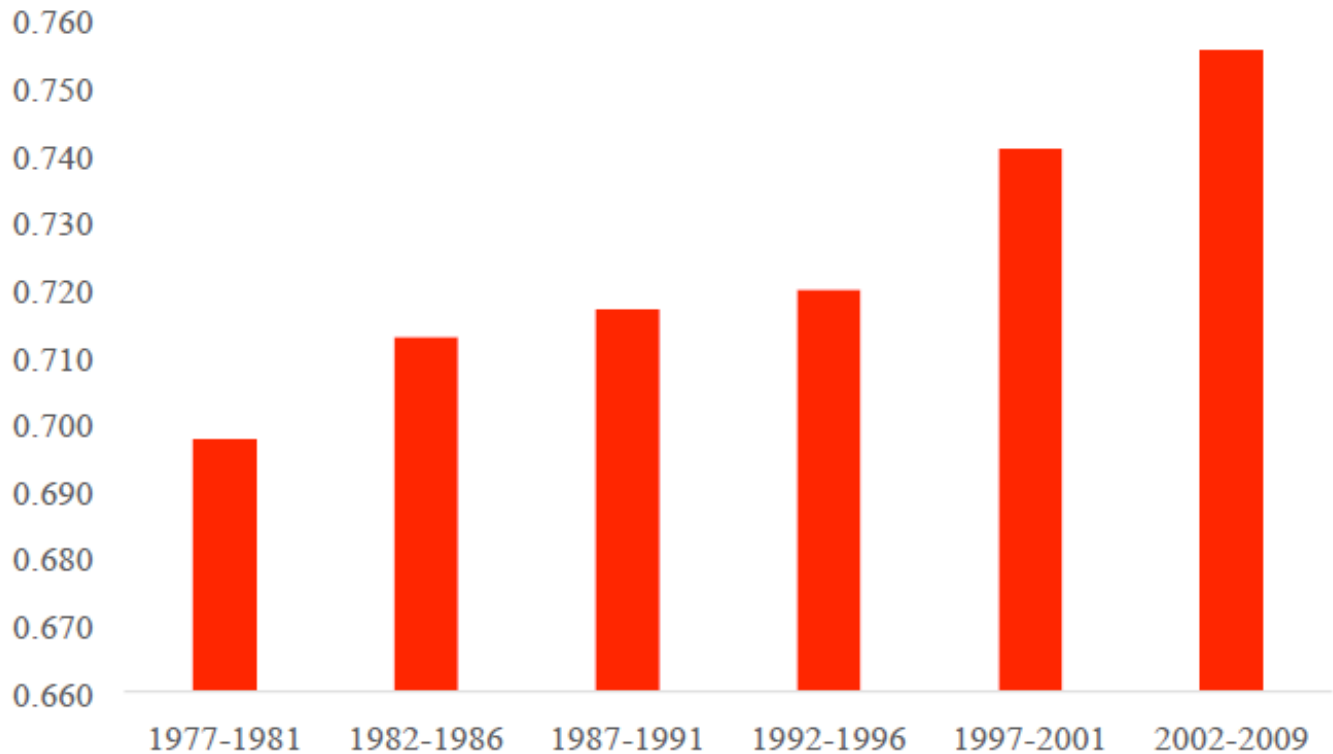
	Measure			
	Wage bill		Employment	
	1976	2014	1976	2014
Herfindahl	0.19	0.14	0.18	0.12
Effective number of firms (inverse hrfindahl)	5.37	7.17	5.71	8.31
Number of Firms (Right Axis)	42.6	51.6	-	-
Average within market correlations (employment weighted across markets)				
Wage share, Relative wage	0.18	0.24		
Emp share, Relative wage	0.10	0.13		
Emp share, Wage share	0.92	0.89		

- Market j: NAICS3$\times$ Commuting Zone
- Herfindahl: $HHI_j^x = \sum_{f \in j} s_{fj}^x \quad , \quad x_f = \sum_{e \in f} x_{efj}$
- Average Herfindahl: $HHI^x = \sum_j s_j^x HHI_j^x$

Decreasing labor market concentration

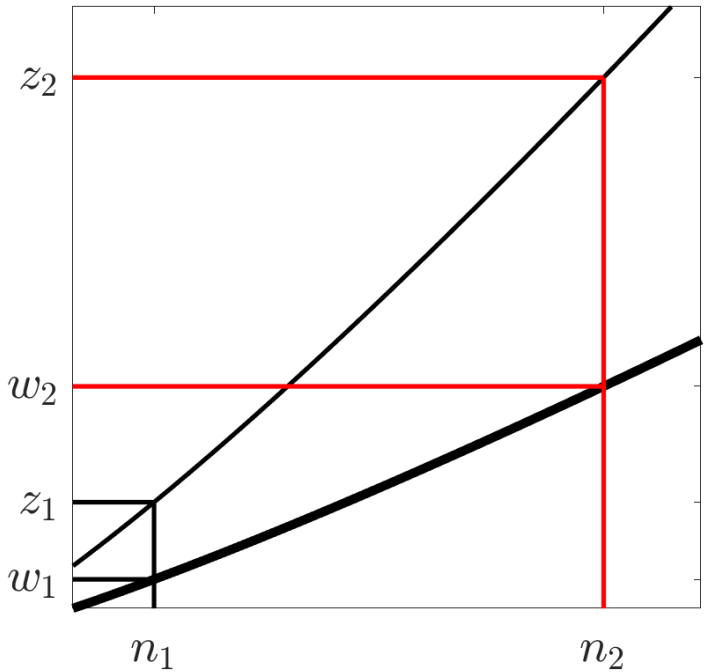
Figure I: Trends in Average Local-Level Employment Concentration, 1977–2009

This figure plots trends in the employment-weighted average of the Herfindahl-Hirschman Index (HHI) of employment by firms computed at the county-three-digit industry-year level. The computed HHI is averaged across county-three-digit industry-year cells within each of the five-year periods (the last period includes eight years, 2002–2009) using the number of employees in each cell as the weight. Thus, the average HHI represents the degree of employer concentration the average worker faces in the labor market.

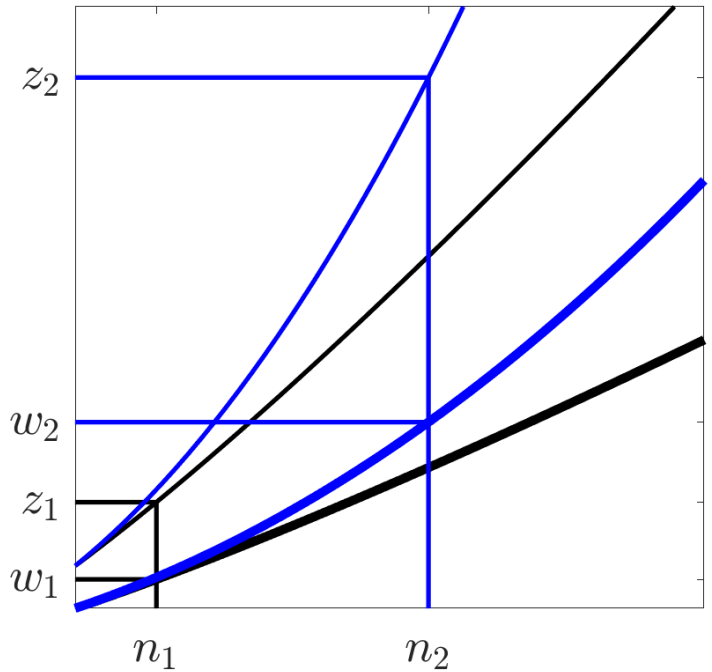


Discussion - Pass-through

A. Monopsonistic competition



B. Oligopsonistic competition



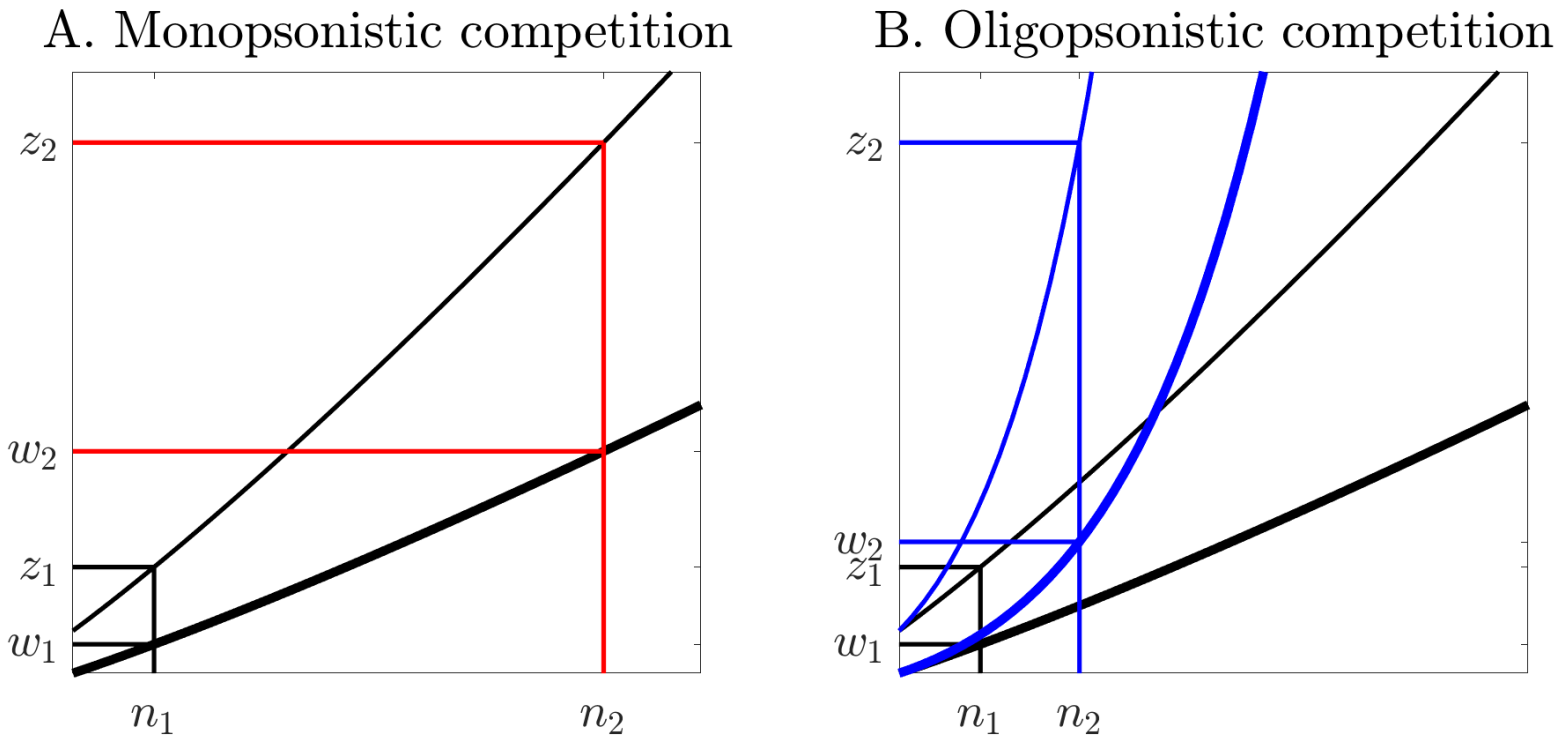
A. Increase in $w_{ij}n_{ij}$, Constant $\bar{\varepsilon}_{ij}$, Constant $\bar{\mu}_{ij} = w_{ij}/z_{ij}$

B. Increase in $w_{ij}n_{ij}$, Lower $\varepsilon(s_{ijt})$, Lower $\mu_{ij} = w_{ij}/z_{ij}$

Oligopolist understands that as wage share grows, labor supply elasticity falls $\varepsilon(s_{ijt}) = \uparrow s_{ijt}\theta + (1 - s_{ijt})\eta$

▸ Back - Discussion: Pass-through

Discussion - Pass-through



A. Increase in $w_{ij}n_{ij}$, Constant $\bar{\varepsilon}_{ij}$, Constant $\bar{\mu}_{ij} = w_{ij}/z_{ij}$

B. Increase in $w_{ij}n_{ij}$, Lower $\varepsilon(s_{ijt})$, Lower $\mu_{ij} = w_{ij}/z_{ij}$

Oligopolist understands that as wage share grows, labor supply elasticity falls $\varepsilon(s_{ijt}) = \uparrow s_{ijt}\theta + (1 - s_{ijt})\eta$

▸ Back - Discussion: Pass-through

Discussion - Wage bill shares and MRPL

Identifying *MRPL*

$$\frac{s_{ijt}^{wn}}{s_{ikt}^{wn}} = \left(\frac{\mu\left(s_{ijt}^{wn}\right)}{\mu\left(s_{ikt}^{wn}\right)} \right)^{1+\eta} \left(\frac{MRPL_{ijt}}{MRPL_{ikt}} \right)^{1+\eta}$$

- Up to a normalization, $\{s_{ijt}^{wn}\}$ can be used to infer $\{MRPL_{ijt}\}$

Implications for measurement in LBD

- Labor markets relatively easy to define
- Wage bill shares observed s_{ijt}^{wn}
- Construct wage bill Herfindahl indices $HHI_{jt} = \sum_i s_{ijt}^{wn2}$
- Contrast with studies of competition in goods markets which do not have local measures of sales shares

  Autor, Dorn, Katz, Patterson, Van Reenen (2018), Phillipon Gutierrez (2018)

▸ Back - Discussion - Aggregate supply

Discussion - Bias estimates of labor supply elasticities

Want to estimate η

$$n_{ijt} = \left(\frac{w_{ijt}}{\mathbf{W}_{jt}}\right)^{\eta} \left(\frac{\mathbf{W}_{jt}}{\mathbf{W}_{t}}\right)^{\theta} \mathbf{N}_{t}$$

Estimating equation

$$\log n_{ijt} = \alpha_t + \gamma_{jt} + \beta \log w_{ijt} + \varepsilon_{ijt}$$

Bias

- Under monopsonistic competition then $\beta = \eta$
- Under oligopsonistic competition $\beta > \eta$ since w_{ijt} enters $\mathbf{W}_{jt}$
- Estimating η requires more (i) data, or (ii) assumptions
- Can implement both using (i) LBD data, (ii) indirect inference

Representation - 'Address' model

CES model

$$n_i(w_1, \ldots, w_N) = \arg\min_{n_i} \left[\sum_{i=1}^{M} n_{it}^{\frac{\theta+1}{\theta}} \, dj \right]^{\frac{\theta}{\theta+1}} \quad s.t. \quad \sum_{i=1}^{M} w_{ij} n_{ij} = Z$$

Address model

$$n_i(w_1, \ldots, w_N) \quad = \quad \int_1^{M+1} \mathbf{1}\left[\text{Individual } k \text{ chooses firm } i\right] \frac{1}{M+1} dk$$

Choice of individual k

$$i^*(k) = \max_i \left\{ w_i - \kappa d(k,i)^2 \right\} \quad , \quad d(k,i) = \text{Min. distance}$$

Result - Anderson, de Palma, Thisse (1992)

- Both models imply the same supply curves to the firm with $\kappa \leftrightarrow \theta$

▸ Household problem

Representation - Logit model

- Workers $m \in [0,1]$ with committed income $y_m \sim F(y)$
- Minimize total labor disutility of attaining y_m

$$\min_{ij} \ \log h_m - \varepsilon_{ij} \qquad \text{s.t.} \qquad w_{ij} h_m = y_m$$

- Random labor disutility

$$F(\varepsilon_{11}, \ldots, \varepsilon_{ij}, \ldots \varepsilon_{NJ}) = \exp\left[-\sum_{j=1}^{J} \left(\sum_{i=1}^{M_j} e^{-(1+\eta)\varepsilon_{ij}} \right)^{\frac{1+\theta}{1+\eta}} \right]$$

- Labor supply

$$n_{ijt} = Prob\left(w_{ijt}, w_{-ijt}\right) \int \left(\frac{y}{w_{ijt}} \right) dF(y)$$

- Result Delivers same supply system as rep. agent CES

▸ Back - Household problem - Elasticities

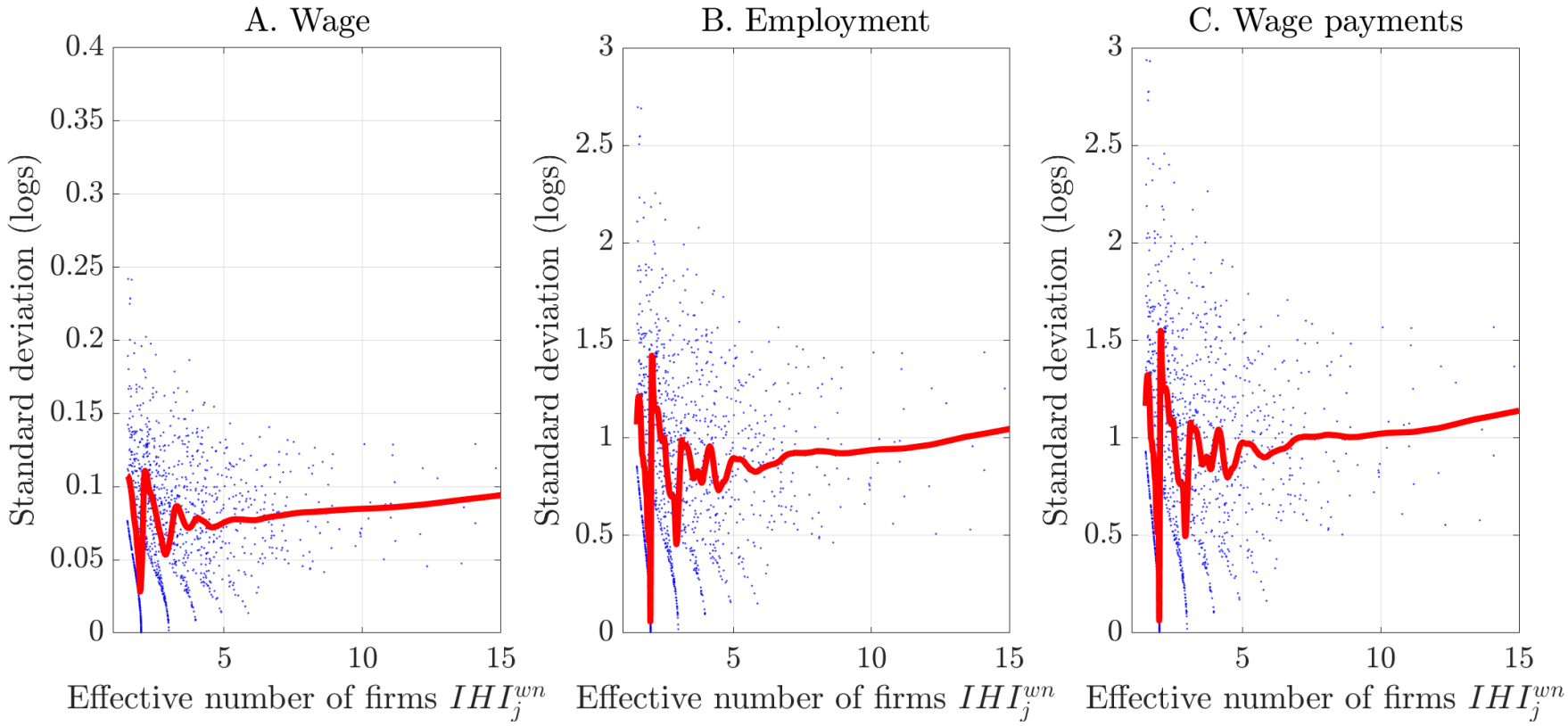
Calibration without capital

Parameter		Value	Target	Model	Data
A. Internally calibrated					
Output elasticity of labor	α	0.75	Agg. labor share	0.622	0.60
Across sector substitution	θ	3.90	Agg. profit share	0.128	0.15
Within sector substitution	η	11.14	Wage/Size elasticity across CBP size classes	0.127	0.096
Pareto - Scale parameter	μ_z	0.123	Mean HHI_j^n	0.575	0.545
Pareto - Shape parameter	σ_z	0.322	Std. dev. HHI_j^n	0.326	0.355
			Estab. share $n_{ij} > 1000$	0.0014	0.0012
			Empl. share $n_{ij} > 1000$	0.117	0.122
			Wage share $n_{ij} > 1000$	0.225	0.187
B. Normalizations					
Aggregate productivity	$\bar{z}$		Ave. estab. size	24.5	24.5
Labor disutility shifter	$\bar{\varphi}$		Ave. earnings ($'000 per qtr)	15.6	15.6
Frisch elasticity	φ		*Not featured today*		

- Mean and standard deviation of HHI_j^n taken from Benmelech et. al (2018), Table 1. (NAICS3 in the LBD across all sectors).
- All other data from Census *County Business Patterns* for 2015
- Add capital $y_i = z_i k_i^{1-\alpha} n_i^{\alpha}$. Labor share $S_{ij}^n = \alpha \mu_{ij}$. Profit share $S_{ij}^{\pi} = \alpha(1 - \mu_{ij})$.

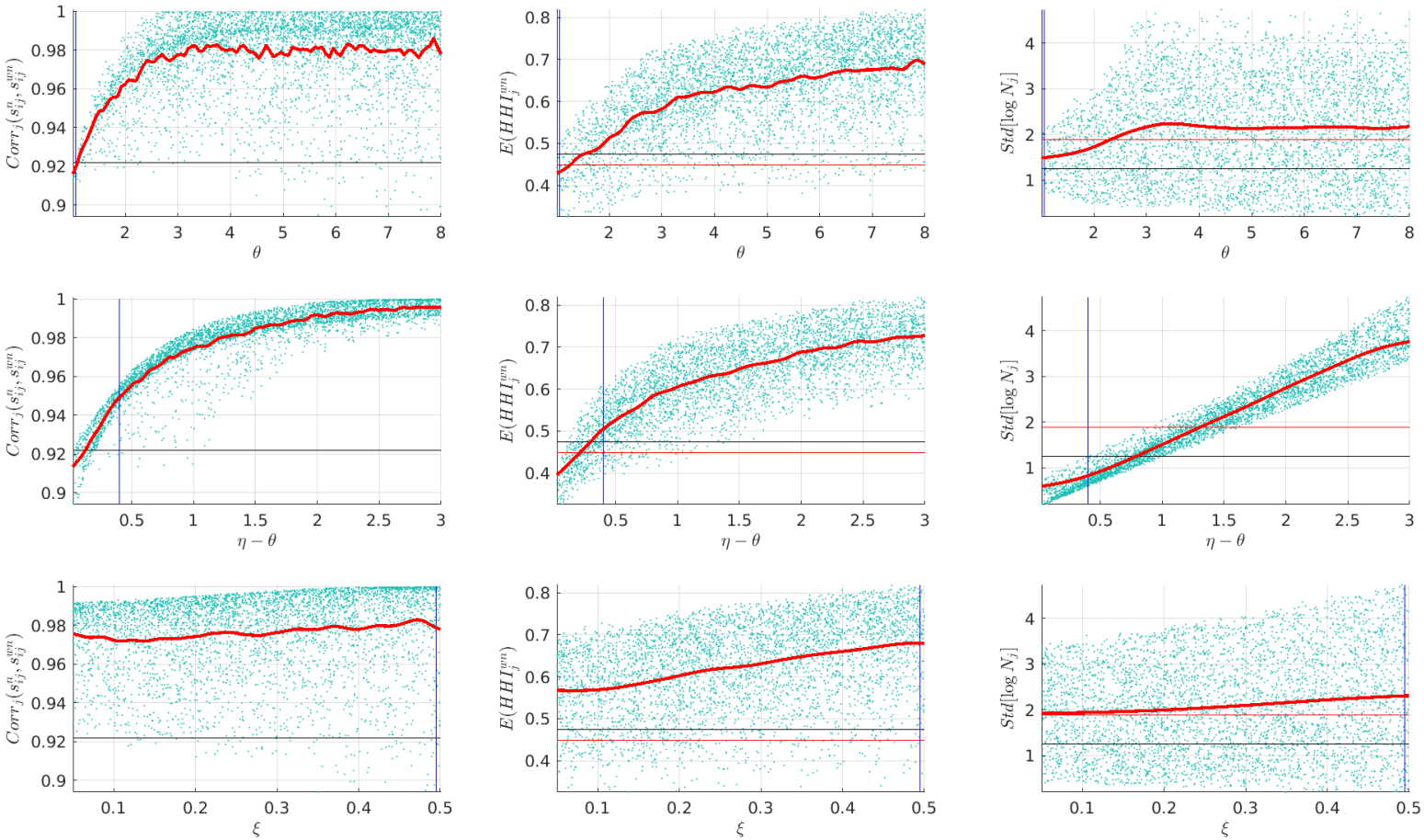
▸ Back to calibration

Distribution of establishments and wage payments



- Relationship between dispersion and concentration
- Can be computed directly in Census with LBD data

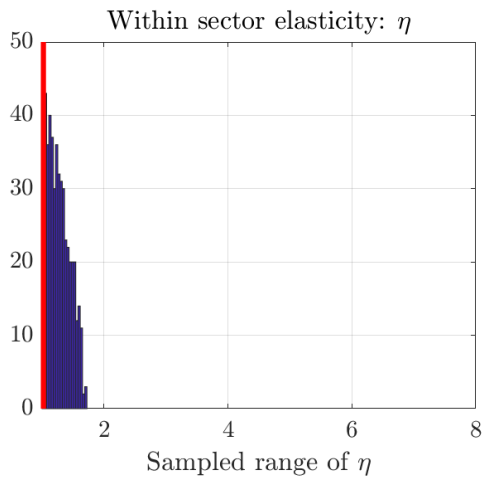
Calibration - Moment comparative statics

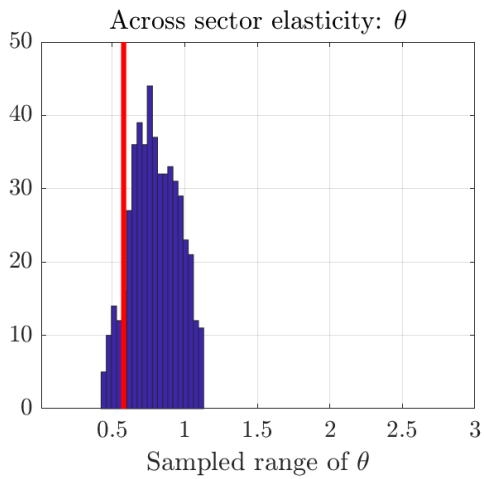


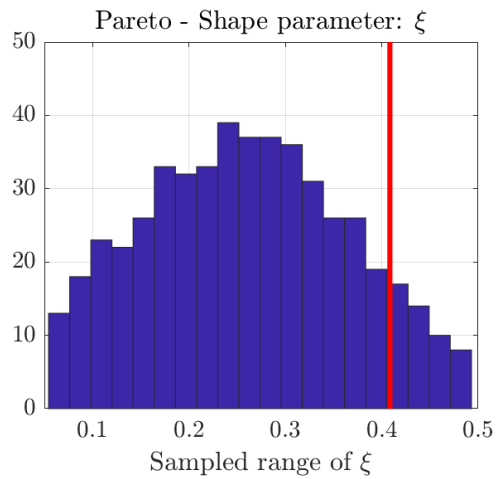
Data moment, Model Moment, Estimated parameter

▸ Back - Main calibration table

Calibration - Moment comparative statics



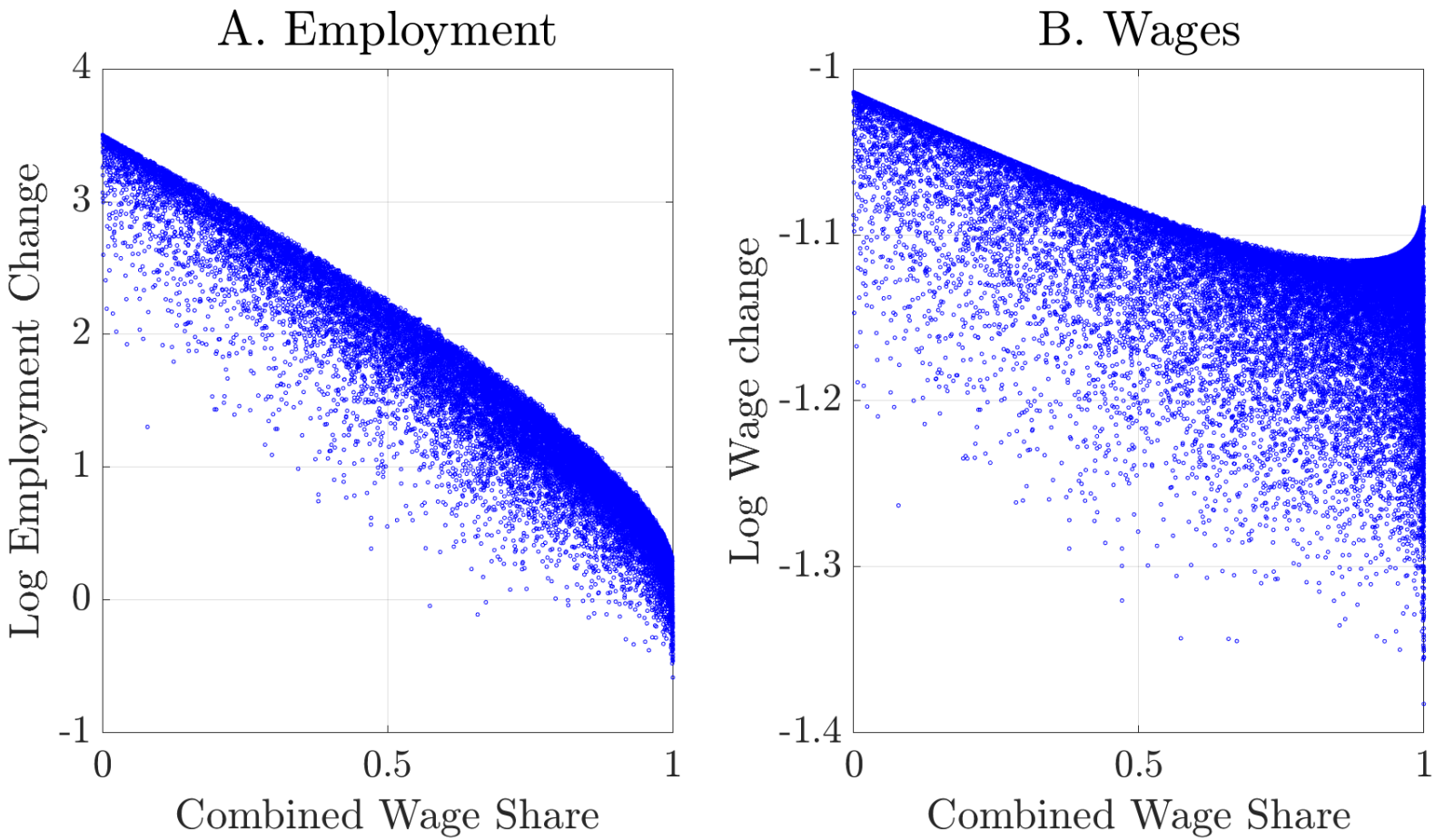




Estimated parameter

▸ Back - Main calibration table

Mergers - Results



Data - Measurement

- Labor market County c, 2-digit industry k, Year t
- Observation Establishment i, within Firm f
- Data Employment n_{icfkt}, Average wage w_{icfkt}

$$n_{cfkt} = \sum_{i \in cfkt} n_{icft}, \qquad w_{cfkt} = \sum_{i \in cfkt} w_{icft} n_{icfkt} \Big/ n_{cfkt}$$

- Concentration variables

1. Wage bill share

$$s^{wn}_{cfkt} = \frac{w_{cfkt} n_{cfkt}}{\sum_{f \in ckt} w_{cfkt} n_{cfkt}}$$

2. Inverse herfindahl index

$$IHI_{ckt} = 1 \Big/ \sum_{f \in ckt} s^{wn\ 2}_{cfkt}$$

Back to empirical specifications.

Summary Statistics

	Mean	Std. Dev.
Employment	274.1	706.6
Total Payroll (Thousands)	15090	64910
Wage per worker	58.98	779.7
Wage Share (Year of Merger)	0.007	0.026
Change Log Wage Share (Year of Merger Minus Year Before)	0.832	0.929
HHI (Year of Merger)	0.026	0.063
Inverse HHI (Year of Merger)	153.6	151.5
Number of Counties Per Merger	4.6	
Rounded Sample Size (Nearest 1k)	10000	

Inverse HHI Interpretation: typical county in which merger occurs has degree of labor market competition equivalent to 154 equally sized firms.

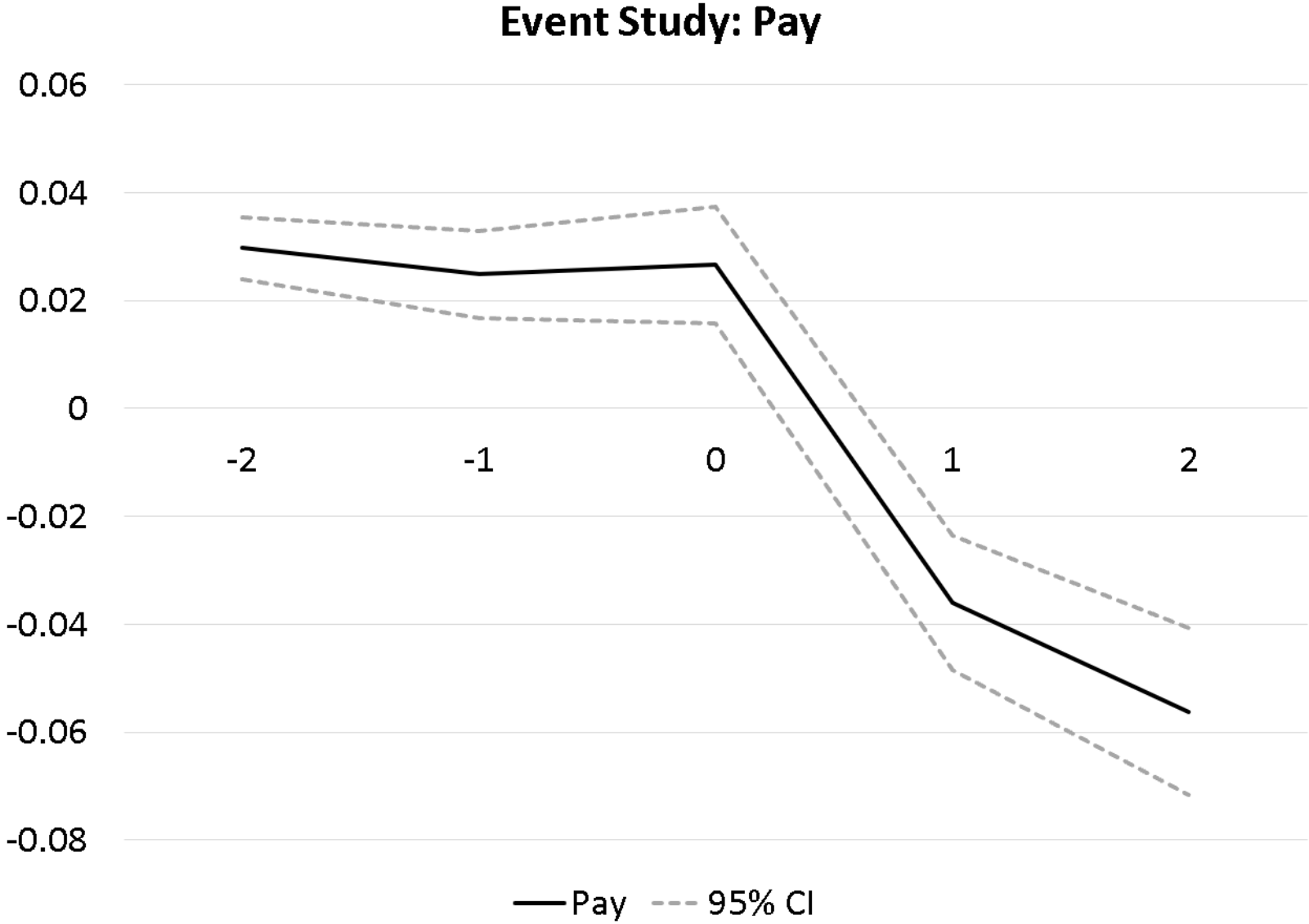
▸ Back to empirical specifications. ▸ Back to event

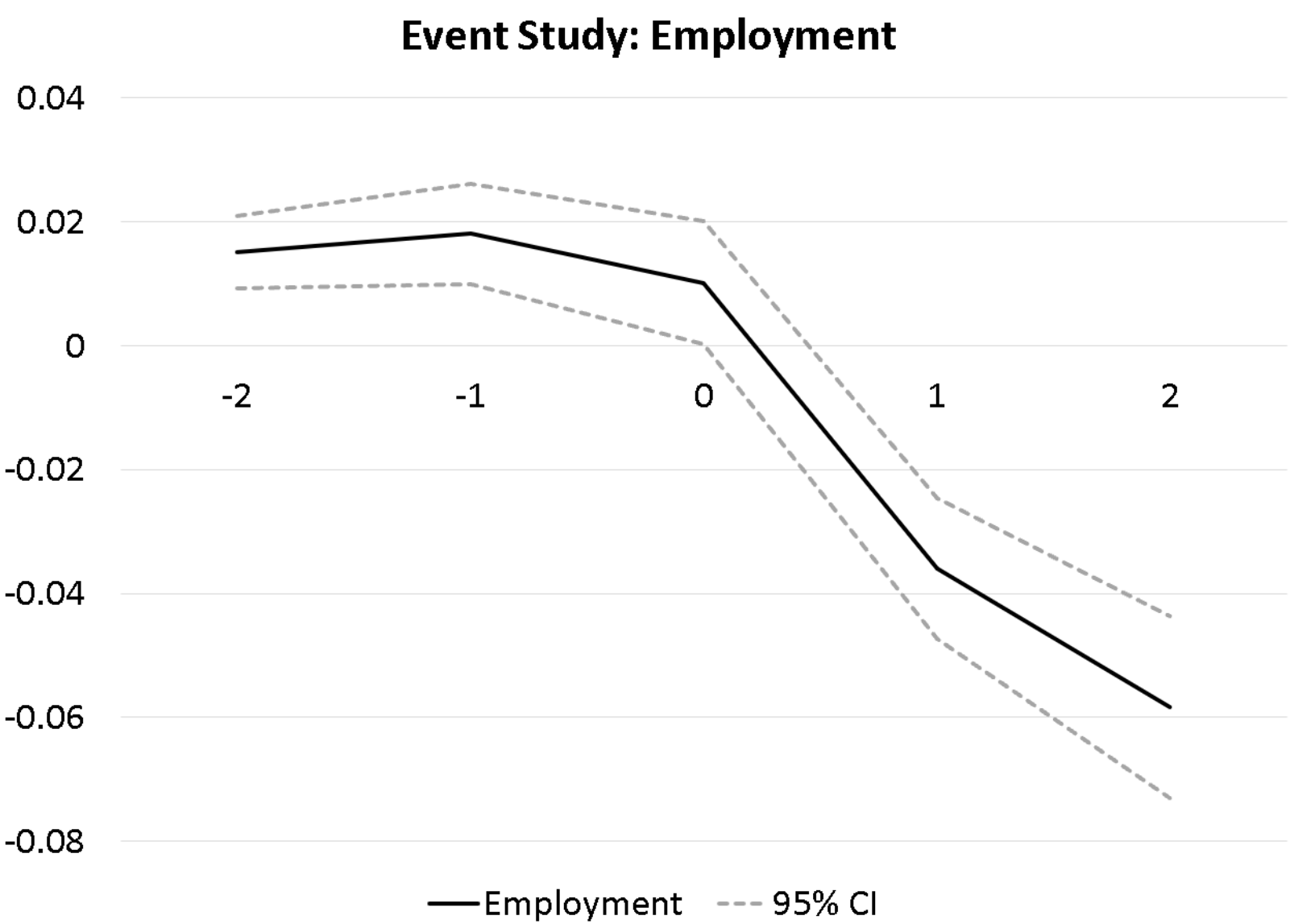
Event-Study Regressions

Dep. Var.:	(1) Log pay	(2) Log Employment	(3) Log wage
2 Years Before Merger (d)	0.0297***	0.0151**	0.0146***
	(0.00575)	(0.00584)	(0.00337)
1 Year Before Merger (d)	0.0248***	0.0180**	0.00686*
	(0.00816)	(0.00813)	(0.00378)
Year of Merger (d)	0.0266**	0.0101	0.0165***
	(0.0108)	(0.00991)	(0.00397)
1 Year After Merger (d)	-0.0360***	-0.0360***	5.06e-05
	(0.0124)	(0.0113)	(0.00443)
2 Years After Merger (d)	-0.0562***	-0.0583***	0.00208
	(0.0155)	(0.0147)	(0.00480)
Fixed Effects	Y	Y	Y
R-squared	0.604	0.596	0.666
Round N	53000	53000	53000

Fixed effects include: firmid, year, 2-digit naics, and county

▸ Back to empirical specifications. ▸ Summary Stats


Event Study: Pay
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-2
-1
0
1
2
Pay
95% CI


Event Study: Employment
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-2
-1
0
1
2
Employment
95% CI

Back to empirics.

Welfare

Aggregate supply

$$
\begin{aligned}
y_{ijt} &= z_{ijt}^{1+\eta} \mu_{ijt}^{\eta} \left(\frac{\mathbf{w}_{jt}}{P_t} \right)^{\eta-\theta} \left(\frac{\mathbf{W}_t}{P_t} \right)^{-\theta} \mathbf{N}_t \\
Y_t &= \int_0^1 \sum_i^{M_j} y_{ijt} dj \\
Y_t &= \frac{1}{\tau_t} \left(\frac{\mathbf{W}_t}{P_t} \right)^{-\theta} \mathbf{N}_t \\
\frac{1}{\tau_t} &= \int_0^1 \left[\sum_i^{M_j} z_{ijt}^{1+\eta} \mu_{ijt}^{1+\eta} \right]^{\frac{\eta-\theta}{1+\eta}} \left[\sum_i^{M_j} z_{ijt}^{1+\eta} \mu_{ijt}^{\eta} \right] dj
\end{aligned}
$$

1. Increase in wedge $\uparrow \tau_t$ as $\downarrow \mu_{ijt}$
2. Wedge τ_t can be computed from data on wage bill shares $\{s_{ijt}\}$
3. Given τ_t general equilibrium can be simply computed (next)

Welfare

Labor market clears under the wage index

$$\frac{\mathbf{W}_t}{P_t} = \left[\int_0^1 \left[\sum_i \mu_{ijt}^{1+\eta} z_{ijt}^{1+\eta} \right]^{\frac{1+\theta}{1+\eta}} dj \right]^{\frac{1}{1+\theta}}$$

Aggregate goods supply

$$\frac{\mathbf{Y}_t}{\mathbf{N}_t} = \left(\frac{\mathbf{W}_t}{P_t} \right)^{-\theta} \int_0^1 \sum_i z_{ijt}^{1+\eta} \left(\frac{\mu_{ijt}}{\mu_{jt}} \right) \mu_{jt}^{\theta} \, dj$$

Aggregate demand

$$\frac{U_N(\mathbf{C}_t, \mathbf{N}_t)}{U_C(\mathbf{C}_t, \mathbf{N}_t)} = \frac{\mathbf{W}_t}{P_t} \quad , \quad \mathbf{N}_t = \bar{\varphi} \left(\frac{\mathbf{W}_t}{P_t} \right)^{\varphi}$$

Solution

Set $P_t = 1$, solve three equations for $\{\mathbf{W}_t \, \mathbf{N}_t, \mathbf{Y}_t\}$

2. Pass-through - Corporate tax effects

After-tax profits with a corporate profit tax

$$\begin{aligned} \pi &= \pi^{Econ.} - \tau_C \pi^{Acc.} \\ \pi^{Econ.} &= Pzn^{\alpha} k^{1-\alpha} - wn - rk - \delta k \\ \pi^{Acc.} &= Pzn^{\alpha} k^{1-\alpha} - wn - \lambda rk - \delta k \end{aligned}$$

- Can only write off fraction λ of capital financed by debt

Result

$$\begin{aligned} \pi &= (MRPL(z, r, \tau_C) - w)\, n \\ MRPL(z, r, \tau_C) &= \frac{1}{1+\tau_C} P\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}} \left(\frac{\tilde{z}}{\tilde{r}}\right)^{\frac{1-\alpha}{\alpha}} \tilde{z} \\ \tilde{z} &= (1-\tau_C)z \\ \tilde{r} &= (1+\lambda\tau_C)r + (1+\tau_C)\delta \end{aligned}$$

▸ Back to corporate tax exercise.

2. Across region mergers

- Sample: Cross-section of all multi-county mergers in year t
- $\Delta \log y_{fckt}$: Change in combined aquirer-aquired outcome
- s^{wn}_{cfkt}: Combined aquirer-aquired wage share in year of merger

$$\Delta \log y_{fckt} = \alpha_f + \alpha_c + \alpha_k + \alpha_t + \beta_1 s^{wn}_{fckt} + \varepsilon_{fckt}$$

- This specification uses within-firm, across county variation to isolate the impact of post-merger wage shares on employment, pay, and wages

2. Across region mergers

	(1) Δ Log Wage t to $t+1$	(2) Δ Log Wage t to $t+1$	(3) Δ Log Pay t to $t+1$	(4) Δ Log Pay t to $t+1$	(5) Δ Log Empl. t to $t+1$	(6) Δ Log Empl. t to $t+1$
Wage Share (Year of Merger)	-1.081***	-1.132***	-1.576***	-1.485***	-0.495***	-0.353
	(0.341)	(0.409)	(0.380)	(0.443)	(0.171)	(0.226)
Fixed Effects	N	Y	N	Y	N	Y
R-squared	0.006	0.428	0.005	0.316	0.001	0.219
Round N	10000	10000	10000	10000	10000	10000

Interpreting coefficients: If wage share is 1-std deviation (0.026) higher, then wages fall by 2.9% $(= 0.026 \times -1.132 \times 100)$ more

2. Across region mergers

- Keep only markets with at least 3 firms
- Merge firm $i = 1$ and $i = 2$ in each county-industry j
- Remove firm 1, set firm 2 productivity to

$$z'_{2j} = \left(z_{1j}^{\rho} + z_{2j}^{\rho} \right)^{\frac{1}{\rho}} \quad , \quad \rho = 1.5$$

- Estimate

$$\log \frac{n'_{1j} + n'_{2j}}{n_{1j} + n_{2j}} = Const. + \beta^{Share} s_{2j}^{wn} + \beta^{Prod} z'_{2j}$$

	$Const.$	β^{Share}	β^{Prod}
Employment	4.593	-2.948	-0.270
Wages	-0.856	-0.064	-0.050
Wage bill	3.737	-3.012	-0.320

- 1pp greater wage share associated with 3% lower wage bill and employment, 0.06% lower wages