Labor Market Power

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

1. How has labor market power in U.S. changed over time?

2. Implications for (i) welfare, (ii) labor share, (iii) minimum wage policy?
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2. Implications for (i) welfare, (ii) labor share, (iii) minimum wage policy?

Quantitative approach

- Develop tractable general equilibrium oligopsony framework

- Wage is firm-specific markdown on MRPL

  \[ \text{Labor market power} := \text{Markdown} \]

- Estimate key model parameters using Census LBD data
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Quantitative approach

- Develop tractable general equilibrium oligopsony framework
- Wage is firm-specific markdown on MRPL
  
  Labor market power := Markdown

- Estimate key model parameters using Census LBD data
- Validate (i) Pass-through rates, (ii) Concentration distribution
- Extend (i) Mergers, (ii) Cross-region empirics
Findings

1. Welfare

- Gains associated with Walrasian labor market equilibrium: 3 to 8%
Findings

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- Gains associated with *Walrasian labor market equilibrium*: 3 to 8%

2. Labor share

- Closed-form link to a measure of *local labor market concentration*
- Between 1976 and 2014, this measure *declined* significantly
- Contribution to labor share: +2.89 ppt
Findings

1. Welfare
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2. Labor share
- Closed-form link to a measure of local labor market concentration
- Between 1976 and 2014, this measure declined significantly
- Contribution to labor share: +2.89 ppt

3. Minimum wage policy
- Optimal minimum wage binds for 5%, raises welfare by 0.07%.
- Larger minimum wages reduce employment, increase concentration
Literature

1. Theory
   Oilgopsony  Robinson (1933), Hotelling (1929), Salop (1979), Bhaskar, Manning & To (2002)

   New - (i) Quantitative framework for Census data
       (ii) Strategic interaction, (iii) Map discreteness to data

2. Empirics
   Wage pass-through  Card, Cardoso, Heining, Kline (’16), Kline, Petkova, Williams, Zidar (’18)
   Corp. Taxes       Suarez Serrato, Zidar (2016), Giroud and Rauh (2017)

   New - (i) Model-relevant concentration statistics, map to welfare
       (ii) Identification: Within-firm, across-market variation
MODEL
Environment

Representative family
- Disutility of supplying workers across firms
- Continuum of labor markets $j \in [0, 1]$
- Labor market $j$ has a fixed number of firms $M_j \in [1, 2, \ldots, \infty)$
Environment

Representative family
- Disutility of supplying workers across firms
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Firms
- Firm $i$ has idiosyncratic productivity $z_{ijt}$
- Hire workers $n_{ijt}$, rent capital $k_{ijt}$ to produce identical final good
- Profits rebated lump sum to family
Environment

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Firms
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Markets
- Local, Cournot competition for labor
- National, Walrasian markets for output and capital
Household

Preferences

\[ U_0 = \max_{\{n_{ijt}, c_{ijt}, K_{t+1}\}} \sum_{t=0}^{\infty} \beta^t u \left( C_t - \frac{1}{\varphi} \frac{N_t^{1+\frac{1}{\varphi}}}{1+\frac{1}{\varphi}} \right), \quad \beta \in (0, 1), \quad \varphi > 0 \]

Disutility of labor supply

\[ N_t := \left[ \int_0^1 N_{jt}^{\frac{\theta+1}{\theta}} \, dj \right]^{\frac{\theta}{\theta+1}}, \quad \theta > 0 \]
\[ N_{jt} := \left[ n_{1jt}^{\eta} + \cdots + n_{M_{jt}}^{\eta} \right]^{\frac{\eta}{\eta+1}}, \quad \eta > \theta \]

Budget constraint

\[ C_t + \left[ K_{t+1} - (1 - \delta) K_t \right] = \int_0^1 \left[ w_{1jt} n_{1jt} + \cdots + w_{M_{jt}} n_{M_{jt}} \right] dj + R_t K_t + \Pi_t, \]
\[ C_t := \int_0^1 \left[ c_{1jt} + \cdots + c_{M_{jt}} \right] dj. \]
1. Markets are perfect complements

\[
N_t := \left[ \int_0^1 N_{jt}^{\theta+1} \frac{\theta}{\theta+1} dj \right]^{\frac{\theta}{\theta+1}} = \min_j \{ N_{jt} \}
\]

\( \theta \to 0 \): Same allocation of \( N_{jt} \) to all markets

2. Firms within markets are perfect substitutes

\[
N_{jt} := \left[ n_{1jt}^{\eta+1} + \cdots + n_{Mjt}^{\eta+1} \right]^{\frac{\eta}{\eta+1}} = \sum_{i=1}^{M_j} n_{ijt}
\]

\( \eta \to \infty \): All workers to highest productivity firm
Example - Maximum labor market power

1. Markets are perfect complements

\[ N_t := \left[\int_0^1 N_{jt}^{\theta+1} \,dj\right]^{\frac{\theta}{\theta+1}} = \min_j \{ N_{jt} \} \]

\( \theta \to 0 \): Same allocation of \( N_{jt} \) to all markets

2. Firms within markets are perfect substitutes

\[ N_{jt} := \left[ n_1^{\eta+1} + \cdots + n_{Mj}^{\eta+1} \right]^{\frac{\eta}{\eta+1}} = \sum_{i=1}^{Mj} n_{ijt} \]

\( \eta \to \infty \): All workers to highest productivity firm

Equivalence result - Nested logit individual choice model
Firms - Cournot competition

\[ \pi_{ijt} = \max_{n_{ijt}, k_{ijt}} \bar{Z}_{ijt} \left( k_{ijt}^{1-\gamma} n_{ijt}^{\gamma} \right)^\alpha - R_t k_{ijt} - w_{ijt} n_{ijt} , \quad \alpha > 0 \]

s.t.

\[ w_{ijt} = \varphi - \frac{1}{\varphi} \left( \frac{n_{ijt}}{N_{jt}} \right)^{\frac{1}{\eta}} \left( \frac{N_{jt}}{N_t} \right)^{\frac{1}{\theta}} N_t^{\frac{1}{\phi}} \]

\[ N_{jt} = \left[ \frac{\eta+1}{n_{1jt}^{\eta}} + \ldots + \frac{\eta+1}{n_{ijt}^{\eta}} + \ldots + \frac{\eta+1}{n_{M_{jt}}^{\eta}} \right]^{\frac{\eta}{\eta+1}} \]
Firms - Nash equilibrium

Wages

\[ w_{ijt} = \mu_{ijt} MRPL_{ijt} \]

\[ MRPL_{ijt} = \tilde{\alpha} \tilde{Z} \tilde{z}_{ijt} n_{ijt}^{\tilde{\alpha}-1} \]
Firms - Nash equilibrium

Wages

\[ w_{ijt} = \mu_{ijt} \text{MRPL}_{ijt} \]

\[ \text{MRPL}_{ijt} = \tilde{\alpha} \tilde{Z} \tilde{z}_{ijt} n_{ijt}^{-1} \]

Markdown

\[ \mu_{ijt} = \frac{\varepsilon_{ijt}}{\varepsilon_{ijt} + 1} \]

\[ s_{wn}^{ijt} = \frac{w_{ijt} n_{ijt}}{\sum_{k \in j} w_{kjt} n_{kjt}} \]

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

Uncompensated individual labor supply elasticities

Product market competition
Larger firms face lower labor supply elasticity, $\frac{\partial \epsilon_{ij}}{\partial s_{ij}^{ln}} < 0$

Have greater mark-downs, $\frac{\partial \mu_{ij}}{\partial s_{ij}^{ln}} < 0$
Concentration and the labor share

Payroll Herfindahl index

\[ HH_j^{wn} := \sum_{i \in j} (s_{ij}^{wn})^2, \quad \tilde{IHI}_j^{wn} := \left[ \int_0^1 s_j^{wn} HH_j^{wn} dj \right]^{-1} \]
Concentration and the labor share

Payroll Herfindahl index

\[ HHI_{jn}^{wn} := \sum_{i \in j} (s_{i,j}^{wn})^2 \quad \text{and} \quad \tilde{IHI}_{jn}^{wn} := \left[ \int_{0}^{1} s_{j}^{wn} HHI_{jn}^{wn} dj \right]^{-1} \]

Labor share

\[ LS = \frac{\tilde{\alpha} \tilde{IHI}_{jn}^{wn}}{\left( \frac{\eta+1}{\eta} \right) \tilde{IHI}_{jn}^{wn} + \left( \frac{\theta+1}{\theta} - \frac{\eta+1}{\eta} \right)} \quad (1) \]
Concentration and the labor share

Payroll Herfindahl index

\[ HHI_{jn}^{wn} := \sum_{i \in j} (s_{ijn}^{wn})^2, \quad \tilde{IHI}_{jn}^{wn} := \left[ \int_0^1 s_{jn}^{wn} HHI_{jn}^{wn} \, dj \right]^{-1} \]

Labor share

\[ LS = \frac{\tilde{\alpha} \tilde{IHI}_{jn}^{wn}}{\left( \frac{\eta+1}{\eta} \right) \tilde{IHI}_{jn}^{wn} + \left( \frac{\theta+1}{\theta} - \frac{\eta+1}{\eta} \right)} \]  

Two results

1. If \( \theta < \eta \) then labor share is increasing in \( \tilde{IHI}_{jn}^{wn} \)

2. If \( \theta = \eta \) then labor share is independent of \( \{HHI_{jn}^{wn}\} \) distribution
Concentration, 1976 and 2014

Data: LBD tradeable firms, Market: NAICS3 × Commuting Zone
Concentration, 1976 and 2014

Data: LBD tradeable firms, Market: NAICS3 × Commuting Zone

A. Average Herfindahl index

<table>
<thead>
<tr>
<th>Year</th>
<th>Employment</th>
<th>Wage-bill</th>
</tr>
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<tbody>
<tr>
<td>1976</td>
<td>0.17</td>
<td></td>
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B. Inverse Average Herfindahl Index

<table>
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<tr>
<th>Year</th>
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At estimated \{\eta, \theta, \tilde{\alpha}\} (next) falling HHI added 2.89 ppt to Labor Share

Berger Herkenhoff Mongey, "Labor Market Power"
Concentration, 1976 and 2014

Data: LBD tradeable firms,  Market: NAICS3 × Commuting Zone

A. Average Herfindahl index

- Employment
- Wage-bill

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At estimated $\{\eta, \theta, \tilde{\alpha}\}$ (next) falling HHI added 2.89 ppt to Labor Share

Berger Herkenhoff Mongey, "Labor Market Power"
CALIBRATION
Identifying $\theta$ and $\eta$

- **Large** firm ($s_{ijt}^{wn,L}$) with labor supply elasticity ($\varepsilon_{ijt}^L$)

- **Small** firm ($s_{ijt}^{wn,S}$) with labor supply elasticity ($\varepsilon_{ijt}^S$)

- Exact identification:

$$\varepsilon_{ijt}^L = \left[ s_{ijt}^{wn,L} \frac{1}{\theta} + \left(1 - s_{ijt}^{wn,L} \right) \frac{1}{\eta} \right]^{-1} , \quad \varepsilon_{ijt}^S = \left[ s_{ijt}^{wn,S} \frac{1}{\theta} + \left(1 - s_{ijt}^{wn,S} \right) \frac{1}{\eta} \right]^{-1}$$
Identifying $\theta$ and $\eta$

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1. State-corporate tax changes $\tau_{s(j)t}$ map to $MRPL_{ijt}$ shocks
2. Recover $\varepsilon(s_{ij}^{wn})$ with share-dependent responses

$$\varepsilon(s_{ij}^{wn}) := \frac{\partial \log n_{ijt}(s_{ijt}^{wn})}{\partial \log w_{ijt}(s_{ijt}^{wn})} \approx \frac{d \log n_{ijt}(s_{ijt}^{wn})}{d \tau} \cdot \frac{d \log w_{ijt}(s_{ijt}^{wn})}{d \tau}$$

Details - How corporate taxes map to $MRPL_{ijt}$ through Accounting vs. Economic profits
1. Share-dependent tax pass-through

State corporate taxes

- **Sample**  Tradeable C-corps operating in 2 mkts in state $s$, ‘02-‘12

- **Variation**  Within firm-state $is$, across markets $j \in s$

**Specification**

$$
\log n_{ijt+1} = \mu_t + \alpha_{is(j)} + \psi s_{ijt}^{wn} + \beta_n \tau_{s(j)t} + \gamma_n \left( s_{ijt}^{wn} \times \tau_{s(j)t} \right) + e_{ijt}
$$

$$
d\log n_{ijt+1} = \left[ \hat{\beta}_n + \hat{\gamma}_n s_{ijt}^{wn} \right] d\tau_{s(j)t}
$$
2. Recovering $\theta$ and $\eta$

Data

$$\hat{\epsilon}(s_{ijt}^{\text{wn}}) \approx \frac{d \log n_{ijt} / d \tau_{s(j)t}}{\frac{d \log w_{ijt} / d \tau_{s(j)t}}{\frac{-0.00321 + 0.0172 s_{ijt}^{\text{wn}}}{-0.000913 + 0.00373 s_{ijt}^{\text{wn}}}}}$$

Model

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

- Draw $s_{ijt}^{\text{wn}}$ from empirical distribution and compute $\hat{\epsilon}(s_{ijt}^{\text{wn}})$

- Use NLLS to recover $\theta = 0.76$, $\eta = 3.74$:

Details - Non-linear least-squares
Model fit

\[ \theta = 0.76, \eta = 3.74 \quad (\text{Year } t + 1) \]

Fig - Distribution of elasticities \( \varepsilon_{ij} \) and markdowns \( \mu_{ij} \)

Berger Herkenhoff Mongey, "Labor Market Power"
Calibration - Annual, 2014

- $J = 5,000$ markets in model ($15,000$ in LBD)
- $M_j$ mixture of Paretos, mass pt. at $M_j = 1$  [1 firm in 15% mkts, LBD]

Parameters

- Frisch elasticity: $\varphi = 0.5$
- Log-normal productivity: $\log \tilde{z}_{ij} \sim_{iid} N(1, \sigma_{\tilde{z}})$

Match

$\bar{\varphi}$ Average earnings per worker
$\bar{Z}$ Average firm size
$\bar{\alpha}$ Labor share
$\sigma_{\bar{Z}}$ Payroll weighted wage-bill Herfindahl
## Calibration - Annual, 2014

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varphi$</td>
<td>Aggregate Frisch elasticity</td>
<td>0.50</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Across market substitutability</td>
<td>0.76</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Within market substitutability</td>
<td>3.74</td>
</tr>
<tr>
<td>$J$</td>
<td>Number of markets</td>
<td>5,000</td>
</tr>
<tr>
<td>$r$</td>
<td>Risk free rate</td>
<td>0.04</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.10</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Cobb-Douglas labor exponent</td>
<td>0.818</td>
</tr>
<tr>
<td>$G(M_j)$</td>
<td>Firms per mkt, mixtures of Paretos w/ mass pt at 1</td>
<td>{15% mktks have 1 firm, Loc1=2, Sh1=0.67, Sc1=5.7, Loc2=2, Sh2=0.67, Sc2=35.6}</td>
</tr>
</tbody>
</table>

| Estimated |                                            |                |
| $\tilde{\alpha}$ | DRS parameter                  | 0.984          |
| $\sigma_z$    | Productivity dispersion           | 0.391          |
| $\tilde{Z}$    | Productivity shifter              | 23,570         |
| $\bar{\varphi}$ | Labor disutility shifter         | 6.904          |

[Figure - Distribution of $M_j$, and calibration of $G(M_j)$]
1. Validation
   (i) Weighted and unweighted concentration distribution
   (ii) Pass-through (Kline, Petkova, Williams, Zidar, QJE 2019)

2. Welfare

3. Labor share

4. Minimum wage
1. Non-targeted concentration measures

Fact  Unweighted $HHI^{wn}$ is 2 times larger than weighted $HHI^{wn}$

Fact  Concentrated markets are small

<table>
<thead>
<tr>
<th>Wage bill herfindahl</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unweighted average</td>
<td>0.35</td>
<td>0.45</td>
</tr>
<tr>
<td>Payroll weighted average</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>Correlation with market employment</td>
<td>-0.75</td>
<td>-0.21</td>
</tr>
</tbody>
</table>
1. Non-targeted concentration measures

- Matches both weighted and unweighted across market distributions

- Similar concentration distribution outside tradeables
2. Pass-through

- Replicate patent experiment in Kline et al (2018)
- Same sample properties & increase in average labor productivity

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass-through</td>
<td>0.423</td>
<td>0.317</td>
<td>0.327</td>
</tr>
<tr>
<td>Dependent var.</td>
<td>$w_{ij}$</td>
<td>Labor compensation per worker</td>
<td>Hourly wage $w_{ij}$</td>
</tr>
<tr>
<td>Independent var.</td>
<td>$y_{ij}/n_{ij}$</td>
<td>Labor compensation plus earnings (EBITDA) per worker</td>
<td>Value added per worker (IV with avg. sales per worker)</td>
</tr>
</tbody>
</table>

- Increase VA per worker by $1$, wages per worker by $0.42$
Welfare cost of labor market power

- How much would consumption have to increase to be indifferent between U.S. labor market and a competitive labor market?
Welfare cost of labor market power

- How much would consumption have to increase to be indifferent between U.S. labor market and a competitive labor market?

Competitive equilibrium

Wages $w_{ijt}$ and an allocation of workers $n_{ijt}$ such that

1. Taking $w_{ijt}$ as given, $n_{ijt}$ solves each firm’s optimization problem

$$n_{ijt} = \arg \max_{n_{ijt}} \tilde{Z}z_{ijt}n_{ijt}^{\alpha} - w_{ijt}n_{ijt}$$

2. Taking $w_{ijt}$ as given, $n_{ijt}$ is the household’s optimal labor supply

$$n_{ijt} = \phi \left( \frac{w_{ijt}}{W_{jt}} \right)^{\eta} \left( \frac{W_{jt}}{W_{t}} \right)^{\theta} W_{t}^{\varphi}$$
Welfare

Consumption equivalent gain

\[ u \left( (1 + \lambda)C_o - \frac{1}{\varphi^\frac{1}{\varphi}} \frac{N_o^{1+\frac{1}{\varphi}}}{1 + \frac{1}{\varphi}} \right) = u \left( C_c - \frac{1}{\varphi^\frac{1}{\varphi}} \frac{N_c^{1+\frac{1}{\varphi}}}{1 + \frac{1}{\varphi}} \right) \]
Welfare

Consumption equivalent gain

\[ u \left( (1 + \lambda)C_o - \frac{1}{\phi} \frac{N_o^{1+\frac{1}{\phi}}}{1} \right) = u \left( C_c - \frac{1}{\phi} \frac{N_c^{1+\frac{1}{\phi}}}{1} \right) \]

<table>
<thead>
<tr>
<th>Frisch elasticity (( \phi ))</th>
<th>Welfare gain (( \lambda ))</th>
<th>( N_c / N_o )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>2.9</td>
<td>1.08</td>
</tr>
<tr>
<td>0.5</td>
<td>5.4</td>
<td>1.20</td>
</tr>
<tr>
<td>0.8</td>
<td>8.0</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Interpretation

Households would need additional 5.4% of lifetime consumption to be indifferent across markets
- Overall output gain: 21 percent
- *Share* due to reallocation: 26 percent
Welfare - Output decomposition

Details - Reallocation vs. Scale decomposition

Berger Herkenhoff Mongey, "Labor Market Power"
Labor share

What are implications of declining concentration for labor share?

\[ LS = \frac{\tilde{\alpha} \tilde{I}H I^{wn}}{\left( \frac{\eta+1}{\eta} \right) \tilde{I}H I^{wn} + \left( \frac{\theta+1}{\theta} - \frac{\eta+1}{\eta} \right)} \]

- \( \tilde{I}H I^{wn} \) increased from 5.01 in 1976 to 7.09 in 2014
- Use estimated parameters \( \{ \eta = 3.74, \theta = 0.76, \tilde{\alpha} = 0.98 \} \)
- Contributed +2.89 ppt to Labor share
- Labor market concentration not driving declining Labor share
Minimum wage

Implications for Minimum wage

- (New) Tractable theory of minimum wage in oligopoly with DRS

- Simulate minimum wage hike to $12 per hour (binds for 10.4% of workers pre-min wage)

- Comparable increase studied in Germany, 2016
e.g. Dustmann, Lindner, Schoenberg, Umkehrer, vom Berge (2018)

- Compare estimates of employment reallocation across firm sizes

- Use model to assess welfare and optimal policy
Minimum wage - Example of an increase

- Choose \( w \) such that 10.4% of workers initially receive \( w < w \)

<table>
<thead>
<tr>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
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</thead>
<tbody>
<tr>
<td>Post experiment min-median ratio (percent):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( w_{min} / w_{p50} )</td>
<td>61</td>
<td>48</td>
</tr>
<tr>
<td>( \Delta \log \text{ Ave firm size} )</td>
<td>0.01</td>
<td>0.12</td>
</tr>
<tr>
<td>( \Delta \log \text{ Number of firms with } n_{ij} \leq 2 )</td>
<td>-0.28</td>
<td>-0.15</td>
</tr>
<tr>
<td>( \Delta \log \text{ Number of firms with } n_{ij} \geq 50 )</td>
<td>0.000</td>
<td>0.120</td>
</tr>
<tr>
<td>( \Delta \text{ Share Emp at firms with } n_{ij} \leq 2 )</td>
<td>-0.04</td>
<td>-0.03</td>
</tr>
<tr>
<td>( \Delta \text{ Share Emp at firms with } n_{ij} \geq 50 )</td>
<td>0.00</td>
<td>0.01</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Inequality</th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p50-p10 ) (log difference)</td>
<td>0.50</td>
<td>0.49</td>
</tr>
<tr>
<td>( p90-p50 ) (log difference)</td>
<td>0.43</td>
<td>0.43</td>
</tr>
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</table>

- Employment increases by +1.07%

- Welfare gain of 0.064%
Optimum Minimum wage binds for 5% of workers (at initial eq.)
- Delivers 0.07% consumption equivalent welfare gain
- Reallocation effect is opposite of the competitive equilibrium
- Agg. \( N \) declines for large min. wage hikes, \( HHI^{wn} \) increases
Productivity, Employment, Concentration

- Oligopsony economy
- Replicates Figure 1 of Combes et al (ECTA 2012)
  - Productivity Advantage of Large Cities: Agglomeration vs. Selection
Productivity, Employment, Concentration

- Recalibrated competitive economy \((\downarrow \tilde{\alpha}, \uparrow \sigma_z)\)
- Replicates Figure 1 of Combes et al (ECTA 2012)
  - *Productivity Advantage of Large Cities: Agglomeration vs. Selection*
- **Left:** Oligopsony economy
- **Right:** Recalibrated competitive economy \((\downarrow \bar{\alpha}, \uparrow \sigma_z)\)
- Replicates Figure 1 of Glaeser Mare (2001) - *Cities and skills*
Productivity, Employment, Concentration

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>( \log HHI_{jn}^{wn} )</th>
<th>( HHI_{jn}^{wn} )</th>
<th>( \log N_j )</th>
<th>( IHI_{jn}^{wn} )</th>
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<tbody>
<tr>
<td>1. Benchmark</td>
<td>( \hat{\beta} )</td>
<td>-0.187</td>
<td>-1.042</td>
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<tr>
<td>2. Recalibrated</td>
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<td>-0.755</td>
<td>0.358</td>
</tr>
<tr>
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<td>( \hat{\beta} )</td>
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<td>-0.731</td>
<td>0.200</td>
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</table>

Berger Herkenhoff Mongey, "Labor Market Power"
Conclusion

Five contributions

1. Develop and validate general equilibrium oligopsony model
2. Estimate using size dependent corporate tax response in LBD
3. Welfare losses from labor market power are large: 2.9% to 8.0%
4. Model relevant concentration measure is wage-bill Herfindahl
5. Declining wage-bill Herfindahls between 1976 and 2014 implies a +2.89 ppt labor share rise
THANK YOU!
APPENDIX
Representation - Logit model

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

\[
\min_{ij} \log h_m - \xi_{ij} \quad \text{s.t.} \quad w_{ij} h_m = y_m
\]

- Random labor disutility

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

- Labor supply

\[
n_{ij} = \frac{w_{ij}^{\eta}}{\sum_{i=1}^{M_j} w_{ij}^{1+\eta}} \frac{\left[ \sum_{i=1}^{M_j} w_{ij}^{1+\eta} \right]^{\frac{1+\theta}{1+\eta}}}{\sum_{l=1}^{J} \left[ \sum_{k=1}^{M_l} w_{kl}^{1+\eta} \right]^{\frac{1+\theta}{1+\eta}}} \cdot Y. \quad (2)
\]

- Result  Delivers same supply system as rep. agent CES
Firms - Notation

- The ‘tilde’ variables are defined as follows:

\[ \tilde{\alpha} := \frac{\alpha \gamma}{1 - (1 - \gamma) \alpha} \]

\[ \tilde{z}_{ijt} := [1 - (1 - \gamma) \alpha] \left( \frac{(1 - \gamma) \alpha}{R_t} \right)^{\frac{(1-\gamma)\alpha}{1-(1-\gamma)\alpha}} \frac{1}{z_{ijt}^{1-(1-\gamma)\alpha}} \]

\[ \tilde{Z} := Z^{\frac{1}{1-(1-\gamma)\alpha}} \]

- Note that \((1 - \gamma) \alpha\) is capital’s share of income
Computation

A firm’s wage-bill share is defined by their relative wage:

\[ s_{ij}^{wn} = \left( \frac{w_{ij}}{w_j} \right)^{1+\eta} \]

Within a market, an equilibrium can be solved by iterating through the following conditions given a guess of \( s_j^{wn} = (s_1^{wn}, \ldots, s_M^{wn}) \):

\[
\varepsilon_{ij} = \begin{cases} 
  s_{ij}^{wn} \theta + (1 - s_{ij}^{wn}) \eta & \text{Bertrand} \\
  \left[ s_{ij}^{wn} \frac{1}{\theta} + (1 - s_{ij}^{wn}) \frac{1}{\eta} \right]^{-1} & \text{Cournot} 
\end{cases}
\]

\[ \mu_{ij} = \frac{\varepsilon_{ij}}{\varepsilon_{ij} + 1} \]

\[ w_{ij} = \mu_{ij} MRPL_{ij} \]

\[ w_j = \left[ \int_0^1 w_{ij}^{1+\eta} \, dj \right]^{\frac{1}{1+\eta}} \]

\[ s_{ij}^{wn(NEW)} = \left( \frac{w_{ij}}{w_j} \right)^{1+\eta} \]

We guess equal shares, and then iterate until \( s_j^{wn(NEW)} = s_j^{wn} \).
Sub in inverse supply curve for \( n_{ij} \):

\[
MRPL_{ij} = \omega W^{(1-\bar{\alpha})(\theta-\varphi)} \hat{z}_{ij} \left\{ w_{ij}^{-\eta} w_j^{-\theta} \right\}^{1-\bar{\alpha}}
\]

Write the wage in terms of the marginal revenue product of labor:

\[
w_{ij} = \mu_{ij} MRPL_{ij}
\]

\[
= \mu_{ij} \omega W^{(1-\bar{\alpha})(\theta-\varphi)} \hat{z}_{ij} \left\{ w_{ij}^{-\eta} w_j^{-\theta} \right\}^{1-\bar{\alpha}}
\]

Use \( w_j = w_{ij} s_{ij}^{-\frac{1}{\eta+1}} \): \( w_{ij} = \omega^{\frac{1}{1+(1-\alpha)\theta}} W^{\frac{(1-\bar{\alpha})(\theta-\varphi)}{1+(1-\alpha)\theta}} \mu_{ij}^{\frac{1}{1+(1-\alpha)\theta}} \hat{z}_{ij}^{\frac{1}{1+(1-\alpha)\theta}} s_{ij}^{-\frac{(1-\bar{\alpha})(\eta-\theta)}{\eta+1}} \frac{1}{1+(1-\alpha)\theta}
\]

We will solve for an equilibrium in ‘hatted’ variables, and then rescale:

\[
\hat{w}_{ij} := \mu_{ij}^{\frac{1}{1+(1-\alpha)\theta}} \hat{z}_{ij}^{\frac{1}{1+(1-\alpha)\theta}} s_{ij}^{-\frac{(1-\bar{\alpha})(\eta-\theta)}{\eta+1}} \frac{1}{1+(1-\alpha)\theta}
\]

\[
\hat{w}_j := \left[ \sum_{i \in j} \hat{w}_{ij}^{\eta+1} \right]^{\frac{1}{\eta+1}}
\]

\[
\hat{W} := \left[ \int \hat{w}_j^{\theta+1} d_j \right]^{\frac{1}{\theta+1}}
\]

\[
\hat{n}_{ij} := \left( \frac{\hat{w}_{ij}}{\hat{w}_j} \right)^{\eta} \left( \frac{\hat{w}_j}{\hat{W}} \right)^{\theta} \left( \frac{\hat{W}}{1} \right)^{\varphi}
\]
These definitions imply that

\[ w_{ij} = \omega \frac{1}{1+(1-\tilde{\alpha})\theta} W \frac{(1-\tilde{\alpha})(\theta-\varphi)}{1+(1-\tilde{\alpha})\theta} \hat{w}_{ij} \]

\[ w_j = \omega \frac{1}{1+(1-\tilde{\alpha})\theta} W \frac{(1-\tilde{\alpha})(\theta-\varphi)}{1+(1-\tilde{\alpha})\theta} \hat{w}_j \]

\[ W = \omega \frac{1}{1+(1-\tilde{\alpha})\theta} W \frac{(1-\tilde{\alpha})(\theta-\varphi)}{1+(1-\tilde{\alpha})\theta} \hat{W} \]

These definitions allow us to compute the equilibrium market shares in terms of ‘hatted’ variables:

\[ s_{jn}^{\text{wn}} = \left( \frac{w_{ij}}{w_j} \right)^{\eta+1} = \left( \frac{\hat{w}_{ij}}{\hat{w}_j} \right)^{\eta+1} \quad (3) \]
For a given set of values for parameters \( \{ \bar{\varphi}, \bar{Z}, \bar{\alpha}, \beta, \delta \} \), we can solve for the non-constant returns to scale equilibrium as follows:

1. Guess \( s_{j}^{wn} = (s_{1j}^{wn}, \ldots, s_{Mj}^{wn}) \)

2. Compute \( \{ \epsilon_{ij} \} \) and \( \{ \mu_{ij} \} \) using the industry eq formulas.

3. Construct the ‘hatted’ equilibrium values as follows:

\[
\hat{w}_{ij} = \mu_{ij} \left( \frac{1}{1+(1-\bar{\alpha})\theta} \right) \hat{z}_{ij} \left( \frac{1}{1+(1-\bar{\alpha})\theta} \right) s_{ij} - \frac{(1-\bar{\alpha})(\eta-\theta)}{\eta+1} \left( \frac{1}{1+(1-\bar{\alpha})\theta} \right)
\]

\[
\hat{w}_{j} = \left[ \sum_{i \in j} \hat{w}_{ij}^{\eta+1} \right]^{\frac{1}{\eta+1}}
\]

\[
\hat{W} = \left[ \int \hat{w}_{j}^{\theta+1} dj \right]^{\frac{1}{\theta+1}}
\]

\[
\hat{n}_{ij} = \left( \frac{\hat{w}_{ij}}{\hat{w}_{j}} \right)^{\eta} \left( \frac{\hat{w}_{j}}{\hat{W}} \right)^{\theta} \left( \frac{\hat{W}}{1} \right)^{\varphi}
\]

4. Update the wage-bill share vector using previous expression (prior slide).

5. Iterate until convergence of wage-bill shares.
DRS Computation

Recovering true equilibrium values from ‘hatted’ equilibrium: Once the ‘hatted’ equilibrium is solved, we can construct the true equilibrium values by rescaling as follows:

\[ \omega = \frac{\hat{Z}}{\phi^{1-\tilde{\alpha}}} \] (4a)

\[ \hat{W} = \omega^{\frac{1}{1+(1-\tilde{\alpha})\theta}} \hat{W}^{\frac{1+(1-\tilde{\alpha})\theta}{1+(1-\tilde{\alpha})\theta}} \] (4b)

\[ w_{ij} = \omega^{\frac{1}{1+(1-\tilde{\alpha})\theta}} \hat{W}^{\frac{(1-\tilde{\alpha})(\theta-\phi)}{1+(1-\tilde{\alpha})\theta}} \hat{w}_{ij} \] (4c)

\[ w_j = \omega^{\frac{1}{1+(1-\tilde{\alpha})\theta}} \hat{W}^{\frac{(1-\tilde{\alpha})(\theta-\phi)}{1+(1-\tilde{\alpha})\theta}} \hat{w}_j \] (4d)

\[ n_{ij} = \bar{\varphi} \left( \frac{w_{ij}}{w_j} \right)^{\eta} \left( \frac{w_j}{\hat{W}} \right)^{\theta} \left( \frac{\hat{W}}{1} \right)^{\varphi} \] (4e)
We set the scale parameters $\bar{\varphi}$ and $\bar{Z}$ in order to match average firm size observed in the data ($AveFirmSize^{Data} = 27.96$ from Table 6), and average earnings per worker in the data ($AveEarnings^{Data} = $65,773 from Table 6):

\[
\hat{AveFirmSize}^{Data} = \frac{\int \left\{ \sum_{i \in j} n_{ij} \right\} dj}{\int \left\{ M_j \right\} dj} \tag{5a}
\]

\[
\hat{AveEarnings}^{Data} = \frac{\int \left\{ \sum_{i \in j} w_{ij} n_{ij} \right\} dj}{\int \left\{ \sum_{i \in j} n_{ij} \right\} dj} \tag{5b}
\]
DRS Computation

To compute the values of $\bar{\varphi}$ and $\tilde{Z}$ that allow us to match $AveFirmSize^\text{Data}$ and $AveEarnings^\text{Data}$, we substitute the model’s values for $n_{ij}$, $w_{ij}$, and $M_j$ into $AveFirmSize^\text{Data}$ and $AveEarnings^\text{Data}$. We repetitively substitute equations (4a) through (4e) into (5a) and (5b). We then solve for $\bar{\varphi}$ and $\tilde{Z}$:

$$\bar{\varphi} = \frac{AveFirmSize^\text{Data}}{AveFirmSize^\text{Model}} \frac{AveEarnings^\text{Data}}{AveEarnings^\text{Model}}$$  \hspace{1cm} (6)

$$\tilde{Z} = \varphi^{1-\tilde{\alpha}} \left( \frac{AveEarnings^\text{Data}}{AveEarnings^\text{Model}} \right)^{1+(1-\tilde{\alpha})\varphi} \times \hat{W}^{-(1-\tilde{\alpha})(\theta-\varphi)}$$  \hspace{1cm} (7)

where

$$AveFirmSize^\text{Model} = \frac{\int \{ \sum_{i \in j} \hat{n}_{ij} \} \, dj}{\int \{ M_j \} \, dj}$$

$$AveEarnings^\text{Model} = \frac{\int \{ \sum_{i \in j} \hat{w}_{ij} \hat{n}_{ij} \} \, dj}{\int \{ \sum_{i \in j} \hat{n}_{ij} \} \, dj}$$
Firms - Local labor market equilibrium

A. Wage payment shares: $s_{ij}^{wn}$

B. Markdown: $\mu_{ij} = \frac{\varepsilon(s_{ij}^{wn})}{\varepsilon(s_{ij}^{wn})+1}$

C. Wage ($000s$): $w_{ij} = \mu_{ij}MRPL_{ij}$

D. Employment: $n_{ij}$
Firms - Local labor market equilibrium - Competitive

A. Wage payment shares: $s_{ij}^{wn}$

B. Markdown: $\mu_{ij} = \frac{\varepsilon(s_{ij}^{wn})}{\varepsilon(s_{ij}^{wn}) + 1}$

C. Wage ($000s$): $w_{ij} = \mu_{ij} MRPL_{ij}$

D. Employment: $n_{ij}$
Aggregation – Labor share and concentration

\[ ls_{ij} = \frac{w_{ij} n_{ij}}{\tilde{z}_{ij} \tilde{Z} n_{ij}^{\tilde{\alpha}}} \]

\[ ls_{ij} = \tilde{\alpha} \frac{w_{ij}}{\tilde{\alpha} \tilde{z}_{ij} \tilde{Z} n_{ij}^{\tilde{\alpha}-1}} \]

\[ ls_{ij} = \tilde{\alpha} \frac{w_{ij}}{MRPL_{ij}} \]

\[ ls_{ij} = \tilde{\alpha} \mu_{ij} \]

Let \( y_{ij} = \tilde{z}_{ij} \tilde{Z} n_{ij}^{\tilde{\alpha}} \). At the market level, the labor share in market \( j \), \( LS_j \), is given by the following expression:

\[ LS_j = \left[ \frac{\sum_i y_{ij}}{\sum_i w_{ij} n_{ij}} \right]^{-1} \]

\[ = \left[ \sum_i \left( \frac{w_{ij} n_{ij}}{\sum_i w_{ij} n_{ij}} \right) \frac{y_{ij}}{w_{ij} n_{ij}} \right]^{-1} \]
Using the definition of the wage-bill share,

\[ LS_j^{-1} = \sum_i s_{ij}^{wn} \tilde{\alpha}^{-1} \mu_{ij}^{-1} \]

\[ LS_j^{-1} = \tilde{\alpha}^{-1} \sum_i s_{ij}^{wn} \left[ \frac{\eta + 1}{\eta} + s_{ij}^{wn} \left( \frac{\theta + 1}{\theta} - \frac{\eta + 1}{\eta} \right) \right] \]

\[ LS_j^{-1} = \tilde{\alpha}^{-1} \frac{\eta + 1}{\eta} + \tilde{\alpha}^{-1} \left( \frac{\theta + 1}{\theta} - \frac{\eta + 1}{\eta} \right) HHI_j^{wn} \]

Define the inverse Herfindahl at the market level as \[ IHI_j^{wn} = (HHI_j^{wn})^{-1} \].

Aggregating across markets yields the economy-wide labor share:

\[ LS^{-1} = \frac{\int \sum y_{ij}}{\int \sum w_{ij}n_{ij}} = \frac{\int \sum w_{ij}n_{ij}}{\int \sum w_{ij}n_{ij} \sum w_{ij}n_{ij}} \sum y_{ij} \]

\[ = \int s_{j}^{wn} LS_j^{-1} \]

\[ LS^{-1} = \frac{1}{\tilde{\alpha}} \left( \frac{\eta + 1}{\eta} + \left( \frac{\theta + 1}{\theta} - \frac{\eta + 1}{\eta} \right) \int s_{j}^{wn} \left( IHI_j^{wn} \right)^{-1} dj \right) \]
Aggregation – Labor share and concentration

Wage Bill Herfindahl: \[ HHI_{j}^{wn} \equiv \sum_{i} (s_{ij}^{wn})^2 , \quad s_{ij}^{wn} = \frac{w_{ij}n_{ij}}{\sum_{i} w_{ij}n_{ij}} \]

Employment Herfindahl: \[ HHI_{j}^{n} \equiv \sum_{i} (s_{ij}^{n})^2 , \quad s_{ij}^{n} = \frac{n_{ij}}{\sum_{i} n_{ij}} \]

Note:

\[ HHI_{j}^{wn} = \sum_{i} \left( \frac{w_{ij}}{\sum_{i} s_{ij}^{n} w_{ij}} \right) (s_{ij}^{n})^2 \]

1. Employment Herfindahl yields less concentration:
   Since \( \text{cov}(s_{ij}^{n}, w_{ij}) > 0 \), then \( HHI_{j}^{wn} > HHI_{j}^{n} \)

2. \( \text{cov}(s_{ij}^{n}, w_{ij}) \) is endogenous and depends on concentration
Table: Summary Statistics, Longitudinal Employer Database 1976 and 2014

<table>
<thead>
<tr>
<th></th>
<th>(A) Firm-market-level averages</th>
<th>(B) Market-level averages</th>
<th>(C) Market-level correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1976</td>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>Total firm pay (000s)</td>
<td>470.90</td>
<td>1839.00</td>
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<tr>
<td>Total firm employment</td>
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</tr>
<tr>
<td>Pay per employee</td>
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<td>$65,773</td>
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<td>Firm-level observations</td>
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<td>810,000</td>
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</tr>
<tr>
<td>Wage-bill Herfindahl (Unweighted)</td>
<td>0.45</td>
<td>0.45</td>
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<tr>
<td>Employment Herfindahl (Unweighted)</td>
<td>0.43</td>
<td>0.42</td>
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<tr>
<td>Wage-bill Herfindahl (Weighted by market’s share of total employment)</td>
<td>0.19</td>
<td>0.14</td>
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<tr>
<td>Employment Herfindahl (Weighted by market’s share of total employment)</td>
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<td>0.12</td>
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</tr>
<tr>
<td>Firms per market</td>
<td>42.56</td>
<td>51.60</td>
<td></td>
</tr>
<tr>
<td>Percent of markets with 1 firm</td>
<td>14.6%</td>
<td>14.7%</td>
<td></td>
</tr>
<tr>
<td>National employment share of markets with 1 firm</td>
<td>0.63%</td>
<td>0.36%</td>
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<td>Market-level observations</td>
<td>15,000</td>
<td>16,000</td>
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</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and number of firms</td>
<td>-0.22</td>
<td>-0.21</td>
<td></td>
</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and Std. Dev. Of Relative Wages</td>
<td>-0.49</td>
<td>-0.51</td>
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<td>Correlation of Wage-bill Herfindahl and Employment Herfindahl</td>
<td>0.98</td>
<td>0.98</td>
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<tr>
<td>Correlation of Wage-bill Herfindahl and Market Employment</td>
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<td>-0.21</td>
<td></td>
</tr>
<tr>
<td>Market-level observations</td>
<td>15,000</td>
<td>16,000</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Tradeable NAICS2 codes (11,21,31,32,33,55).
### (A) Firm-market-level averages

<table>
<thead>
<tr>
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<th>2014</th>
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<tbody>
<tr>
<td>Total firm pay (000s)</td>
<td>209.40</td>
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<tr>
<td>Total firm employment</td>
<td>19.43</td>
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<td>Pay per employee</td>
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<td>Firm-Market level observations</td>
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### (B) Market-level averages

<table>
<thead>
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<tr>
<td>Wage-bill Herfindahl (Unweighted)</td>
<td>0.36</td>
<td>0.34</td>
</tr>
<tr>
<td>Employment Herfindahl (Unweighted)</td>
<td>0.33</td>
<td>0.32</td>
</tr>
<tr>
<td>Wage-bill Herfindahl (Weighted by market’s share of total wage-bill)</td>
<td>0.17</td>
<td>0.11</td>
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<td>Employment Herfindahl (Weighted by market’s share of total wage-bill)</td>
<td>0.15</td>
<td>0.09</td>
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<tr>
<td>Firms per market</td>
<td>75.70</td>
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<tr>
<td>Percent of markets with 1 firm</td>
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<td>9.4%</td>
</tr>
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### (C) Market-level correlations

<table>
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<tr>
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<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation of Wage-bill Herfindahl and number of firms</td>
<td>-0.20</td>
<td>-0.17</td>
</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and Employment Herfindahl</td>
<td>0.97</td>
<td>0.97</td>
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<tr>
<td>Correlation of Wage-bill Herfindahl and Market Employment</td>
<td>-0.15</td>
<td>-0.16</td>
</tr>
<tr>
<td>Market-level observations</td>
<td>49,000</td>
<td>52,000</td>
</tr>
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Notes: All NAICS.
## Corporate taxes, labor and wages

<table>
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<th></th>
<th>$\log n_{ijt+1}$</th>
<th>$\log n_{ijt+1}$</th>
<th>$\log w_{ijt+1}$</th>
<th>$\log w_{ijt+1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>$\tau_s(j) t$</td>
<td>-0.00164***</td>
<td>-0.00321***</td>
<td>-0.00203***</td>
<td>-0.000913***</td>
</tr>
<tr>
<td></td>
<td>(0.000627)</td>
<td>(0.000740)</td>
<td>(0.000647)</td>
<td>(0.000902)</td>
</tr>
<tr>
<td>$s^{wn}_{ijt}$</td>
<td>1.931***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0460)</td>
<td></td>
<td></td>
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<tr>
<td>$\tau_s(j) t \times s^{wn}_{ijt}$</td>
<td>0.0172***</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.00490)</td>
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<td>Year FE</td>
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<td>Y</td>
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<tr>
<td>R-squared</td>
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<td>0.877</td>
<td>0.096</td>
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<tr>
<td>Round N</td>
<td>4,425,000</td>
<td>4,425,000</td>
<td>4,425,000</td>
<td>4,425,000</td>
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</tbody>
</table>

**Notes:** *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ Standard errors clustered at State × year level. Tradeable C-Corps from 2002 to 2014.
Data Appendix

Data:

- Isolate all plants (lbdnums) with non-missing firmids, with strictly positive pay, strictly positive employment, non-missing county codes for the continental US (we exclude Alaska, Hawaii, and Puerto Rico)
- Isolate all lbdnums with non-missing 2 digit NAICS codes equal to 11, 21, 31, 32, 33, or 55.
- We use the consistent 2007 NAICS codes provided by Fort & Klimek throughout the paper.
- Define a firm to be the sum of all establishments in a commuting zone with a common firmid and NAICS3 classification.

1. **Summary Statistics Sample**: Our summary statistics include all observations that satisfy the above criteria in 1976 and 2014.

2. **Corporate Tax Sample**: The corporate tax analysis includes all observations that satisfy the above criteria between 2002 and 2014 with an LFO of ‘C’. Firms must operate in at least two markets within a state.
### Table: Sample NAICS3 Codes.

<table>
<thead>
<tr>
<th>NAICS3</th>
<th>Description</th>
<th>NAICS3</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Crop Production</td>
<td>322</td>
<td>Paper Manufacturing</td>
</tr>
<tr>
<td>112</td>
<td>Animal Production and Aquaculture</td>
<td>323</td>
<td>Printing and Related Support Activities</td>
</tr>
<tr>
<td>113</td>
<td>Forestry and Logging</td>
<td>324</td>
<td>Petroleum and Coal Products Manufacturing</td>
</tr>
<tr>
<td>114</td>
<td>Fishing, Hunting and Trapping</td>
<td>325</td>
<td>Chemical Manufacturing</td>
</tr>
<tr>
<td>115</td>
<td>Support Activities for Agriculture</td>
<td>326</td>
<td>Plastics and Rubber Products Manufacturing</td>
</tr>
<tr>
<td></td>
<td>and Forestry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>Oil and Gas Extraction</td>
<td>327</td>
<td>Nonmetallic Mineral Product Manufacturing</td>
</tr>
<tr>
<td>212</td>
<td>Mining (except Oil and Gas)</td>
<td>331</td>
<td>Primary Metal Manufacturing</td>
</tr>
<tr>
<td>213</td>
<td>Support Activities for Mining</td>
<td>332</td>
<td>Fabricated Metal Product Manufacturing</td>
</tr>
<tr>
<td>311</td>
<td>Food Manufacturing</td>
<td>333</td>
<td>Machinery Manufacturing</td>
</tr>
<tr>
<td>312</td>
<td>Beverage and Tobacco Product</td>
<td>334</td>
<td>Computer and Electronic Product Manufact.</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>Textile Mills</td>
<td>335</td>
<td>Electrical Equipment, Appliance, and Component Manuf.</td>
</tr>
<tr>
<td>314</td>
<td>Textile Product Mills</td>
<td>336</td>
<td>Transportation Equipment Manufacturing</td>
</tr>
<tr>
<td>315</td>
<td>Apparel Manufacturing</td>
<td>337</td>
<td>Furniture and Related Product Manufacturing</td>
</tr>
<tr>
<td>316</td>
<td>Leather and Allied Product</td>
<td>339</td>
<td>Miscellaneous Manufacturing</td>
</tr>
<tr>
<td></td>
<td>Manufacturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>Wood Product Manufacturing</td>
<td>551</td>
<td>Management of Companies and Enterprises</td>
</tr>
</tbody>
</table>
### Table: Commuting Zone Examples

<table>
<thead>
<tr>
<th>CZ ID, 2000</th>
<th>County Name</th>
<th>Metropolitan Area, 2003</th>
<th>County Pop. 2000</th>
<th>CZ Pop. 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>Cook County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>5,376,741</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>DeKalb County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>88,969</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>DuPage County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>904,161</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Grundy County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>37,535</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Kane County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>404,119</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Kendall County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>54,544</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Lake County</td>
<td>Lake County-Kenosha County, IL-WI Metropolitan Division</td>
<td>644,356</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>McHenry County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>260,077</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Will County</td>
<td>Chicago-Naperville-Joliet, IL Metropolitan Division</td>
<td>502,266</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Kenosha County</td>
<td>Lake County-Kenosha County, IL-WI Metropolitan Division</td>
<td>149,577</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Racine County</td>
<td>Racine, WI Metropolitan Statistical Area</td>
<td>188,831</td>
<td>8,704,935</td>
</tr>
<tr>
<td>58</td>
<td>Walworth County</td>
<td>Whiterwater, WI Micropolitan Statistical Area</td>
<td>93,759</td>
<td>8,704,935</td>
</tr>
<tr>
<td>47</td>
<td>Anoka County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>298,084</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Carver County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>70,205</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Chisago County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>41,101</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Dakota County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>355,904</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Hennepin County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>1,116,200</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Isanti County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>31,287</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Ramsey County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>511,035</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Scott County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>89,498</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Washington County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>201,130</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Wright County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>89,986</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>Pierce County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>36,804</td>
<td>2,904,389</td>
</tr>
<tr>
<td>47</td>
<td>St. Croix County</td>
<td>Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area</td>
<td>63,155</td>
<td>2,904,389</td>
</tr>
</tbody>
</table>
Migration Rates

Figure 2
Annual Internal Migration Rates

A: Inter-Region

B: Interstate

C: Inter-MSA

D: Inter-County

Source: Author’s calculations based on Internal Revenue Service (IRS), Current Population Survey (CPS), and American Community Survey (ACS) data.

Notes: Current Population Survey and American Community Survey statistics are authors’ calculations from microdata excluding residents of group quarters and imputed values of migration. IRS statistics are authors’ calculations based on state-level and county-level flows. “MSA” is Metropolitan Statistical Area.
Inter-industry mobility

Occupational Mobility

a) One digit level

Industry Mobility

b) Three digit level

Berger Herkenhoff Mongey, "Labor Market Power"
# Summary Statistics

## Table: Summary Statistics, C-Corp Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Tax Rate in Percent ($\tau_{s(j)t}$)</td>
<td>7.14</td>
<td>3.19</td>
</tr>
<tr>
<td>Change in Corporate Tax Rate</td>
<td>0.05</td>
<td>0.78</td>
</tr>
<tr>
<td>Total Pay At Firm (Thousands)</td>
<td>2148</td>
<td>19010</td>
</tr>
<tr>
<td>Total Employment At Firm</td>
<td>37.99</td>
<td>215.2</td>
</tr>
<tr>
<td>Wage Bill Share ($s_{ijt}^{wn}$)</td>
<td>0.03</td>
<td>0.12</td>
</tr>
<tr>
<td>HHI - Wage Bill</td>
<td>0.10</td>
<td>0.16</td>
</tr>
<tr>
<td>Log Number of Firms per Market [exp(5.56)=259.8]</td>
<td>5.56</td>
<td>2.01</td>
</tr>
<tr>
<td>Log Total Employment (log $n_{ijt}$) [exp(2.39)=10.9]</td>
<td>2.39</td>
<td>1.32</td>
</tr>
<tr>
<td>Log Wage (log $w_{ijt}$) [exp(3.58)=$35k]</td>
<td>3.58</td>
<td>0.71</td>
</tr>
<tr>
<td>Observations</td>
<td>4,425,000</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Tradeable C-Corps from 2002 to 2012.
Summary Statistics

Reproduced from Giroud and Rauh (2011):

Panel (A): Corporate Income Tax Rate
- Mean(τc)
- 25th Pctl(τc)
- Median(τc)
- 75th Pctl(τc)

Panel (A): Changes in Corporate Income Tax Rate
- Number of increases in τc
- Number of decreases in τc
Recovering the elasticities of substitution, $\eta$, and $\theta$

**Table**: Non-linear regression estimates of substitutability

<table>
<thead>
<tr>
<th></th>
<th>(1) Year $t$</th>
<th>(2) Year $t+1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within market substitutability, $\eta$</td>
<td>2.09</td>
<td>3.74</td>
</tr>
<tr>
<td>Across market substitutability, $\theta$</td>
<td>0.31</td>
<td>0.76</td>
</tr>
</tbody>
</table>

**Notes**: We use an evenly spaced grid of labor shares on $[s, \bar{s}] = [0.0025, 0.14]$ (within 1 standard deviation of the mean wage-bill share), in conjunction with the OLS regression equation for $\epsilon_{ij}$ to generate 56 tuples of labor supply elasticities and wage-bill shares, $\{\epsilon(s_{ijkt}), s_{ijkt}\}$ (one for every grid point). We then use these predicted values as data for $\{\epsilon_{ij}, s_{ij}\}$ to provide non-linear regression estimates of $\eta$ and $\theta$ using the equation for $\epsilon_{ij}$. 
Distribution of labor supply elasticities and markdowns

A. Perceived elasticities

- Firms
- Wage payments

\[ E[\varepsilon_{ij}] \]

\[ \eta^* = \frac{\text{LaborShare}}{\text{LaborShare} - 1} \]

Elasticity - \( \varepsilon_{ij} \)

B. Markdowns

- Firms
- Wage payments

\[ E[\mu_{ij}] \]

\[ \mu^* = \text{LaborShare} \]

Markdown - \( \mu_{ij} \)

- Back - Share dependent labor supply elasticity
Calibration - Number of firms $M_j$

- 15% of markets have one firm ($M_j = 1$)
- Rest drawn from two Paretos, same shape $\gamma$, different scales $\mu_1, \mu_2$

<table>
<thead>
<tr>
<th>Distribution of number of firms $M_j$</th>
<th>Mean</th>
<th>Std.Dev.</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data (LBD, 2014)</td>
<td>51.6</td>
<td>264.9</td>
<td>29.9</td>
</tr>
<tr>
<td>Model</td>
<td>51.6</td>
<td>264.9</td>
<td>28.7</td>
</tr>
</tbody>
</table>
Table: Estimated parameters

<table>
<thead>
<tr>
<th>Par.</th>
<th>Description</th>
<th>Value</th>
<th>Targeted Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>˜(\alpha)</td>
<td>DRS parameter</td>
<td>0.984</td>
<td>Labor share</td>
<td>0.57</td>
<td>0.57</td>
</tr>
<tr>
<td>(\sigma_{\tilde{z}})</td>
<td>Log Normal Standard Deviation</td>
<td>0.391</td>
<td>(E(\text{HHI}_j^{wn})) Payroll wtd.</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>˜(\tilde{z})</td>
<td>Productivity shifter</td>
<td>23,570</td>
<td>Avg. wage per worker</td>
<td>$ 65,773</td>
<td>$ 65,773</td>
</tr>
<tr>
<td>(\bar{\phi})</td>
<td>Aggregate labor disutility shifter</td>
<td>6.904</td>
<td>Avg firm size</td>
<td>27.96</td>
<td>27.96</td>
</tr>
</tbody>
</table>

**Labor share:**

- To recover labor-share, we must take a stance on capital's share of income
- Assume \(KS = .18\) as in Barkai (2018)

\[
\tilde{\alpha} = \frac{\alpha \gamma}{1 - (1 - \gamma) \alpha}
\]

\[
\tilde{\alpha} = \frac{\alpha \gamma}{1 - KS}
\]
1. Non-targeted concentration measures

<table>
<thead>
<tr>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Unweighted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wage-bill Herfindahl (unweighted)</td>
<td>0.35</td>
<td>0.45</td>
</tr>
<tr>
<td>Std. Dev. of Wage-bill Herfindahl (unweighted)</td>
<td>0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>Skewness of Wage-bill Herfindahl (unweighted)</td>
<td>1.07</td>
<td>0.48</td>
</tr>
<tr>
<td><strong>B. Weighted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wage-bill Herfindahl (weighted by market's share of total payroll)</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>Std. Dev. of Wage-bill Herfindahl (weighted by market's share of total payroll)</td>
<td>0.03</td>
<td>0.20</td>
</tr>
<tr>
<td>Skewness of Wage-bill Herfindahl (weighted by market's share of total payroll)</td>
<td>3.01</td>
<td>2.20</td>
</tr>
<tr>
<td><strong>C. Correlations of Wage-bill Herfindahl</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of firms</td>
<td>-0.52</td>
<td>-0.21</td>
</tr>
<tr>
<td>Std. Dev. Of Relative Wages</td>
<td>-0.31</td>
<td>-0.51</td>
</tr>
<tr>
<td>Employment Herfindahl</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Market Employment</td>
<td>-0.75</td>
<td>-0.21</td>
</tr>
</tbody>
</table>

- Model generates $2x$ difference between wtd. and unwtd. $HHI^{wn}$
Replicate patent experiment in Kline et al (2018):

- Same sample properties (firm size) & same average VA increase

- Model point estimate generated by randomly sampling 1% of firms in the benchmark oligopsonistic economy with size greater than 10 employees (delivers median size of 25.9 in the sample vs 25.2 in Kline et al (2018))

- Then increasing productivity by 30% (delivers 26% increase in $y_{ij} / n_{ij}$ versus $\approx 20\%$ in Kline et al (2018))

- Repeat this exercise 100 times.

- Average point estimate over 100 repetitions is reported.
3. Size wage premium


\[ \log w_{ij} = \beta_0 + \beta_1 \log n_{ij} + \epsilon_{ij} \]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity of wage WRT size</td>
<td>0.18</td>
<td>0.11</td>
<td>0.03</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>( \log(w_{ij}) )</td>
<td>Log annual earnings</td>
<td>Log annual earnings</td>
</tr>
<tr>
<td>Independent variable</td>
<td>( \log(n_{ij}) )</td>
<td>Log firm employees</td>
<td>Log firm employees</td>
</tr>
</tbody>
</table>

- Model implies 10% larger firm pays 1.8% more
A. Increase in $w_{ij}n_{ij}$, Constant $\bar{\epsilon}_{ij}$, Constant $\bar{\mu}_{ij} = w_{ij} / z_{ij}$

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

Oligopolist understands that as wage share grows, labor supply elasticity falls

$$\epsilon(s_{ijt}) = \uparrow s_{ijt}\theta + (1 - s_{ijt})\eta$$

Berger Herkenhoff Mongey, "Labor Market Power"
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 $\varepsilon(s_{ijt}) = \uparrow s_{ijt}\theta + (1 - s_{ijt})\eta$
Discussion - Wage bill shares and MRPL

Identifying MRPL

\[ \frac{s^{wn}_{ijt}}{s^{wn}_{ikt}} = \left( \frac{\mu(s^{wn}_{ijt})}{\mu(s^{wn}_{ikt})} \right)^{1+\eta} \left( \frac{MRPL_{ijt}}{MRPL_{ikt}} \right)^{1+\eta} \]

- Up to a normalization, \( \{s^{wn}_{ijt}\} \) can be used to infer \( \{MRPL_{ijt}\} \)
Discussion - Wage bill shares and MRPL

Identifying $MRPL$

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

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

Implications for measurement in LBD

- Labor markets relatively easy to define
- Wage bill shares observed $s_{ijn}^{wn}$
- Construct wage bill Herfindahl indices $HHI_{ijt} = \sum_i s_{ijn}^{wn^2}$
- 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)
2. Pass-through - Corporate tax effects

After-tax profits with a corporate profit tax

\[ \pi_{ij} = \pi_{ij}^{\text{Econ.}} - \tau_C \pi_{ij}^{\text{Acc.}} \]

\[ \pi_{ij}^{\text{Econ.}} = z_{ij} n_{ij}^\alpha k_{ij}^{1-\alpha} - w_{ij} n_{ij} - r k_{ij} - \delta k_{ij} \]

\[ \pi_{ij}^{\text{Acc.}} = z_{ij} n_{ij}^\alpha k_{ij}^{1-\alpha} - w_{ij} n_{ij} - \lambda r k_{ij} - \delta k_{ij} \]

- Can only write off fraction \( \lambda \) of capital financed by debt

Result

\[ \pi_{ij} = \text{MRPL} \left( z_{ij}, r, \tau_C \right) n_{ij} - w_{ij} n_{ij} \]

\[ \text{MRPL} \left( z_{ij}, r, \tau_C \right) = \frac{1}{1 + \tau_C} \alpha (1 - \alpha) \frac{1-\alpha}{\alpha} \left( \frac{\tilde{z}_{ij}}{\tilde{r}} \right)^{\frac{1-\alpha}{\alpha}} \tilde{z}_{ij} \]

\[ \tilde{z} = (1 - \tau_C) z_{ij} \]

\[ \tilde{r} = (1 + \lambda \tau_C) r + (1 + \tau_C) \delta \]
Perceived vs. uncompensated labor supply elasticity

- Perceived \((\varepsilon_{ij})\):

\[
\frac{\partial n_{ij}}{\partial w_{ij}} \frac{w_{ij}}{n_{ij}} = \eta + (\theta - \eta)s_{ij}^{wn}
\]

- Uncompensated (Marshallian):

\[
\frac{\partial n_{ij}}{\partial w_{ij}} \frac{w_{ij}}{n_{ij}} = \eta + (\theta - \eta)s_{ij}^{wn} + (\psi - \theta) \frac{w_{ij}}{W} \frac{\partial W}{\partial w_{ij}}
\]

- Perceived \(\approx\) uncompensated if \(\frac{\partial W}{\partial w_{ij}} \approx 0\).

- Our perceived elasticity ranges from \(\theta = 0.76\) to \(\eta = 3.74\). Estimates range from 0.1 to 3, depending on gender, country, and variation used (Evers, Mooij, van Vuuren, 2008).
Product market discussion

- Labor market power $\mu_{ijt}$ identified from product market power in tradeable goods market (the focus of our paper)

- Tradeable goods prices that are set non-competitively by a firm enter the marginal revenue product, $\text{MRPL}_{ijt}$

- $\text{MRPL}_{ijt}$ is distinct from what we call the labor market markdown

- We recover $\mu_{ijt}$ by comparing local labor market responses to corporate tax changes within a NAICS3 code

- If tradeable good prices (e.g. furniture prices) do not differ across local labor markets within a state, our estimate of $\mu_{ijt}$ only captures labor market power.
Evidence of upward sloping labor supply curves

**Generation 1:** Exogenous variation in employment demand or wages

- Staiger, Spetz, Phibbs (2010): mandated pay changes in registered nurse market (from national payscale to local)
  - LS elast of .1
- Ashenfelter, Farber, Ransom (2010) provide summary

**Generation 2:** Vacancy applications and wages

- Banfi and Villena-Roldan (2018): controlling for firm size, job title, and all available observables, higher wage offering attracts more workers
- Belot, M., P. Kircher, and P. Muller (2015): in actual UI sponsored job search office, post fake vacancies with higher wages, those vacancies draw more job searchers

Strong evidence for upward sloping LS curve faced by individual firms, conditional on size
Is monopsony power generated by outside options

**Theory**: Zhu (2011) provides framework with $N$ firms, agents understand outside option is to match with remaining $N - 1$ firms

- Wages (asset prices) fall if bargaining breaks down

**Empirics**: Does outside option affect wages?

- Jager, Schoefer, Young, Zweimüller (2018): outside options not strong determinant of wages
  - Four large reforms of UI in Austria.
  - Wage response less than 1 cent per 1.00 dollar UI increase
  - Nash-bargaining implies 39 cent per 1.00 dollar UI increase in calibrated model

- Hagedorn, Karahan, Manovskii, Mitman (2014): important determinants
  - County border-pair identification strategy
- Compute counterfactual output with scale effect only:

\[ n^s_{ij} = n_{ij} \frac{\int \sum n^c_{ij} \, dj}{\int \sum n_{ij} \, dj} \]

\[ y^s_{ij} = \tilde{z}_{ij} \tilde{Z}(n^s_{ij})^{\tilde{\alpha}} \]

- We then compute the share of gains due to reallocation:

\[ \frac{\int \sum y^c_{ij} \, dj}{\int \sum y_{ij} \, dj} - \frac{\int \sum y^s_{ij} \, dj}{\int \sum y_{ij} \, dj} \]

\[ \frac{\int \sum y^c_{ij} \, dj}{\int \sum y_{ij} \, dj} - 1 \]

- Share output gains due to reallocation: 26%
- Share output gains due to scale: 74%
Minimum wage - Appendix

Household - Additional constraint: Labor supply less than labor demand:

\[ n_{ijt} \leq n_{ijt} \]

- Define \( \lambda_t \nu_{ijt} \) as associated multiplier
- \( \lambda_t \) is the multiplier on the budget constraint
- \( \nu_{ijt} \) is marginal utility of sending a worker to firm with a binding \( w_{ij} = w \)
- \( \tilde{w}_{ijt} = w_{ijt} - \nu_{ijt} \) is the perceived wage

Firm - Problem as before with added constraint:

\[
w_{ijt} = \begin{cases} 
\bar{\varphi} - \frac{1}{\varphi} N_t^{\frac{1}{\varphi}} \left( \frac{N_{jt}}{N_t} \right)^{\frac{1}{\vartheta}} \left( \frac{n_{ijt}}{N_{jt}} \right)^{\frac{1}{\eta}}, & \text{if } n_{ijt} > n_{ijt} \\
w, & \text{otherwise}
\end{cases}
\]

Result - Equilibrium can be solved in perceived wages \( \tilde{w}_{ijt} \)
Define the *perceived* wage-bill share:

$$\tilde{s}_{ijt} = \frac{(w_{ijt} - \nu_{ijt}) n_{ijt}}{\sum_{i \in j} (w_{ijt} - \nu_{ijt}) n_{ijt}}$$

Define the *perceived* sectoral and aggregate wage indexes:

$$\tilde{W}_{jt} := \left[ \sum_{i \in j} \left( w_{ijt} - \nu_{ijt} \right)^{1+\eta} \right]^{\frac{1}{1+\eta}}, \quad \tilde{W}_t := \left[ \int \tilde{W}_{jt}^{1+\theta} dj \right]^{\frac{1}{1+\theta}}.$$
A. Region I - No effect

B. Region II - Increase in employment
(Household on labor supply curve)

C. Region III - Increase employment
(Household off labor supply curve)

D. Region IV - Decrease employment
(Household off labor supply curve)
Minimum wage - Scale effects

A. Wages

(i) Perceived wages, which determine $n_{ij}$, do not increase as much

(ii) Small firms shrink, (enter Region IV), employment falls

(iii) HHI monotonically increases, implying falling labor share
Minimum wage - Concentration

E.g. Would imply decline in labor share of 2 ppt over this range
Minimum wage - Appendix

- Initialize the algorithm by (i) guessing a value for $\tilde{W}_t^{(0)}$, (ii) assuming all firms are in Region I, which implies guessing $\nu_{ijt}^{(0)} = 0$. These will all be updated in the algorithm.

1. Solve the sectoral equilibrium:

1.1 Guess perceived shares $\tilde{s}_{ijt}^{(0)}$.

1.2 In Region I, where minimum wage does not bind, solve for the firm’s wage as before, except with the perceived aggregate wage index $\tilde{W}_t$ instead of $W_t$:

$$w_{ijt} = \left[ \omega \mu (\tilde{s}_{ijt}) \tilde{W}_t^{(1-\bar{\alpha})(\theta-\varphi)} \tilde{z}_{ijt} \tilde{s}_{ijt} \right]^{\frac{1}{1+(1-\bar{\alpha})\theta}}$$

1.3 In all other regions Region II, III, IV, set $w_{ijt} = w$.

1.4 Compute perceived wages using the guess $\nu_{ijt}^{(k)}$: $\tilde{w}_{ijt} = w_{ijt} - \nu_{ijt}^{(k)}$

1.5 Update shares using $\tilde{w}_{ijt}$:

$$\tilde{s}_{ijt}^{(l+1)} = \frac{\tilde{w}_{ijt}^{1+\eta}}{\sum_{i \in j} \tilde{w}_{ijt}^{1+\eta}} \left( \begin{array}{c} \tilde{w}_{ijt} n_{ijt} \\ \sum_{i \in j} \tilde{w}_{ijt} n_{ijt} \\ \frac{\tilde{w}_{ijt} \tilde{W}_t}{\tilde{W}_t^{(1+\eta)}} \end{array} \right) = \frac{\tilde{w}_{ijt} \tilde{W}_t}{\tilde{W}_t^{(1+\eta)}} \left( \begin{array}{c} \tilde{w}_{ijt} \tilde{W}_t^{\varphi} \\ \sum_{i \in j} \tilde{w}_{ijt} \tilde{W}_t^{\varphi} \end{array} \right)$$

1.6 Iterate over (b)-(e) until $\tilde{s}_{ijt}^{(l+1)} = \tilde{s}_{ijt}^{(l)}$. 

Berger Herkenhoff Mongey, "Labor Market Power"
1. Recover employment $n_{ijt}$ according to the current guess of firm region. First use $\tilde{w}_{ijt}$ to compute $\tilde{W}_{jt}$, $\tilde{W}_t$. Then by region:

(I) Firm is unconstrained:

$$n_{ijt} = \varphi \left( \frac{w_{ijt}}{\tilde{W}_{jt}} \right)^{\eta} \left( \frac{\tilde{W}_{jt}}{\tilde{W}_t} \right)^{\theta} \tilde{W}_t$$

(II) Firm is constrained and employment is determined by the household labor supply curve at $w$:

$$n_{ijt} = \varphi \left( \frac{w}{\tilde{W}_{jt}} \right)^{\eta} \left( \frac{\tilde{W}_{jt}}{\tilde{W}_t} \right)^{\theta} \tilde{W}_t$$

(III),(IV) Firm is constrained and employment is determined by firm MRPL$_{ij}$ curve at $w$:

$$n_{ijt} = \left( \tilde{\alpha} \tilde{Z}_{ijt} \right)^{\frac{1}{1-\tilde{\alpha}}}$$

2. Update $\nu_{ijt}$:

2.1 Use $n_{ijt}$ to compute $N_{jt}$, $N_t$.

2.2 Update $\nu_{ijt}$ from the household’s first order conditions:

$$v^{(k+1)}_{ijt} = w_{ijt} - \varphi^{-1} \left( n_{ijt} \frac{1}{N_{jt}} \right)^{\frac{1}{\eta}} \left( \frac{N_{jt}}{N_t} \right)^{\frac{1}{\theta}} N_t^{\frac{1}{\varphi}}$$

3. Update $\tilde{W}_t^{(k)}$:

3.1 Compute $\tilde{w}_{ijt} = w_{ijt} - v^{(k+1)}_{ijt}$

3.2 Use $\tilde{w}_{ijt}$ to update the aggregate wage index to $\tilde{W}_t^{(k+1)}$.

4. Update firm regions:

4.1 Compute profits for all firms: $$\pi_{ijt} = \tilde{Z}_{ijt} n_{ijt} \tilde{\alpha} - w_{ijt} n_{ijt}$$

4.2 If in sector $j$ there exists a firm with $w_{ijt} < \tilde{w}$, then move the firm with the lowest wage into Region II.

4.3 If in sector $j$ there exists a firm that was initially in Region II and has negative profits $\pi_{ijt} < 0$, move that firm into Region III.

5. Iterate over (1) to (5) until $v^{(k+1)}_{ijt} = v^{(k)}_{ijt}$ and $\tilde{W}_t^{(k+1)} = \tilde{W}_t^{(k)}$.

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We do not need to distinguish Region III from Region IV in the algorithm, since the determination of equilibrium wages and employment are the same in each region.

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Berger Herkenhoff Mongey, "Labor Market Power" p.34/34