Labor Market Power

David Berger  
Duke University and NBER

Kyle Herkenhoff  
Federal Reserve Bank of New York

Simon Mongey  
University of Chicago and NBER

October 17, 2019

The views expressed herein are those of the authors and not those of the Census or the Federal Reserve System.
Measuring labor market power in the U.S. labor market

- **Fact**  Labor markets are concentrated. Many employers, concentrated employment.

- **Model** Tractable general equilibrium oligopsony model with strategic interaction

- **Estimate** Match reduced form responses to changes in tax policy in Census data

- **Validate** (i) Pass-through, (ii) Concentration across markets

- **Micro** Measure labor market power in terms of wage markdowns on MRPL
  \[ \mathbb{E}[\mu_{ij}] = 0.8, \bar{\mu} = 0.7 \]

- **Macro** Measure labor market power in terms of (i) welfare, (ii) \( \Delta HHI \rightarrow \Delta \text{Labor share} \)
  - 3 - 8%
  - 1974-2014: +3.3 ppt

- **Apply** (i) Minimum wage, (ii) Mergers
MODEL
Environment

Representative family
- Continuum of labor markets $j \in [0, 1]$
- Labor market $j$ has a fixed number of firms $i \in \{1, 2, \ldots, M_j\}$
- Disutility of supplying workers $\{n_{ijt}\}$ across firms

Firms
- Firm $i$ has idiosyncratic productivity $z_{ijt}$, produce identical final good

$$y_{ijt} = z_{ijt} \left( k_{ijt}^{1-\gamma} n_{ijt}^\gamma \right)^\alpha, \quad \alpha > 0$$

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

Preferences

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

Disutility of labor supply

\[ N_t := \left[ \int_{0}^{1} \left[ N_{jt}^{\frac{\vartheta+1}{\vartheta}} \right]^{\frac{\vartheta}{\vartheta+1}} d\varphi \right], \quad \theta > 0 \]

\[ N_{jt} := \left[ n_{1jt}^{\frac{\eta+1}{\eta}} + \cdots + n_{Mjt}^{\frac{\eta+1}{\eta}} \right]^{\frac{\eta}{\eta+1}}, \quad \eta > \theta \]

Budget constraint

\[ C_t + \left[ K_{t+1} - (1 - \delta) K_t \right] = \int_{0}^{1} \left[ w_{1jt} n_{1jt} + \cdots + w_{Mjt} n_{Mjt} \right] d\varphi + R_t K_t + \Pi_t, \]

\[ C_t := \int_{0}^{1} \left[ c_{1jt} + \cdots + c_{Mjt} \right] d\varphi. \]
Household Preferences

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

Disutility of labor supply

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

\[ N_{jt} := \left[ n_{1jt}^{\eta+1} \eta + \cdots + n_{Mjt}^{\eta+1} \eta \right]^{\frac{\eta}{\eta+1}}, \quad \eta > \theta \]

Equivalence result - Nested logit individual choice model

Anderson, De Palma, Thisse (EL 1987), Verboven (EL 1996)
Firms - Cournot competition

$$\max_{k_{ijt}, n_{ijt}} \pi_{ijt}(k_{ijt}, n_{ijt}, n_{ijt}^*) = \bar{Z} z_{ijt} \left( k_{ijt}^{1-\gamma} n_{ijt}^\gamma \right)^\alpha - R_t k_{ijt} - w(n_{ijt}, n_{ijt}^*, N_t) n_{ijt}$$

subject to

$$w(n_{ijt}, n_{ijt}^*, N_t) = \varphi - \frac{1}{\varphi} \left( \frac{n_{ijt}}{N_{jt}} \right) \left( \frac{N_{jt}}{N_t} \right)^{1/\theta} \left( \frac{N_t}{N_{jt}} \right)^{1/\varphi}$$

$$N_{jt} = \left[ n_{1jt}^{\eta+1/\eta} + \ldots + n_{ijt}^{\eta+1/\eta} + \ldots + n_{M_{jt}}^{\eta+1/\eta} \right]^\eta/\eta+1$$
Market equilibrium

A. Low productivity firm

B. High productivity firm

- Larger firms face lower equilibrium labor supply elasticity → Wider mark-downs $\downarrow \mu_{ijt}$
- Endogenous negative covariance: $\text{cov}(z_{ijt}, \mu_{ijt}) < 0$
Micro measurement - Markdowns

Wages

\[ w_{ijt} = \mu_{ijt} \quad MRPL_{ijt} = \mu_{ijt} \tilde{\alpha} \left( \frac{va_{ijt}}{n_{ijt}} \right) \]

Structural elasticity of labor supply, \( s_{wn_{ijt}} = w_{ijt} n_{ijt} \sum_{k \in j} w_{kjt} n_{kjt} \)
Wages

\[ w_{ijt} = \mu_{ijt} MRPL_{ijt} = \mu_{ijt} \tilde{\alpha} \left( \frac{v_{ijt}}{n_{ijt}} \right) \]

\[ \tilde{\alpha} \tilde{Z}_{ijt} n_{ijt}^{\tilde{\alpha} - 1} \]

Markdown

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

\[ \varepsilon_{ijt} := \frac{\partial \log n_{ijt}}{\partial \log w_{ijt}} \bigg|_{n_{ijt}^*} = \left[ s_{wn} \frac{1}{\theta} + \left( 1 - s_{wn} \right) \frac{1}{\eta} \right]^{-1} \]

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

Structural elasticity of labor supply

Market payroll share

Berger Herkenhoff Mongey, “Labor Market Power”
Macro measurement - Labor share

Labor share

\[ LS = \alpha \gamma \times \left[ \left( 1 - HHI_{wn} \right) \left( \frac{\eta}{\eta + 1} \right)^{-1} + HHI_{wn} \left( \frac{\theta}{\theta + 1} \right)^{-1} \right]^{-1} \]

Aggregate concentration measure

\[ HHI_{wn} := \int_0^1 s_{wn}^j HHI_{wn}^j \, dj \in [0, 1] \quad , \quad HHI_{wn}^j := \sum_{i \in j} (s_{ij}^{wn})^2 \]
Macro measurement - Labor share

Labor share

\[ LS = \alpha \gamma \times \left( 1 - HHI^{wn} \right) \left( \frac{\eta}{\eta + 1} \right)^{-1} + HHI^{wn} \left( \frac{\theta}{\theta + 1} \right)^{-1} \right]^{-1} \]

Aggregate concentration measure

\[ HHI^{wn} := \int_0^1 s_j^{wn} HHI_j^{wn} dj \in [0, 1], \quad HHI_j^{wn} := \sum_{i \in j} (s_{ij}^{wn})^2 \]

At estimated \( \{\theta, \eta, \tilde{\alpha}\} \); \( \downarrow HHI_t^{wn} \) from 1974 to 2014 added 3.31 ppt to Labor Share
CALIBRATION
Strategy

- If known, *structural elasticities* and payroll shares identify \((\theta, \eta)\)

\[
\varepsilon(s_{ij}, \theta, \eta) := \frac{\partial \log n_{ij}}{\partial \log w_{ij}} \bigg|_{n^*_{ij}} = \left[ s_{ij} \frac{1}{\theta} + (1 - s_{ij}) \frac{1}{\eta} \right]^{-1}
\]
- If known, \textit{structural elasticities} and payroll shares identify \((\theta, \eta)\)

\[
\varepsilon(s_{ij}, \theta, \eta) := \left. \frac{\partial \log n_{ij}}{\partial \log w_{ij}} \right|_{n^*_{ij}} = \left[ s_{ij} \frac{1}{\theta} + (1 - s_{ij}) \frac{1}{\eta} \right]^{-1}
\]

- Quasi-experiments with IV's for labor demand deliver \textit{reduced form elasticities}

\[
\varepsilon(s_{ij}, \theta, \eta, \ldots) := \frac{\Delta \log n_{ijt}}{\Delta \log w_{ijt}} \approx \frac{\varepsilon(s_{ijt}, \theta, \eta)}{1 + \varepsilon(s_{ij}, \theta, \eta) \left( \frac{1}{\theta} - \frac{1}{\eta} \right) \left( \frac{\sum_{k \neq i} s_{kjt} \Delta \log n_{kjt}}{\Delta \log n_{ijt}} \right)}
\]
Strategy

- If known, *structural elasticities* and payroll shares identify \((\theta, \eta)\)

\[
\varepsilon(s_{ij}, \theta, \eta) := \left. \frac{\partial \log n_{ij}}{\partial \log w_{ij}} \right|_{n_\text{ij}^*} = \left[ s_{ij} \frac{1}{\theta} + (1 - s_{ij}) \frac{1}{\eta} \right]^{-1}
\]

- Quasi-experiments with IV’s for labor demand deliver *reduced form elasticities*

\[
\varepsilon(s_{ij}, \theta, \eta, \ldots) := \frac{\Delta \log n_{ij}}{\Delta \log w_{ij}} \approx \frac{\varepsilon(s_{ijt}, \theta, \eta)}{1 + \varepsilon(s_{ijt}, \theta, \eta) \left( \frac{1}{\theta} - \frac{1}{\eta} \right) \left( \sum_{k \neq i} s_{kjt} \Delta \log n_{kjt} / \Delta \log n_{ijt} \right)}
\]

Indirect inference

1. **Data**  
   Quasi-experiment to estimate average relationship \(\hat{\varepsilon}^{\text{Data}}(s)\)

2. **Model**  
   Replicate experiment in model and \(\min_{\theta, \eta} \left| \hat{\varepsilon}^{\text{Data}}(s) - \hat{\varepsilon}^{\text{Model}}(s, \theta, \eta) \right|\)

Berger Herkenhoff Mongey, “Labor Market Power”
1. Empirical estimates of reduced form elasticities - $\hat{e}^{Data}(s)$

State corporate tax changes

- **Policy** Large changes in state corporate taxes (Giroud Rauh, JPE 2019)

- **Variation** Across markets $j \in s$, within firm-state $is$,

- **Sample** Tradeable C-corps

**Specification**

\[
\log n_{ijt} = \alpha_{is(j)} + \psi_t + \xi_j + \psi s_{ijt}^{wn} + \beta_n \tau_{s(j)t} + \gamma_n \left( s_{ijt}^{wn} \times \tau_{s(j)t} \right) + e_{ijt}
\]

\[
\hat{e}^{Data}(s_{ijt}) = \frac{d \log n_{ijt}}{d \log w_{ijt}} = \frac{\hat{\beta}_n + \hat{\gamma}_n s_{ijt}^{wn}}{\hat{\beta}_w + \hat{\gamma}_w s_{ijt}^{wn}}
\]
2. Model simulation of reduced form elasticities - $\hat{e}^{Model}(s, \theta, \eta)$

$$\pi_{ijt} = \left(1 - \tau_C\right) \lambda_C z_{ijt} \left(n_{ijt}^{\gamma} k_{ijt}^{1-\gamma}\right) - \left(1 - \tau_C\right) w_{ijt} n_{ijt} - \left(1 - \tau_C \lambda_K\right) R_t k_{ijt}$$

1. Tax on profits $\tau_C = 7.15\%$ (Giroud Rauh, 2019)

2. Distorts after tax return on $\lambda_K = 0.31$ fraction of capital (Graham Leary Roberts, 2014)

3. Only affects C-Corps. $\omega_C = 43$ percent of firms (County Business Patterns)

4. Assume C-Corps are $\lambda_C > 1$ times more productive. 66 percent of employment (CBP)

5. Tax cut $\Delta \tau_C = -1$ ppt (Giroud Rauh, 2019)

- **SMM:** Data: $\{\tau_C, \lambda_K, \Delta \tau_C, G(M_j)\}$. Estimate: $\{\lambda_C, \theta, \eta, \tilde{\alpha}, \gamma, \sigma_z, \bar{Z}, \bar{\varphi}\}$

Details - How corporate taxes map to $MRPL_{ijt}$ through Accounting vs. Economic profits

Berger Herkenhoff Mongey, "Labor Market Power"
**Reduced form** and **Structural** elasticities ($\theta = 0.66, \eta = 5.38$)

- Strategic interactions important for interpreting observed elasticities $\varepsilon \leq \varepsilon'$

![Graph showing labor supply elasticity vs payroll share](image)

Berger Herkenhoff Mongey, "Labor Market Power"
# Parameters and moments

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Moment</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Assigned</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r )</td>
<td>Risk free rate</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \delta )</td>
<td>Depreciation rate</td>
<td>0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \varphi )</td>
<td>Aggregate Frisch elasticity</td>
<td>0.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( J )</td>
<td>Number of markets</td>
<td>5,000</td>
<td>Mean, Std. Dev., Skewness of distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( G(M_j) )</td>
<td>Mix two paretos</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \omega_C )</td>
<td>Share of firms that are C-corps</td>
<td>0.43</td>
<td>Share of estabs. that are C-corps (CBP, 2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tau_C )</td>
<td>State corporate tax rate</td>
<td>0.071</td>
<td>Mean of state corp. tax rate ( \tau_{C, st} ) (Giroud Rauh, 2019)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \tau )</td>
<td>State corporate tax rate increase</td>
<td>0.010</td>
<td>Std. dev. of annual ( \tau_{C, st} ) (Giroud Rauh, 2019)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \lambda_K )</td>
<td>Fraction of capital debt financed</td>
<td>0.309</td>
<td>Tradeable industries (Compustat, 2014)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B. Estimated</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \eta )</td>
<td>Within market substitutability</td>
<td>5.38</td>
<td>Average ( \hat{e}^{Data}(s_{wn}) ) for ( s_{wn} \in [0, 0.05] )</td>
<td>1.70</td>
<td>1.80</td>
</tr>
<tr>
<td>( \theta )</td>
<td>Across market substitutability</td>
<td>0.66</td>
<td>Average ( \hat{e}^{Data}(s_{wn}) ) for ( s_{wn} \in [0.05, 0.10] )</td>
<td>1.60</td>
<td>1.52</td>
</tr>
<tr>
<td>( \Delta \theta )</td>
<td>Relative productivity of C-corps</td>
<td>1.29</td>
<td>Emp. share of C-corps</td>
<td>0.65</td>
<td>0.66</td>
</tr>
<tr>
<td>( \sigma_z )</td>
<td>Productivity dispersion</td>
<td>0.227</td>
<td>Payroll weighted ( \mathbb{E}[HHI^{wn}] )</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>DRS parameter</td>
<td>0.985</td>
<td>Labor share</td>
<td>0.58</td>
<td>0.57</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>Labor exponent</td>
<td>0.811</td>
<td>Capital share</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>( \bar{Z} )</td>
<td>Productivity shifter</td>
<td>2.10e+04</td>
<td>Ave. firm size</td>
<td>28.0</td>
<td>28.0</td>
</tr>
<tr>
<td>( \bar{\varphi} )</td>
<td>Labor disutility shifter</td>
<td>5.383</td>
<td>Ave. payroll per worker ($000)</td>
<td>65.8</td>
<td>65.8</td>
</tr>
</tbody>
</table>

Berger Herkenhoff Mongey, “Labor Market Power”

p.12/23
1. Validation
   (i) Pass-through (Kline, Petkova, Williams, Zidar, QJE 2019)
   (ii) Distribution of employment and concentration across markets

2. Measurement
   (i) Welfare gains from Walrasian equilibrium
   (ii) Historical labor share

3. Applications
   (i) Minimum wage
   (ii) Mergers
Validation 1 - Pass-through

- Replicate Kline et al (2018) patent quasi-experiment

- Productivity increase to match average increase in value added per worker

- Match sample properties (larger firms)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass-through coefficient</td>
<td>0.795</td>
<td>0.470</td>
<td>0.327</td>
<td>1.000</td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>$w_{ij}$</td>
<td>Wage bill per worker $VAPW_{ij}$</td>
<td>Hourly wage $VAPW_{ij}$</td>
<td>$w_{ij}$</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>$VAPW_{ij}$</td>
<td>(IV: Patent approvals)</td>
<td>(IV: Sales per worker)</td>
<td>$VAPW_{ij}$</td>
</tr>
</tbody>
</table>

- (i) $VAPW_{ij} = \tilde{Z}_{ij} \tilde{n}_{ij}^{-1}$, (ii) Meghir, Pistaferri et al (‘19) → Structural model: 0.315
Validation 2 - Non-targeted concentration measures

### A. Distribution of wage payments

- **Model**
- **Data - Tradeable sectors**
- **Data - All sectors**

### B. Distribution of markets

- **Model**
- **Data - Tradeable sectors**
- **Data - All sectors**

<table>
<thead>
<tr>
<th>Wage bill Herfindahl</th>
<th>Model</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payroll weighted average</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>Unweighted average</td>
<td>0.33</td>
<td>0.45</td>
</tr>
<tr>
<td>Correlation with market employment</td>
<td>-0.80</td>
<td>-0.21</td>
</tr>
</tbody>
</table>
Measurement 1 - Welfare

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

$$n_{ijt} = \arg \max_{n_{ijt}} \tilde{Z}_{ijt} \alpha_{ijt} - w_{ijt} n_{ijt}$$

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

$$n_{ijt} = \varphi \left( \frac{w_{ijt}}{W_{jt}} \right)^{\eta} \left( \frac{W_{jt}}{W_t} \right)^{\theta} W_t^{\phi}$$
Measurement 1 - Welfare

**Define** - Welfare gain associated with competitive labor market, $\lambda_{SS}$

$$u \left( (1 + \lambda_{SS}) C_o - \frac{1}{\phi} N_o^{1+\frac{1}{\phi}} \right) = u \left( C_c - \frac{1}{\phi} N_c^{1+\frac{1}{\phi}} \right)$$
Define - Welfare gain associated with competitive labor market, $\lambda_{SS}$

$$u \left( (1 + \lambda_{SS}) C_o - \frac{1}{\frac{1}{\varphi^1} \frac{1+1}{\varphi}} \right) = u \left( C_c - \frac{1}{\frac{1}{\varphi^1} \frac{1+1}{\varphi}} \right)$$

<table>
<thead>
<tr>
<th>Frisch elasticity</th>
<th>A. Welfare</th>
<th>B. Labor market</th>
<th>C. Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varphi$</td>
<td>Steady state $\lambda_{SS} \times 100$</td>
<td>Transition $\lambda_{Trans} \times 100$</td>
<td>Ave. wage $E[w_{it}]$</td>
</tr>
<tr>
<td>0.2</td>
<td>3.3</td>
<td>2.8</td>
<td>41.8</td>
</tr>
<tr>
<td>0.5</td>
<td>5.4</td>
<td>4.1</td>
<td>41.6</td>
</tr>
<tr>
<td>0.8</td>
<td>7.6</td>
<td>5.6</td>
<td>41.3</td>
</tr>
</tbody>
</table>

Results

- Need additional 5.4% of lifetime consumption to be indifferent. Rellocation; 80% of $\uparrow Y$
- Increase in competition but increase in concentration
Measurement 1 - Efficiency and market power

(i) Symmetric productivity $z_{ij} = Z$;  
(ii) Monopsony labor market $\theta = \eta =: \mathcal{E}$

$$
\max_{n_{ij}, k_{ij}} Z \left( k_{ij}^{1-\gamma} n_{ij}^\gamma \right)^\alpha - w_{ij} n_{ij} - R k_{ij}
$$

s.t. 

$$
w_{ij} = \bar{\varphi} \left( \frac{n_{ij}}{N} \right)^{1/\mathcal{E}} W
$$

Result - Equivalent aggregate quantities and prices when

$$
Z = Z \left[ \int \sum_i \left( z_{ij}^{\text{Olig}} v_{ij}^{\text{Olig}} \gamma^\alpha \right)^{1 \over 1-(1-\gamma)^\alpha} \right]^{1-(1-\gamma)\alpha}, \quad v_{ij}^{\text{Olig}} = \frac{n_{ij}^{\text{Olig}}}{N^{\text{Olig}}}
$$

$$
\frac{\mathcal{E}}{\mathcal{E} + 1} = \frac{1}{1 - (1-\gamma)^\alpha} \left( \frac{\eta+1}{\eta} \right) \tilde{I}_\text{Hlw}^{\text{Olig}} + \left( \frac{\theta+1}{\theta} - \frac{\eta+1}{\eta} \right)
$$
Measurement 1 - Efficiency and market power

Welfare gain

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

<table>
<thead>
<tr>
<th>Counterfactual</th>
<th>Welfare gain ((\lambda_{SS}))</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive</td>
<td>((\mathcal{E}_c, Z_c))</td>
<td>5.4</td>
</tr>
<tr>
<td>Efficiency only</td>
<td>((\mathcal{E}_o, Z_c))</td>
<td>3.0 56.0</td>
</tr>
<tr>
<td>Labor market only</td>
<td>((\mathcal{E}_c, Z_o))</td>
<td>2.0 37.9</td>
</tr>
</tbody>
</table>

Interpretation

- Better allocative efficiency accounts for 56 percent of welfare improvement
- Higher labor market competition accounts for 38 percent of welfare improvement
Measurement 2 - Labor share

What are implications of declining concentration for labor share?

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

- \( \tilde{HI}^{wn} \) increased from 5.01 in 1976 to 7.09 in 2014
- Use estimated parameters \( \{\theta = 0.66, \eta = 5.38, \tilde{\alpha} = 0.98\} \)
- Contributed +3.13 ppt to Labor share
- Labor market concentration not driving declining Labor share
Application 1 - Minimum wage

- **Contribution** - New tractable theory of minimum wage in oligopsony with DRS

- **Result** - Unconstrained model goes through with equilibrium in *perceived shares*

  - Where $\tilde{s}_{ijt}^{wn}$ is the share determined by the firms’ payroll and the wage that rationalizes the (sub-optimal) level of equilibrium labor supply to the firm

1. Show how the model works $\rightarrow$ Rationalizes Dustmann et. al. (2019)

2. Minimum wage, welfare, concentration
Application 1 - Minimum wage - Welfare and concentration

- **Optimum** Minimum wage covers 12 percent of workers (at initial eq.)
- Concentration monotone, welfare non-monotone
Application 2 - Mergers - Welfare and concentration

Result: \( \mu_1(s_{1j}), \mu_2(s_{2j}) \)  
\[ \text{Merge} \quad \mu_{1j}(s'_{1j} + s'_{2j}) = \mu_{2j}(s'_{1j} + s'_{2j}) = \frac{\varepsilon(s'_{1j} + s'_{2j})}{\varepsilon(s'_{1j} + s'_{2j}) + 1} \]
Result: $\mu_1(s_{1j}), \mu_2(s_{2j}) \quad \rightarrow \quad \mu_{1j}(s'_{1j} + s'_{2j}) = \mu_{2j}(s'_{1j} + s'_{2j}) = \frac{\varepsilon(s'_{1j} + s'_{2j})}{\varepsilon(s'_{1j} + s'_{2j}) + 1}$

<table>
<thead>
<tr>
<th>Merger firms</th>
<th>A. Welfare</th>
<th></th>
<th>B. Labor market</th>
<th></th>
<th>C. Concentration</th>
<th></th>
<th>D. Back of envelope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steady state $\lambda_{SS} \times 100$</td>
<td>Ave. wage $E[w_{it}]$</td>
<td>Agg. emp. $\sum_i n_{it}$</td>
<td>Weighted $\Delta HHI^{\text{wn}}$</td>
<td></td>
<td>Weighted $\Delta HHI^{\text{wn}}$</td>
<td></td>
</tr>
<tr>
<td>Two highest productivity</td>
<td>-1.063</td>
<td>-2.83</td>
<td>-0.38</td>
<td>0.025</td>
<td>&lt;</td>
<td>0.070</td>
<td></td>
</tr>
<tr>
<td>Two random</td>
<td>-0.083</td>
<td>-0.23</td>
<td>-0.34</td>
<td>0.009</td>
<td>&lt;</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>Two lowest productivity</td>
<td>0.003</td>
<td>-0.01</td>
<td>-0.10</td>
<td>0.003</td>
<td>&gt;</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

1. Again, non-monotonic relationship between policy, welfare and concentration

2. One-fourth as large ↑ $HHI_j$. as ‘back-of-envelope’ counterfactual

* Equilibrium realloc. important for understanding labor market effects of mergers
Contributions

1. Develop and validate general equilibrium oligopsony model
   - Model relevant concentration measure is wage-bill Herfindahl
   - Tractable theory of minimum wage effects

2. New evidence on size dependent corporate tax response, used in estimation
   - Quantitatively important to model strategic interaction if inferring labor market power via employment and wage responses to identified shocks

3. Declining payroll concentration from 1976-2014 implies a +3.31 ppt labor share rise

4. Welfare losses from labor market power are large: 3% to 8%

5. Higher minimum wages can have quantitatively large effects
THANK YOU!
APPENDIX
Concentration, 1976 and 2014

Data: LBD tradeable firms, Market: NAICS3 $\times$ Commuting Zone

At estimated $\{\theta, \eta, \tilde{\alpha}\}$ increasing competition added 3.31 ppt to Labor Share

Berger Herkenhoff Mongey, "Labor Market Power"
Representation - Logit model

- Workers $m \in [0, 1]$ with committed income $y_m \sim F(y)$
- Minimize total labor disutility of attaining $y_m$
  $$\min_{ij} \log h_m - \tilde{\zeta}_{ij} \quad \text{s.t.} \quad w_{ij}h_m = y_m$$

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

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

- Result Delivers same supply system as rep. agent CES
Application - Minimum wage

- Minimum wage non-binding. $w_{ij}^*, n_{ij}^*, \mu_{ij} < 1$

Berger Herkenhoff Mongey, “Labor Market Power”
- Minimum wage binding: $\uparrow w, \uparrow n_{ij}^*, \mu_{ij} < 1$
Application - Minimum wage

- Minimum wage binding: $\uparrow w$, $\uparrow n_{ij}$, $\mu_{ij} = 1$. Excess supply: $\tilde{w}_{ij} < w$
- Minimum wage non-binding: $\uparrow w, \downarrow n_{ij}, \mu_{ij} = 1$ Excess supply: $w_{ij} << w$
Optimizing out capital

\[ \pi_{ijt} = \max_{n_{ijt}} \tilde{Z}_{ijt} \tilde{n}_{ijt}^\alpha - w_{ijt} n_{ijt} \]

The ‘\( \tilde{} \)’ variables are defined as follows:

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

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

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

Note that \((1 - \gamma) \alpha\) is capital’s share of income
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 \( s_j^{wn} = (s_{1j}^{wn}, \ldots, s_{Mj}^{wn}) \)

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

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

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

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

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

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

$$MRPL_{ij} = \omega W^{(1-\tilde{\alpha})(\theta-\varphi)} \hat{z}_{ij} \left\{ w_{ij}^{-\eta} w_{j}^{\eta-\theta} \right\}^{1-\tilde{\alpha}}$$

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

$$w_{ij} = \mu_{ij} MRPL_{ij} = \mu_{ij} \omega W^{(1-\tilde{\alpha})(\theta-\varphi)} \hat{z}_{ij} \left\{ w_{ij}^{-\eta} w_{j}^{\eta-\theta} \right\}^{1-\tilde{\alpha}}$$

Use $w_{j} = w_{ij} s_{ij}$: $w_{ij} = \omega^{1+(1-\alpha)\theta} W^{\frac{1}{\eta+1}} \mu_{ij}^{\frac{\theta}{1+(1-\alpha)\theta}} \hat{z}_{ij}^{\frac{\theta}{1+(1-\alpha)\theta}} s_{ij}^{\frac{1-\tilde{\alpha}(\eta-\theta)}{\eta+1}}$. $\frac{1}{1+(1-\alpha)\theta}$

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

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

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

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

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

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

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

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

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

\[ s_j^{wn} = \left( \frac{w_{ij}}{w_j} \right)^{\eta+1} = \left( \frac{\hat{w}_{ij}}{\hat{w}_j} \right)^{\eta+1} \] (2)
DRS Computation

For a given set of values for parameters \( \{ \varphi, \bar{Z}, \bar{\alpha}, \beta, \delta \} \), we can solve for the non-constant returns to scale equilibrium as follows:

1. Guess \( s_{wn}^j = (s_{wn}^{1j}, \ldots, s_{wn}^{Mj}) \)
2. Compute \( \{ \epsilon_{ij} \} \) and \( \{ \mu_{ij} \} \) using the industry eq formulas.
3. Construct the ‘hatted’ equilibrium values as follows:

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

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

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

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

4. Update the wage-bill share vector using previous expression (prior slide).
5. Iterate until convergence of wage-bill shares.
Recovering true equilibrium values from ‘hatted’ equilibrium: Once the ‘hatted’ equilibrium is solved, we can construct the true equilibrium values by rescaling as follows:

\( \omega = \frac{\tilde{Z}}{\phi^{1-\tilde{\alpha}}} \)  
(3a)

\[ W = \omega \frac{1}{1+(1-\tilde{\alpha})\phi} \tilde{W} \frac{1+(1-\tilde{\alpha})\theta}{1+(1-\tilde{\alpha})\phi} \]  
(3b)

\[ w_{ij} = \omega \frac{1}{1+(1-\tilde{\alpha})\theta} \tilde{W} \frac{(1-\tilde{\alpha})(\theta-\phi)}{1+(1-\tilde{\alpha})\theta} \hat{w}_{ij} \]  
(3c)

\[ w_j = \omega \frac{1}{1+(1-\tilde{\alpha})\theta} \tilde{W} \frac{(1-\tilde{\alpha})(\theta-\phi)}{1+(1-\tilde{\alpha})\theta} \hat{w}_j \]  
(3d)

\[ n_{ij} = \frac{\phi}{\eta} \left( \frac{w_{ij}}{w_j} \right)^{\theta} \left( \frac{W}{W} \right)^{\phi} \left( \frac{1}{W} \right) \]  
(3e)
We set the scale parameters $\bar{\varphi}$ and $\tilde{Z}$ in order to match average firm size observed in the data ($AveFirmSize^{Data} = 27.96$ from Table 5), and average earnings per worker in the data ($AveEarnings^{Data} = 65,773$ from Table 5):

\[
\hat{AveFirmSize}^{Data} = \frac{\int \{ \sum_{i,j} n_{ij} \} \, dj}{\int \{ M_j \} \, dj} \quad (4a)
\]

\[
\hat{AveEarnings}^{Data} = \frac{\int \{ \sum_{i,j} w_{ij} n_{ij} \} \, dj}{\int \{ \sum_{i,j} n_{ij} \} \, dj} \quad (4b)
\]

Berger Herkenhoff Mongey, "Labor Market Power"
To compute the values of $\varphi$ and $\tilde{Z}$ that allow us to match $AveFirmSize^{Data}$ and $AveEarnings^{Data}$, we substitute the model's values for $n_{ij}$, $w_{ij}$, and $M_j$ into $AveFirmSize^{Data}$ and $AveEarnings^{Data}$. We repetitively substitute equations (3a) through (3e) into (4a) and (4b). We then solve for $\varphi$ and $\tilde{Z}$:

\[ \varphi = \frac{AveFirmSize^{Data}}{AveFirmSize^{Model}} \frac{AveEarnings^{Data}}{AveEarnings^{Model}} \] (5)

\[ \tilde{Z} = \varphi^{1-\tilde{\alpha}} \left( \frac{AveEarnings^{Data}}{AveEarnings^{Model}} \right)^{1+(1-\tilde{\alpha})\varphi} \times \hat{\mathcal{W}}^{-(1-\tilde{\alpha})(\theta-\varphi)} \] (6)

where

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

\[ AveEarnings^{Model} = \frac{\int \{ \sum_{i \in j} \hat{w}_{ij} \hat{n}_{ij} \} \, dj}{\int \{ \sum_{i \in j} \hat{n}_{ij} \} \, dj} \]
A. Share of market payroll: $s_{ij}^{wn}$

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

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

D. Employment: $n_{ij}$

Berger Herkenhoff Mongey, "Labor Market Power"
A. Share of market payroll: $s_{ij}^{wn}$

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

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

D. Employment: $n_{ij}$

Berger Herkenhoff Mongey, "Labor Market Power"
Aggregation – Labor share and concentration

\[ ls_{ij} = \frac{w_{ij} n_{ij}}{\bar{z}_i \bar{Z} n_{ij}^{\alpha}} \]

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

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

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

Let \( y_{ij} = \bar{z}_i \bar{Z} n_{ij}^{\alpha} \). 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:

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

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

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

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

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

(A) Firm-market-level averages

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total firm pay (000s)</td>
<td>470.90</td>
<td>1839.00</td>
</tr>
<tr>
<td>Total firm employment</td>
<td>37.09</td>
<td>27.96</td>
</tr>
<tr>
<td>Pay per employee</td>
<td>$12,696</td>
<td>$65,773</td>
</tr>
<tr>
<td>Firm-level observations</td>
<td>660,000</td>
<td>810,000</td>
</tr>
</tbody>
</table>

(B) Market-level averages

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage-bill Herfindahl (Unweighted)</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Employment Herfindahl (Unweighted)</td>
<td>0.43</td>
<td>0.42</td>
</tr>
<tr>
<td>Wage-bill Herfindahl (Weighted by market’s share of total employment)</td>
<td>0.19</td>
<td>0.14</td>
</tr>
<tr>
<td>Employment Herfindahl (Weighted by market’s share of total employment)</td>
<td>0.18</td>
<td>0.12</td>
</tr>
<tr>
<td>Firms per market</td>
<td>42.56</td>
<td>51.60</td>
</tr>
<tr>
<td>Percent of markets with 1 firm</td>
<td>14.6%</td>
<td>14.7%</td>
</tr>
<tr>
<td>National employment share of markets with 1 firm</td>
<td>0.63%</td>
<td>0.36%</td>
</tr>
<tr>
<td>Market-level observations</td>
<td>15,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

(C) Market-level correlations

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation of Wage-bill Herfindahl and number of firms</td>
<td>-0.22</td>
<td>-0.21</td>
</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and Std. Dev. Of Relative Wages</td>
<td>-0.49</td>
<td>-0.51</td>
</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and Employment Herfindahl</td>
<td>0.98</td>
<td>0.98</td>
</tr>
<tr>
<td>Correlation of Wage-bill Herfindahl and Market Employment</td>
<td>-0.20</td>
<td>-0.21</td>
</tr>
<tr>
<td>Market-level observations</td>
<td>15,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total firm pay (000s)</td>
<td>209.40</td>
<td>1102.00</td>
</tr>
<tr>
<td>Total firm employment</td>
<td>19.43</td>
<td>23.21</td>
</tr>
<tr>
<td>Pay per employee</td>
<td>$ 10,777</td>
<td>$ 47,480</td>
</tr>
<tr>
<td>Firm-Market level observations</td>
<td>3,746,000</td>
<td>5,854,000</td>
</tr>
</tbody>
</table>

### (B) Market-level averages

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<td>Employment Herfindahl (Weighted by market’s share of total wage-bill)</td>
<td>0.15</td>
<td>0.09</td>
</tr>
<tr>
<td>Firms per market</td>
<td>75.70</td>
<td>113.20</td>
</tr>
<tr>
<td>Percent of markets with 1 firm</td>
<td>10.4%</td>
<td>9.4%</td>
</tr>
<tr>
<td>Market level observations</td>
<td>49,000</td>
<td>52,000</td>
</tr>
</tbody>
</table>

### (C) Market-level correlations

<table>
<thead>
<tr>
<th></th>
<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>
</tr>
<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>
</tbody>
</table>

**Notes:** All NAICS.
### Corporate taxes, labor and wages

#### Regression Table

<table>
<thead>
<tr>
<th></th>
<th>log $n_{ijt}$</th>
<th>log $n_{ijt}$</th>
<th>log $w_{ijt}$</th>
<th>log $w_{ijt}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_{s(j)t}$</td>
<td>-0.00357***</td>
<td>-0.00368***</td>
<td>-0.00181***</td>
<td>-0.00187***</td>
</tr>
<tr>
<td></td>
<td>(0.000644)</td>
<td>(0.000757)</td>
<td>(0.000584)</td>
<td>(0.000588)</td>
</tr>
<tr>
<td>$s_{ijt}^{wn}$</td>
<td>2.085***</td>
<td></td>
<td>0.214***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0467)</td>
<td></td>
<td>(0.00724)</td>
<td></td>
</tr>
<tr>
<td>$\tau_{s(j)t} \times s_{ijt}^{wn}$</td>
<td>0.0158***</td>
<td></td>
<td>0.00310***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00495)</td>
<td></td>
<td>(0.000749)</td>
<td></td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Commuting Zone FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Firm × State FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.872</td>
<td>0.877</td>
<td>0.819</td>
<td>0.821</td>
</tr>
<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>
</tr>
</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.

---

Berger Herkenhoff Mongey, "Labor Market Power"
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 and Forestry</td>
<td>326</td>
<td>Plastics and Rubber Products Manufacturing</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 Manufacturing</td>
<td>334</td>
<td>Computer and Electronic Product Manufacture</td>
</tr>
<tr>
<td>313</td>
<td>Textile Mills</td>
<td>335</td>
<td>Electrical Equipment, Appliance, and Component Manufacture</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 Manufacturing</td>
<td>339</td>
<td>Miscellaneous Manufacturing</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>Whitewater, 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>
### 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 ($s_{wnjt}^{w}$)</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>
</tbody>
</table>

**Observations** 4,425,000

**Notes:** Tradeable C-Corps from 2002 to 2012.
Reproduced from Giroud and Rauh (2011):
Distribution of labor supply elasticities and markdowns

A. Structural elasticities

Elasticity - $\varepsilon_{ij}$

0 0.2 0.4 0.6 0.8

$\theta$ 1 2 3 4 5

Firms
Wage payments
$E[\varepsilon_{ij}]$
$\varepsilon$

B. Markdowns

Markdown - $\mu_{ij}$

0 0.2 0.4 0.6 0.8

$\mu_o = \varepsilon / (\varepsilon + 1)$
Bias in idiosyncratic shock casey

A. Comparative statics \((\theta, \eta)\)

B. Number of C-corps

Back - Measured and perceived elasticities
Measured and perceived labor supply elasticities

- **Method** Simulate purely idiosyncratic shock to a single firm
- **Result** Estimated *Reduced form* $\hat{\epsilon}(s)$ is always larger than *Structural* $\epsilon(s)$
- **Implication** Treating reduced form as structural understates labor market power

---

Berger Herkenhoff Mongey, "Labor Market Power"
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>

Berger Herkenhoff Mongey, "Labor Market Power"
Calibration

**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>$\tilde{\alpha}$</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>$E(\text{HHI}_{j}^{\text{wn}})$ 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>$\bar{\varphi}$</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. $HHI^{wn}$
Pass-through - Details

1. Replicate experiment in KPWZ (QJE 2019)
   - Same sample properties: (i) median firm size, (ii) average VAPW increase
   - Randomly sample 1% of firms with size greater than \( \bar{n} \) employees
     - With \( \bar{n} = 2 \), match median size of 25 in KPWZ
   - Then increase productivity by \( \Delta \)
     - With \( \Delta = 14\% \) match increase in \( vapw_{ij} \) of 13 percent in KPWZ
   - Repeat exercise 10 times, report average point estimates

2. Compare to following statistic from KPWZ
   - Table 2, Panel A. Top dosage quintile - Mean \( VAPW = \$120,160 \), Median \( n = 25.26 \)
   - Table 5 col(4) - Event study. \( \uparrow VAPW = \$15,740 \implies \uparrow 13\% \)
   - Table 8B col(1b) - IV regression \( w_{ijt} = \alpha_{ij} + 0.23vapw_{ijt} \). Elast. = 0.23 \( \left( \frac{vapw}{w} \right) = 0.47 \)
2. Pass-through

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size cutoff</td>
<td>2.00</td>
</tr>
<tr>
<td>Fraction of Firms</td>
<td>0.01</td>
</tr>
<tr>
<td>N firms</td>
<td>906</td>
</tr>
<tr>
<td>Log change in VAPW (VAPW=(\bar{z}z_{ij}n_{ij}^{\bar{\alpha}-1}))</td>
<td>0.13</td>
</tr>
<tr>
<td>Data Percent change in VAPW (Panel A Table 2 and Table 5 =15.74/120.16)</td>
<td>.13</td>
</tr>
<tr>
<td>Shock size</td>
<td>0.14</td>
</tr>
<tr>
<td>Nsims</td>
<td>1.00</td>
</tr>
<tr>
<td>Median firm size</td>
<td>25.07</td>
</tr>
<tr>
<td>Data median firm size</td>
<td>25.26</td>
</tr>
<tr>
<td>Mean firm size</td>
<td>56.37</td>
</tr>
<tr>
<td>Data mean firm size</td>
<td>61.49</td>
</tr>
<tr>
<td>Median VAPW (dollars)</td>
<td>90565</td>
</tr>
<tr>
<td>Data median VAPW (dollars)</td>
<td>86870</td>
</tr>
<tr>
<td>Mean VAPW (dollars)</td>
<td>92314</td>
</tr>
<tr>
<td>Data mean VAPW (dollars)</td>
<td>120160</td>
</tr>
</tbody>
</table>
3. Size wage premium

- Size-wage premium regressions in Bloom et al (2018)

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

<table>
<thead>
<tr>
<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>
</tr>
<tr>
<td>Dependent variable</td>
<td>( \log (w_{ij}) )</td>
<td>Log annual earnings</td>
</tr>
<tr>
<td>Independent variable</td>
<td>( \log (n_{ij}) )</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 $\bar{\varepsilon}_{ij}$, 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

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

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

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

Identifying MRPL

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

- 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 \( HHI_{jt} = \sum_i s_{ijt}^{wn^2} \)
- 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

\[ \pi_{ij} = \pi_{ij}^{Econ.} - \tau_C \pi_{ij}^{Acc.} \]
\[ \pi_{ij}^{Econ.} = z_{ij} n_{ij}^{\alpha} k_{ij}^{1-\alpha} - w_{ij} n_{ij} - R k_{ij} - \delta k_{ij} \]
\[ \pi_{ij}^{Acc.} = z_{ij} n_{ij}^{\alpha} k_{ij}^{1-\alpha} - w_{ij} n_{ij} - \lambda_K R k_{ij} - \delta k_{ij} \]

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

Result

\[ \pi_{ij} = MRPL(z_{ij}, r, \tau_C) n_{ij} - w_{ij} n_{ij} \]
\[ MRPL(z_{ij}, r, \tau_C) = \frac{1}{1 + \tau_C} \alpha (1 - \alpha) \frac{1-\alpha}{\alpha} \left( \frac{\tilde{z}_{ij}}{\tilde{R}} \right) \frac{1-\alpha}{\alpha} \tilde{z}_{ij} \]
\[ \tilde{z}_{ij} = (1 - \tau_C) z_{ij} \]
\[ \tilde{R} = (1 + \lambda_K \tau_C) r + (1 + \tau_C) \delta \]
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, $MRPL_{ijt}$

- $MRPL_{ijt}$ 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:

\[
n_{ij}^s = \frac{\int \sum n_{ij}^c \, dj}{\int \sum n_{ij} \, dj}
\]

\[
y_{ij}^s = \tilde{z}_{ij} \tilde{Z} (n_{ij}^s)^{\tilde{\alpha}}
\]

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

\[
\frac{\int \sum y_{ij}^c \, dj}{\int \sum y_{ij} \, dj} - \frac{\int \sum y_{ij}^s \, dj}{\int \sum y_{ij} \, dj} = \frac{\int \sum y_{ij}^c \, dj}{\int \sum y_{ij} \, dj} - 1
\]

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

Firm - Problem as before with added constraint:

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

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:

$$\tilde{w}_{jt} := \left[ \sum_{i \in j} (w_{ijt} - \nu_{ijt})^{1+\eta} \right]^{1+\eta}, \quad \tilde{w}_t := \left[ \int \tilde{w}_{jt}^{1+\theta} \, dj \right]^{1+\theta}.$$
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)

Berger Herkenhoff Mongey, "Labor Market Power"
(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
Initialize the algorithm by (i) guessing a value for $\tilde{W}_t^{(0)}$, (ii) assuming all firms are in Region I, which implies guessing $\nu^{(0)}_{ijt} = 0$. These will all be updated in the algorithm.

1. Solve the sectoral equilibrium:
   
   1.1 Guess perceived shares $\tilde{s}^{(0)}_{ijt}$.
   
   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 $W_t$:
   
   $$w_{ijt} = \left[ \omega \mu (\tilde{s}_{ijt}) \tilde{W}_t \left( 1 - \tilde{\alpha} \right) (\theta - \varphi) \tilde{z}_{ijt} \tilde{s}_{ijt} \right] \left[ \frac{1}{1 + (1 - \tilde{\alpha}) \tilde{\theta}} \right]$$
   
   1.3 In all other regions Region II, III, IV, set $w_{ijt} = w$.
   
   1.4 Compute perceived wages using the guess $\nu^{(k)}_{ijt}$: $\tilde{w}_{ijt} = w_{ijt} - \nu^{(k)}_{ijt}$.
   
   1.5 Update shares using $\tilde{w}_{ijt}$:
   
   $$\tilde{s}^{(l+1)}_{ijt} = \frac{\tilde{w}_{ijt}^{1+\eta}}{\sum_{i,j} \tilde{w}_{ijt}^{1+\eta}} \begin{pmatrix} \tilde{w}_{ijt} n_{ijt} = \frac{\tilde{w}_{ijt} \bar{q}_{ijt} \left( \frac{\tilde{w}_{ijt}}{\bar{w}_{jt}} \right)^{\eta} \left( \frac{\tilde{w}_{jt}}{\bar{W}_t} \right)^{\theta} \tilde{W}_t^\varphi}{\sum_{i,j} \tilde{w}_{ijt} \bar{q}_{ijt} \left( \frac{\tilde{w}_{ijt}}{\bar{w}_{jt}} \right)^{\eta} \left( \frac{\tilde{w}_{jt}}{\bar{W}_t} \right)^{\theta} \tilde{W}_t^\varphi} \end{pmatrix}$$
   
   1.6 Iterate over (b)-(e) until $\tilde{s}^{(l+1)}_{ijt} = \tilde{s}^{(l)}_{ijt}$. 

1. Recover employment $n_{ijt}$ according to the current guess of firm region. First use $\bar{w}_{ijt}$ to compute $\tilde{W}_jt$, $\tilde{W}_t$. Then by region:

(I) Firm is unconstrained:

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

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

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

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

$$n_{ijt} = \left( \frac{\bar{Z}z_{ijt}}{w} \right) \frac{1}{1-\alpha}$$

2. Update $\nu_{ijt}^{(k)}$:

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

2.2 Update $\nu_{ijt}^{(k+1)}$ from the household’s first order conditions:

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

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

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

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

4. Update firm regions:

4.1 Compute profits for all firms: $\pi_{ijt} = \bar{Z}z_{ijt}n_{ijt}^{\alpha} - w_{ijt}n_{ijt}$

4.2 If in sector $j$ there exists a firm with $w_{ijt} < w$, 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.$^1$

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

$^1$ We do not need to distinguish Region III from Region IV in the algorithm, since it the determination of equilibrium wages and employment are the same in each region.