Imperfect Competition and Rents in Labor and Product Markets: The Case of the Construction Industry

Kory Kroft, Yao Luo, Magne Mogstad, Bradley Setzler

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Motivation

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- **Labor market:** firms may markdown wages below MRPL.
- **Product market:** firms may markup prices above MC.
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Empirical context: We link the universe of U.S. **firm** and **worker** tax returns with records we collected from **procurement auctions**.

This Paper (1/2)

Framework for jointly analyzing **labor** and **product** market power.

- **Distinguish** supply and demand factors in both markets.
- **Closed-form** identification of all model parameters.
- **Measures** of rents and incidence of procurement.
- **Counterfactual** changes to power in either market.

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- **Approach:** Leverage institutional features of the **auction**.
- **Preview:** Labor supply elasticity ≈ 4, wage markdown 20%.

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Identify returns to labor and product demand elasticities:

- **Challenge:** Firm-specific productivity shocks.
- **Approach:** Invert the bidding strategy in the **auction**.
- **Preview:** technology $\approx$ CRS, 16% price markup.

This Paper (2/2)

Model estimates:

- **Double markdown:** the usual **wage markdown** is 20%, rises to 31% when accounting for **product** market power.
- **Rents:** per capita, workers earn \$12k and firms capture \$43k.
- **Rent heterogeneity:** higher TFP $\implies$ **lower rent-share**.
- **Incidence:** per capita, **procurement** contract generates rents of \$6k for workers and \$9k for firms $\implies$ **higher rent-share**.
- **Crowd-out:** a **procurement** contract leads to large increase in total output but reduction in private market output.

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Model counterfactuals:

- **Theoretical finding:** impacts of **labor market power** are attenuated by existence of **product market power**.
- **Intuition:** Cut **employment** to exploit **labor** $\Longrightarrow$ less **output** means higher **prices** $\Longrightarrow$ mitigates incentive to cut.
- **Quantitative finding:** Reducing labor supply elasticity in half,
  - if the firm were a **price-taker**: 22% less employment
  - with **product market power**: 12% less employment

Related Literature

Wage inequality, imperfect competition, compensating differentials

- Rosen 1986; Murphy and Topel 1990; Gibbons and Katz 1992; Abowd Lemieux 1993; Abowd et al 1999; Hamermesh 1999; Pierce 2001; Bhaskar et al 2002; Manning 2003, 2011; Mas and Pallais 2017; Wiswall and Zafar 2017; Card et al 2013, 2016, 2018; Maestas et al 2018; Caldwell Oehlsen 2018; Berger et al 2019; Jarosch et al 2019; Chan et al 2020; Bassier et al 2020; Hershbein et al 2020; Azar Berry Marinescu 2020; many more

Inferring monopsony from pass-through of firm-specific shocks

- van Reenen 1996; Kline et al 2019; Howell Brown 2020; Lamadon Mogstad Setzler 2022

Empirical designs for auctions

- Ferraz et al 2015; Lee 2017; Cho 2018; Hvide Meling 2019; Gugler et al 2020

Outline

1. Framework with Labor and Product Market Power
2. Data Sources
3. Recovering Key Model Parameters
4. Results from Estimated Model
5. Interactions between Labor and Product Market Power

Model

We develop a model with imperfect competition in both **labor** and **product** markets.

The model serves several purposes:

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Key equations provided by the model in **blue**, they will be:

- Labor supply curve
- Product demand curve
- Optimal intermediate inputs
- Optimal auction bid
- Rents expression

Labor Market

Preferences If employed by firm j at wage W_{jt}, worker i utility is

$$\mathcal{U}_{it}(j, W_{jt}) = \log W_{jt} + g_{jt} + \eta_{ijt} \tag{1}$$

- g_{jt} is common, gives rise to *vertical* differentiation
- η_{ijt} is idiosyncratic to worker i, gives *horizontal* differentiation
- Parameterize η_{ijt} as T1EV with dispersion θ
- Information asymmetry: firms don't see η_{ijt} for a given worker

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Firm-specific labor supply curve:

$$W_{jt} = L_{jt}^{\theta} U_{jt} \tag{2}$$

where $1/\theta$ is the LS elasticity and U_{jt} is the firm-specific amenity

- Strategically small: no firm can shift aggregate labor supply

Technology

Production Function Firms produce using labor L, capital K, and intermediate inputs M in the Ackerberg et al (2015) technology,

$$Q_{jt} = \min\{\Omega_{jt} L_{jt}^{\beta_L} K_{jt}^{\beta_K}, \beta_M M_{jt}\} \exp(e_{jt}) \tag{3}$$

where Ω_{jt} is TFP and e_{jt} is production error in output quantity

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Composite Production If capital market is perfect, simplifies to

$$Q_{jt} = \min\{\Phi_{jt} L_{jt}^{\rho}, \beta_M M_{jt}\} \exp(e_{jt}) \tag{4}$$

where ρ is composite labor returns and Φ_{jt} is composite TFP.

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Optimal intermediate inputs Defining $X_{jt} \equiv p_M M_{jt}$, the Leontief FOC and competitive market for intermediate inputs gives,

$$X_{jt} = \frac{p_M}{\beta_M} L_{jt}^{\rho} \Phi_{jt} \tag{5}$$

Firm's Problem

Output Let G denote govt market and H denote private market. Denote output in G by Q_{jt}^G and in H by Q_{jt}^H

- First-stage: Firms bid to produce $\bar{Q}^G$, $D_{jt} = 1$ if winner
- Second-stage: Choose total output $Q_{jt} = \bar{Q}^G D_{jt} + Q_{jt}^H$

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Private Market Firms face downward-sloping demand,

$$P_{jt}^H = p_H \left(Q_{jt}^H\right)^{-\epsilon} \implies R_{jt}^H = P_{jt}^H Q_{jt}^H = p_H \left(Q_{jt}^H\right)^{1-\epsilon} \qquad (6)$$

where $1/\epsilon$ is the price elasticity of demand

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Firm's Problem Given $Q_j \geq \bar{Q}^G d$ and auction outcome $D_j = d$,

$$\max_{L_{djt}, K_{djt}, M_{djt}} \quad \pi_{djt}^H = R_{djt}^H - W_{djt} L_{djt} - p_M M_{djt} - p_K K_{djt} \tag{7}$$

subject to the labor supply curve, the product demand curve, and the production function.

Government Market for Procurements

Opportunity Cost Given private market profits π^H_{djt} if $D_{jt} = d$,

$$\sigma_u(\phi_{jt}) = \pi^H_{0jt} - \pi^H_{1jt} > 0, \tag{8}$$

Auction problem Firm j chooses optimal bid Z_{jt} that solves,

$$\max_{Z_{jt}} \underbrace{(Z_{jt} - \sigma_u(\phi_{jt}))}_{\text{payoff}} \times \underbrace{\Pr(D_{jt} = 1 | Z_{jt})}_{\text{probability of winning}} \tag{9}$$

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Optimal bid Unique symmetric equilibrium is defined by,

$$s_u(\phi_{jt}) = \sigma_u(\phi_{jt})\, \delta_u(\phi_{jt}),\ \delta_u(\phi_{jt}) \equiv 1 + \frac{\int_{\sigma_u(\phi_{jt})}^{\bar{\sigma}} [1 - F_u(\tilde{\sigma})]^{I-1} d\tilde{\sigma}}{\sigma_u(\phi_{jt})\, [1 - F_u(\sigma_u(\phi_{jt}))]^{I-1}}$$

where I is number of bidders and δ is markup on opportunity cost

Defining Worker Rents

Notation Suppose firm j increases wage from W_{jt} to $\widetilde{W}_{jt}$, and denote worker i's preferred firm excluding j as j_t^*

Worker Rents The equivalent variation V_{ijt} for the wage change is

$$\underbrace{\max \left\{ \begin{array}{c} \log \widetilde{W}_{jt} + g_{jt} + \eta_{ijt}, \\ \log W_{j_t^* t} + g_{j_t^* t} + \eta_{ij_t^* t} \end{array} \right.}_{\text{utility with wage increase at firm } j} = \underbrace{\max \left\{ \begin{array}{c} \log \left(W_{jt} + V_{ijt} \right) + g_{jt} + \eta_{ijt}, \\ \log \left(W_{j_t^* t} + V_{ijt} \right) + g_{j_t^* t} + \eta_{ij_t^* t} \end{array} \right.}_{\text{equivalent utility at the initial choice of firm}}$$

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Sum of Worker Rents Using our functional form to simplify,

$$V_{jt} \equiv \sum_i V_{ijt} = \frac{\widetilde{B}_{jt} - B_{jt}}{1 + 1/\theta} \qquad (10)$$

where $\widetilde{B}_{jt} - B_{jt}$ is the change in wage bill and $1/\theta$ is LS elasticity

Rents and Incidence

Incidence of Procurements

$$\underbrace{V_{1jt}}_{\text{Total rents}} = \underbrace{V_{0jt}}_{\text{Baseline rents}} + \underbrace{V_{\Delta jt}}_{\text{Incidence}} = \underbrace{\frac{B_{0jt}}{1+1/\theta}}_{\text{Baseline rents}} + \underbrace{\frac{B_{1jt}-B_{0jt}}{1+1/\theta}}_{\text{Incidence}} \quad (11)$$

Incidence for Incumbents and New Hires

$$\underbrace{V_{\Delta jt}}_{\text{Incidence}} = \underbrace{L_{0jt}\left(W_{1jt} - W_{0jt}\right)}_{\text{Incidence for incumbents}} + \underbrace{W_{1jt}\left(L_{1jt} - L_{0jt}\right) - \frac{B_{1jt}-B_{0jt}}{1+\theta}}_{\text{Incidence for new hires}}.$$

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Firm Rents

$$\underbrace{\pi_{1jt}}_{\text{Total firm rents}} = \underbrace{\pi_{0jt}}_{\text{Baseline firm rents}} + \underbrace{\pi_{\Delta jt}}_{\text{Incidence on firms}} \quad (12)$$

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Data Sources (1/2)

US tax data 2001-15 universe of business and worker tax returns

Firms: Business tax returns include balance sheet and other information for C-corps, S-corps, and partnerships

- **firm:** tax entity (EIN)
- **sales:** gross receipts from business operations (not dividends)
- **profits:** EBITD (earnings before interest, taxes, deductions)
- **intermediate inputs:** COGS (cost of goods sold)
  - includes intermediate goods, transit costs, etc
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Workers: W-2 records on employment and total earnings

- **labor:** link workers to their highest-paying employer with earnings above FTE threshold, restrict to age 25-60
- **contractors:** also observe indep. contractors (Form 1099)

Data Sources (2/2)

Auction data Firm-auction records on bids and winners of department of transportation (DOT) procurement contracts

- state DOTs use auctions to procure construction and landscaping work on roads and bridges
- First-price sealed-bid auctions (output price = lowest bid), where we observe bid of each firm, not only the winner
- FOIA or webscraped from BidX.com & state-specific websites
- Cover more than **100,000** auctions by 28 state DOTs, including large states like California, Texas, and Florida
- No evidence of collusion test results

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Final data Link tax returns to auction records by fuzzy matching on firm name and address

- Final data: **8,000** unique firms, **360,000** unique workers
- 6 states provide EIN, used for training algorithm & robustness

Descriptive Statistics for the Linked Sample

	Sample Size		Share of the Construction Sector
Number of Firms	7,876		0.9%
Workers per Firm	46		11.7%
	Value Per Firm ($ millions)	Mean of the Log	Share of the Construction Sector (%)
Sales	19.927	15.061	12.1%
EBITD	9.159	14.075	9.6%
Intermediate Costs	14.661	14.719	12.4%
Wage bill	2.737	13.549	13.4%

- Final sample: 8,000 unique firms, 360,000 unique workers
- Average firm has 46 employees and $9M in profits

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Recovering Key Model Parameters

Using the key equations provided by the model that were in **blue** above, we now identify and estimate:

- **Labor supply** elasticity (5 slides)
- **Firm technology** & **product demand** elasticities (4 slides)

Labor Supply Elasticity (1/5)

Goal: Identify the labor supply elasticity, $1/\theta$.

Model: Log inverse labor supply curve is,

$$w_{jt} = \theta \ell_{jt} + u_{jt} = \theta \ell_{jt} + \psi_j + \xi_t + \nu_{jt} \tag{13}$$

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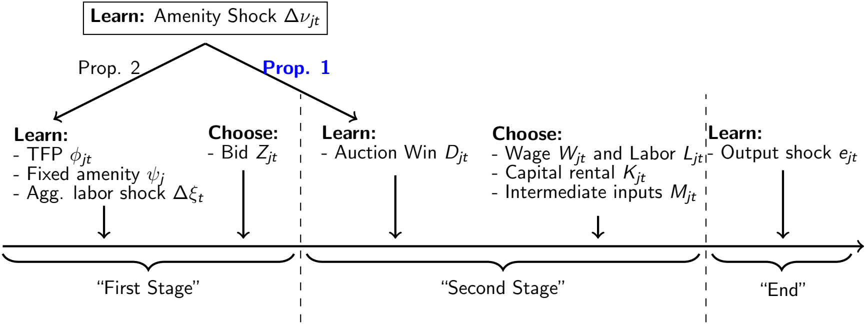
Easy to deal with:

- Time-invariant firm-specific amenities ψ_j (take differences)
- Aggregate labor supply shocks $\Delta \xi_t$ (add year fixed effects)

$$\Delta w_{jt} = \theta \Delta \ell_{jt} + \Delta \xi_t + \Delta \nu_{jt} \tag{14}$$

Challenge: Regression of change in log wage on change in log employment biased for θ due to firm-specific amenity shock $\Delta \nu_{jt}$

Sequence of Events within Time Period t



Labor Supply Elasticity (2/5)

Assumption 1. $\Delta\nu_{jt}$ not in information set at "First Stage" of t when bid is placed in auction $\implies D_{jt} \perp \nu_{jt} | (\psi_j, \xi_t)$.

- Time delay assumptions are standard for identification in empirical IO (Ackerberg et al 2015; Gandhi et al 2020).
- Delay is between *estimating* labor cost (bidding at beginning of period t) and actually hiring labor (middle of period t)

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Proposition 1. θ is recovered by the IV estimator,

$$\theta_{\text{IV}} \equiv \frac{\text{Cov}\left[\Delta w_{jt}, D_{jt}\right]}{\text{Cov}\left[\Delta \ell_{jt}, D_{jt}\right]} \tag{15}$$

Important to emphasize what is **not** restricted by Assumption 1:

- no additional restrictions on joint dist of $(Z_{jt}, D_{jt}, \phi_{jt}, \psi_j, \xi_t)$.
- allows $\text{Var}(\Delta\nu_{jt}) > 0$, clear step forward in this literature.
- allows $\Delta\ell_{jt}, \Delta w_{jt}$ to depend on $\Delta\nu_{jt}$, no time delay here.

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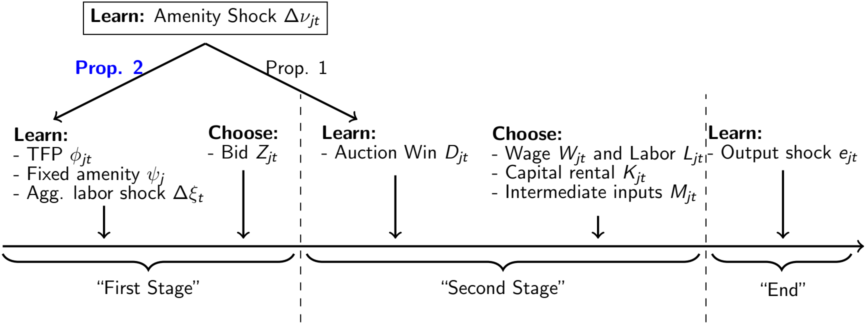

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Intuition:

- First-price auctions $\implies$ winning fully determined by bids Z_{jt}.
- Restrict sample to $\tau_{jt} \leq \overline{\tau}$. As $\overline{\tau} \to 0^{+}$, Z_{jt} of winners=losers.
- Therefore, $\mathbb{E}[\Delta \nu_{jt}]$ of winners and losers converges as $\overline{\tau} \to 0^{+}$

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Proposition 2: Define an IV estimator of the form,

$$\theta_{\overline{\tau}} \equiv \frac{\mathbb{E}\left[\Delta w_{jt} | \tau_{jt} = 0\right] - \mathbb{E}\left[\Delta w_{jt} | 0 < \tau_{jt} \leq \overline{\tau}\right]}{\mathbb{E}\left[\Delta \ell_{jt} | \tau_{jt} = 0\right] - \mathbb{E}\left[\Delta \ell_{jt} | 0 < \tau_{jt} \leq \overline{\tau}\right]} \tag{16}$$

where $\overline{\tau}$ is a proximity parameter and the conditioning on ι is implicit. Then, $\lim_{\overline{\tau} \to 0^+} \theta_{\overline{\tau}} = \theta$.

Labor Supply Elasticity (4/5)

Results using multiplicity of approaches:

- Estimator of Proposition 1: $1/\theta = 4.1$, markdown $= 0.80$
- Estimator of Proposition 2: $1/\theta = 3.5$, markdown $= 0.78$
- Estimator of Lamadon Mogstad Setzler (2022) panel-IV for full construction sample: $1/\theta = 4.0$, markdown $= 0.80$

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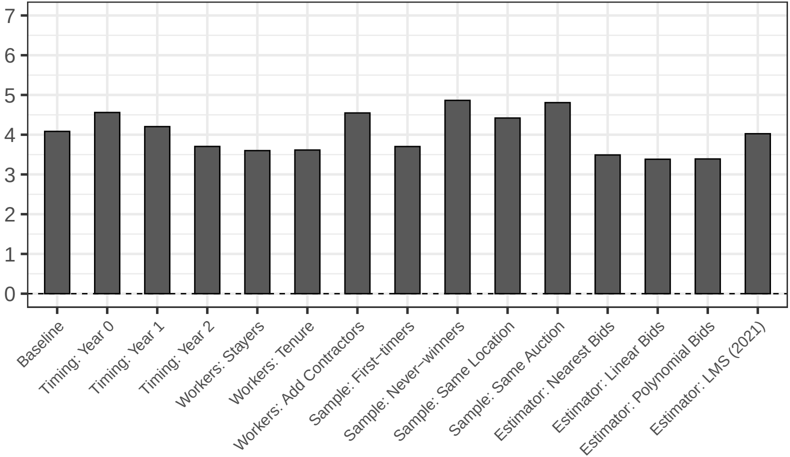
Sensitivity checks:

- Passes falsification test using IV on the pre-period outcomes
- No evidence of bias from slow adjustments over time
- No evidence of bias from worker composition changes
- No evidence of bias from local aggregate shocks
- Not sensitive to alternative choices of auction loser sample
- Not sensitive to right-to-work or prevailing wage law coverage
- Not sensitive to alternative parameterizations of Proposition 2
- Various checks using this sample and external BLS and Census wage surveys indicate wage effects not due to hours responses
- ... more

Labor Supply Elasticity (5/5)



Product Demand and Technology Elasticities (1/4)

Goal: Identify the product demand elasticity, $1/\epsilon$.

Model: Private market log revenue curve is,

$$r_{jt}^{H} = \log p_{H} + (1-\epsilon)\, q_{jt}^{H} \tag{17}$$

However, output quantity Q_{jt}^{H} is not observed in our data.

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$$r_{jt}^{H} = \log p_H + (1-\epsilon)\, q_{jt}^{H} \tag{17}$$

However, output quantity Q_{jt}^{H} is not observed in our data.

Leontief assumption: The Leontief production function implies $Q_{jt} \propto X_{jt}$ for intermediate input expenditures X_{jt}, so we can write

$$r_{jt} = \kappa_R + (1-\epsilon)\, x_{jt} + (1-\epsilon)\, e_{jt} \quad \text{if} \quad D_{jt} = 0 \tag{18}$$

Product Demand and Technology Elasticities (1/4)

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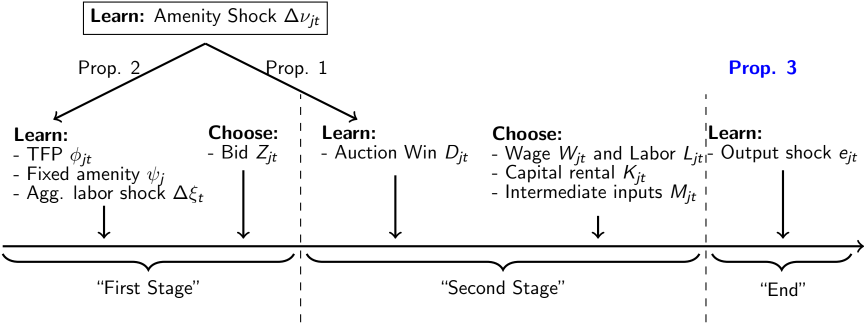
Timing of information: Ackerberg et al (2015) restriction that x is chosen before output shock e is realized (timeline on next slide)

Proposition 3:

$$e_{jt} \perp x_{jt} \implies \frac{\text{Cov}\left[r_{jt}, x_{jt} | D_{jt} = 0\right]}{\text{Var}\left[x_{jt} | D_{jt} = 0\right]} = 1-\epsilon \tag{19}$$

Sequence of Events within Time Period t



Product Demand and Technology Elasticities (2/4)

Goal: Identify the composite returns to labor, ρ.
Model: Optimal intermediate inputs imply,

$$x_{jt} = \kappa_X + \rho \ell_{jt} + \phi_{jt} \tag{20}$$

Challenge: log TFP ϕ is a determinant of both log labor ℓ and log intermediate input expenditures x.

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Proposition 4: Controlling for (Z_{jt}, u_{jt}) controls for ϕ_{jt}:

$$\frac{\mathrm{Cov}\left[x_{jt}, \ell_{jt} | \widehat{u}_{jt}, Z_{jt}\right]}{\mathrm{Var}\left[\ell_{jt} | \widehat{u}_{jt}, Z_{jt}\right]} = \frac{\mathrm{Cov}\left[x_{jt}, \ell_{jt} | \widehat{u}_{jt}, \phi_{jt}\right]}{\mathrm{Var}\left[\ell_{jt} | \widehat{u}_{jt}, \phi_{jt}\right]} = \rho \tag{21}$$

Product Demand and Technology Elasticities (3/4)

Two additional identifying moments:

- We extend the de Loecker Eeckhout Unger (2020) measure of inverse markups to incorporate labor market power ($\theta > 0$):

$$\overbrace{(1-\epsilon)}^{\text{markup}^{-1}} = \frac{\overbrace{(1+\theta)}^{\text{markdown}^{-1}}}{\beta_L} \frac{B_{jt}}{R_{jt}} + \frac{X_{jt}}{R_{jt}} \tag{22}$$

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- First-order condition for auction winners: for any candidate parameters (ϵ, ρ, θ), we can construct the left-hand and right-hand sides of the winner's FOC wrt labor:

$$\Lambda_{jt} = \kappa_\Lambda + \rho \ell_{jt} + \phi_{jt} + e_{jt} \quad \text{if} \quad D_{jt} = 1. \tag{23}$$

where we can construct log TFP $\phi_{jt} = x_{jt} - \rho \ell_{jt}$ for any candidate ρ and Λ is a term we can construct.

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where we can construct log TFP $\phi_{jt} = x_{jt} - \rho \ell_{jt}$ for any candidate ρ and Λ is a term we can construct.

Over-identification: We combine these two moments with the key identifying moments for ϵ and ρ above, then estimate these 4 equations in 3 unknowns using GMM.

Product Demand and Technology Elasticities (4/4)

	Baseline Estimates using Over-identified GMM		
	Parameters	**Data**	
Private demand parameter	$1-\epsilon$	0.863	(0.015)
Composite labor scale parameter	ρ	1.089	(0.017)
Returns to labor parameter	β_L	0.499	(0.192)
	Alternative Estimates using Exactly-identified OLS		
	Parameters	**Data**	
Diminishing returns to output	$1-\epsilon$	0.863	(0.008)
Optimal intermediate inputs	ρ	1.057	(0.015)
Labor to value added ratio	β_L	0.514	(0.209)

Product demand elasticity: We estimate $1/\epsilon = 7.3$, which gives a **price markup**, $(1/\epsilon)/(1/\epsilon - 1)$, that is 16% above marginal cost.

Composite returns to labor: We estimate $\rho = 1.09$, just above **constant returns to scale** (like Levinsohn and Petrin 2003).

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- Robust to using main identifying moments instead of GMM.
- Robust to Cobb-Douglas instead of Leontief prod function.
- Robust to relaxing the auction symmetry assumption.
- Robust to controlling for aggregate price shocks.

Outline

Results from Estimated Model (1/5): Double Markdown

$$W_{jt} = \overbrace{\frac{1}{1+\theta}}^{\text{markdown}} \times \text{MRPL}_{jt}$$

A natural measure of monopsony power is the **markdown**

- We estimate a **markdown** of 0.80, so workers are paid 20% below the marginal revenue product of labor (MRPL)

Results from Estimated Model (1/5): Double Markdown

$$W_{jt} = \overbrace{\frac{1}{1+\theta}}^{\textbf{markdown}} \times \text{MRPL}_{jt} = \underbrace{\overbrace{\frac{\theta}{1+\theta}}^{\textbf{markdown}} \times \overbrace{\left(\frac{1/\epsilon}{1/\epsilon - 1}\right)^{-1}}^{\textbf{inverse markup}}}_{\textbf{composite markdown}} \times \underbrace{P_{jt} \times \text{MPL}_{jt}}_{\textbf{VMPL}}$$

A natural measure of monopsony power is the **markdown**

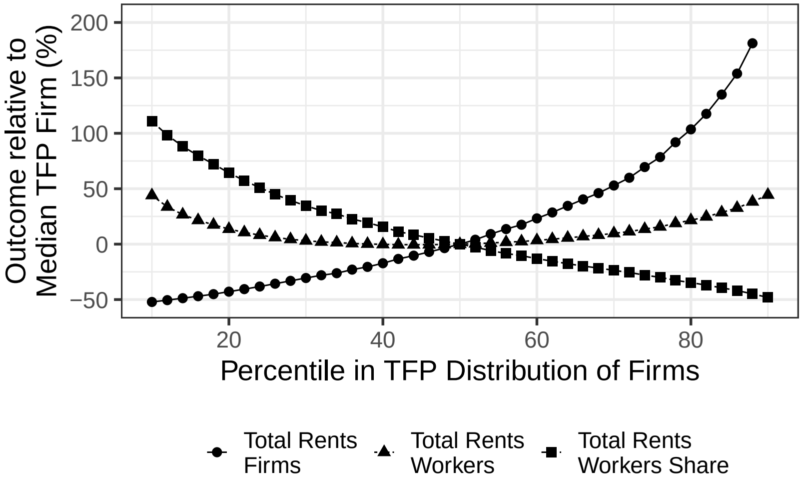
- We estimate a **markdown** of 0.80, so workers are paid 20% below the marginal revenue product of labor (MRPL)
- But MRPL depends on **product market power**
- Special case w/o intermediate inputs: MRPL equals **inverse markup** times the value of the marginal product of labor (MPL) at fixed prices, so **higher markup** $\implies$ **lower wage**
- We estimate a **composite markdown** of 0.69, so workers are paid 31% below VMPL, versus 20% if ignoring the markup

Results from Estimated Model (2/5): Baseline Rents

		Actual	Counterf.	Difference	
		$d = 1$	$d = 0$	Level	Relative
Labor market					
L_{jt}	Employment (#)	**24.7**	12.8	11.9	92.7%
W_{jt}	Wage ($1K)	**59.1**	50.4	8.8	17.4%
B_{jt}	Wage bill ($1K)	**1,459.6**	645.2	814.4	126.2%
Rents					
V_{jt}	Worker rents ($1K/$L$)	**11.6**	5.1	6.5	126.2%
π_{jt}	Firm profits ($1K/$L$)	**43.1**	33.4	9.6	28.7%

In the actual economy ($d = 1$), per-capita worker rents $\frac{W}{1+1/\theta}$ are about $12,000 per year, less than 1/4 of all rents.

Results from Estimated Model (3/5): Rents and TFP



Workers' share of rents is smaller at more productive firms.

Results from Estimated Model (4/5): Marginal Rents

		Actual	Counterf.	Difference	
		$d = 1$	$d = 0$	Level	Relative
Labor market					
L_{jt}	Employment (#)	24.7	12.8	11.9	92.7%
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π_{jt}	**Firm profits ($1K/$L$)**	**43.1**	**33.4**	**9.6**	**28.7%**

We simulate winning versus losing an auction among winners.

Hiring to fulfill the government contract leads to bidding up wages, running up worker rents, with only a small increase in firm rents.

Results from Estimated Model (5/5): Output/Crowd-out

		Actual	Counterf.	Difference	
		$d = 1$	$d = 0$	Level	Relative
Input Expenditures					
B_{jt}	Wage bill (\$1K)	1,459.6	645.2	814.4	126.2%
X_{jt}	Intermediate inputs (\$1K)	4,715.1	2,308.6	2,406.5	104.2%
$p_K K_{jt}$	Capital rentals (\$1K)	1,724.7	762.4	962.3	126.2%
Total production					
Q_{jt}	Output (#)	38.3	18.7	19.5	**104.2%**
R_{jt}	Revenue (\$1K)	8,962.1	4,541.6	4,420.5	**97.3%**
Private production					
Q^H_{jt}	Output (#)	13.7	18.7	-5.1	**-27.0%**
R^H_{jt}	Revenue (\$1K)	3,460.7	4,541.6	-1,080.9	**-23.8%**

The government contract nearly doubles the firm's revenues.

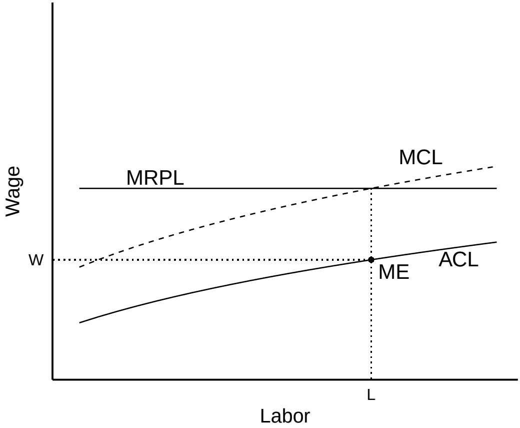
However, it crowds out about 1/4 of private sector output.

Note that output declines more than revenues due to markups.

Outline

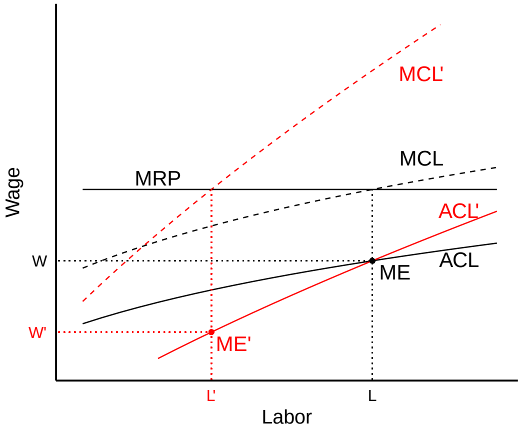
1. Framework with Labor and Product Market Power
2. Data Sources
3. Recovering Key Model Parameters
4. Results from Estimated Model
5. Interactions between Labor and Product Market Power

Theory: Impacts of Labor Market Power (1/3)



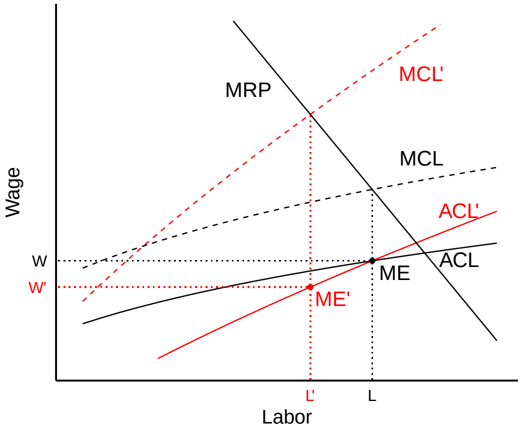
- No price-setting power $\implies$ flat MRPL curve
- Labor market power: upward-sloping MCL
  - Firm chooses L such that MRPL $=$ MCL, W $<$ MRPL

Theory: Impacts of Labor Market Power (2/3)



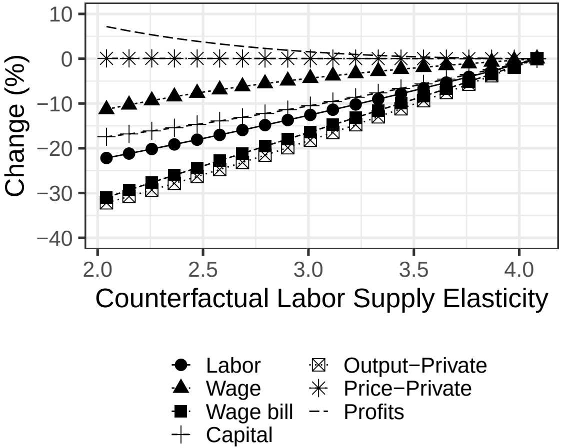
- No price-setting power $\implies$ flat MRPL curve
- More labor market power $\implies$ steeper MCL (red) $\implies$ less employment, greater wage markdown

Theory: Impacts of Labor Market Power (3/3)



- Firm has price-setting power $\Longrightarrow$ downward-sloping MRPL
- Cut employment $\Longrightarrow$ cut output $\Longrightarrow$ higher output price $\Longrightarrow$ incentive not to cut employment as much

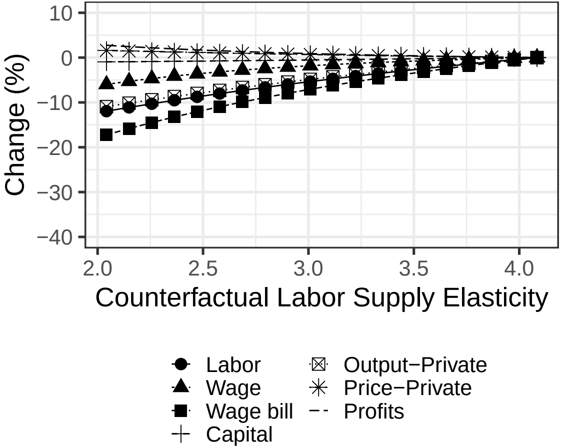
Model Simulation: Impacts of Labor Market Power (1/2)



Consider reducing LS elasticity $1/\theta$ in half

- Simulate from estimated model, counterfactually set $\epsilon = 0$
- Employment $\downarrow$ 22%, wages $\downarrow$ 11%, profits $\uparrow$ 7%

Model Simulation: Impacts of Labor Market Power (2/2)



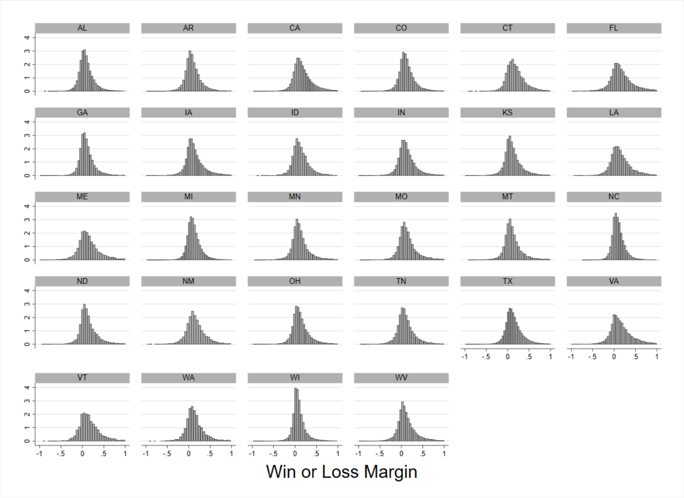
- Simulate from estimated model, use estimated $1/\epsilon = 7.3$
- Employment $\downarrow$ 12%, wages $\downarrow$ 6%, profits $\uparrow$ 3% $\implies$ impacts of labor market power mitigated by product market power

Conclusions

- Developed a framework for jointly analyzing **labor** and **product** market power
- Leveraged features of **procurement auctions** to recover **labor supply**, **technology**, and **product demand**
- While the usual markdown is only 20%, we found a **double wage markdown** of 31% due to **product** market power
- Firms capture more than 3/4 of rents, high productivity firms share less, but workers capture a high share of marginal rents
- Simulations from estimated model show that impacts of **labor** market power depend on degree of **product** market power

Appendix

Visual test of collusion from Chassang et al (2019)



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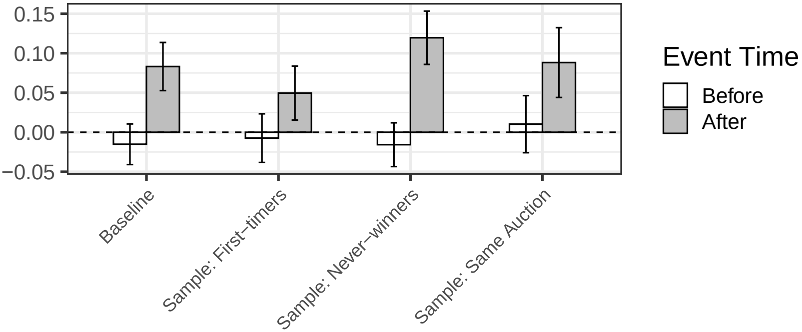
Falsification using Pre-period (1/2)

Effects on employment:



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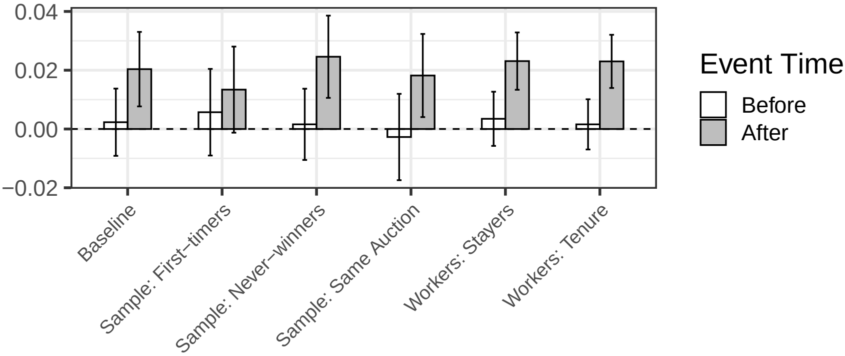
Falsification using Pre-period (2/2)

Effects on wages:



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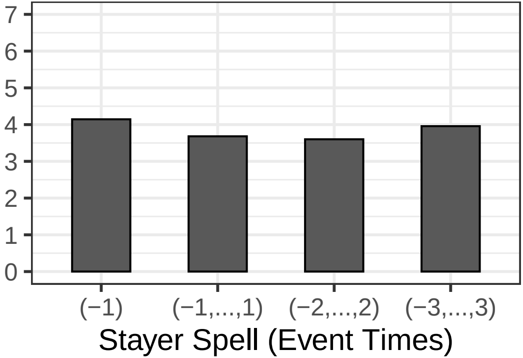
Stayers and Tenure Samples (1/2)

Labor supply elasticity by stayer spell:



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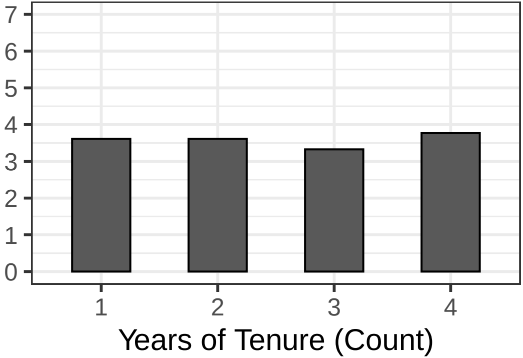
Stayers and Tenure Samples (2/2)

Labor supply elasticity by tenure length:



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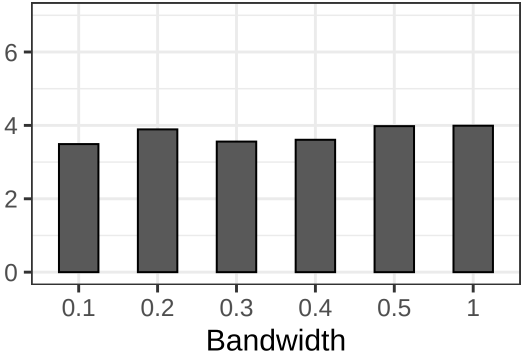
Bandwidths in the Prop 2 estimator (1/1)

Labor supply elasticity for alternative bandwidths ($\bar{\tau}$):



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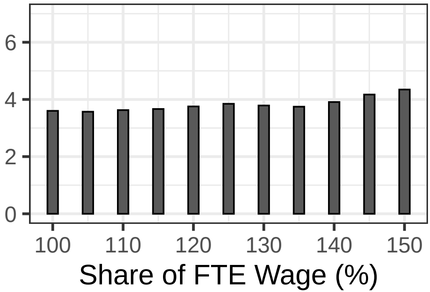
Hours and full-time status (1/2)

Labor supply elasticity by FTE threshold (as % of min. wage):



Other notes:

- US construction industry during 2001-2015 was 4.6% part-time labor vs 13.9% in entire private sector (BLS)
- LMS estimator in Norway: revenue shock pass-through of 0.092 (annual earnings) and 0.091 (hourly wages)

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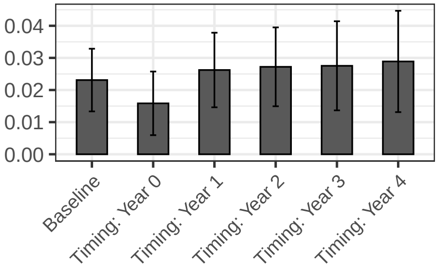
Hours and full-time status (2/2)

Wage effects persist over time (inconsistent with over-time pay):



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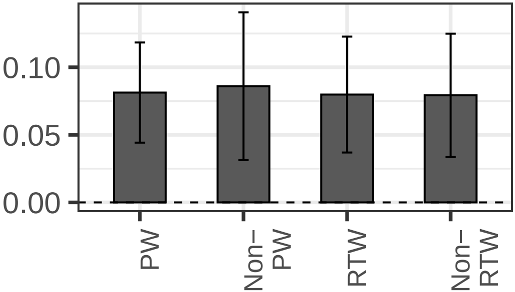
Right-to-Work and Prevailing Wage States (1/2)

Effects on employment:



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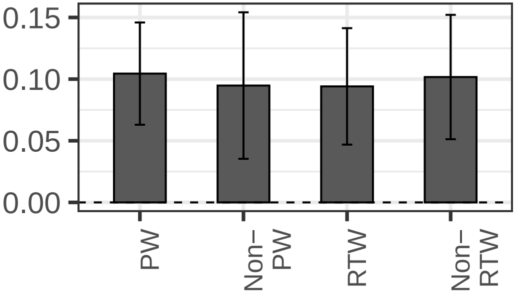
Right-to-Work and Prevailing Wage States (2/2)

Effects on wage bill:



◂ Back

Measurement Error Orthogonality

The goal is to estimate $1 - \epsilon$ using the relationship:

$$r_{jt} = \kappa_R + (1 - \epsilon)\, x_{jt} + (1 - \epsilon)\, e_{jt}$$

where e_{jt} is the error in the relationship between log revenues r_{jt} and log intermediates x_{jt}. The key identifying restriction is,

$$\text{Cov}(x_{jt}, e_{jt}) = 0$$

This orthogonality condition is satisfied under the assumption by Ackerberg et al. (2015) that the firm has no information about e_{jt} at the time inputs are chosen:

> *"The [e_{jt}] represent shocks to production or productivity that are* **not observable (or predictable)** *by firms before making their input decisions at t... [e_{jt}] can also represent (potentially serially correlated) measurement error in the output variable." Ackerberg et al. (2015, ECMA)*

Indeed, x_{jt} should be uncorrelated with e_{jt} if e_{jt} is completely unpredictable at the time x_{jt} is chosen.

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