Dynamic Wage Setting: The Role of Monopsony Power and Adjustment Costs

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Motivation:

- Workers are not paid their marginal product.
  Berger et al. 22; Yeh et al. 22; Lamadon et al. 22; Chan et al. 24...
- Wages and employment respond to firm-level productivity shocks.
  Guiso et al. 05; Carlsson et al. 16, 21; Card et al. 18; Pistaferri & Guiso 20

$\Longrightarrow$ Suggesting: imperfect market competition, and firms have wage-setting power.

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Research Questions:

- How much do wages differ from workers MRPL (*markdown* $\mu = \frac{W}{MRPL}$)?
- How much do firms pass productivity shocks to wages (*passthrough* $\varepsilon = \frac{dW/W}{d\eta/\eta}$)?
- What are the mechanisms driving markdowns and passthrough?

Monopsony power in labor markets:

- Firms face upward sloping labor supply curves.
- Wages set at markdown $\mu < 1$ from MRPL, depending on LS elasticity.
- Productivity affects wages as firms move up and down the labor supply curve.
- Primarily **static** in nature (Berger et al. 22; Lamadon et al. 22; Yeh et al. 22; Chan et al. 24)

▸ graphical explanation

Two Key Mechanisms

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graphical explanation

Adjustment constraints:

- Firms face non-wage costs when employing and adjusting labor inputs.
- Wages/employment distorted away from static optimality.
- Drives wedge between wage and MRPL and affects passthrough.
- Inherently **dynamic** in nature: Adjustment costs (Hopenhayn & Rogerson 93), financial constraints (Michelacci & Quadrini 09), optimal contracts (Balke & Lamadon 22)

graphical explanation

Our Contributions

Develop dynamic model of firms and wage setting:

- Monopsony power, labor adjustment costs, heterogeneous production technology.
  - Add firm dynamics to classic static monopsony wage posting model.
- Identification strategy requires few/weak assumptions.
  - Don’t need knowledge of production function, adjustment costs or labor market structure.

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Estimate the model:

1. Recover joint distribution of productivity, wages, passthrough, markdowns.
   - Average markdown (μ) of 83%, 15% of firms with $\mu > 1$.
   - Evidence of large adjustment costs.
   - Markdowns are poor measure of monopsony power.
2. Quantify the relative role of adjustment costs and monopsony power *(in progress)*
   - Estimate labor supply elasticity and cost function. Recover monopsony markdown.
   - Majority of Danish firms are constrained above static equilibrium employment.
   - Adjustment costs moderate effect of monopsony power on markdowns and passthrough.

Model

Workers $i \in I$**:** characterized by time-varying productivity/ability A_{it}

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Firms $j \in J$**:** produce output with capital K_{jt}, materials M_{jt} and labor L_{jt}

$$Y_{jt} = F(K_{jt}, L_{jt}, M_{jt})e^{\nu_{jt}}$$

- $\nu_{jt} = \omega_{jt} + \epsilon_{jt} = h_j(\omega_{jt-1}) + \eta_{jt} + \epsilon_{jt}$
- η_{jt} is *persistent* shock to productivity (observed *before* choosing inputs)

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Labor Input: L_{jt} is the sum of ability-weighted hours of labor: $L_{jt} = \sum_{i \in I_j} A_{it} H_{ijt}$

Perfect substitutability of labor *conditional on ability*:

- Firms pay single "ability price" W_{jt} per hour of ability-adjusted labor.
- Worker hourly wage is $W_{ijt} = A_{it} \times W_{jt}$

Timing and characteristics:

- Firms have exogenous (Z_{jt}) and endogenous ($\tilde{Z}_{jt}$) characteristics, face agg. prices P_t
- Information set at beginning of period: $\mathcal{I}_{jt} = \{\eta_{jt}, Z_{jt}, K_{jt}, P_t, L_{jt-1}, \tilde{Z}_{jt-1}\}$

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Firms maximize expected profits:

$$V_{jt}(\mathcal{I}_{jt}) = \max_{L_{jt}, \tilde{Z}_{jt}, K^I_{jt}, M_{jt}} \mathbb{E}_{\epsilon_{jt}}\left[P^Y_t F(K_{jt}, L_{jt}, M_{jt}) e^{\nu_{jt}} \mid \mathcal{I}_{jt}\right] - \mathbb{E}_{\epsilon_{jt}}\left[W_{jt} \mid W^c_{jt}\right] L_{jt} - P^I_t K^I_{jt} - P^M_t M_{jt} - \Phi_{jt}$$

$$+ \beta \mathbb{E}_{\epsilon_{jt}, \eta_{jt+1}, P_{t+1}}\left[V_{jt+1}(\mathcal{I}_{jt+1}) | \mathcal{I}_{jt}\right]$$

$$K_{jt+1} = (1-\delta)K_{jt} + K^I_{jt} \quad \text{(capital evolution)}$$

$$L_{jt} = L_j(\overline{W}_{jt}, Z_{jt}, \tilde{Z}_{jt-1}) \quad \text{(labor supply)}$$

$$\Phi_{jt} = \Phi(L_{jt}, L_{jt-1}, Z_{jt}, \tilde{Z}_{jt}, \tilde{Z}_{jt-1}) \quad \text{(labor/adjustment costs)}$$

Note: Variables with overlines are expected values. i.e.: $\overline{W}_{jt} \equiv \mathbb{E}_{\epsilon_{jt}}\left[W_{jt} \mid W^c_{jt}\right]$ ▸ Assumptions

Wage Equation: $W_{jt} = \mu_{jt} MRPL_{jt}$

$\overline{W}_{jt} =$ $\overline{\text{MRPL}}_{jt}$

In our model, wages and passthrough depend on three mechanisms:

- Production Technology: Firms differ in RTS, productivity, input substitution.

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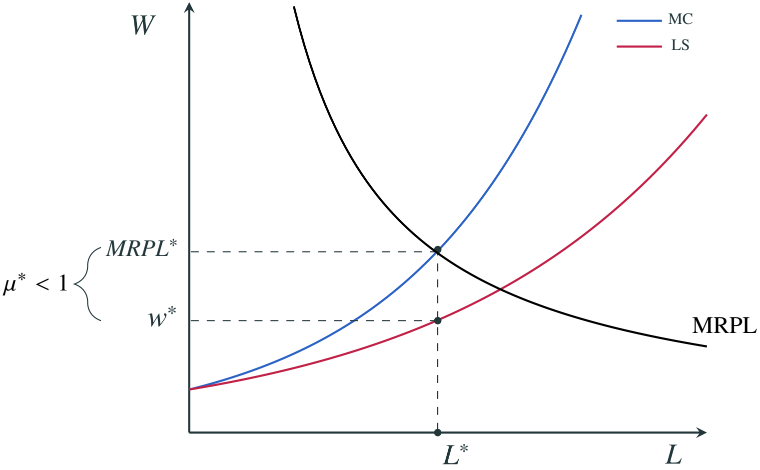
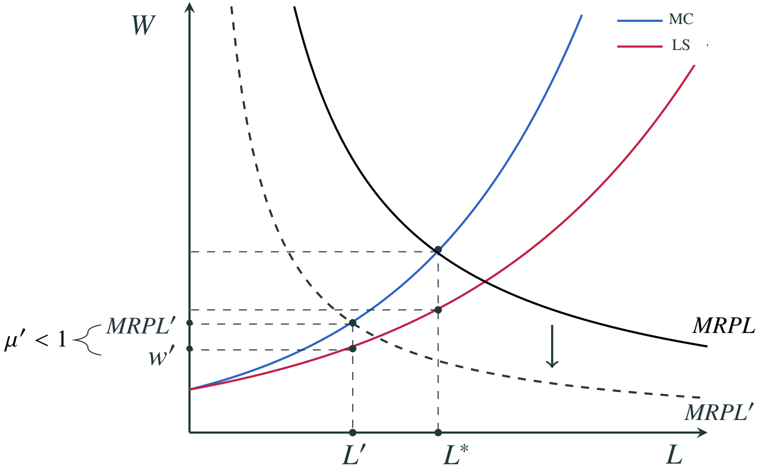
In our model, wages and passthrough depend on three mechanisms:

- Monopsony Power: Firms face different labor supply elasticities.
- Labor Costs: Firms differ in degree of constraint and expected future value of labor.
- Production Technology: Firms differ in RTS, productivity, input substitution.

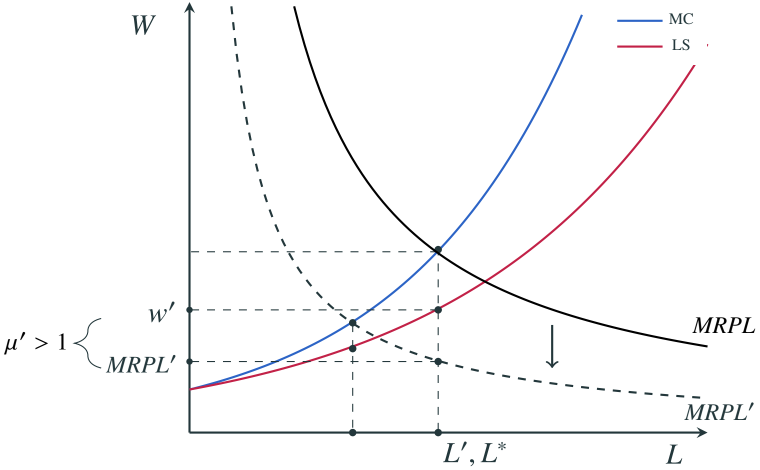


Equilibrium wages and markdown of *unconstrained firm* with monopsony wage setting.

Productivity Shock & No Adjustment Costs



Effect of productivity shift on wages and markdown of *unconstrained firm* with monopsony wage setting.



Effect of productivity shift on wages and markdown of *fully constrained firm* with monopsony wage setting.

Estimation and Results

Estimation of the Markdown

1. Individual wage equation recovers joint distribution of A_{it} and firm wages w_{jt} ▸ Details

$$\underbrace{w_{ijt}}_{\text{Log hourly wage}} = \underbrace{a_i + \lambda_t(X_{it})}_{\text{Ability units } (A_{it})} + \underbrace{w_{jt}}_{\text{Firm wage}}$$

- Method: AKM (1999) style approach with time-varying firm fixed effects
- Data: Danish matched employer-employee panel data. ▸ Danish Labor Markets

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2. Estimate production function controlling for ability ($\ell_{jt} = \log \sum_i A_{it} H_{ijt}$) ‣ Details ‣ GNR

$$y_{jt} = f(k_{jt}, \ell_{jt}, m_{jt}) + \nu_{jt}$$

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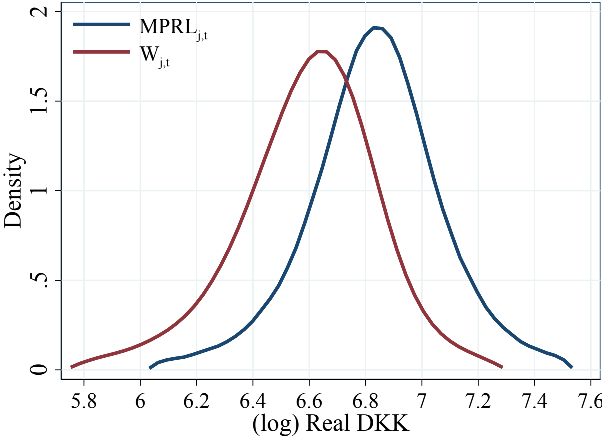
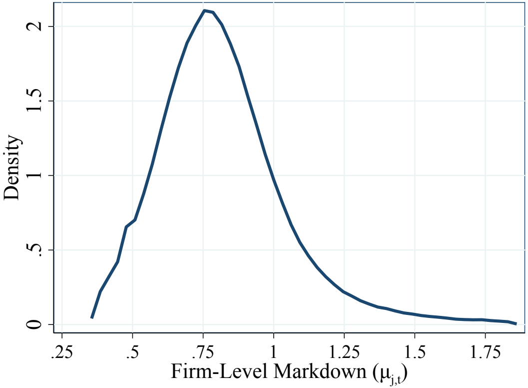
3. Markdown recovered as $\mu_{jt} = \frac{W_{jt}}{MRPL_{jt}}$ ▸ Assumptions

MRPL (blue) vs Ability-adjusted Wage Rate (red)



Mean log $MRPL_{jt} = 6.83$; Mean log $W_{jt} = 6.59$

Markdown Distribution (mean = 0.83; std = 0.27)



$$\mu_{jt} = \underbrace{\frac{\varepsilon^{L}_{Wjt}}{1+\varepsilon^{L}_{Wjt}}}_{\text{monopsony markdown } (\mu^{\varepsilon}_{jt} < 1)} \underbrace{\left(1 - \left(\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial}{\partial L_{jt}} \overline{V}_{jt+1}\right) \overline{\text{MRPL}}_{jt}^{-1}\right)}_{\text{labor cost wedge } (\mu^{\phi}_{jt} <> 1)}$$

▸ More Results

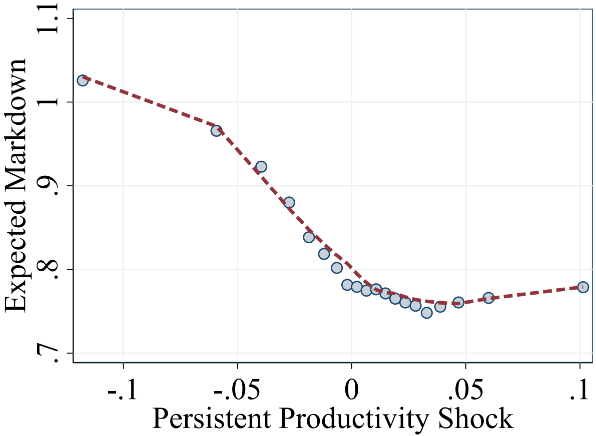
Markdowns greater than one suggests adjustment costs, but could be noise.

If firms actually face adjustment costs, what should we expect to see?

1. Firms with $\mu_{jt} > 1$ should have large negative shocks, lower profits, more debt.
2. Constrained firms have less passthrough to wages as well as markdowns and MRPL.
3. Constrained firms adjust inputs less.

What do we find?

Characteristics of Firms with $\mu > 1$: Cross-sectional Evidence



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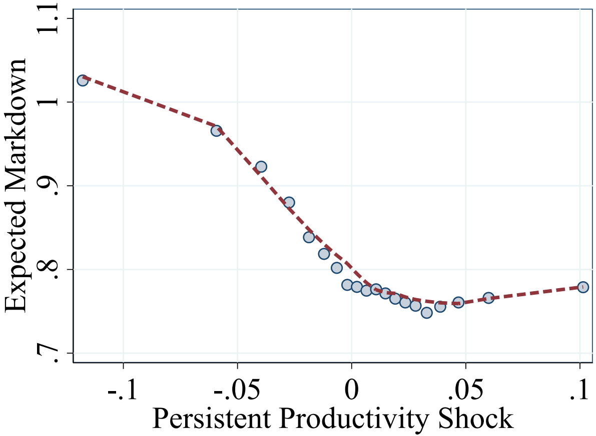

Firms with $\mu > 1$ are:

- Less profitable. $\mathbb{E}[\pi/\text{revenue}|\mu > 1] = -1\%$ (vs 10% for $\mu < 1$)
- More leveraged. $\mathbb{E}[\text{debt}/\text{assets}|\mu > 1] = 96\%$ (vs 84% for $\mu < 1$)

Passthrough of Productivity Shock to Wages

Use wage equation to estimate the elasticities of wages to firm productivity ▸ Details

$$\varepsilon^{W}_{\eta_{jt}} = \frac{dw_{jt}}{d\eta_{jt}}$$

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The passthrough from η_{jt} to the MRPL is

$$\varepsilon^{MRPL}_{\eta_{jt}} = \underbrace{1}_{\text{direct}} + \underbrace{\frac{\partial \log F^L}{\partial \ell_{jt}} \frac{d\ell_{jt}}{d\eta_{jt}}}_{\text{labor } <0} + \underbrace{\frac{\partial \log F^L}{\partial m_{jt}} \frac{dm_{jt}}{d\eta_{jt}}}_{\text{materials } >0}$$

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The passthrough from η_{jt} to the markdown is

$$\varepsilon^{\mu}_{\eta_{jt}} = \underbrace{\frac{d}{d\eta_{jt}} \log \frac{\varepsilon^{L}_{\overline{W}jt}}{1+\varepsilon^{L}_{\overline{W}jt}}}_{\text{monopsony md} <0} + \underbrace{\frac{d}{d\eta_{jt}} \log \left(1 - \left(\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial}{\partial L_{jt}} \overline{V}_{jt+1}\right) \overline{MRPL}_{jt}^{-1}\right)}_{\text{cost wedge} <>0}$$

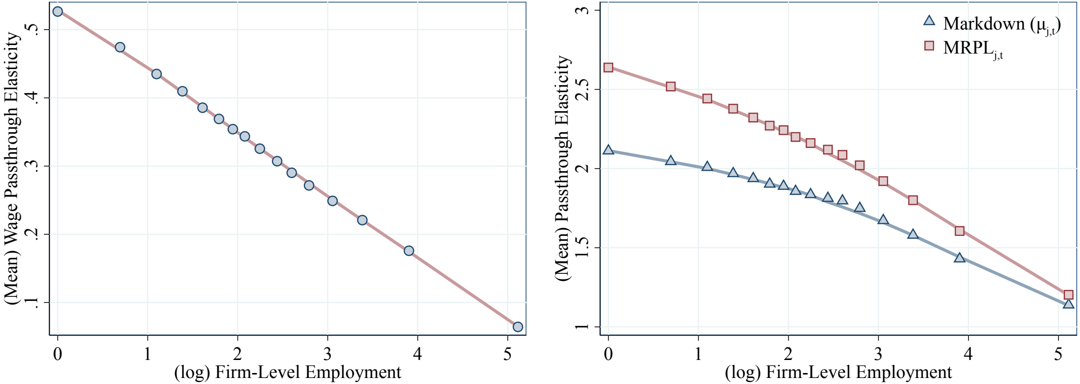
What should we expect to see if firms are constrained?

- Constrained firms who adjust inputs little (or not at all) will have:
  - Passthrough to wages $\to$ 0 (no movement on supply curve).
  - Passthrough to MRPL $\to$ 1 (only direct effect on MRPL).
  - Passthrough to markdown $\to$ -1 (only direct effect on MRPL component).
- Unconstrained firms will have higher passthrough (input adjustment channels).
- Shape of passthrough (e.g.: asymmetry) tells us about nature of constraints.

What we do:

- Estimate the firm-time level distribution of passthrough elasticities.
- Infer which firms are constrained by looking at passthrough elasticities.
- Examine passthrough of firms we know are more constrained to verify model intuition.

Passthrough elasticities not consistent with (only) monopsony power



(a) Wage Passthrough ($\varepsilon^{W}_{\eta_{jt}}$) **(b)** Decomposition ($\varepsilon^{MRPL}_{\eta_{jt}}$, $|\varepsilon^{\mu}_{\eta_{jt}}|$)

- $\mathbb{E}[\varepsilon^{W}_{\eta_{jt}}] = 0.35, \qquad \mathbb{E}[\varepsilon^{MRPL}_{\eta_{jt}}] = 2.2, \qquad \mathbb{E}[\varepsilon^{\mu}_{\eta_{jt}}] = -1.85.$
- Passthrough to MRPL and markdown (absolute values) from η declines with size.
- Canonical monopsony models predict **opposite** decomposition result. example

Monopsony Power or Labor Costs?

Results:

- Significant portion of firms have passthrough close to constrained minimum.
- Larger firms have lower passthrough (more constrained).
- Results appear inconsistent with predictions of monopsony power.

Other evidence supporting either monopsony power or adjustment costs (in paper)

- Lower passthrough in high tenure firms and low churn markets (adjustment costs). go
- Large firms adjust labor inputs relatively less (adjustment costs) go
- Passthrough is highly asymmetric (adjustment costs). go
- Passthrough to markdown increases (in magnitude) in market share (monopsony power). go
- No passthrough of aggregate shocks to markdowns (monopsony power). go

Taking Stock

So far :

- We estimated markdowns and passthrough with minimal assumptions on LS and Φ_{jt}
- We showed evidence of adjustment costs
    - Markdown and passthrough distributions consistent with the presence of adjustment costs
    - Bigger firms are more constrained by adjustment costs

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Now: Quantify the relative importance of monopsony power and adjustment costs

1. Put structure on LS and estimate monopsony markdown (μ^{ε}_{jt})
2. Recover/estimate net marginal costs $\left(\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}}\right)$
3. Validation exercises (does the cost wedge behave as expected?)
4. Quantification and Counterfactual exercises (ongoing)

Assume workers utility at firms depends on:

- Wages, firm characteristics, amenities, preference shocks
- Preference shock is iid and follows type I extreme value distribution (Nested Logit)

Estimate supply elasticity following Lamadon et al. 22 and Chan et al. 24.

Details

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Details

Results:

- $\mathbb{E}[\varepsilon^{L}_{W_{jt}}] = 2.8$, $\mathbb{E}[\mu^{\varepsilon}_{jt}] = 0.74 \implies \mathbb{E}[\mu^{\phi}_{jt}] = 1.09$. Recall that $\mathbb{E}(\mu_{jt}) = 0.83$

$$\mu_{jt} = \mu^{\varepsilon}_{jt}\mu^{\phi}_{jt} = \frac{\varepsilon^{L}_{Wjt}}{1+\varepsilon^{L}_{Wjt}}\left(1 - \left(\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial}{\partial L_{jt}}\overline{V}_{jt+1}\right)\overline{\mathrm{MRPL}}_{jt}^{-1}\right)$$

- Firms *hoard* labor and pay higher wages on average due to adjustment costs.

Recovering Net Adjustment Costs

Assume quadratic cost function in employment, and cost depends on firm characteristics and labor composition. Estimate the net marginal cost of labor and recover $\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}}$

Go.

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▸ Go.

- $\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}} < 0$ on average. 83% of firms constrained above static optimum employment.
- Which firms are more constrained? $\left(\text{larger} \left| \frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}} \right|\right)$
  - Larger firms. Less productive firms. Lower revenue firms.
  - More leveraged firms. Firms in lower mobility/churn labor markets.
  - Consistent with markdown estimate predictions
- Which firms tend to under-employ? $\left(\frac{\partial \Phi}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}} > 0\right)$
  - Smaller firms, more productive firms, firms with positive shocks.

How much do adjustment costs matter for markdown dispersion?

- $Var(\log \mu_{jt}) = Var(\log \mu_{jt}^{\varepsilon}) + Var(\log \mu_{jt}^{\phi}) + Var(\epsilon_{jt}^{\phi})$ + covariance terms
- Removing estimated cost wedge (μ_{jt}^{ϕ}) reduces markdown variance by **27%**.
- Removing monopsony markdown (μ_{jt}^{ε}) reduces variance by 4%.
- This doesn't account for non-linear interactions

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How much do adjustment costs matter for dynamics/passthrough?

- Note: $\varepsilon^{\mu}_{\eta_{jt}}(-1.85) = \varepsilon^{\mu^{\varepsilon}}_{\eta_{jt}}(-0.03) + \varepsilon^{\mu^{\phi}}_{\eta_{jt}}(-1.41) + \varepsilon^{\epsilon^{\phi}}_{\eta_{jt}}(-0.41)$
- **Cost function accounts for 76% of passthrough to markdown.**
- Very little passthrough (directly) from monopsony power.

Next Steps

- Conduct counterfactual (equilibrium) decomposition of variance of markdown and passthrough (in progress).

Conclusion

What we do:

- Add firm dynamic component to classic static monopsony wage posting model
- Estimate markdown and passthrough distributions

- Quantify the relative role of adjustment costs and monopsony power on wage levels and dispersion

What we do:

- Add firm dynamic component to classic static monopsony wage posting model
- Estimate markdown and passthrough distributions
  - 15% of firms have a markdown>1 (W > MRPL)
  - Show evidence of dynamic forces contributing to the wedge between wage and MRPL
- Quantify the relative role of adjustment costs and monopsony power on wage levels and dispersion
  - 83% of firms pay above monopsony level due to adjustment costs.
  - Removing cost wedge reduces empirical wage variance by 27%.
  - Removing monopsony markdown reduces variance by 4%.
  - Labor adjustment costs account for 76% of passthrough to markdown.
  - Adjustment costs moderate the effect of monopsony power on markdowns and passthrough.

Estimation: Ability and Firm-level Wage

Assume $\lambda_t(X_{it}) = X_{it}\Gamma_t$, so worker ability can be recovered by estimating the following:

$$\underbrace{w_{ijt}}_{\text{Log hourly wage}} = \underbrace{\alpha_i + \mathbf{X}_{it}\Gamma_t}_{\text{Ability units}} + \underbrace{w_{jt}}_{\text{Per-unit ability price}} + \xi_{ijt}$$

- Ability includes unobserved (α_i) and observed characteristics (age, educ., occ.)
- Allows for time-varying firm ability price, w_{jt}.
- $L_{jt} = \sum_{i(j,t)} \exp\left(\hat{\alpha}_i + X_{it}\hat{\Gamma}_t\right) H_{ijt}$

▸ Identification ▸ Multi-job Connected Set ▸ SMB ▸ Variance decomposition

▸ Back

Estimation: Firm-Level TFP

Estimate firm productivity using *non-parametric* approach building on Gandhi et al. (2020)

$$y_{jt} = f(k_{jt}, m_{jt}, \ell_{jt}) + \underbrace{\omega_{jt} + \epsilon_{jt}}_{\nu_{jt}}, \quad \omega_{jt} = \mathbb{E}[\omega_{jt} | \omega_{jt-1}] + \eta_{jt}$$

- **Innovation**
  - Controlling for labor ability (from previous step)
  - Allow labor adjustment costs rather than flexible labor input assumption
  - Does *not* require knowledge of adjustment cost or labor supply functions.
- **Non-parametric estimation**
  - Allows arbitrary substitution patterns between inputs.
- **Outcome**
  - Provides distributions of *productivity* ($\nu_{jt}, \eta_{jt}, \epsilon_{jt}$), RTS_{jt}, MRPL_{jt} and *markdowns* (μ_{jt}).

Back

TFP Estimation Relative to GNR Back

Follows GNR (2020) very closely:

- Almost identical timing assumptions (M_{jt} flexible, K_{jt} predetermined).
- Materials elasticity identified off of intermediate expenditures share of revenue.
- Capital and Labor elasticities identified off covariation with output.
- Estimated non-parametrically following GNR.

Deviates from GNR in a few key ways:

- Labor not predetermined, and so is correlated with η_{jt}.
- IVs for labor are terms in $\tilde{Z}_{jt-1}$ other than size/ability.
- Controls for variation in labor quality/labor-enhancing productivity.
    - $L_{jt} = \sum_{ijt} A_{ijt} H_{ijt} = \overline{A}_{jt} H_{jt}$ where H_{jt} is total hours of labor at firm j, and $\overline{A}_{jt}$ is hours-weighted mean ability.
    - Can think of $\overline{A}_{jt}$ as capturing firm-specific labor-enhancing productivity.

Key Assumptions

Back to model Back to estimation

Sufficient to recover productivity, wages, markdowns:

- (Almost) Standard GNR assumptions on production function.
  - e.g.: Firms are price takers in output/input markets. Timing/productivity assumptions.
  - Provides identification of production function absent price data.
  - Only deviation from GNR is that L_{jt} is dynamic and firms are not price takers in labor.
- Labor perfectly substitutable (in production) conditional on ability.
  - Law of one price in firm. Identification of worker ability/ability price via AKM equation.
- L_{jt} is monotone function of $\tilde{Z}_{jt-1}$ via cost function.
  - Validity of IVs used to identify production function.

Needed to derive passthrough equations and analyze markdowns:

- LS function is monotone and differentiable in $\overline{W}_{jt}$, Φ is differentiable in L_{jt}.
  - Deriving markdown and passthrough equations.
- Additional regularity conditions to ensure existence of solution to firm problem.

Variance Decomposition

	1991-2000	2001-2010	Pooled
Variance of hourly wages $Var\left(w_{ijt}\right)$	0.287	0.315	0.302
Worker heterogeneity $Var\left(\alpha_i + X_{it}\Gamma_t\right)$	0.138	0.155	0.148
Firm heterogeneity $Var\left(\psi_{j(i,t)t}\right)$	0.045	0.052	0.049
Residuals $Var\left(\xi_{ijt}\right)$	0.106	0.110	0.108
Wage sorting $2 \times Cov\left(\alpha_i + X_{it}\Gamma_t, \psi_{j(i,t)t}\right)$	-0.001	-0.003	-0.002
Largest connected set	98.0%	99.0%	99.0%
R^2	62.0%	63.0%	63.0%

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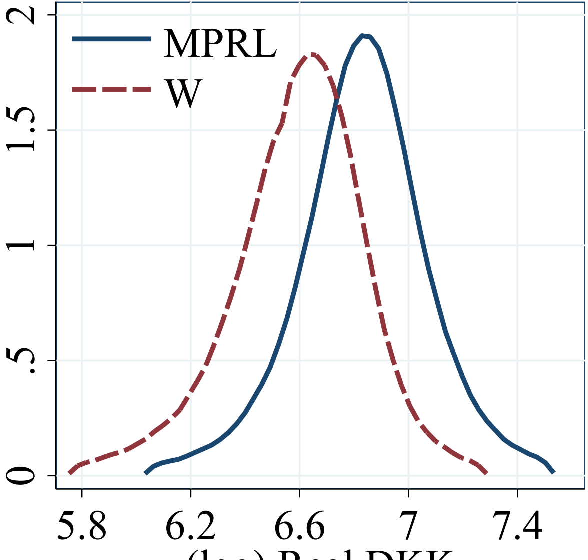
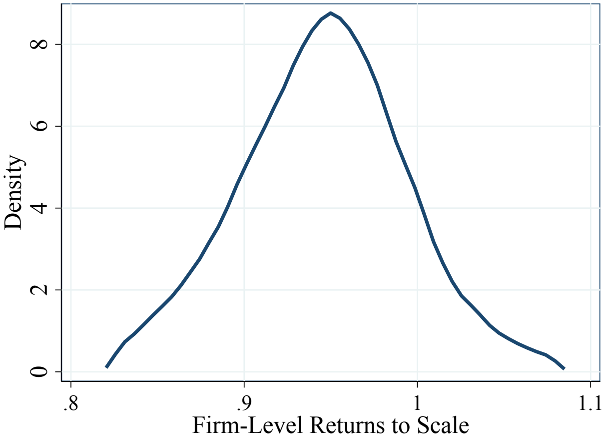
MRPL (red) vs Wage Rate (blue)



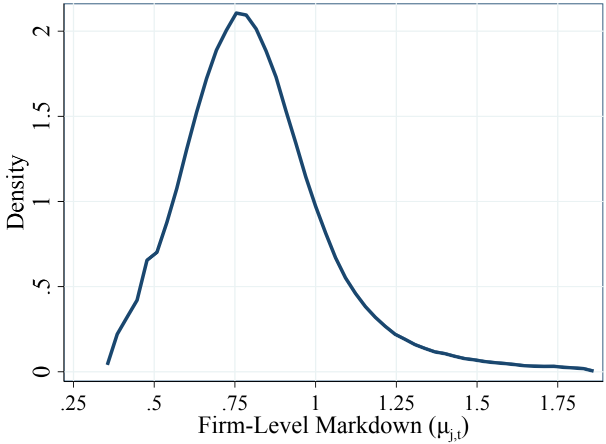
Return to Scale



Mean = 0.95; std = 0.05; p99 = 1.08

Back

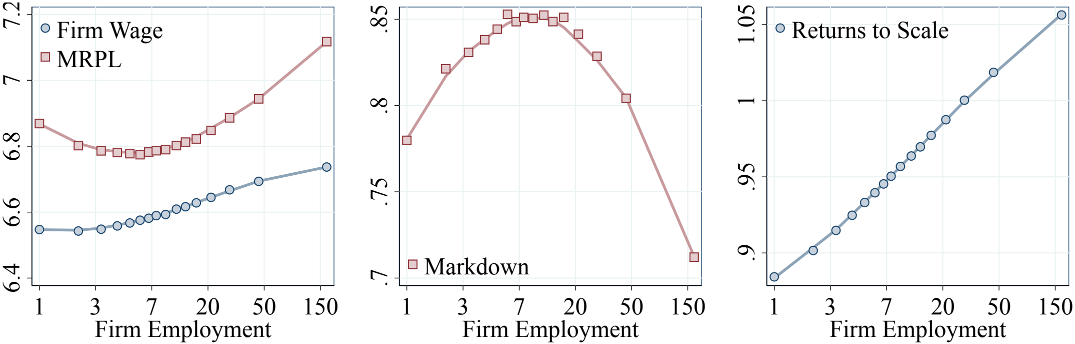
Markdown Distribution



Mean = 0.83; std = 0.27

Back

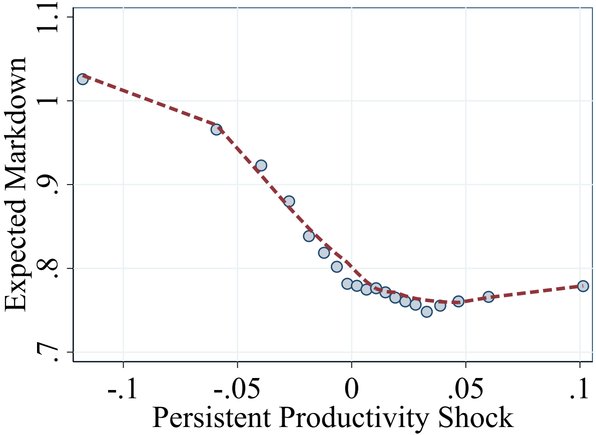
Correlation of Wages, MRPL, RTS and MD with Size



(c) W_{jt} and $MRPL_{jt}$ **(d)** Markdowns **(e)** Returns to Scale

Back

Expected Markdowns by Shock Size



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Sample Details

Firms: TFP shocks

- Firms in private sector with at least one employee
- Firms with at least three years of data (we use two lags in TFP estimation)
- Drop firms with imputed variables
- About 380,000 firm-year observations

Workers: Change in Annual Wage

- All private-sector workers including part-time and multiple jobs.
- No public sector or self-employed workers
- About 9.1 million worker-year observations

back

Passthrough of Idiosyncratic and Aggregate Shocks back

Elasticity	$\varepsilon^{W}_{\eta_{jt}}$ (1)	$\varepsilon^{MRPL}_{\eta_{jt}}$ (2)	$\varepsilon^{\mu}_{\eta_{jt}}$ (3)
Idiosyncratic shocks	0.425	2.256	-1.731
Industry shocks	0.074	1.071	-0.997
Aggregate shocks	1.175	1.140	0.035

- Aggregate labor and intermediate supply curves very inelastic $\implies$ only direct passthrough effect to MRPL.
- Market power comes from *relative* market share. No change in relative shares from economy-wide shock $\implies$ less (no) passthrough to markdowns.

AKM Identification ▸ Back

- Identify returns to covariates using "common switchers"

$$w_{ijt} - w_{mjt} = \alpha_i - \alpha_m + (\mathbf{X}_{it} - \mathbf{X}_{mt})\Gamma_t + \xi_{ijt} - \xi_{mjt}$$
$$w_{ikt-1} - w_{mkt-1} = \alpha_i - \alpha_m + (\mathbf{X}_{it-1} - \mathbf{X}_{mt-1})\Gamma_{t-1} + \xi_{ikt-1} - \xi_{mkt-1}$$
$$\implies \Delta w_{it} - \Delta w_{mt} = (\mathbf{X}_{it} - \mathbf{X}_{mt})\Gamma_t - (\mathbf{X}_{it-1} - \mathbf{X}_{mt-1})\Gamma_{t-1} + \Delta\xi_{it} + \Delta\xi_{mt}$$

- Identify firm time effects using all switchers

$$\psi_{j(i,t)t} - \psi_{k(i,t-1)t-1} = w_{ijt} - w_{ikt-1} + \mathbf{X}_{it}\Gamma_t - \mathbf{X}_{it-1}\Gamma_{t-1} + \xi_{ijt} - \xi_{ikt-1}$$

- Worker time invariant fixed effects then recovered as

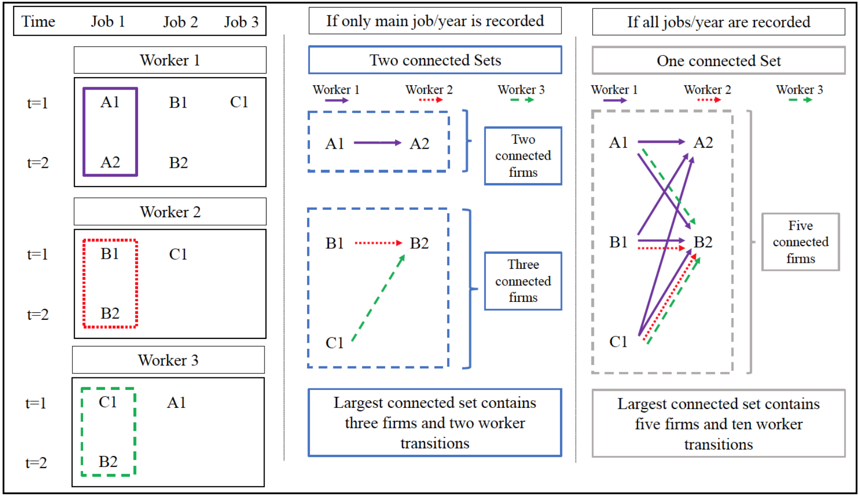
$$\alpha_i = \mathbb{E}_{j(i,t)t}\left[w_{ijt} - \psi_{j(i,t)t} - \mathbf{X}_{it}\Gamma_t\right]$$

- Multiple jobs per worker provides additional identification

$$w_{ijt} - w_{ikt} = \psi_{jt} - \psi_{kt} + \xi_{ijt} - \xi_{ikt}$$

Connected Set Using Multiple Jobs

Back



Note: 54.4% of workers have held a second job in at least one year, and 4.7% of workers have held three or

Accounting for Small Mobility Bias ▸ Back

Min # Connections:	Minimum number of ex-ante connections: 1	2	3	4	5	10	15	50	100
Share Explained by:									
$\alpha_i + X_{it}\Gamma$	51.0%	51.0%	51.1%	51.3%	51.4%	52.1%	52.7%	54.4%	55.4%
$\psi_{(i,t)j}$	11.3%	11.0%	10.3%	10.0%	9.5%	8.4%	7.9%	6.8%	6.4%
$2 \times Cov\left(\psi_{(i,t)j}, \alpha_i + X_{it}\Gamma\right)$	1.0%	1.0%	1.3%	1.4%	1.5%	1.6%	1.6%	1.2%	1.1%
$Corr\left(\psi_{(i,t)j}, \alpha_i + X_{it}\Gamma\right)$	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.03	0.03
Num $i \times j \times t$ obs.	57,509,434								
Unique firms	450,467								
Unique firm/times	2,967,450								
Unique Workers	4,329,825								
Largest Connected set contains:									
Firm/times	2,784,546	2,639,123	2,258,122	2,043,546	1,800,386	1,196,300	871,560	257,752	116,421
% of baseline sample	(93.8%)	(89.0%)	(76.1%)	(68.9%)	(60.7%)	(40.3%)	(29.4%)	(8.7%)	(3.9%)
Workers	4,303,394	4,299,071	4,290,456	4,281,289	4,271,422	4,219,321	4,169,563	3,931,396	3,755,195
% of the sample	(99.4%)	(99.3%)	(99.1%)	(98.9%)	(98.7%)	(97.4%)	(96.3%)	(90.8%)	(86.7%)
Firms	412,822	389,135	349,627	313,090	281,466	188,705	138,320	39,909	17,532
$i \times j \times t$ observations	57,295,638	57,130,540	56,666,144	56,308,219	55,812,613	53,721,761	51,828,097	44,116,870	39,491,246
Mean hourly wage	5.17	5.17	5.17	5.17	5.17	5.18	5.19	5.2	5.21
Variance of hourly wage	0.30	0.30	0.30	0.30	0.30	0.29	0.29	0.26	0.25
R^2	0.63	0.63	0.63	0.63	0.62	0.62	0.62	0.62	0.63
RMSE	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.33	0.32
% of Firms in connected set:									
<=2 connections	35.1%	14.8%	4.0%	2.30%	1.40%	0.55%	0.35%	0.04%	0.00%
<5 connections	39%	31.90%	21.90%	15.60%	7.90%	1.80%	1.10%	0.14%	0.00%
<10 connections	57.00%	54.70%	47.30%	42.20%	35.10%	13.00%	5.80%	0.80%	0.20%
Mean connections	42.0	44.2	51.2	56.1	62.9	89.9	117.8	325.6	632.1
Median connections	8	8	10	12	14	21	29	81	166

Notes: Table II presents the results of our AKM wage decomposition exercise and analyses the effects of limited mobility bias in our estimates. Specifically, it shows how the contribution of worker's characteristics, firms' characteristics and sorting varies at different minimum thresholds of number of ex-ante connections. Our procedure is to use the full sample to characterize the graph of connections between workers and firms. We then obtain for each firm-time pair the number of (ex-ante connections) in this graph and drop any firm-times which have below the minimum number of connections listed in the top row of each column. We then recalculate the largest connected set and estimate our AKM model on that subset of firms and workers. All estimations are obtained by pooling data from 1991 to 2010.

Moments of the TFP Distribution and Shocks

Controlling for worker ability greatly reduces the dispersion in firm-level TFP and shocks

Table 1: Moments of the log-TFP and TFP shock Distribution

		Std. Dev.	P75-P25	P90-P10	Skewness
Log TFP, ν_{jt}	Hours	1.57	1.75	3.55	-1.82
	AKM	0.63	0.67	1.43	1.41
TFP shock, η_{jt}	Hours	0.64	0.43	1.10	0.50
	AKM	0.19	0.13	0.29	8.14

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Cross Sectional Moments: Workers Characteristics

Back

	Earnings	Wages	Hourly Wage	Age
Mean	51725	57603	38	38
Std. Dev.	38104	116043	160	13
P10	6831	10947	17	20
P25	25889	38466	27	28
P50	51621	54835	35	38
P75	67973	70411	44	48
P90	89303	92626	58	57
P99	167349	181440	117	66
Obs		9,130,859		

Workers Sample: Cross sectional moments in US dollars of 2010

Note: percentiles are means of adjacent quantiles (>500 observations)

Cross Sectional Moments: Firms Characteristics

Back

	Employment	Revenue	Value Added	Firm Age
Mean	24	6766746	2180807	16
Std. Dev.	211	82763326	22441249	11
P10	1	288728	113692	5
P25	3	493095	195792	7
P50	6	1023965	402569	14
P75	14	2735885	1018729	22
P90	36	8532308	2918440	30
P99	283	86353925	27468089	50
Obs		380,191		

Firms Sample: Cross sectional moments in US dollars of 2010

Note: percentiles are means of adjacent quantiles (>500 observations)

Cross Sectional Moments: TFP Estimates Back

Table 2: Cross-Sectional Model Estimates

Variables	ν_{jt}	η_{jt}	w_{jt}	$\log \mu_{jt}$	$\log MRPL_{jt}$	RTS	ε_K^Y	ε_L^Y	ε_M^Y
Mean	0.00	0.01	6.59	0.83	6.83	0.95	0.05	0.35	0.54
Std. Dev.	0.19	0.05	0.28	0.27	0.27	0.05	0.02	0.14	0.17
p10	-0.22	-0.05	6.26	0.55	6.52	0.88	0.03	0.16	0.33
p25	-0.10	-0.02	6.45	0.66	6.69	0.91	0.04	0.26	0.43
p50	0.01	0.01	6.61	0.79	6.84	0.95	0.05	0.36	0.54
p75	0.10	0.03	6.76	0.94	6.98	0.98	0.06	0.44	0.66
p90	0.21	0.05	6.89	1.11	7.13	1.01	0.07	0.53	0.77
p99	0.52	0.12	7.27	1.85	7.52	1.08	0.10	0.68	0.91
obs					374470				

Note: percentiles are means of adjacent quantiles (>500 observations)

Danish Labor Market ▸ Back

- Similar to other Scandinavian countries, the Danish economy is known for a large welfare state, redistribute policies (eg. free health care, child care, education, etc.), and generous unemployment benefits.
- The Danish labor market is characterized by lax employment protection, generous unemployment insurance, and active participation of firms, workers, and the government in the promotion of employment.
- The low barriers to firing and hiring workers and the presence of a safety net for unemployed workers—a system that has been called "flexicurity" (Andersen and Svarer (2007))—has generated a resilient labor market with high turnover keeping unemployment spells short even during periods of economic distress (Andersen (2021)).
- Income inequality in Denmark is lower relative to other countries, but it has increased in recent years, in part, because of a significant decline in unemployment insurance (Leth-Petersen and Sæverud (2021)).

Model Estimation Results

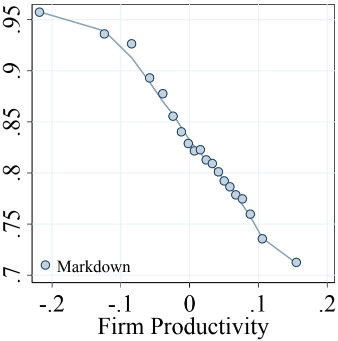
Variables	ν_{jt}	η_{jt}	w_{jt}	μ_{jt}	$\log MRPL_{jt}$	RTS	ε_K^Y	ε_L^Y	ε_M^Y
Mean	0.00	0.01	6.59	0.83	6.83	0.95	0.05	0.35	0.54
Std. Dev.	0.19	0.05	0.28	0.27	0.27	0.05	0.02	0.14	0.17
p10	-0.22	-0.05	6.26	0.55	6.52	0.88	0.03	0.16	0.33
p50	0.01	0.01	6.61	0.79	6.84	0.95	0.05	0.36	0.54
p90	0.21	0.05	6.89	1.11	7.13	1.01	0.07	0.53	0.77
p99	0.52	0.12	7.27	1.85	7.52	1.08	0.10	0.68	0.91
obs					374470				

Note: percentiles are means of adjacent quantiles (>500 observations)

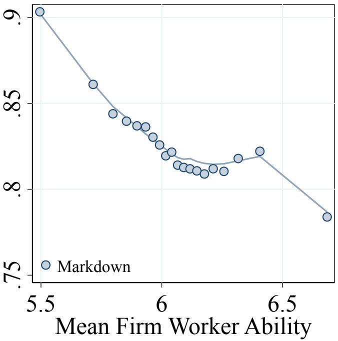
Correlation of Wages, MRPL, RTS and Markdowns with Size

(f) W_{jt} and $MRPL_{jt}$ **(g)** Markdowns **(h)** Returns to Scale

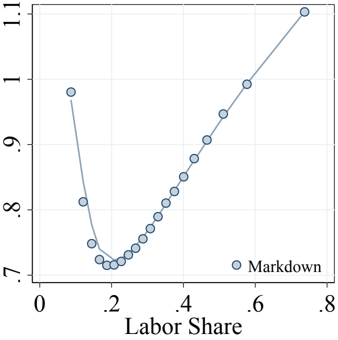
Markdowns by Productivity, Ability and Labor Share



(i) Markdowns and ω_{jt}



(j) Markdowns and $\mathbb{E}(A_{ijt})$



(k) Markdowns and WL/R

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Passthrough Estimating Equations ▸ Back

Our main equation to estimate $\epsilon_{\eta}^{W} = \frac{\partial \log W_{ijt}}{\partial \eta_{jt}}$ is derived directly from the model:

$$\varepsilon_{\eta}^{W} = \frac{d}{d\eta} w_{jt}(\eta_{jt}, \epsilon_{jt}, K_{jt}, P_t, L_{jt-1}, Z_{jt}, \tilde{Z}_{jt-1})$$

Where:

- Z_{jt} includes industry, location, work amenities, and firm age.
- $\tilde{Z}_{jt-1}$ includes lags of workforce characteristics (ability, age, education, experience, tenure, etc).
- To save on notation, define $\bar{X}_{jt} \equiv \{K_{jt}, L_{jt-1}, \tilde{Z}_{jt-1}, Z_{jt}\}$
- Control for unknown P_t using time FE δ_t.
- Control for unobserved amenities/competition using lagged labor market shares.
    - *Exact control if amenities/competition only enter wage via market share (logit/CES).*

Passthrough Estimating Equations: Two Approaches

Average Passthrough (log-linear approximation)

$$\Delta w_{jt} = \alpha + \underbrace{\beta^{\eta}\eta_{jt} + \beta^{\epsilon}\epsilon_{jt}}_{\text{TFP Shocks}} + \underbrace{\bar{X}_{jt}\Gamma + \beta^{w} w_{jt-1} + \delta_t}_{\text{Controls}} + \zeta_{ijt}$$

Passthrough elasticity $\varepsilon^{W}_{\eta} = \beta^{\eta}$. Captures **average** passthrough of η to wages.

Heterogeneous Passthrough (second-degree polynomial approximation)

$$\varepsilon^{W}_{\eta_{jt}} = \varepsilon^{W}_{\eta}(\eta_{jt}, \epsilon_{jt}, \bar{X}_{jt}, w_{jt-1}, \delta_t)$$

Recovers distribution of **firm-level** passthrough.

MRPL and μ functions of same information set, so estimate $\varepsilon^{MRPL}_{\eta_{jt}}$ and $\varepsilon^{\mu}_{\eta_{jt}}$ same way.

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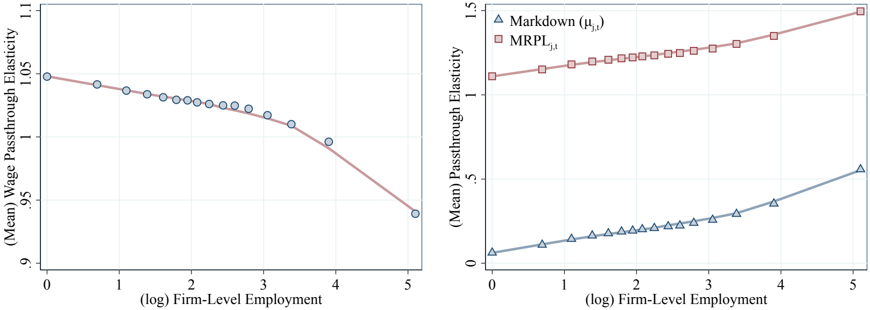
Simple Market Power Example

Logit Oligopsony Labor Supply ($\varepsilon^L_W = \theta(1 - S_{jt})$), Cobb-Douglas PF, No adjustment costs.



(l) Wage Passthrough **(m)** Decomposition

- Set PF parameters to mean estimated output elasticities: e.g. $\alpha_L = \mathbb{E}[\varepsilon^Y_L]$.

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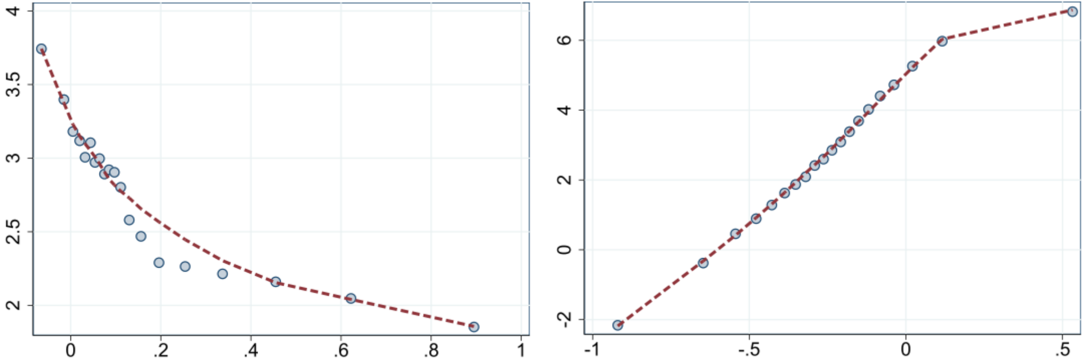
Labor Supply Elasticity by Market Share and Markdown

Back



(a) Labor Market Share (b) (Log) Markdown

- Labor supply elasticity declines in firm-level labor market share.
- Labor supply elasticity increases in the markdown.

Passthrough Mechanisms – Market Power

Simple regression of passthrough elasticities on firm characteristics:

$$\varepsilon_{\eta_{jt}}^{W,\mu,MRPL} = \beta_0^c + \beta^c C_{jt} + X_{jt}^c \Gamma^c + \zeta_{jt}^c$$

Results: Market Power Mechanism

C_{jt}	$\varepsilon_{\eta_{jt}}^{W}$	$=$	$\varepsilon_{\eta_{jt}}^{MRPL}$	$+$	$\varepsilon_{\eta_{jt}}^{\mu}$
Market Share	-0.10		0.06		-0.16

Intuition:

- Lower LS elasticity $\implies$ higher MC of labor $\implies$ adjust labor less $\implies$ (negative) labor channel weaker $\implies \uparrow \varepsilon_{\eta_{jt}}^{MRPL}$.
- Lower LS elasticity $\implies$ greater (negative) superelasticity (i.e.: larger firms more able to widen markdowns) $\implies \uparrow |\varepsilon_{\eta_{jt}}^{\mu}|$.
- Effect on passthrough to markdowns outweighs effect on MRPL.

back

Passthrough Mechanisms – Technology

Simple regression of passthrough elasticities on firm characteristics:

$$\varepsilon_{\eta_{jt}}^{W,\mu,MRPL} = \beta_0^c + \beta^c C_{jt} + X_{jt}^c \Gamma^c + \zeta_{jt}^c$$

Results: Production Heterogeneity

C_{jt}	$\varepsilon_{\eta_{jt}}^{W}$	=	$\varepsilon_{\eta_{jt}}^{MRPL}$	+	$\varepsilon_{\eta_{jt}}^{\mu}$
$\varepsilon_{M_{jt}}^{Y}$	0.06		1.10		-1.04
$\varepsilon_{L_{jt}}^{Y}$	-0.11		-2.01		1.90

Intuition:

- Larger materials elasticity $\implies \uparrow$ impact of materials channel $\implies \uparrow \varepsilon_{\eta_{jt}}^{MRPL}$ and $\varepsilon_{\eta_{jt}}^{W}$
- Larger labour elasticity $\implies \uparrow$ impact of labour channel $\implies \downarrow \varepsilon_{\eta_{jt}}^{MRPL}$ and $\varepsilon_{\eta_{jt}}^{W}$

back

Passthrough Mechanisms – Adjustment Costs

Simple regression of passthrough elasticities on firm characteristics:

$$\varepsilon_{\eta_{jt}}^{W,\mu,MRPL} = \beta_0^c + \beta^c C_{jt} + X_{jt}^c \Gamma^c + \zeta_{jt}^c$$

Results: Adjustment Cost Mechanism

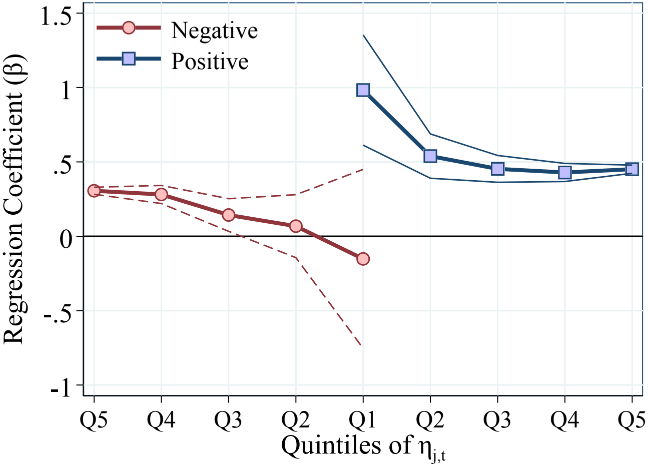
C_{jt}	$\varepsilon_{\eta_{jt}}^{W}$	=	$\varepsilon_{\eta_{jt}}^{MRPL}$	+	$\varepsilon_{\eta_{jt}}^{\mu}$
Mean Tenure	-0.12		-0.36		0.24
Labour Churn	0.26		1.57		-1.43

Intuition:

- Firms with high tenure workers $\implies$ increased adjustment costs $\implies \downarrow \varepsilon_{\eta jt}^{W}$.
- Firms in high churn labor markets $\implies$ decreased adjustment costs $\implies \uparrow \varepsilon_{\eta jt}^{W}$

PT by shock size ▸ back

Passthrough by Shock Sizes



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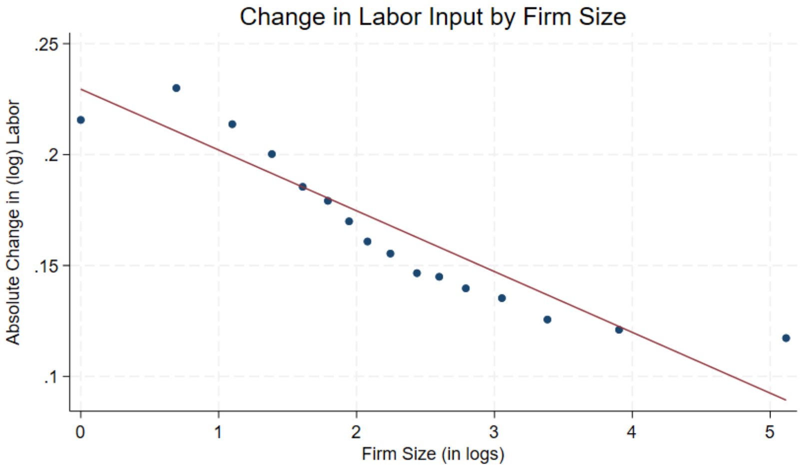
Labor Adjustment by Firm Size



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Labor Supply Function Estimation Back

Assume worker i utility at firm j is:

$$U_{ijt} = f(W_{jt}) + X_{jt}\beta + \xi_{jt} + \epsilon^{u}_{ijt}$$

Nested Logit estimating equation:

$$\log s_{jt} - \log s_{0t} = f(W_{jt}) + X_{jt}\beta + (1 - 1/\sigma_{cz}) \log s_{jgt} + \xi_{jt}$$

- Market g defined as municipality/4-digit industry. σ_{cz} sets correlation of ϵ^{u}_{jt} within g.
- Estimate (in long changes) following Lamadon et al. 22 and Chan et al. 24.

Labor supply elasticities:

$$\varepsilon^{L}_{W_{jt}} = \frac{\partial f(W_{jt})}{\partial W_{jt}} \left(\sigma_g + (1 - \sigma_g) s_{jgt} - s_{jt}\right)$$

Adjustment Costs Function Estimation Back

Assumptions:

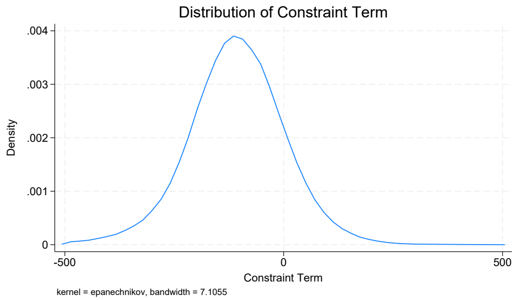
- Adjustment costs is convex in employment level changes
- Adjustment costs varies with firm size and labor force composition

Adjustment Costs Function:

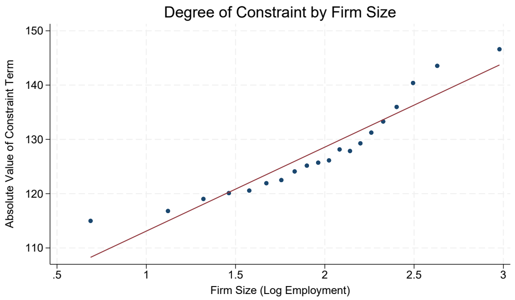
$$\Phi_{jt} = \alpha_0 (L_{jt} - L_{jt-1})^2 + L_{jt} \left[(\tilde{\mathbf{Z}}_{jt} - \tilde{\mathbf{Z}}_{jt-1})^2 \Gamma + \beta \overline{\mathbf{Z}}_{jt} \right]$$

- $\tilde{\mathbf{Z}}_{jt}$ is labor force composition variables: average workers age, average workers ability, share of college workers, share of managers, etc
- $\overline{\mathbf{Z}}_{jt}$ is exogenous firm characteristics: firm ages, industry, municipality

Adjustment Costs Back



(a)



(b)

Note: y-axis for (b) $\left|\frac{\partial \phi_{jt}}{\partial L_{jt}} - \frac{\partial \overline{V}_{jt+1}}{\partial L_{jt}}\right|$