Monopsony Power and Creative Destruction

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Introduction

Research Question

- **Research Question:**
  - How does labor market power affect output and growth?
- **Key trade-off:**
  - Monopsony $\rightarrow$ markdown distribution
  - Static misallocation (lower current output)
  - Innovation incentives (higher output growth)

Motivation

- Productivity growth in developed countries:
  - Slowdown over last decades broadly
- One approach in existing research: product market power
  - Aghion et al., 2023, De Ridder, 2022
- We incorporate labor market power: monopsony
  - Studied e.g. by Berger et al., 2022, Bachmann et al., 2022
  - Focus in existing literature: static misallocation
  - This paper: incorporate long-run growth implications

Overview

- Framework builds on existing firm dynamics & growth models:
    - Klette and Kortum, 2004, Aghion et al., 2023
    - Growth model of creative destruction and product market power
- We expand this with labor market power:
    - Discrete choice workplaces & home production, Card et al., 2018
- Note on monopsony:
    - 'New classical monopsony' as in Card et al., 2018, Manning, 2021
    - Wage setting power: upward sloping labor supply curve facing firm

Model Setup

Workers

- Mass $\mathcal{L}$ workers, no savings
- Choose to work ($g = e$) at firm $j \in \{1, ..., \mathcal{J}\}$, or at home ($g = u$)
- Utility of worker o, choosing to work at firm j:

$$u_{oj} = \beta \log C_j + \xi_{oe} + (1 - \sigma)\varepsilon_{oj}. \quad \xi_{og}, \varepsilon_{oj} \sim EVT1$$

- From logit-choice then follows labor supply given net wage:

$$L_j(W_j) = zW_j^{\frac{\beta}{1-\sigma}},$$

Details

- where z includes the option value of all wages and the outside option
- The labor supply elasticity is:

$$\frac{\partial \log L_j}{\partial \log W_j} = \frac{\beta}{1 - \sigma}$$

Goods Production

- **Final goods production:** $Y = \exp \int_0^1 \ln(q_i y_i) di$.
  - q_i is quality level of good i
- **Intermediate good demand:** $p_i y_i = PY$, normalize $P \equiv 1$.
- **Competition**: Details
  - Bertrand competition in product lines, quality breaks ties.
  - Quality leader in line i is $j(i)$, follower $j'(i)$
  - Leader's quality is one γ-step above follower's: $q_{j(i)} = \gamma q_{j'(i)}$
  - Nash equilibrium: Leader fulfills line demand, $p_i = \gamma mc_{j'(i)}$.
- **Intermediate goods production:** $y_{i,j(i)} = s_{j(i)} l_{i,j(i)}$.
- **Key link:** $mc_{j'(i)}$ depends on firm size due to monopsony! Details
- **Firm types:** Top 10% with productivity s_h, remaining with s_l

Dynamic Block

Dynamic decision: Research effort

- Given line-level solutions:
  - $n_{j,t}$: number of product lines where firm j is quality leader
  - This is firms' only state variable, L_{jt} & W_{jt} follow from it
  - Markups, markdowns function of firm size Details
- The dynamic problem is how much to invest in research:
  - Stock of lines develops according to: $n_{j,t+1} = (1 - X_t)n_{j,t} + x_{jt}$
  - Aggregate rate of creative destruction: $X_t = \sum_j x_{jt}$
  - Cost of drawing x_t new lines: $R(x_{jt}) = \psi Y x_{jt}^{\Phi}$.

Firm Problem on BGP

- Focus on a balanced growth path
  - Constant $\mathcal{J}, X$, constant Top 10% concentration h
  - Quality growth $Q_{t+1}/Q_t = g = \gamma^X$
  - Y_t, mc_{jt}, W_{jt} all grow at g & z at $g_z = g^{-\frac{\beta}{1-\sigma}}$
- Restate firm problem, relative to output Y:

$$v_j(n_j) = \max_{n'_j} n_j - \frac{W_j}{Y} L_j$$
$$- \psi(n'_j - (1-X)n_j)^{\Phi} + \rho v(n'_j),$$

- W_j, L_j are functions of n_j, which is constant on BGP

Output Decomposition

- Define $S \equiv \int_0^1 s_{j(i)} di$, $L \equiv \sum_j L_j$

$$Y = \exp \int_0^1 \ln(q_i y_i) di = Q \exp \int_0^1 \ln(s_{j(i)}) di \exp \int_0^1 \ln(l_{j(i)}) di$$
$$= Q \cdot S \cdot M \cdot L$$

Details

- Where $M = \frac{\exp \int_0^1 \ln \mu_{j(i)} di}{\int_0^1 \mu_{j(i)} di}$ is misallocation from price dispersion
- Decomposition of present value, accounting for g:

$$PV \left\{ \frac{Y}{\mathcal{L}} \right\}_{t=0}^{\infty} \approx \underbrace{\frac{Q_0}{1 - \rho(1+g)} \cdot S \cdot M}_{TFP} \cdot L$$

- Tension between static- and dynamic efficiency. Higher h:
  - Increases S, but also R&D spending $Y \sum_j \psi(Xn_j)^\phi$ for given X

Quantitative Results

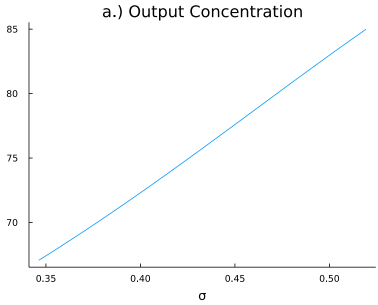
Model Fit

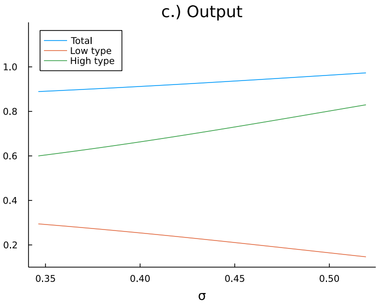
- Match U.S. economy 1954 – 2007: Details

Definition	Data	Model
Average Markup	1.24	1.28
Growth rate	1.078%	1.077%
R&D spending (% of GDP)	2.45%	6.33%
Share of Output, top 10% firms	75.59%	75.74%
Labor Market Participation	83.4%	83.41%
Profit Share	5.45%	5.45%
Top 10% wage premium	21%	25.4%

- Good overall match, although R&D spending too high

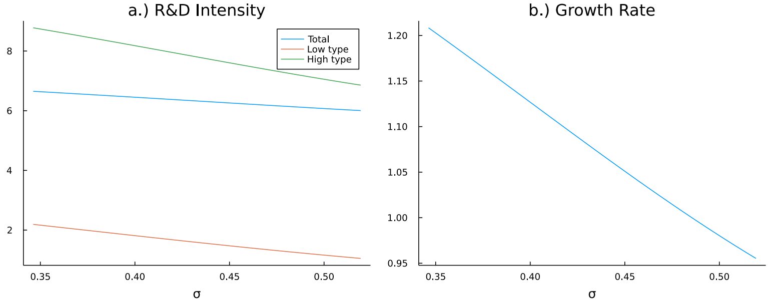
Static Results





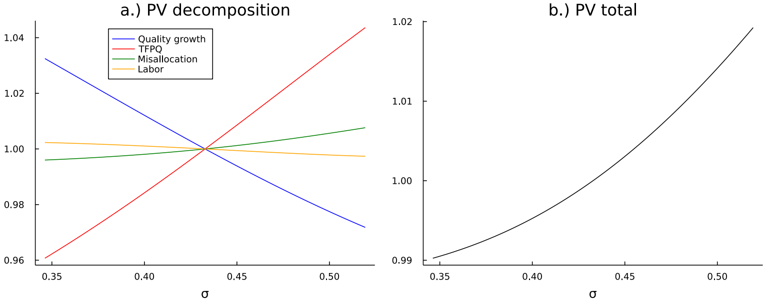
- Concentration increases as σ increases (labor elasticity increases)
- Production (by large firms) increases

Dynamic Results



- R&D by large firms increases, but not in line with Output increases
- Small firm R&D declines
- More concentrated R&D also less efficient
- Strong decline in productivity growth

Present Value Decomposition



- Main channels: Quality growth versus Static TFPQ
- Here: PV maximized for high concentration – low growth scenario!
- Preference change, so no welfare analysis here

Conclusion

- Contribution:
  - Importance of labor supply elasticities for output, wages and growth
  - Key result: Static-dynamic tradeoff
- Omitted in this presentation:
  - Detailed results w.r.t markups, markdowns and wages
  - Policy exercise: Income taxes
  - Amenity-heterogeneity (WIP)

Extension: Taxes

Government, Taxes

- Tax function as in Borella et al., 2022, but here paid by firm:

$$T\left(\frac{W_j}{\bar{W}}\right) = \left(\frac{1}{1-\lambda}\frac{W_j^\tau}{\bar{W}^\tau}\right)^{\frac{1}{1-\tau}} - 1$$

- λ governs average tax level, τ progressivity
- $1-\tau$ is the elasticity of post tax income w.r.t pre tax income
- Reference wage: $\bar{W} = \sum_j L_j W_j / \sum_j L_j$
- The budget balances, government spending G per household:

$$\mathcal{L}G = \sum_j T(W_j/\bar{W})W_j L_j$$

Gross Wage Labor Supply Elasticity

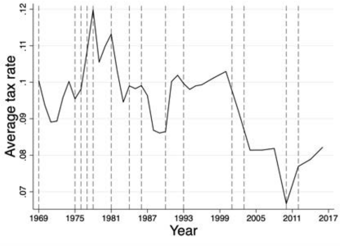
- Gross wage: $W^G = (1 + T(W_j/\bar{W}))W_j$
- Labor supply elasticity wrt the gross wage W^G:

$$\frac{\partial \log(L_j)}{\partial \log(W^G)} = \underbrace{\frac{\beta}{1-\sigma}}_{\textit{preferences}} \underbrace{(1-\tau)}_{\textit{policy}} \tag{1}$$

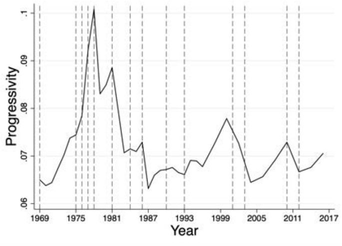
- This is the elasticity relevant to the firm
- Can be directly affected by changing τ

Income Taxation

- Tax level λ and progressivity τ from Borella et al., 2022



(a) Average tax rate at median income (λ)



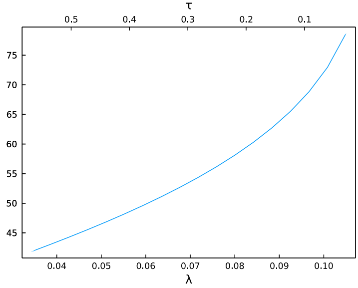
(b) Progressivity parameter (τ)

- Macnamara et al., 2024 suggest tax cuts should increase TFP growth
- TFP growth in data not high(er) post tax cuts, according to model:
  - $\lambda \downarrow$ has no effect on h, slightly increases R&D for all firms
  - $\tau \downarrow$ increases labor elasticity, increases h, decreases (small) firm R&D

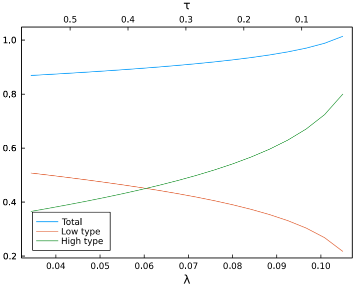
Comparing Tax Regimes

- Before: Little effect from historical reforms
- Now: Show that tax regime can strongly affect growth
- To discipline this exercise, we fix todays G at its base level
- Increasing λ, decreasing τ makes taxes less progressive
- Concentration (almost) entirely from τ, through labor elasticity

Static Results



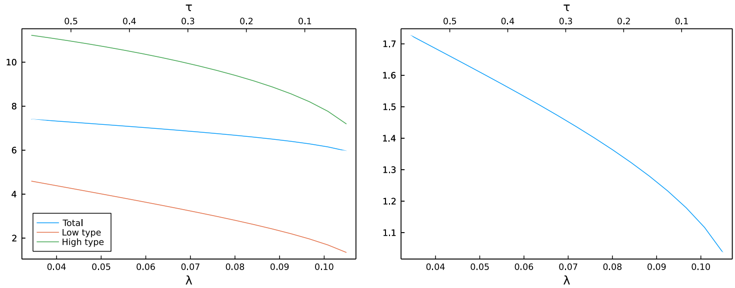
(a) Top 10% Concentration (in %)



(b) Output, relative to base

- Concentration increases as τ decreases (labor elasticities increase)
- Note: Higher λ decreases Output
- Effect from τ (higher S) dominates, Output increases overall

Dynamic Results

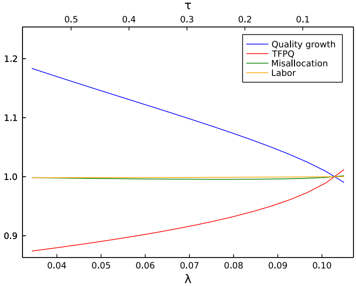


(a) R&D intensity (in %)

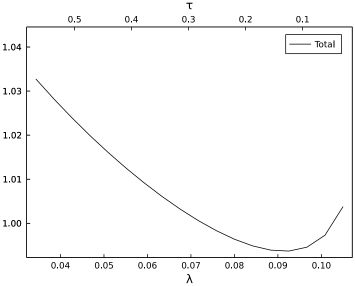
(b) Productivity Growth (in %)

- R&D by large firms increases, but not in line with Output increases
- Small firm R&D declines
- more concentrated R&D also less efficient
- strong decline in productivity growth

Present Value Decomposition



(a) PV Decomposition, relative to base



(b) Total PV, relative to base

- Main channels: Quality growth versus Static TFPQ
- Present value maximized in low base – high progressivity regime
- PV U-Shape, but S capped at $h = 1$ (requires regressive $\tau < 0$!)

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Appendix

Labor Supply: details

- Using $D_e = \sum_{k=1}^{\mathcal{J}} W_k^{\frac{\beta}{1-\sigma}}$ and $D_u = (\omega Y)^{\frac{\beta}{1-\sigma}}$:

$$P(g=e) = \frac{D_e^{1-\sigma}}{D_e^{1-\sigma} + D_u^{1-\sigma}}$$

$$P(j|g=e) = \frac{\exp(\beta \frac{\log W_j)}{1-\sigma}}{D_e} = \frac{W_j^{\frac{\beta}{1-\sigma}}}{D_e}$$

$$P(g=e)P(j|g=e) = \frac{W_j^{\frac{\beta}{1-\sigma}}}{D_e^{\sigma}(D_e^{1-\sigma} + D_u^{1-\sigma})}$$

which implies:

$$L_j(W_j) = \mathcal{L}P(W_j) = \mathcal{L}\frac{W_j^{\frac{\beta}{1-\sigma}}}{\left(\sum_{k=1}^{\mathcal{J}} W_k^{\frac{\beta}{1-\sigma}}\right)^{\sigma} (\omega Y)^{\beta} + \sum_{k=1}^{\mathcal{J}} W_k^{\frac{\beta}{1-\sigma}}}$$

GO BACK

Within-line Nash equilibrium

- There are other equilibria, in which j' threatens price $< mc_{j'}$
- This feature exists in all Klette-Kortum type models
- Competition is in prices, firms commit to produce by setting price
  - Is this a crazy assumption with our increasing marginal cost?
  - Recall that lines are atomistic....
  - ... and that acquiring them is costly!
  - Producing in a single additional line has little of effect on cost
  - In addition, acquiring a line and then not producing in it is clearly not optimal

GO BACK

Note on marginal costs

- Firm-level employment: $L_j = \frac{Y_j}{s_j,}$
- Firm-level output: $Y_j = \int_0^{n_j} y_i di = \int_0^{n_j} \frac{Y}{\gamma mc_{j'(i)}} di$.
  - On BGP, every firm faces the same distribution of 'followers' marginal costs.
  - Therefore, $Y_j = \int_0^{n_j} \frac{Y}{\gamma mc_{j'(i)}} di = \frac{Y}{\gamma m} n_j$, where $m^{-1} \equiv \int_0^1 \frac{1}{mc_{j'(i)}} di$
- Wage: $W_j = \left(\frac{L_j}{z}\right)^{\frac{1-\sigma}{\beta}} = \left(\frac{Y_j}{s_j z}\right)^{\frac{1-\sigma}{\beta}}$
  - Recall $z \equiv \frac{\mathcal{L}}{D_e^\sigma (\bar{W} Y)^\beta + D_e}$
- Production costs: $C(Y_j) = (1 + T(W_j(Y_j)/\bar{W}))W_j(Y_j)L_j(Y_j)$
- Marginal cost of increasing production: $mc_j = C'(Y_j)$.

GO BACK

Markups and Markdowns

- From line-level equilibrium: $p_i = \gamma mc_{j'(i)}$
- Line-level markups p/mc thus depend on leader, follower:

$$\mu_{j(i)j'(i)} = \gamma \frac{mc_{j'(i)}}{mc_{j(i)}}$$

- Firm-level markups additionally a function of $m = \left(\int_0^1 mc_{j(i)}^{-1} di \right)^{-1}$

$$\mu_j \equiv \frac{\int_0^{n_j} y_i p_i di}{mc_j \cdot \int_0^{n_j} y_i di} = \frac{\gamma m}{mc_j}.$$

- Gross wage markdown is then a function of markup, taxes:

$$\frac{W_j \cdot \left(1 + T\left(\frac{W_j}{\bar{W}}\right)\right)}{\gamma ms_j} = \frac{1}{\mu_j} \cdot \frac{\frac{\beta}{1-\sigma}}{1 + \frac{\beta}{1-\sigma} + \frac{\tau}{1-\tau}}$$

Go back

Closing the model

- Final output is spent on private consumption C, government consumption $\mathcal{L}G$, research spending X, and rents R.
  1. $X = Y \sum_j \psi(n'_j - (1-X)n_j)^{\phi}$
  2. $C = \int_o W_o$
  3. $R = \sum_j (Y - (1 + T(W_j/\bar{W}))L_j W_j - Y\psi(n'_j - (1-X)n_j)^{\phi})$
- Growth rate depends on aggregate rate X of creative destruction:

$$X = \sum_j x_j, \quad g = \gamma^X.$$

Algorithm, Outer Loop

- **Outer loop:** Guess J_{guess}
- **Inner loop:** Fully solve model given J_{guess}
- **Compute:** $V_{\text{entry}} = \frac{\alpha \tilde{v}_h(n_h) + (1-\alpha)\tilde{v}_l(n_l)}{1-\rho}$
- **Outer Check:** $|V_{\text{entry}} - \text{entry cost}|$

Back to results

Algorithm, Inner Loop

Inner loop: Guess $h_{\text{guess}}, \left(\frac{Y}{mz}\right)_{\text{guess}}$

- Compute $n_h = \frac{h_{\text{guess}}}{J_h}, n_l = \frac{1-h_{\text{guess}}}{J_l}$
- Get $w_j = \left(n_h \left(\frac{Y}{mz}\right)_{\text{guess}} \frac{1}{\gamma s_j}\right)^{\frac{1-\sigma}{\beta}}$ and $\bar{W} = f_w(h, w_h, w_l)$
- $mc_j = f_{mc}\left(n_j, s_j, \frac{Y}{mz}, \bar{W}\right)$ and $m = \left[\frac{h}{mc_h} + \frac{1-h}{mc_l}\right]^{-1}$
- $D_e = J_h w_h^{\frac{\beta}{1-\sigma}} + J_l w_l^{\frac{\beta}{1-\sigma}}$
- Find Y such that $\left(\frac{Y}{mz}\right)_{\text{guess}} = \frac{Y^{1+\beta}\omega D_e^{\sigma} + YD_e}{mLs}$
- $D_0 = (\omega Y)^{\beta}$
- $z = \frac{Ls}{D_0 D_e^{\sigma} + D_e}$, $L_j = w_j^{\frac{\beta}{1-\sigma}} z$

Inner Check: $\left|n_h^{\phi-1}(mc_l - \gamma m) - n_l^{\phi-1}(mc_h - \gamma m)\right| + \left|mc_h^h mc_l^{1-h} - \frac{Q}{\gamma}\right|$

- Solve for $X \in (0,1)$ using $\frac{mc_j - \gamma m}{\gamma m} \frac{1}{\psi\phi} \frac{1}{n_j^{\phi-1}} = X^{\phi-1}\frac{\rho-1}{\rho} - X^{\phi}$

Back to results

Calibration Details

Parameter	Value	Moment	Moment source
β	7.19	Top 10% Output share	Computestat: Standard & Poor's, 2020
σ	0.43	Top 10% Wage Premium	Wong, 2023
ω	0.61	Labor Market Participation	BLS, 2024a, 1986 – 1999 average
ψ	3.09	TFP growth rate	BLS, 2024b, 1954 – 2007 average
ϕ	1.48	R&D Spending (% of GDP)	World Bank, 2024, 1996
γ	1.26	Average Markup	Autor et al., 2020
ζ	0.92	Profit share	BEA, 2024a, 1986 – 1999 average

Parameter	Value	Source
λ	0.103	Borella et al., 2022, 1969 – 1981 average
τ	0.078	Borella et al., 2022, 1969 – 1981 average
s_h	1.49	Compustat: Standard & Poor's, 2020, s_h/s_l, 1954 – 2007 average
η	0.32	BEA, 2024b, G/Y, 1969 – 2007 average

Back to calibration

Decomposition details

$$
\begin{aligned}
Y &= Q \cdot \exp \int_0^1 \ln s_{j(i)} di \cdot \exp \int_0^1 \ln l_i di \\
&\approx Q \cdot \exp \int_0^1 \ln s_{j(i)} di \cdot \left(\ln \bar{l} + \int_0^1 \frac{1}{l_i}(l_i - \bar{l}) - \frac{1}{2\bar{l}^2}(l_i - \bar{l})^2 di \right) \\
&= Q \cdot S \cdot (1 - \frac{CV^2}{2}) \int_0^1 l_i di \\
&= \underbrace{Q \cdot S \cdot (1 - \frac{CV^2}{2})}_{TFP} \cdot \sum_{j \in \mathcal{J}} L_j \\
&= Q \cdot S \cdot M \cdot L, \quad \text{where } M \text{ follows from price/markup dispersion:}
\end{aligned}
$$

$$
M = \left(1 - \frac{CV^2}{2}\right) = \left(\frac{3}{2} - \frac{\mathbb{E}\left(\frac{1}{\left(s_j mc_{j'}\right)^2}\right)}{2 \cdot \mathbb{E}\left(\frac{1}{s_j mc_{j'}}\right)^2} \right)
$$

Back to decomposition