A Brief Overview of Monopsony, Wage Inequality, and Labor Market Sorting

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Part 1: Prior Literature: The Role of Firms in Wages

Early Literature: Evidence that Firms Drive Wage Differences

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- Abowd, Kramarz, and Margolis (1999, ECMA): Firms with higher wages are more productive and more profitable, after controlling for worker fixed effects.

All of these papers suggest that the same worker would earn a different wage if employed by a different type of firm.

Within-Between Decompositions (1/3)

Notation:

- worker i
- time t
- firm j,
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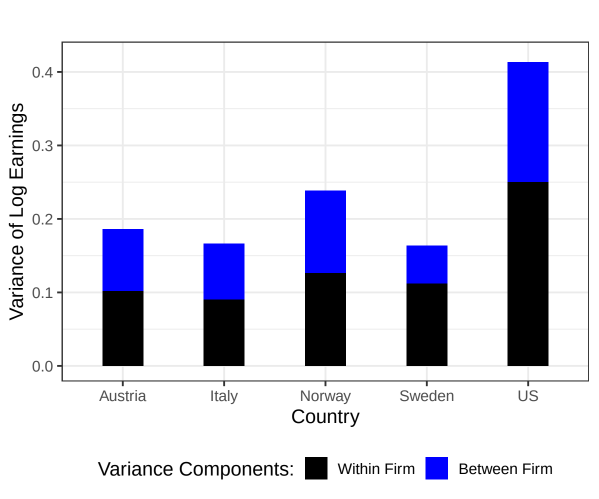
Within-between firm decomposition:

$$\underbrace{\mathrm{Var}(w_{it})}_{\text{total}} = \underbrace{\mathrm{Var}(w_j)}_{\text{between firm}} + \underbrace{\mathrm{Var}\left(w_{it} - w_j\right)}_{\text{within firm}}$$

$$\underbrace{100\%}_{\text{total share}} = \underbrace{\frac{\mathrm{Var}(w_j)}{\mathrm{Var}(w_{it})} \times 100\%}_{\text{between firm share}} + \underbrace{\frac{\mathrm{Var}(w_{it} - w_j)}{\mathrm{Var}(w_{it})} \times 100\%}_{\text{within firm share}}$$

Within-Between Decompositions (2/3)

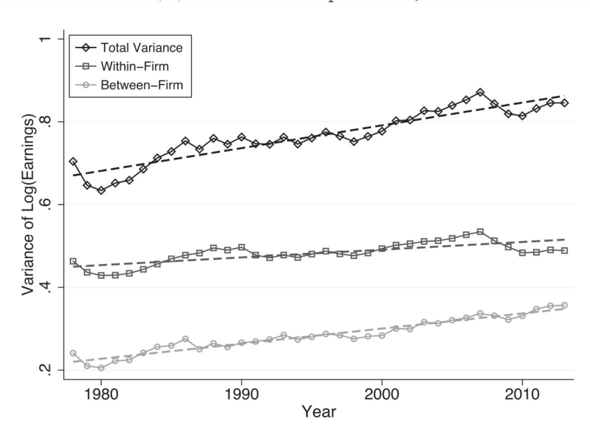
Bonhomme, Holzheu, Lamadon, Manresa, Mogstad, and Setzler (2023, JOLE) harmonize the data construction for comparability across tax records from a number of developed countries:



In each country, firms explain 30% to 50% of wage variation.

Within-Between Decompositions (3/3)

Song, Price, Guvenen, Bloom, and von Wachter (2019, QJE) use 30+ years of US tax data to do this decomposition:



They find that between-firm inequality explains much more of the long-run increase than within-firm inequality does.

They follow Card, Heining, and Kline (2013, QJE), who similarly find a rising role for between-firm variation over time in Germany.

AKM Firm Premia and Sorting (1/4)

Two-way Fixed Effects: Abowd, Kramarz, and Margolis (1999, ECMA) consider the following model (now simply called **AKM**):

$$w_{it} = \psi_{j(i,t)} + \alpha_i + \epsilon_{it}$$

It imposes that firms impact workers only through the fixed effect ψ_j, which is referred to as the "firm premium". The worker-specific fixed effect α_i is interpreted as the worker's "ability" or "skill".

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Re-interpreting the Within-Between Decomposition:
Under the AKM model, it follows immediately that,

$$\underbrace{\mathrm{Var}(w_j)}_{\text{between firm}} = \underbrace{\mathrm{Var}(\psi_j)}_{\text{firm premia}} + \underbrace{\mathrm{Var}(\mathbb{E}[\alpha_i|j])}_{\text{worker composition}} + \underbrace{2\mathrm{Cov}(\mathbb{E}[\alpha_i|j], \psi_j)}_{\text{average sorting}}$$

Thus, the fact that there is between-firm wage variation does not imply it is due to the firm premia. It could instead be due to the composition of workers varying across firms.

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AKM identification using movers: If moves are exogenous of ϵ,

$$\mathbb{E}[w_{it+1} - w_{it}|j(i,t+1) \neq j(i,t)] = \psi_{j(i,t+1)} - \psi_{j(i,t)}$$

The *average wage change around a move* recovers the *difference in firm premia* between two firms. Need "connected set" to get all ψ.

AKM Firm Premia and Sorting (2/4)

Firm Premia and the Sorting of Workers to Firms: Given the AKM model $w_{it} = \psi_{j(i,t)} + \alpha_i + \epsilon_{it}$, we can provide a more useful decomposition than the within-between decomposition:

$$\underbrace{\mathrm{Var}(w_{it})}_{\text{total}} = \underbrace{\mathrm{Var}(\psi_j)}_{\text{firm premia variation}} + \underbrace{\mathrm{Var}(\alpha_i)}_{\text{worker quality variation}} + \underbrace{2\mathrm{Cov}(\psi_j, \alpha_i)}_{\text{sorting of workers to firms}}$$

Limited mobility bias (LMB): Dummy regression estimates of $\mathrm{Var}(\psi_j)$ are upward-biased due to the small number of movers to most firms. How do we fix this bias?

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- **Plug-in:** Andrews et al. (2008) and Kline et al. (2020, ECMA) provide plug-in formulas for estimating the LMB term.

AKM Firm Premia and Sorting (3/5)

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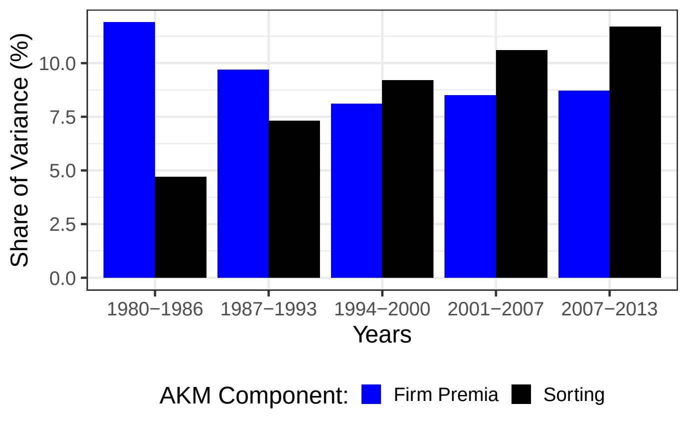


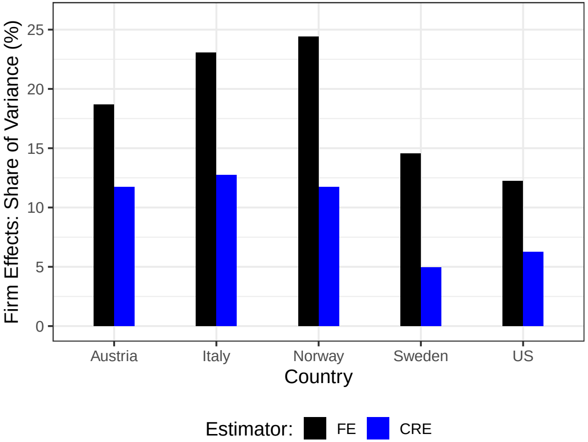
They find that the **sorting** of high-skill workers to high-premium firms has become **more important** in the US over time, while the **firm premia** variation itself has become **less important**.

AKM Firm Premia and Sorting (4/5)

Bonhomme, Holzheu, Lamadon, Manresa, Mogstad, Setzler (2023)

Having shown that AKM estimation is in danger of estimation bias, they apply both AKM and bias-corrected CRE to full data:

Firm premia component in 5 countries:



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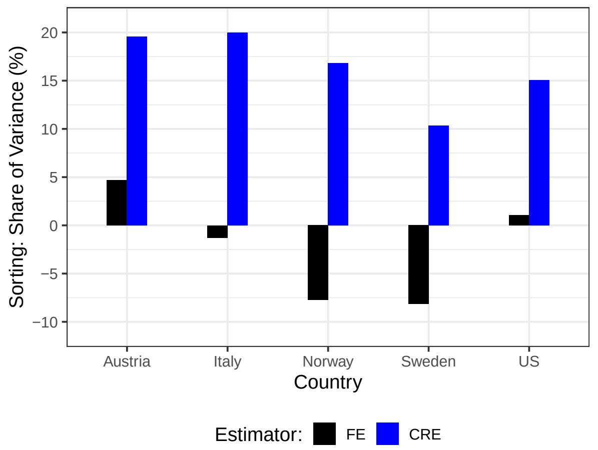

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Related: Guiso, Pistaferri, and Schivardi (2005, JPE) estimate a joint permanent-transitory shock process for firms and workers. This essentially treats past shocks as instruments for current rents.

Compensating Differentials (1/2)

While the sharing of rents is one possible reason for wage inequality across firms, another explanation has a rich history.

Compensating Differentials: The good non-wage characteristics of jobs are called "amenities". Rosen (1974 JPE) provides a general characterization of how amenities translate into wage variation across firms. The intuition is simple:

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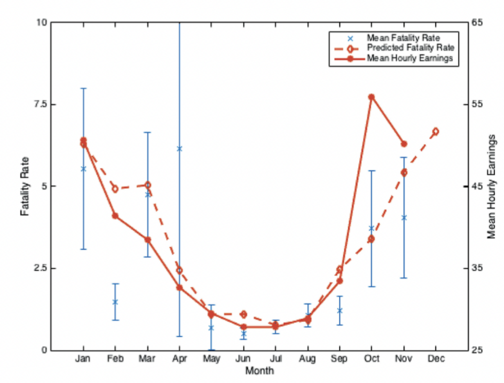
Absence of comp diffs: Bonhomme and Jolivet (2009, JAE) summarize the hedonic regression literature as failing to find significant comp diffs. Mas and Pallais (2017, AER, Table 1) demonstrate how poorly these regressions perform.

Compensating Differentials (2/2)

Deadliest Catch: Perhaps the most compelling hedonic regression evidence on comp diffs is this plot from Lavetti (2020, JBES):



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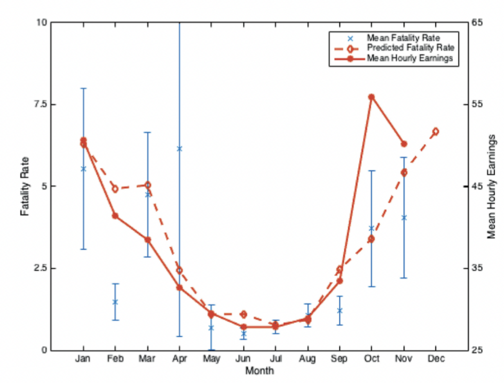

Recent papers: A number of papers recently used elicited preference surveys or experimental job/task offers to estimate the value of certain workplace amenities (esp. hours flexibility), e.g., Mas and Pallais (2017, AER), Wiswall and Zafar (2018, QJE), Maestas, Mullen, Powell, von Wachter, and Wenger (2018).

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More generally, no paper has written down a tractable framework for answering these questions. Such a framework is demanding.

$\Longrightarrow$ Lamadon, Mogstad, and Setzler (2022, AER).

Part 2: Lamadon, Mogstad, and Setzler (2022, AER)

LMS: Worker Preferences and Labor Supply (1/4)

Vertical Preferences as Common Information: An "amenity" is a non-wage benefit of working at a firm. If the amenity is common so that all workers enjoy it, it differentiates employers vertically.

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- Card, Cardoso, Heining, & Kline (2018, JOLE): assume Logit.

LMS: Worker Preferences and Labor Supply (2/4)

Horizontal Preferences are Logit: Denote $w_j \equiv \log W_j$ and $g_j \equiv \log G_j$. Worker preferences over firms:

$$\mathcal{U}_i(W_j, j) = w_j + g_j + \eta_{ij}, \quad \text{CDF}(\eta_{ij}) = \exp\left(-exp\left(-\beta\eta_{ij}\right)\right)$$

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Implied Choice Probabilities: Following McFadden (1973),

$$\Pr(i \text{ chooses } j) = \frac{\exp(\beta(\log W_j + g_j))}{\sum_{j \in \mathcal{J}} \exp(\beta(\log W_j + g_j))} = \frac{W_j^{\beta} G_j^{\beta}}{\sum_{j \in \mathcal{J}} W_j^{\beta} G_j^{\beta}}$$

LMS: Worker Preferences and Labor Supply (2/4)

Horizontal Preferences are Logit: Denote $w_j \equiv \log W_j$ and $g_j \equiv \log G_j$. Worker preferences over firms:

$$\mathcal{U}_i(W_j, j) = w_j + g_j + \eta_{ij}, \quad \text{CDF}(\eta_{ij}) = \exp\left(-exp\left(-\beta\eta_{ij}\right)\right)$$

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Labor Supply Curve: Summing across an economy of size N,

$$L_j = N \cdot \Pr(i \text{ chooses } j) = \frac{W_j^\beta G_j^\beta}{\mathcal{W}/N}, \quad \mathcal{W} \equiv \sum_{j \in \mathcal{J}} W_j^\beta G_j^\beta$$

LMS: Worker Preferences and Labor Supply (3/4)

Recap: In logs, the LMS labor supply curve is,

$$\ell_j = \beta w_j + \beta g_j - \log(\mathcal{W}/N)$$

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$$\frac{d \log \mathcal{W}}{dw_j} = 0 \quad \Longrightarrow \quad \frac{d\ell_j}{dw_j} = \beta$$

We see that the LS elasticity is β for each firm, regardless of wage.
Note: Smaller $\beta \implies$ more dispersion in $\eta \implies$ less elastic LS.

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Clarifying the roles of vertical vs horizontal preferences: Although the LS *elasticity* is the same at each firm, the LS *curve* varies across firms due to vertical amenities entering log-additively.

- Separability of wage w_j and amenities g_j in labor supply will be key in relating LMS to the AKM regression.

LMS: Worker Preferences and Labor Supply (4/4)

Firm-skill labor supply: LMS allow each firm to have skill-specific vertical and horizontal amenities. However, the distribution of horizontal amenities is assumed to be the same for both skill types, with common dispersion β. It follows immediately from the above derivation that the labor supply curve for skill type X to firm j is,

$$\ell_j(X) = \beta w_j(X) + \beta g_j(X) - \log(\mathcal{W}(X)/N(X))$$

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Progressive Taxation: LMS allow for progressive taxation by assuming that the after-tax wage $\tilde{W}_j$ rather than the gross wage W_j enters the utility function. They use the parsimonious log-linear tax schedule from Heathcote, Storesletten, and Violante (2017, QJE). This leads to the log labor supply curve,

$$\tilde{W}_j = \tau W_j^{\lambda} \quad \Longrightarrow \quad \ell_j = \lambda\beta w_j + \beta g_j - \log(\mathcal{W}/N)$$

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Thus, the net-of-taxes LS elasticity becomes $\lambda\beta$. Implications:

- Progressive tax $\Longrightarrow$ smaller λ $\Longrightarrow$ inelastic LS.
- Progressive tax $\Longrightarrow$ g_j more valuable $\Longrightarrow$ favor high-g firms

LMS: Labor Demand and Equilibrium Outcomes (1/5)

For simplicity, we return to the case without skills and without progressive taxation for now.

Production: We assume that revenue satisfies,

$$R_j = f_j(L_j), \quad \mathrm{MR}_j(L_j) \equiv \frac{\partial}{\partial L_j} f_j(L_j) > 0, \quad \frac{\partial}{\partial L_j} \mathrm{MR}_j(L_j) < 0$$

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Firm's Problem: Choose the wage offer to maximize profits:

$$\max_{W_j} f_j(L_j) - W_j L_j \;\; : \quad L_j = L_j^*(W_j)$$

The FOC of the firm's problem is,

$$\mathrm{MR}_j(L_j) \frac{\partial L_j}{\partial W_j} = L_j + W_j \frac{\partial L_j}{\partial W_j} \implies \left(\frac{\mathrm{MR}_j(L_j) - W_j}{W_j} \right) \frac{W_j}{L_j} \frac{\partial L_j}{\partial W_j} = 1$$

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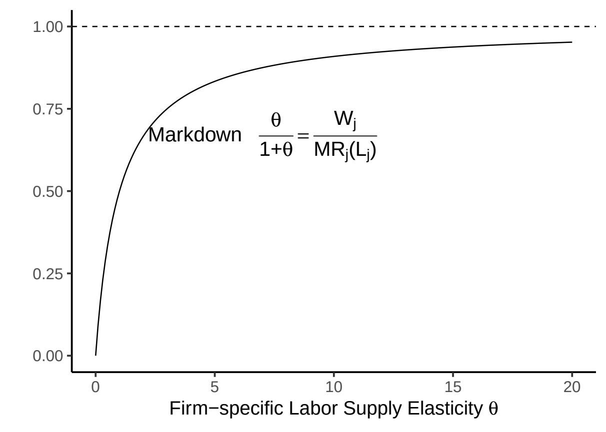
Firm's Solution is a Wage Markdown: Since $\frac{W_j}{L_j} \frac{\partial L_j}{\partial W_j} = \beta$,

$$W_j(L_j) = \text{markdown} \cdot \mathrm{MR}_j(L_j), \quad \text{markdown} \equiv \frac{\beta}{1+\beta}$$

LMS: Labor Demand and Equilibrium Outcomes (2/5)

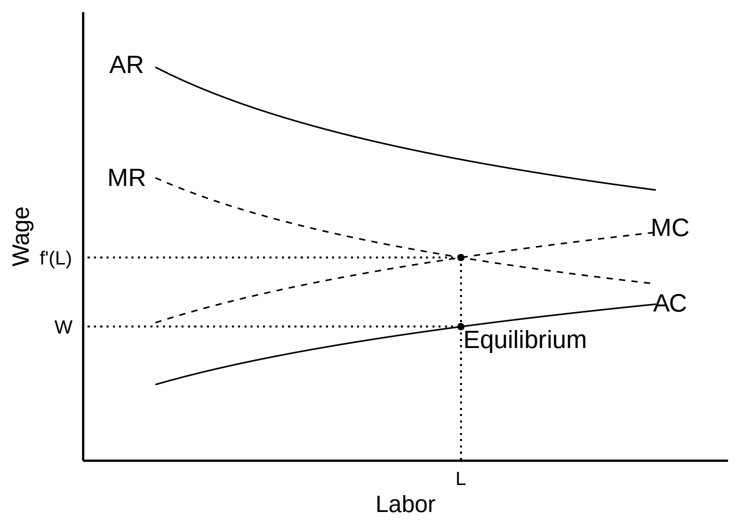
Labor demand: $W_j = \frac{\theta}{1+\theta} MR_j(L_j)$.



E.g. if LS elasticity is 4, the markdown is $4/(1+4) = 0.8$, so the wage is 20% less than MR.

LMS: Labor Demand and Wages (3/5)

Labor supply: $W_j = \eta L_j^{1/\theta}$. Labor demand: $W_j = \frac{\theta}{1+\theta} MR_j(L_j)$.



LMS: Labor Demand and Equilibrium Outcomes (4/5)

While we did not have to take a stand on the functional form of $f_j(L_j)$ to derive the markdown, we restrict it to solve for the wages.

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Constant-elasticity Assumption: Suppose $f_j(\cdot)$ has constant elasticity in labor, i.e., $R_j = A_j(L_j)^{1-\alpha}$, where A_j is TFP.

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FOC from LMS: Using $\mathrm{MR}_j(L_j) = A_j(1-\alpha)L_j^{-\alpha}$ and taking logs,

$$\text{(supply) } \ell_j = \beta w_j + \beta g_j + \text{constant}$$
$$\text{(demand) } w_j = a_j - \alpha \ell_j + \text{constant}$$

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Optimal Wage and Labor: Equating supply and demand,

$$\text{(wage) } w_j = \frac{1}{1+\alpha\beta} a_j - \frac{\alpha\beta}{1+\alpha\beta} g_j + \text{constant}$$
$$\text{(labor) } \ell_j = \frac{\beta}{1+\alpha\beta} a_j + \frac{\beta}{1+\alpha\beta} g_j + \text{constant}$$
$$\text{(revenue) } r_j = \frac{1+\beta}{1+\alpha\beta} a_j + \frac{(1-\alpha)\beta}{1+\alpha\beta} g_j + \text{constant}$$

The system is conveniently log-linear in TFP and amenities!

LMS: Labor Demand and Equilibrium Outcomes (5/5)

LMS production with skills: LMS consider a diminishing returns technology over a composite productivity of skill types X:

$$f_j(\{L_j^X\}_X) = A_j\,(H_j)^{1-\alpha}\,, \quad H_j = \sum_X (L_j^X) X^{\theta_j}$$

where θ_j controls firm j's relative returns to high-X vs low-X.

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LMS wage with skills:

$$w_j^X = \theta_j x + \frac{1}{1+\alpha\beta} a_j - \frac{\alpha\beta}{1+\alpha\beta} \overline{g}_j$$

where $\bar{g}_j$ is a weighted-average of skill-firm-specific amenities.

Two nice properties:

- $\theta_j x$ is log-separable from the other determinants of wage!
- We don't have to keep up with the $g_j(X)$ terms, only $\bar{g}_j$!

However, the wage derivation is harder than in the case with no skills, which had a simple linear 2-equations-in-2-unknowns system. With skills, one must solve a fixed-point problem to recover $\bar{g}_j$.

LMS: From Theory to the Regression Models (1/5)

We will now show how to inform the regression models discussed in Part 1 using the theory from LMS, and vice versa.

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

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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)
- **intermediate inputs:** COGS (cost of goods sold)
  - includes intermediate goods, transit costs, etc
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Workers: W-2 records on employer and total earnings

- **labor:** link workers to their highest-paying employer with earnings above FTE threshold, restrict to age 25-60
- **mobility:** we observe when the worker changes employers, following the earnings before and after

Local labor market: 2-digit NAICS $\times$ commuting zone

Sample size: 445 million worker-years.

LMS: From Theory to the Regression Estimates (2/5)

Recall the LMS Equilibrium:

$$\text{(wage) } w_j = \frac{1}{1+\alpha\beta} a_j - \frac{\alpha\beta}{1+\alpha\beta} g_j + \text{constant}$$

$$\text{(labor) } \ell_j = \frac{\beta}{1+\alpha\beta} a_j + \frac{\beta}{1+\alpha\beta} g_j + \text{constant}$$

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LMS Comparative Statics for TFP:

$$\frac{dr_j}{da_j} = \frac{1+\beta}{1+\alpha\beta}, \quad \frac{dw_j}{da_j} = \frac{1}{1+\alpha\beta}, \quad \frac{d\ell_j}{da_j} = \frac{\beta}{1+\alpha\beta}$$

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Passthrough relative to Revenues: How does a 1% revenue shock due to productivity changes impact wages? The LMS model provides a structural interpretation of this exercise:

$$\frac{dw_j}{dr_j} = \frac{\frac{dw_j}{da_j}}{\frac{dr_j}{da_j}} = \frac{\frac{1}{1+\alpha\beta}}{\frac{1+\beta}{1+\alpha\beta}} = \frac{1}{1+\beta} \implies \beta = \left(\frac{dw_j}{dr_j}\right)^{-1} - 1$$

Thus, this passthrough regression identifies the LS elasticity!

LMS: From Theory to the Regression Estimates (3/5)

We show that the permanent-transitory pass-through rate identification can be represented as an IV regression. Under the assumption that productivity shocks are more persistent than amenity shocks to the firm, short-differences instrument for long-differences in log revenues (or log value added):

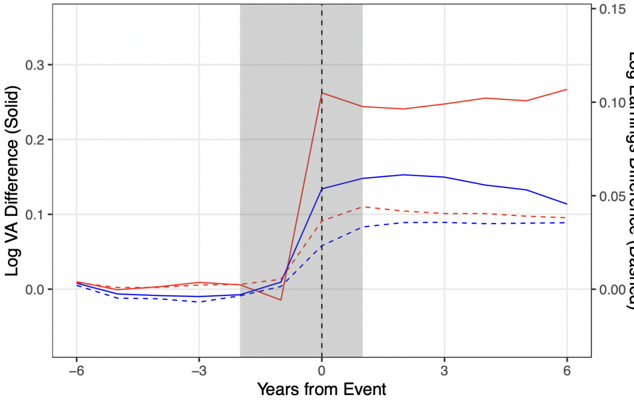

Figure 1: Difference-in-differences representation of the estimation procedure

LMS: From Theory to the Regression Estimates (4/5)

Estimates of the LS elasticity (firm-level and market-level):

- Internal IV: justified by the transitory-permanent structure.
- External IV: justified "outside of the model" like most IVs. In practice, we provide results from the procurement auction IV of Kroft, Luo, Mogstad, and Setzler (2022).

TABLE 2—ESTIMATES OF PASS-THROUGH RATES AND LABOR SUPPLY ELASTICITIES

Panel A	Firm-level estimation	
Instrumental variable	Pass-through ($E[\gamma_r]$)	Implied elasticity
Internal instrument:	0.13	6.52
Lagged firm-level value-added shock under MA(1) errors	(0.01)	(0.56)
External instrument:	0.14	6.02
Procurement auction shock at firm level	(0.07)	(3.37)

Panel B	Market-level estimation	
Instrumental variable	Pass-through (Υ)	Implied elasticity
Internal instrument:	0.18	4.57
Lagged market-level value-added shock under MA(1) errors	(0.03)	(0.80)
External instrument:	0.19	4.28
Shift-share industry value-added shock	(0.04)	(1.13)

LMS: From Theory to the Regression Estimates (5/5)

We will now relate LMS to AKM regressions.

LMS wage with skills but no complementarities: Impose that $\theta_j = \bar{\theta}, \forall j$, which captures the AKM assumption that there are no skill-complementarities across firms. The LMS wage becomes,

$$w_{it} = \bar{\theta} x_i + \frac{1}{1+\alpha\beta} a_{j(i,t)t} - \frac{\alpha\beta}{1+\alpha\beta} \overline{g}_{j(i,t)}$$

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Removing the TFP shocks: We already estimated β from the pass-through regressions. Once we estimate the returns-to-scale parameter α, we can back out TFP a_j. Define $\bar{a}_j \equiv \mathbb{E}[a_j|j]$ as the firm's average TFP. Defining the TFP shock as $\tilde{a}_{jt} \equiv a_{jt} - \bar{a}_j$, we can define a measure of the wage that is free of TFP shocks:

$$\tilde{w}_{it} \equiv w_{it} - \frac{1}{1+\alpha\beta} \tilde{a}_{j(i,t)t}$$

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LMS includes the AKM model as a special case: Rearranging,

$$\tilde{w}_{it} = \underbrace{\bar{\theta} x_i}_{\alpha_i} + \underbrace{\frac{1}{1+\alpha\beta} \bar{a}_{j(i,t)} - \frac{\alpha\beta}{1+\alpha\beta} \overline{g}_{j(i,t)}}_{\psi_j} = \underbrace{\alpha_i + \psi_{j(i,t)}}_{\text{AKM!}}$$

LMS: Understanding Inequality and Sorting (1/5)

We wanted a tractable framework for answering these questions:

1. **Inequality Mechanisms:** Are the AKM estimates of wage inequality across firms driven by comp diffs or rent-sharing?
2. Sorting Mechanisms: What mechanisms drive the sorting of high-skill workers to high-productivity firms?

Regarding the first, we now have this equation:

$$\underbrace{\psi_j}_{\text{firm premium}} = \underbrace{\frac{1}{1+\alpha\beta}\bar{a}_j}_{\text{rent-sharing}} - \underbrace{\frac{\alpha\beta}{1+\alpha\beta}\bar{g}_j}_{\text{comp diffs}}$$

We can simply plug-in our estimates of $\beta, \alpha, \psi_j, \bar{a}_j$ to infer $\bar{g}_j$.

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We can simply plug-in our estimates of $\beta, \alpha, \psi_j, \bar{a}_j$ to infer $\bar{g}_j$.

Thus, we can perform a decomposition of the AKM firm premium ψ_j into rent-sharing vs comp diffs for the first time!

- Extends the work of Card, Kline, et al. (2013 QJE, 2016 QJE, 2018 JOLE), who assume $\psi_j = \gamma S_j$, where S_j is a per-worker productivity measure (no comp diffs by assumption).

LMS: Understanding Inequality and Sorting (2/5)

LMS structural decomposition of $\mathrm{Var}(\psi_{jt})$:

TABLE 4—DECOMPOSITION OF THE VARIATION IN FIRM PREMIUMS

	Between broad markets	Within broad markets: Between detailed markets	Within broad markets: Within detailed markets
Panel A. Preferred specification			
Total	0.4%	2.0%	3.1%
Decomposition			
Amenity differences	16.0%	7.8%	7.1%
TFP differences	15.5%	11.9%	8.6%
Amenity-TFP covariance	−31.1%	−17.7%	−12.6%

If one were to ignore the covariance between amenities and productivity, the considerable heterogeneity in amenities and productivity across firms would imply that firm effects should have a large contribution to inequality.

However, **productive firms tend to have good amenities**, which act as compensating differentials and push wages down in productive firms. As a result, firm effects explain only a few percent of overall wage inequality.

LMS: Understanding Inequality and Sorting (3/5)

Recall the wage equation with skills and skill-complementarities:

$$w_j^X = \theta_j x + \frac{1}{1+\alpha\beta} a_j - \frac{\alpha\beta}{1+\alpha\beta}\overline{g}_j$$

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2. **Sorting Mechanisms:** What mechanisms drive the sorting of high-skill workers to high-productivity firms?

Regarding the second, our model allows for **two mechanisms**:

- **Demand-side sorting:** Some firms have relatively greater demand for high-skill workers. This corresponds to high θ_j.
- **Supply-side sorting:** Some firms are relatively attractive to high-skill workers. This corresponds to high $g_j(X)$ for high-X.

Empirical approach: We estimate θ_j using the wage equation and the estimator from Bonhomme, Lamadon, and Manresa (2019, ECMA). From the labor supply equations, we back out each $g_j(X)$. Finally, we can simulate model counterfactuals in which we reduce variation in $g_j(X)$ or θ_j to see how equilibrium sorting responds.

LMS: Understanding Inequality and Sorting (4/5)

Estimates of $\psi_j + x\theta_j$, for each decile of skill x:

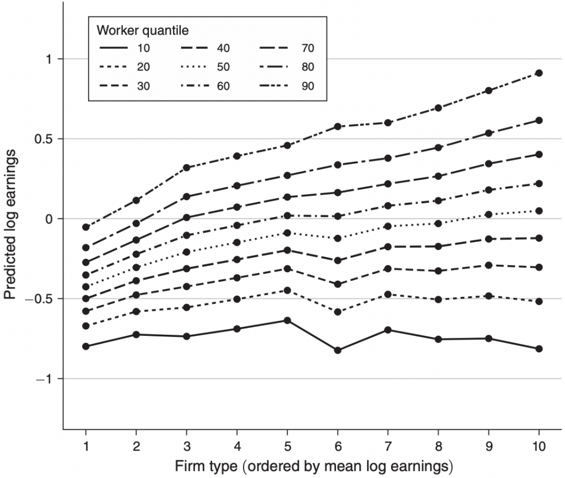
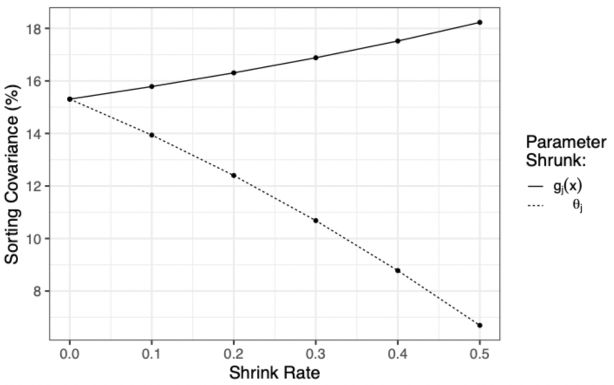


FIGURE 2. PREDICTED LOG EARNINGS FROM THE ESTIMATED MODEL

High-wage (ψ) firms are the most skill-intensive (θ)!

LMS: Understanding Inequality and Sorting (5/5)

Reducing variation: skill-amenities ($g_j(X)$) vs skill-productivity (θ_j)



(a) Sorting

Figure A.7. : Worker sorting with cou

Demand-side drives skill-biased sorting to high-wage firms!

LMS: Labor Supply in Local Markets (1/2)

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Local labor markets: We define a market as a set of firms whose horizontal amenities are correlated. This could be firms in the same industry, region, etc. The specification follows McFadden (1981):

- Denote market of firm j by $m(j)$, and $\mathcal{J}_m \equiv \{j : m(j) = m\}$.
- Same market: $\text{Corr}(\eta_{ij}, \eta_{ij'}) = 1-\rho$ if $m(j) = m(j')$, $\rho \in [0, 1]$.
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Within-market choice: Given that the worker chooses market m, the probability of choosing firm j within m is:

$$\Pr(i \text{ chooses } j | i \text{ chooses } m) = \frac{W_j^{\beta/\rho} G_j^{\beta/\rho}}{\mathcal{W}_m}, \quad \mathcal{W}_m \equiv \sum_{j \in \mathcal{J}_m} W_j^{\beta/\rho} G_j^{\beta/\rho}.$$

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The firm is small, and its market is small: As before, we assume that the firm is "strategically small" relative to its market. We also assume the market is small relative to the total economy.

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$$\frac{d \log}{d \log \gamma_m} \int_0^1 (\mathcal{W}_{m'})^\rho \, d(m') = 0 \implies \frac{d \log \Pr(i \text{ chooses } m, \gamma_m)}{d \log \gamma_m} = \beta$$

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Result: Labor supply is more elastic to firms than markets.
Correlated tastes $\uparrow \implies \rho \downarrow \implies$ within-market more elastic.

Part 3: A Brief Survey of the Post-LMS Literature

Extensions to the Labor Demand-side of the LMS Model

- **Product Market Power:** Kroft, Luo, Mogstad, and Setzler (2022) add Dixit and Stiglitz (1977 AER) product markets into LMS. Letting ϵ denote the product demand elasticity faced by the monopolistic firm, the "double markdown" on wages is about 50% larger than the usual markdown:

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

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- **Production Networks:** Huneeus, Kroft, and Lim (2021) introduce (exogenous) production networks into LMS.

Extensions to the Labor Supply-side of the LMS Model (1/5)

Motivation:

- As we saw, LMS labor supply has 3 features:
  (1) upward-sloping firm-specific labor supply curves,
  (2) those labor supply curves differ by worker skill,
  (3) firm-specific non-wage amenities.
- The specification is very flexible, allowing the amenities to fully interact with skills, yet it is empirically tractable.

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- Being the first paper with all 3 features in an empirically tractable way allowed LMS to answer those two big open questions from 70 years of empirical studies:
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  1. inequality due to rent-sharing vs comp diffs,
  2. supply-side vs demand-side causes of worker sorting.
- However, LMS had one strong assumption that really helped with the mapping to AKM and pass-through regression: the labor supply elasticity was assumed to be a constant β.
  - This was relaxed slightly in the nested-markets specification, but within a market, it is constant.

An active literature seeks to relax the constant LS elasticity assumption, allowing variable markdowns across firms!

Extensions to the Labor Supply-side of the LMS Model (2/5)

Recall within-market LMS: Shutting down the vertical amenities in LMS by setting $G_j = 1, \forall j$, within-market labor supply is,

$$L_j = \frac{W_j^{\beta/\rho}}{\mathcal{W}_m / N_m}, \quad \mathcal{W}_m \equiv \sum_{j \in \mathcal{J}_m} W_j^{\beta/\rho}, \quad N_m \equiv \sum_{j \in \mathcal{J}_m} L_j$$

$$\implies \quad (\beta/\rho) w_j = \ell_j + \log \mathcal{W}_m - \log N_m$$

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Total Derivative of within-market LMS labor supply:

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If firms are NOT small: Point of departure from LMS:

$$\frac{d \log N_m}{d\ell_j} = \frac{1}{N_m} \frac{\partial \sum_{j \in \mathcal{J}_m} L_j}{\partial \ell_j} = \frac{L_j}{N_m} \equiv s_j, \quad \frac{d \log \mathcal{W}_m}{dw_j} =?$$

Extensions to the Labor Supply-side of the LMS Model (3/5)

Recap: So far, we have shown that if firms are NOT small in LMS,

$$(\beta/\rho)\frac{dw_j}{d\ell_j} = (1-s_j) + \frac{d\log\mathcal{W}_m}{d\ell_j}$$

where s_j is labor market share. We still need to solve for $\frac{d\log\mathcal{W}_m}{d\ell_j}$.

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Small markets: Use the idea of Atkeson & Burstein (2008 AER):

$$\frac{d\log N}{d\ell_j} = 0, \quad \frac{d\log\mathcal{W}}{d\ell_j} = 0 \implies \rho\frac{d\log\mathcal{W}_m}{d\ell_j} = \frac{d\log N_m}{d\ell_j} = s_j$$

The trick is to have **not**-small-firms in **small**-markets. Then,

$$\frac{dw_j}{d\ell_j} = \frac{\rho}{\beta}(1-s_j) + \frac{1}{\beta}s_j \implies \text{LS elasticity depends on shares!}$$

Extensions to the Labor Supply-side of the LMS Model (4/5)

Recap: We showed that if we

- relax the small-firm assumption from LMS,
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Berger, Herkenhoff, and Mongey (2022 AER), "BHM": Developed the combination of Atkeson & Burstein and LMS. The key BHM markdown result:

$$\text{markdown}_j = \left[1 + \frac{\rho}{\beta}(1 - s_j) + \frac{1}{\beta}s_j\right]^{-1} \implies \text{firm-specific markdowns!}$$

Extensions to the Labor Supply-side of the LMS Model (5/5)

Post-BHM Literature:

- Chan, Salgado, and Xu (2021): derive the pass-through expression for TFP shocks in the BHM model, reflecting markdown responses to market-share shifts.

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Variable Markdowns without the Atkeson-Burstein Approach:

- Yeh, Macaluso, and Herschbein (2022 AER): Instead of taking a stand on the shape of the labor supply curve, they use production function estimation to recover the MRPL. Then, the markdown can be obtained as the wage-to-MRPL ratio.

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- Chan, Kroft, Mattana, and Mourifie (2023?): Start with "full LMS", then relax both small-firms and small-markets. This allows amenities and skills like LMS (which the BHM literature do not allow), plus variable markdowns.

The literature is very active – many more papers in progress!

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