Firms and Labor Market Inequality: A Review

David Card, Ana Rute Cardoso, Joerg Heining, Patrick Kline

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Motivation

- Well known that firms exhibit substantial heterogeneity in productivity
  - Syverson (2004): 90-10 TFP ratios in US manufacturing $\approx 2$ (within 4-digit industry!)

- How does that heterogeneity influence wage inequality?

- Facts:
  1. Firms/plants exhibit substantial dispersion in average wages (Slichter, 1950; Davis and Haltiwanger, 1991; Groshen, 1991)
  2. Between firm/plant dispersion increasing (CHK, 2013; Song et al., 2015)
  3. Trends in productivity dispersion track trends in wage inequality (Faggio et al., 2010; Barth et al., 2015)
Figure 1: Trends in Between-Establishment Dispersion in Wages and Productivity

Source: Barth et al (2015)
Neoclassical models: firm heterogeneity influences who you hire, not what you pay them!

- Industry wage premium wars (Krueger and Summers, 1989; Katz and Summer, 1988; Murphy and Topel, 1987)

Can we get to the bottom of this w/ longitudinal E-E data?

Two literatures address sorting concerns:
- “Rent sharing” lit: effect of shock to firm on wages of stayers
- “Firm movers” lit: effect of switching between firms on wages
Today

- Review empirical literatures on rent sharing and firm movers

- Rent-sharing elasticities:
  - “Micro” estimates clustered in range 0.05-0.15
  - But room for more work w/ quasi-experimental design

- Firm movers studies:
  - Wage effects of firm moves surprisingly well characterized by additive model
  - Firm wage effects explain ~20% of wage variance
  - Firm effs strongly related to productivity measures
  - But still some outstanding technical problems
Develop a model of imperfect labor market competition capable of rationalizing findings:

- Full information about jobs
- Firms differentiated by TFP and workplace amenities
- Heterogeneous preferences over amenities lead to upward sloping supply to firm

Main insights:

- AKM-style decomposition into worker and firm heterogeneity within broad skill groups
- Plausible rent-sharing elasticities
- Rising heterogeneity across firms ⇒ rising wage inequality
- New predictions regarding relationship between skill group specific wage premia and employment shares
- Also: “SBTC shocks”
Rent Sharing Literature

- Basic idea:

\[ \Delta \ln w_{it} = \alpha + \beta \Delta \ln Rent_{j(i,t)} + \varepsilon_{it} \]

- Problems:
  - How to measure “rents”? 
  - Want firm- (not industry-) level variation 
  - Measurement error and transitory / permanent distinction 
  - Mechanical negative relationship between some measures of \( Rent_{jt} \) (e.g. profits) and wages 
  - Stayers non-randomly selected?
Measuring Rents

- Interested in how firm’s “ability to pay” affects wages, so treat (revenue-based) TFP as “ideal” forcing variable.
- Standard CRTS model:

\[ \pi_j = VA_j - w_j N_j - r_j K_j, \]

\[ VA_j \equiv R_j - M_j = P_j T_j f(N_j, K_j) = P_j T_j N_j g(k_j) \]

- Suppose \( k_j = k^* \). Then:

\[ \ln \left( \frac{VA_j}{N_j} \right) = \ln TFP_j + \ln g(k^*) \]

- Suppose also that \( \frac{M_j}{R_j} = m^* \). Then:

\[ \ln \left( \frac{R_j}{N_j} \right) = \ln TFP_j + \ln g(k^*) - \ln(1 - m^*). \]
Measuring Rents

de Menil (1971) firm and worker split “quasi-rent”:

\[ Q_j = VA_j - w_j^a N_j - r_j K_j \]

Average quasi-rent:

\[ \frac{Q_j}{N_j} = TFP_j g (k^*) - w_j^a - r_j k^* \]

Can show:

\[ \frac{\partial \ln \left( \frac{Q_j}{N_j} \right)}{\partial \ln TFP_j} = \frac{\partial \ln \left( \frac{\pi_j}{N_j} \right)}{\partial \ln TFP_j} = \frac{VA_j/N_j}{Q_j/N_j} \approx 2 \]

Bottom line: sales / VA elasticities \(\approx 2 \times\) quasi-rent / profit elasticities
## Summary of Estimated Rent Sharing Elasticities - Preferred Specifications, Adjusting to TFP Basis

<table>
<thead>
<tr>
<th>Industry-Level Profit Measure</th>
<th>Elasticity</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Christofides and Oswald (1992)</td>
<td>0.140</td>
<td>(0.035)</td>
</tr>
<tr>
<td>2. Blanchflower, Oswald, Sanfey (1996)</td>
<td>0.060</td>
<td>(0.024)</td>
</tr>
<tr>
<td>3. Estevao and Tevlin (2003)</td>
<td>0.290</td>
<td>(0.100)</td>
</tr>
<tr>
<td>4. Abowd and Lemieux (1993)</td>
<td>0.220</td>
<td>(0.081)</td>
</tr>
<tr>
<td>5. Van Reenen (1996)</td>
<td>0.290</td>
<td>(0.089)</td>
</tr>
<tr>
<td>6. Hildreth and Oswald (1997)</td>
<td>0.040</td>
<td>(0.010)</td>
</tr>
<tr>
<td>7. Hildreth (1998)</td>
<td>0.030</td>
<td>(0.010)</td>
</tr>
<tr>
<td>8. Barth et al (2014)</td>
<td>0.160</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Firm-Level Profit but Mean Wage</th>
<th>Elasticity</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Margolis and Salvanes (2001), France</td>
<td>0.062</td>
<td>(0.041)</td>
</tr>
<tr>
<td>10. Arai (2003)</td>
<td>0.020</td>
<td>(0.004)</td>
</tr>
<tr>
<td>11. Guiso, Pistaferri, Schivardi (2005)</td>
<td>0.069</td>
<td>(0.025)</td>
</tr>
<tr>
<td>12. Fakhfakf and FitzRoy (2004)</td>
<td>0.120</td>
<td>(0.045)</td>
</tr>
<tr>
<td>13. Caju, Rycx, Tojerow (2009)</td>
<td>0.080</td>
<td>(0.010)</td>
</tr>
<tr>
<td>14. Martins (2009)</td>
<td>0.039</td>
<td>(0.021)</td>
</tr>
<tr>
<td>15. Guertzgen (2009)</td>
<td>0.048</td>
<td>(0.002)</td>
</tr>
<tr>
<td>16. Cardoso and Portela (2009)</td>
<td>0.092</td>
<td>(0.045)</td>
</tr>
<tr>
<td>17. Arai and Hayman (2009)</td>
<td>0.068</td>
<td>(0.002)</td>
</tr>
<tr>
<td>18. Card, Divincienti, Maida (2014)</td>
<td>0.073</td>
<td>(0.031)</td>
</tr>
<tr>
<td>19. Carlsson, Messina, and Skans (2014)</td>
<td>0.149</td>
<td>(0.057)</td>
</tr>
<tr>
<td>20. Card, Cardoso, Kline (2014), Between Firm</td>
<td>0.156</td>
<td>(0.006)</td>
</tr>
<tr>
<td>20. Card, Cardoso, Kline (2014), Stayers</td>
<td>0.049</td>
<td>(0.007)</td>
</tr>
<tr>
<td>21. Bagger et al. (2014), Mfg</td>
<td>0.090</td>
<td>(0.020)</td>
</tr>
</tbody>
</table>

Mean Elasticity:
- Industry-Level Profit Measure: 0.16
- Firm-Level Profit but Mean Wage: 0.15
- Firm-Level Profit and Indiv. Wage: 0.08
Table 1: Summary of Estimated Rent-Sharing Elasticities

<table>
<thead>
<tr>
<th>Study</th>
<th>Design Features</th>
<th>Measure of Profitability</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Industry-Level Profit Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Christofides and Oswald (1992)</td>
<td>Canadian union contracts; 120 narrowly defined manufacturing industries</td>
<td>Industry profits/worker (wage changes)</td>
<td>0.07</td>
</tr>
<tr>
<td>2. Blanchflower, Oswald, Sanfey (1996)</td>
<td>US individual wage data (CPS), grouped to industry×year cells; manufacturing only</td>
<td>Industry profits/worker (within-industry changes)</td>
<td>0.01-0.06</td>
</tr>
<tr>
<td>3. Estevao and Tevlin (2003)</td>
<td>US manufacturing industry data; adjusted for labor quality; instrument for value-added = demand shocks in downstream sectors</td>
<td>Value added per worker (first differences)</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profit per worker (first differences)</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>B. Firm-Level Profit Measures, Average Firm-level Wages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Abowd and Lemieux (1993)</td>
<td>Canadian union contracts merged to corporate accounts; instrument for revenues = industry selling prices, import and export prices</td>
<td>Quasi-rent/worker (wage change model)</td>
<td>0.22</td>
</tr>
<tr>
<td>5. Van Reenen (1996)</td>
<td>Large British manufacturing firms merged with corporate accounts; instrument for rents = innovations, imports, R&amp;D, industry concentration</td>
<td>Quasi-rent/worker (wage change model)</td>
<td>0.29</td>
</tr>
<tr>
<td>6. Hildreth and Oswald (1997)</td>
<td>British firms (EXSTAT); firm-specific profits (from financial statements); instrument = lagged values of wages and profits</td>
<td>Profit per worker</td>
<td>0.02</td>
</tr>
<tr>
<td>7. Hildreth (1998)</td>
<td>British manufacturing establishments; establishment-specific value added; instrument for rents = innovation measure</td>
<td>Quasi-rent/worker</td>
<td>0.03</td>
</tr>
<tr>
<td>8. Barth et al (2014)</td>
<td>US establishments in LBD. Establishment-specific revenues; instrument for revenues/worker = revenues/worker in same industry, other regions</td>
<td>Sales/worker (within-establishment changes)</td>
<td>OLS = 0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IV = 0.16</td>
</tr>
</tbody>
</table>

Note: Table continues.
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<tr>
<td><strong>C. Individual Wages and Firm-Level Profit Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 9. Margolis and Salvanes (2001) | Worker and firm data for France and Norway; full time male workers in manufacturing; profit from financial filings; *instruments* = sales/worker and subsidies/worker | Profit per worker | France: 0.03  
Norway: 0.01 |
| 10. Arai (2003) | Swedish worker panel matched to employer (10-year stayers design); profits from financial statements | Change in 5-year average profit per worker | 0.01-0.02 |
| 11. Guiso, Pistaferri, Schivardi (2005) | Italian worker panel matched to larger firms; value added from financial statements; model-based decomposition of value-added shocks | Permanent shock to log value added per worker  
Transitory shock to log value added per worker | 0.07  
0.00 |
| 12. Fakhfakf and FitzRoy (2004) | Larger French manufacturing establishments; value added from establishment survey | Mean log value-added/worker over past 3 years | 0.12 |
| 13. Caju, Rycx, Tojerow (2009) | Belgian establishment panel; value added and labor cost from financial statements | Value added minus labor costs per worker | 0.03-0.04 |
| 14. Martins (2009) | Larger Portuguese manufacturing firms; revenue and capital costs from financial statements; *instruments* = export share of sales × exchange rate changes | Revenue-capital costs/worker (differenced) | 0.03-0.05 |
| 15. Guertzgen (2009) | German establishment/worker panel (LIAB) value added from establishment survey. *instruments* for change in quasi-rent = lags of value added and wages | Quasi-rent/worker (no adjustment for capital)  
Change in quasi-rent/worker (stayers design), instrumented | 0.03-0.04  
0.01-0.06 |

Note: Table continues.
<table>
<thead>
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<td><strong>C. Individual Wages and Firm-Level Profit Measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Cardoso and Portela (2009)</td>
<td>Portuguese worker panel; sales from firm reports; model-based decomposition of sales shocks</td>
<td>Permanent shock to log sales</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transitory shock to log sales</td>
<td>0.00</td>
</tr>
<tr>
<td>17. Arai and Hayman (2009)</td>
<td>Swedish worker/firm panel (1996-2000); profits from financial statements; stayers; instrument=change in foreign sales</td>
<td>Change in profit per worker</td>
<td>0.05</td>
</tr>
<tr>
<td>18. Card, Divincienti, Maida (2014)</td>
<td>Italian worker panel matched to firms; value added and capital from financial statements; instrument for value added = sales/worker at firms in other regions</td>
<td>Value added per worker (within job match)</td>
<td>0.06-0.08</td>
</tr>
<tr>
<td>19. Carlsson, Messina, and Skans (2014)</td>
<td>Swedish worker panel matched to firms; mining and manufacturing only; firm-specific output and selling price indexes; instrument for productivity = indexes of firm-specific and sectoral TFPQ;</td>
<td>Firm-specific output/worker (within-job-match)</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sectoral average output/worker (within-job-match)</td>
<td>0.15</td>
</tr>
<tr>
<td>20. Card, Cardoso, and Kline (2014)</td>
<td>Portuguese worker panel matched to firms; value added and capital from financial statements; wage measure=estimated firm effect from AKM model</td>
<td>Mean Value added per worker Males: 0.16 Females: 0.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean Value added per worker (changes for stayers) Males: 0.05 Females: 0.04</td>
<td></td>
</tr>
<tr>
<td>21. Bagger, Christensen, and Mortensen (2014)</td>
<td>Danish worker panel matched to firms; output from firm survey; non-parametric regressions within sector of wages on labor productivity</td>
<td>Output per worker Manuf: 0.09 Trade: 0.13 Transp/Comm: 0.05 Finance/Real Est: 0.07</td>
<td></td>
</tr>
</tbody>
</table>
Summary

- Bigger elasticities for:
  - Aggregate wages (composition effects)
  - Aggregate shocks (equilibrium effects)
  - Permanent shocks (insurance)
  - Instrumented specifications (measurement error / mechanical)

- Would be nice to have more studies w/ E-E microdata exploiting observable firm-level shocks ala Van Reenen (1996)

- Converting to VA/Sales units, most elasticities $\in [0.05, 0.15]$
  - Too small to explain all covariance in trends between productivity and wage dispersion
  - But sorting can amplify effects of dispersion in wage premia
Firm Movers

- Abowd, Kramarz, and Margolis (AKM, 1999):

  \[ \ln w_{it} = \alpha_i + \psi_{J(i,t)} + X'_{it}\beta + \varepsilon_{it} \]

  Average wage effect of moving from firm \( j \) to firm \( k \) given by 
  \( \psi_k - \psi_j \)

- Decomposing inequality:

  \[
  \text{Var} (\ln w_{it}) = \text{Var} (\alpha_i) + \text{Var} (\psi_{J(i,t)}) + \text{Var} (X'_{it}\beta) + \text{Var} (\varepsilon_{it}) \\
  + 2 \text{Cov} (\alpha_i, \psi_{J(i,t)}) + 2 \text{Cov} (\alpha_i, X'_{it}\beta) + 2 \text{Cov} (\psi_{J(i,t)}, X'_{it}\beta)
  \]

- Recent studies: \( \frac{\text{Var}(\psi_{J(i,t)})}{\text{Var}(\ln w_{it})} \in [0.15, 0.25] \)
Decomposition of Variance of Log Wages

- **Var. Residual**
- **Cov. Xb with Person & Establ. Effects**
- **Cov. Person & Establ. Effects**
- **Var. Xb**
- **Var. Establishment Effects**
- **Var. Person Effects**

**Variance Components**

- **1985-1991**
- **1990-1996**
- **1996-2002**
- **2002-2009**
Are AKM-style estimates credible?

- Additive Separability: proportional markup/down for all workers

- Exogeneous mobility: no selection on time-varying errors or match component

\[ P(J(i, t) = j | \alpha_i, \psi, \varepsilon_{i1}, ..., \varepsilon_{iT}) = P(J(i, t) = j | \alpha_i, \psi) \]

- Statistical issues: fixed effect estimates inconsistent in short panels
Figure 2: Mean Wages of West German Male Job Changers, Classified by Quartile of Co-worker Wages at Origin and Destination (2002-09)

Notes: figure shows mean wages of male workers observed in 2002-2009 who change jobs in 2004-2007 and held the preceding job for 2 or more years, and the new job for 2 or more years. Jobs are classified into quartiles based on mean wage of co-workers.
### Appendix Table 3: Mean Log Wages Before and After Job Change, for Movers with Two or More Years of Wage Data Before and After Job Change

<table>
<thead>
<tr>
<th>Origin/destination quartile</th>
<th>Number of Changes:</th>
<th>Mean Log Wages of Movers</th>
<th>4 Year Change</th>
<th>4 Year Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>2 years before</td>
<td>1 year before</td>
<td>1 year after</td>
</tr>
<tr>
<td>Interval 1: 1985-1991</td>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>1 to 1</td>
<td>333,648</td>
<td>4.003</td>
<td>4.025</td>
<td>4.085</td>
</tr>
<tr>
<td>1 to 2</td>
<td>206,251</td>
<td>4.063</td>
<td>4.085</td>
<td>4.207</td>
</tr>
<tr>
<td>1 to 3</td>
<td>136,119</td>
<td>4.064</td>
<td>4.087</td>
<td>4.271</td>
</tr>
<tr>
<td>1 to 4</td>
<td>82,193</td>
<td>4.102</td>
<td>4.132</td>
<td>4.380</td>
</tr>
<tr>
<td>2 to 1</td>
<td>125,376</td>
<td>4.160</td>
<td>4.178</td>
<td>4.144</td>
</tr>
<tr>
<td>2 to 2</td>
<td>204,787</td>
<td>4.229</td>
<td>4.251</td>
<td>4.286</td>
</tr>
<tr>
<td>2 to 3</td>
<td>158,360</td>
<td>4.258</td>
<td>4.278</td>
<td>4.359</td>
</tr>
<tr>
<td>2 to 4</td>
<td>86,038</td>
<td>4.298</td>
<td>4.324</td>
<td>4.474</td>
</tr>
<tr>
<td>3 to 1</td>
<td>59,334</td>
<td>4.245</td>
<td>4.261</td>
<td>4.163</td>
</tr>
<tr>
<td>3 to 2</td>
<td>91,474</td>
<td>4.315</td>
<td>4.337</td>
<td>4.333</td>
</tr>
<tr>
<td>3 to 3</td>
<td>173,160</td>
<td>4.384</td>
<td>4.409</td>
<td>4.452</td>
</tr>
<tr>
<td>3 to 4</td>
<td>136,569</td>
<td>4.460</td>
<td>4.487</td>
<td>4.594</td>
</tr>
<tr>
<td>4 to 1</td>
<td>30,110</td>
<td>4.373</td>
<td>4.396</td>
<td>4.252</td>
</tr>
<tr>
<td>4 to 2</td>
<td>41,079</td>
<td>4.459</td>
<td>4.488</td>
<td>4.447</td>
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<tr>
<td>4 to 3</td>
<td>91,177</td>
<td>4.552</td>
<td>4.584</td>
<td>4.596</td>
</tr>
<tr>
<td>4 to 4</td>
<td>290,921</td>
<td>4.678</td>
<td>4.710</td>
<td>4.777</td>
</tr>
</tbody>
</table>

*Note: Quartiles represent the distribution of job changes.*

**Adjusted for other factors influencing wage changes.*
Figure 3a: Mean Log Wages of Portuguese Male Job Changers, Classified by Quartile of Co-Worker Wages at Origin and Destination

Notes: figure shows mean wages of male workers at mixed-gender firms who changed jobs in 2004-2007 and held the preceding job for 2 or more years, and the new job for 2 or more years. Job is classified into quartiles based on mean log wage of co-workers of both genders.
### Appendix Table B2: Wages of Job Changes for Movers with 2+ Years of Data Before/After Job Change

<table>
<thead>
<tr>
<th>Origin/destination quartile</th>
<th>Number Changes (1)</th>
<th>Pct. Of Changes (2)</th>
<th>2 years before (3)</th>
<th>1 year before (4)</th>
<th>1 year after (5)</th>
<th>2 years after (6)</th>
<th>3 Year Change (%) Raw (7)</th>
<th>Adjusted* (8)</th>
<th>Std Err (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 1</td>
<td>13,787</td>
<td>43.2</td>
<td>1.14</td>
<td>1.14</td>
<td>1.16</td>
<td>1.20</td>
<td>5.6</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>1 to 2</td>
<td>9,139</td>
<td>28.7</td>
<td>1.19</td>
<td>1.18</td>
<td>1.35</td>
<td>1.37</td>
<td>17.6</td>
<td>11.6</td>
<td>0.6</td>
</tr>
<tr>
<td>1 to 3</td>
<td>6,283</td>
<td>19.7</td>
<td>1.20</td>
<td>1.19</td>
<td>1.48</td>
<td>1.51</td>
<td>30.6</td>
<td>23.9</td>
<td>0.7</td>
</tr>
<tr>
<td>1 to 4</td>
<td>2,682</td>
<td>8.4</td>
<td>1.28</td>
<td>1.27</td>
<td>1.71</td>
<td>1.75</td>
<td>47.3</td>
<td>39.0</td>
<td>1.2</td>
</tr>
<tr>
<td>2 to 1</td>
<td>7,293</td>
<td>21.2</td>
<td>1.34</td>
<td>1.35</td>
<td>1.22</td>
<td>1.27</td>
<td>-6.5</td>
<td>-12.0</td>
<td>0.6</td>
</tr>
<tr>
<td>2 to 2</td>
<td>12,326</td>
<td>35.8</td>
<td>1.37</td>
<td>1.38</td>
<td>1.40</td>
<td>1.42</td>
<td>5.0</td>
<td>-0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>2 to 3</td>
<td>10,356</td>
<td>30.0</td>
<td>1.41</td>
<td>1.42</td>
<td>1.54</td>
<td>1.57</td>
<td>15.9</td>
<td>9.3</td>
<td>0.5</td>
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<td>13.0</td>
<td>1.49</td>
<td>1.49</td>
<td>1.81</td>
<td>1.84</td>
<td>35.3</td>
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<td>1.79</td>
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<td>1.93</td>
<td>1.97</td>
<td>1.85</td>
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<td>2.29</td>
<td>2.32</td>
<td>2.41</td>
<td>2.45</td>
<td>15.9</td>
<td>6.1</td>
<td>0.9</td>
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</table>
Figure 3b: Mean Wages of Portuguese Female Job Changers, Classified by Quartile of Co-Worker Wages at Origin and Destination

Notes: figure shows mean wages of female workers at mixed gender firms who changed jobs in 2004-2007 and held the preceding job for 2 or more years, and the new job for 2 or more years. Jobs are classified into quartiles based on mean log wage of co-workers of both genders.
Figure 4a: Test for Symmetry of Regression-Adjusted Wage Changes of Portuguese Male Movers Across Coworker Wage Quartiles

Note: Figure plots regression adjusted mean wage changes over 4 year interval for job changers who move across coworker wage quartile groups indicated. Dashed line represents symmetric changes for upward and downward movers.
Figure 4b: Test for Symmetry of Regression-Adjusted Wage Changes of Portuguese Female Movers Across Coworker Wage Quartiles

Note: Figure plots regression adjusted mean wage changes over 4 year interval for job changers who move across coworker wage quartile groups indicated. Dashed line represents symmetric changes for upward and downward movers.
Figure 5: Mean Residuals by Person/Establishment Deciles, German Male Workers 2002-09

Notes: figure shows mean residuals from estimated AKM model with cells defined by decile of estimated establishment effect, interacted with decile of estimated person effect.
Figure 6a: Mean Residuals by Person/Firm Deciles, Portuguese Male Workers

Note: figure shows mean residuals from estimated AKM model with cells defined by decile of estimated firm effects interacted with decile of estimated person effect.
Figure 7: Relationship of Estimated Firm Fixed Effects with Log Value Added/Worker

Note: points shown represent mean estimated firm-specific wage premiums from AKM models for men and women, averaged across firms in 100 percentile bins of mean log value added per worker.
Finite sample biases

- Under the AKM assumptions, FE estimates are unbiased:
  \[ E \left[ \hat{\psi}_j \right] = \psi_j \ \forall j, E \left[ \hat{\alpha}_i \right] = \alpha_i \ \forall i \]

- But noise leads to upward bias in variance of estimated effects and downward bias in covariance
  - Bias concave in \# movers per firm (Andrews et al, 2008)

- Bias corrections proposed by Andrews et al (2008) and Gaure (2015) rely on strong homoscedasticity / non-correlation assumptions about time-varying errors \( \{ \varepsilon_{it} \} \)
  - But promising work on random effects alternatives (Abowd et al, 2012; Bonhomme et al, 2015)
  - Structural models: joint model of mobility and wages (e.g., Postel-Vinay and Robin, 2002)

- In practice, bias is likely to be fairly substantial if working w/ samples instead of population files
Fig. 1. Increasing the number of movers per establishment in a fixed sample of establishments increases $\text{Corr}(\hat{\theta}_i, \hat{\psi}_j)$. 
Want to think more carefully about how firm heterogeneity can generate wage premia

Standard approach: Search and Matching (S&M)
- S&M gives plausible account of unemployment / labor flows
- But not really a theory of wages *per se*
- In fact, wages often indeterminate (Edgeworth, 1932)

Today: follow IO literature in thinking about imperfect competition due to “workplace differentiation”
- Differentiation gives firms some power to set wages
- Study link between productivity and wage dispersion
- Interpretation of AKM-style firm effects
- And some new testable predictions...
Two types of workers: $L$ and $H$

$J$ firms, each with non-wage attributes

Indirect utility for an individual $i$ of type $S \in \{L, H\}$ of working at firm $j$ is:

$$v_{iSj} = \beta_s \ln w_{Sj} + a_{Sj} + \epsilon_{iSj}$$

- $\{a_{Lj}, a_{Hj}\}$ capture mean valuations of work environment
- $\{\epsilon_{iLj}, \epsilon_{iHj}\} \sim EV1(.)$ capture heterogeneity in valuations
Logit choice probabilities:

\[ p_{Sj} \equiv P(v_{isj} \geq v_{isk} \ \forall \ k \neq j) = \frac{\exp(\beta_S \ln w_{sj} + a_{sj})}{\sum_{k=1}^{J} \exp(\beta_S \ln w_{sk} + a_{sk})} \]

Take \( J \to \infty \) (large market):

\[ p_{Sj} \approx \lambda_S \exp(\beta_S \ln w_{sj} + a_{sj}), \]

where \( (\lambda_H, \lambda_L) \) are constants
Firm-specific supply

Iso-elastic type-specific supply curves:

\[
\ln L_j(w_{Lj}) = \ln(L\lambda_L) + \beta_L \ln w_{Lj} + a_{Lj}
\]

\[
\ln H_j(w_{Hj}) = \ln(H\lambda_H) + \beta_H \ln w_{Hj} + a_{Hj},
\]

As \((\beta_L, \beta_H) \to \infty\), market becomes competitive

\(\{a_{Lj}, a_{Hj}\}\) break mechanical link between firm size and wages
Firm Optimization

- Firm $j$’s production function:

$$Y_j = T_j f(L_j, H_j)$$

- Firm’s problem is to choose wages to minimize cost:

$$\min_{w_L, w_H} w_L L_j(w_L) + w_H H_j(w_H) \text{ s.t. } T_j f(L_j(w_L), H_j(w_H)) \geq Y$$

- Note: firm knows shape of LS fn’s but not identity of workers who comprise them (no 1st-degree price discrim)
Choosing \((w_{jH}, w_{jL})\) yields standard “mark down” formula:

\[
\begin{align*}
    w_{Lj} &= \frac{\beta_L}{1 + \beta_L} T_j f_L \mu_j \\
    w_{Hj} &= \frac{\beta_H}{1 + \beta_H} T_j f_H \mu_j
\end{align*}
\]

where \(\mu_j \equiv MC^{opt} = MR\)

Example: \(\beta_L = \beta_H = 9 \Rightarrow\) workers paid 90% of MRP
Special Case: Linear Production, Fixed Output Price

- Production function:

\[ Y_j = T_j((1 - \theta)L_j + \theta H_j) \]

- Equilibrium Wages:

\[ w_{Lj} = \frac{\beta_L}{1 + \beta_L} (1 - \theta) T_j P_j^0 \]

\[ w_{Hj} = \frac{\beta_H}{1 + \beta_H} \theta T_j P_j^0 \]

- Notes:
  - “Rent-sharing” elasticity = 1
  - No “sharing” going on: rents captured by inframarginal workers due to asym. info
  - No compensating diffs (\( a_{Sj} \)’s don’t influence the LS elasticity)
Figure 8: Equilibrium Wages and Employment

log \( L \)

log \( w \)

inverse labor supply: slope = \( \frac{1+\beta}{\beta} \)

marginal factor cost

log \( w^* \)

MRP

log \( L^* \)

log \( L \)
\[ \ln w_{jH} = \ln \left( \frac{\beta_H}{1 + \beta_H} \right) + \ln 1 - \theta + \ln T_j P_j^0 \]

\[ \ln w_{jL} = \ln \left( \frac{\beta_L}{1 + \beta_L} \right) + \ln \theta + \ln T_j P_j^0 \]

- Stable “person effect” across firms driven by LS elasticity and technology
- Stable “firm effect” driven by productivity
- Inequality trends:
  - Variance of firm effects driven by \( \sigma_T^2, \sigma_P^2 \)
  - Possible group differences due to diffs in \( \beta' \)s (Robinson, 1933)
Relative wages invariant to TFP (stable person eff):

$$\ln \frac{w_{Hj}}{w_{Lj}} = \ln \frac{\beta_H}{1 + \beta_H} - \ln \frac{\beta_L}{1 + \beta_L} + \ln \frac{\theta}{1 - \theta}$$

But relative employment related to TFP if $\beta_H \neq \beta_L$:

$$\ln \frac{H_j}{L_j} = C + \ln \frac{a_{Hj}}{a_{Lj}} + \beta_H \ln \theta - \beta_L \ln \frac{1}{1 - \theta} + (\beta_H - \beta_L) \ln T_j P_j^0$$

Notes:

- Firm size / sorting driven by both productivity and non-wage amenities
- $\beta_H > \beta_L \Rightarrow$ more productive firms have higher skill share
Adding product market power

- Downward sloping demand: \( P_j = P_j^0 Y_j^{-1/\varepsilon} \), \( \varepsilon > 1 \)

- Marginal revenue: \( MR_j = (1 - \frac{1}{\varepsilon}) P_j^0 Y_j^{-1/\varepsilon} \)

- Wages become:

\[
\begin{align*}
w_{Lj} &= \frac{\beta_L}{1 + \beta_L} (1 - \theta) T_j^{1-1/\varepsilon} P_j^0 f(L_j(w_{Lj}), H_j(w_{Hj}))^{-1/\varepsilon} \\
\frac{w_{Hj}}{w_{Lj}} &= \frac{\beta_H}{1 + \beta_H} \theta T_j^{1-1/\varepsilon} P_j^0 f(L_j(w_{Lj}), H_j(w_{Hj}))^{-1/\varepsilon}
\end{align*}
\]

- Note that now "TFPR" = \( T_j^{1-1/\varepsilon} P_j^0 \)

- AKM-style decomp still holds because relative wages \( \frac{w_{Hj}}{w_{Lj}} \) invariant to TFP, now firm effect is (to 1st order):

\[
\psi_j \approx \frac{\varepsilon}{\varepsilon + \beta_j} \ln \frac{P_j^0}{P} + \frac{\varepsilon - 1}{\varepsilon + \beta_j} \ln \frac{T_j}{T}
\]
“Rent-sharing” elasticities

Letting \( \bar{\beta}_j = \beta_L \kappa_j + \beta_H (1 - \kappa_j) \), \( \kappa_j = \frac{(1 - \theta)L_j}{(1 - \theta)L_j + \theta H_j} \), we have:

\[
\frac{\partial \ln w_{Lj}}{\partial \ln P^0_j} = \frac{\partial \ln w_{Hj}}{\partial \ln P^0_j} = \frac{\varepsilon}{\varepsilon + \bar{\beta}_j}
\]
\[
\frac{\partial \ln w_{Lj}}{\partial \ln T_j} = \frac{\partial \ln w_{Hj}}{\partial \ln T_j} = \frac{\varepsilon - 1}{\varepsilon + \bar{\beta}_j}
\]

Special cases:

- As \( \varepsilon \to \infty \), \( \frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to 1 \) (constant MRP)
- As \( \varepsilon \to 1 \), \( \frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to 0 \) (inelastic demand)
- As \( \bar{\beta}_j \to \infty \), \( \frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to 0 \) (competitive labor market)
- As \( \bar{\beta}_j \to 0 \), \( \frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to \frac{\varepsilon - 1}{\varepsilon} \) (fixed labor supply)

Suppose \( \bar{\beta}_j = 9 \), \( \varepsilon = 1.5 \). Then \( \frac{\partial \ln w_{Lj}}{\partial \ln P^0_j} = .14 \), \( \frac{\partial \ln w_{Lj}}{\partial \ln T_j} = .047 \)

“Rent-sharing” elasticity will be weighted average of these two based upon variance-covariance of shocks to \( (P^0_j, T_j) \)
A Shift in Demand

Figure 9: Effect of Demand Variation with Decreasing Marginal Revenue Product

\[ \log w \]
\[ \log L^0 \]
\[ \log L^1 \]

Marg Rev Prod slope = \(-1/\epsilon\)

MFC

inverse supply slope = \(1/\beta\)

Shift in demand

\[ d \log w = \frac{\epsilon}{(\epsilon+\beta)} d \log MRP \]
Adding imperfect substitution

- Suppose we relax linear production technology to allow CES production:

\[ Y_j = Tf(L, H) = T_j[(1 - \theta)L_j^\rho + \theta H_j^\rho]^{1/\rho} \]

where \( \rho \in (-\infty, 1] \). The elasticity of substitution is \( \sigma = (1 - \rho)^{-1} \in [1, \infty) \)

- Wages can be written:

\[
\left(1 + \frac{1}{\sigma} \beta_L\right) \ln w_{Lj} = \ln \left(\frac{\beta_L}{1 + \beta_L}\right) + \ln(1 - \theta) - \frac{1}{\sigma} a'_{Lj} + \Gamma_j \\
\left(1 + \frac{1}{\sigma} \beta_H\right) \ln w_{Hj} = \ln \left(\frac{\beta_H}{1 + \beta_H}\right) + \ln \theta - \frac{1}{\sigma} a'_{Hj} + \Gamma_j
\]

- AKM-decomp holds when \( \beta_L \approx \beta_H \). Otherwise it only holds locally within skill groups.
A new prediction

- Usual inverse relationship between relative quantities and wages now holds at firm-level:

\[
\frac{\partial \ln(H_j/L_j)}{\partial \ln P^0_j} = -\sigma \frac{\partial \ln(w_{Hj}/w_{Lj})}{\partial \ln P^0_j}
\]

- Firm-level evidence on what is usually considered a macro phenomenon?
Figure 11: Relative Wages and Relative Employment of Low-Education Workers vs. Wage Premium for Apprenticeship-Qualified Workers

Note: figure shows 5th to 95th percentile groups only. Mean log relative wage premium is mean wage premium for low-education workers minus wage premium for apprenticeship qualified workers. Mean log relative employment is mean log employment of low-education workers minus log employment of apprenticeship-qualified workers. Based on establishment wage premiums and employment shares among West German male full time workers, 2002-2009.
Figure 12: Relative Wages and Relative Employment of High-Education Workers vs. Wage Premium for Apprenticeship-Qualified Workers

Note: figure shows 10th to 95th percentile groups only. Mean log relative wage premium is mean wage premium for high-education workers minus wage premium for apprenticeship qualified workers. Mean log relative employment is mean log employment of high-education workers minus log employment of apprenticeship-qualified workers. Based on establishment wage premiums and employment shares among West German male full time workers, 2002-2009.
“SBTC” shocks (simple version)

- Technology diffuses unevenly across firms (Griliches, 1957; Doms, Dunne, and Troske, 1997; Dunne et al., 2004)
- No reason to assume all variation is Hicks neutral: Let $\theta$ vary in addition to TFP!

- When $(\sigma, \varepsilon) \to \infty$, we get skill-group specific firm effects:

$$
\psi^L_j = \ln(1 - \theta_j) + \ln T_j P^0_j \\
\psi^H_j = \ln \theta_j + \ln T_j P^0_j
$$

- Regression of type-L FE on type-H FE:

$$
\frac{\text{Cov}[\psi^L_j, \psi^H_j]}{\text{Var}[\psi^H_j]} < 1
$$

- Alternate explanation for imperfect correlation of firm effs across groups
Figure 10: Establishment Wage Premiums for High and Low Education Groups vs. Premium for Apprenticeship-Qualified Workers

Note: figure shows 5th to 95th percentile groups only. Based on estimated establishment effects for West German male full time workers, 2002-2009. Establishment effects are normalized to have mean of 0 for each education.
Define $\xi_j \equiv \frac{\partial \ln f}{\partial \ln \theta_j}$ as “TFP-like” component of SBTC shock.

Distinguish from “pure” shock to relative productivity $\frac{\theta_j}{1-\theta_j}$.

Link between relative wages and quantities now ambiguous:

$$\frac{\partial \ln (w_H/w_L)}{\partial \ln \theta_j} = \frac{\frac{1}{1-\theta_j} \sigma (1 + \frac{\beta}{\varepsilon}) + (\beta_L - \beta_H) \xi_j (1 - \frac{1}{\varepsilon})}{\sigma + \beta_L + \beta_H + \left( \frac{\sigma}{\varepsilon} - 1 \right) \bar{\beta}_j + \frac{1}{\varepsilon} \beta_L \beta_H}$$

$$\frac{\partial \ln (H_j/L_j)}{\partial \ln \theta_j} = \frac{\frac{1}{1-\theta_j} \sigma (\bar{\beta}_j + \frac{1}{\varepsilon} \beta_L \beta_H) - (\beta_L - \beta_H) \xi_j (1 - \frac{1}{\varepsilon})}{\sigma + \beta_L + \beta_H + \left( \frac{\sigma}{\varepsilon} - 1 \right) \bar{\beta}_j + \frac{1}{\varepsilon} \beta_L \beta_H}$$

TFP-like variation induces negative correlation, while “pure” TFP-constant component induces positive correlation.

Expect *under-estimate* of $\sigma$ from regression of relative wages on relative quantities.
Both rent-sharing and firm-mover literatures find that firms important for wages

Static monopsony model can explain AKM style wage structure and “rent sharing” effects

Even a little market power ($\beta = 9$) gives interesting results
Going forward,

- Think about static monopsony as steady state of dynamic model w/ frictions?

- Allow for finite $J$ and study strategic interactions between firms?

- How to handle aggregation with imperfect competition and heterogeneity?

- Supply shocks to individual firms? (converse of rent sharing literature)

- Effects of labor market institutions? (min wage, contracts, regulations)