Firms and Labor Market Inequality: A Review

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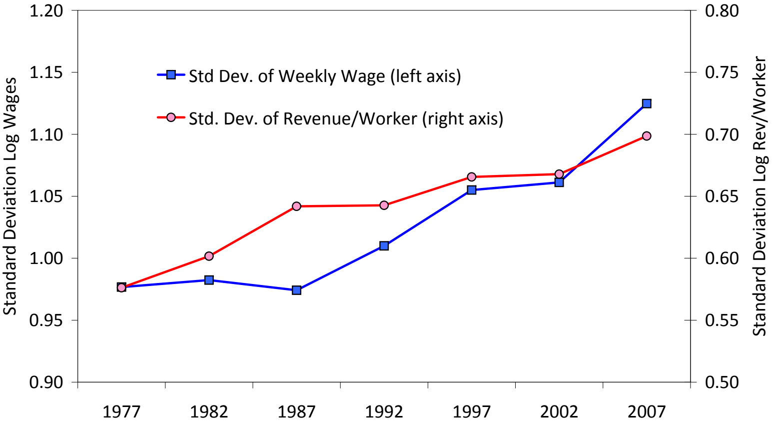
Motivation

- Well known that firms exhibit substantial heterogeneity in productivity
  - Syverson (2004): 90-10 TFP ratios in US manufacturing ≈ 2 (within 4-digit industry!)
  - Hseih and Klenow (2009): 90-10 ratios in India/China ≈ 4.
- 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)

Sorting or Firm Wage Premia?

- 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 $\sim$20% of wage variance
  - Firm effs strongly related to productivity measures
  - But still some outstanding technical problems

Today

- 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 $\Rightarrow$rising wage inequality
    - New predictions regarding relationship between skill group specific wage premia and employment shares
    - Also: "SBTC shocks"

Rent Sharing Literature

- Basic idea:

$$\Delta \ln w_{it} = \alpha + \beta \Delta \ln Rent_{J(i,t)t} + \varepsilon_{it}$$

- 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:

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

- 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:

$$\frac{Q_j}{N_j} = TFP_j g\left(k^*\right) - w_j^a - r_j k^*$$

- Can show:

$$\frac{\partial \ln(\frac{Q_j}{N_j})}{\partial \ln TFP_j} = \frac{\partial \ln(\frac{\pi_j}{N_j})}{\partial \ln TFP_j} = \frac{VA_j/N_j}{Q_j/N_j} \approx 2$$

- Bottom line: sales / VA elasticities $\approx 2\times$ quasi-rent / profit elasticities

Summary of Estimated Rent Sharing Elasticities - Preferred Specifications, Adjusting to TFP Basis

Industry-Level Profit Measure	1. Christofides and Oswald (1992)	0.140	(0.035)	Mean=0.16
	2. Blanchflower, Oswald, Sanfey (1996)	0.060	(0.024)	
	3. Estevao and Tevlin (2003)	0.290	(0.100)	
Firm-Level Profit but Mean Wage	4. Abowd and Lemieux (1993)	0.220	(0.081)	Mean=0.15
	5. Van Reenen (1996)	0.290	(0.089)	
	6. Hildreth and Oswald (1997)	0.040	(0.010)	
	7. Hildreth (1998)	0.030	(0.010)	
	8. Barth et al (2014)	0.160	(0.002)	
Firm-Level Profit and Indiv. Wage	9. Margolis and Salvanes (2001), France	0.062	(0.041)	Mean=0.08
	9. Margolis and Salvanes (2001), Norway	0.024	(0.006)	
	10. Arai (2003)	0.020	(0.004)	
	11. Guiso, Pistaferri, Schivardi (2005)	0.069	(0.025)	
	12. Fakhfakf and FitzRoy (2004)	0.120	(0.045)	
	13. Caju, Rycx, Tojerow (2009)	0.080	(0.010)	
	14. Martins (2009)	0.039	(0.021)	
	15. Guertzgen (2009)	0.048	(0.002)	
	16. Cardoso and Portela (2009)	0.092	(0.045)	
	17. Arai and Hayman (2009)	0.068	(0.002)	
	18. Card, Divincienti, Maida (2014)	0.073	(0.031)	
	19. Carlsson, Messina, and Skans (2014)	0.149	(0.057)	
	20. Card, Cardoso, Kline (2014), Between Firm	0.156	(0.006)	
	20. Card, Cardoso, Kline (2014), Stayers	0.049	(0.007)	
	21. Bagger et al. (2014), Mfg	0.090	(0.020)	

Table 1: Summary of Estimated Rent-Sharing Elasticities

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

Note: Table continues.

Table 1 (continued): Summary of Estimated Rent-Sharing Elasticities

Study	Design Features	Measure of Profitability	Elasticity
C. Individual Wages and Firm-Level Profit Measures			
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	0.07
		Transitory shock to log value added per worker	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)	0.03-0.04
		Change in quasi-rent/worker (stayers design), instrumented	0.01-0.06

Note: Table continues.

Table 1 (continued): Summary of Estimated Rent-Sharing Elasticities

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

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:

$$\begin{aligned} Var\left(\ln w_{it}\right) &= \underbrace{Var\left(\alpha_i\right)}_{\text{workers}} + \underbrace{Var\left(\psi_{J(i,t)}\right)}_{\text{firms}} + Var\left(X_{it}'\beta\right) + Var\left(\varepsilon_{it}\right) \\ &\quad +2\underbrace{Cov\left(\alpha_i, \psi_{J(i,t)}\right)}_{\text{sorting}} + 2Cov\left(\alpha_i, X_{it}'\beta\right) + 2Cov\left(\psi_{J(i,t)}, X_{it}'\beta\right) \end{aligned}$$

- Recent studies: $\frac{Var\left(\psi_{J(i,t)}\right)}{Var(\ln w_{it})} \in [0.15, 0.25]$

Sorting

- in the model:

$$\ln w_{it} = \alpha_i + \psi_{J(i,t)} + X_{it}'\beta + \varepsilon_{it}$$

  positive covariance of α_i and $\psi_J \Rightarrow$ greater wage inequality
- are high-α workers sorted to high-ψ firms?
- problem is that the sampling errors in the estimates are negatively correlated
- Bias concave in # movers per firm (Andrews et al, 2008)
- In practice, bias is likely to be fairly substantial if working w/ samples instead of population files

Andrews et al (2010): Germany, 1998-2007

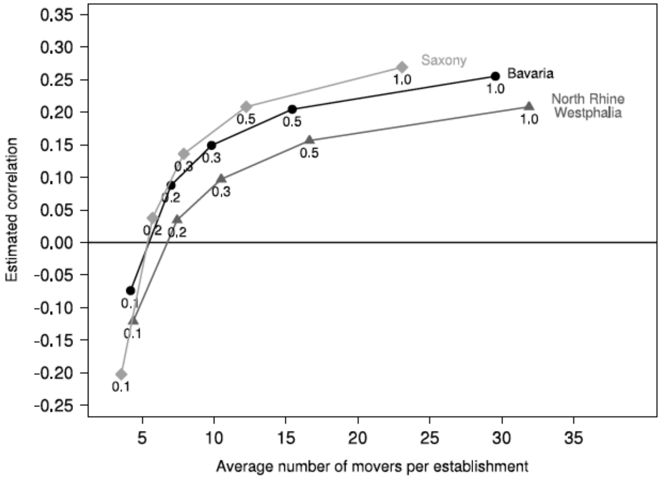


Fig. 1. Increasing the number of movers per establishment in a fixed sample of establishments increases Corr($\hat{\theta}_i$, $\hat{\psi}_j$).

Sorting

- some "direct evidence" on sorting comes from looking at sorting by education. Assume

$$\begin{aligned} \ln w_{it} &= a_t + b_t S_{it} + u_{it} \\ u_{it} &= \mu_{J(i,t),t} + v_{it} \end{aligned}$$

  where b_t is the "causal" effect of schooling in year t and $\mu_{J(i,t),t}$ is a shared firm component
- If we estimate the return to schooling by OLS we get

$$\begin{aligned} b_t^{OLS} &= b_t + \lambda_t c_t \\ \lambda_t &= \frac{cov[\mu_{J(i,t),t}, \overline{S}_{J(i,t),t}]}{var[\overline{S}_{J(i,t)}]} \\ c_t &= \frac{cov[S_i, \overline{S}_{J(i,t),t}]}{var[S_i]} \end{aligned}$$

Sorting(2)

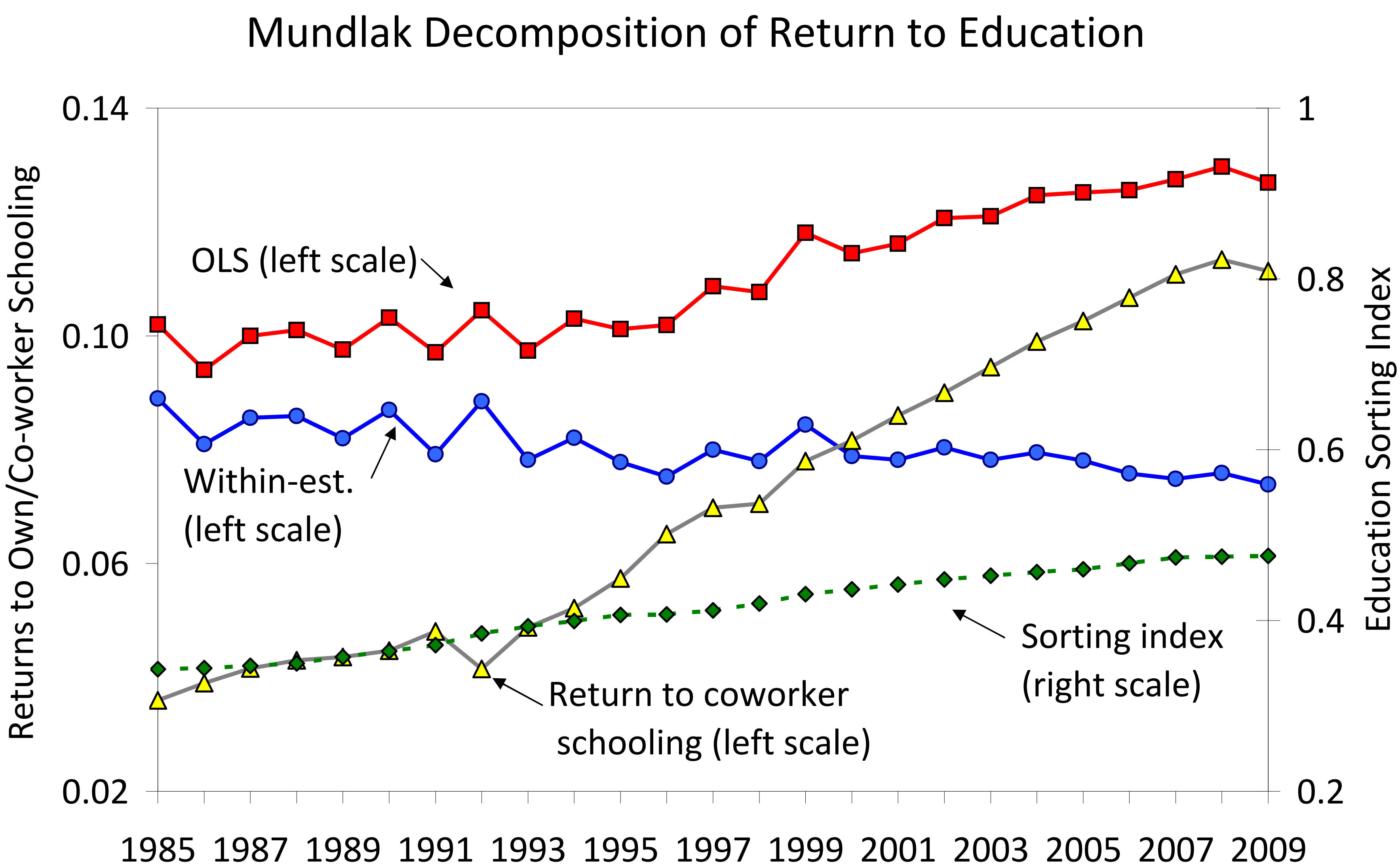
$$b_t^{OLS} = b_t + \lambda_t c_t$$

- The term c_t is the "Kremer-Maskin index" of sorting of schooling.
- The term λ_t is the "between-establishment" return to schooling.
- Using the famous Mundlak result about within/between coefficients we can estimate

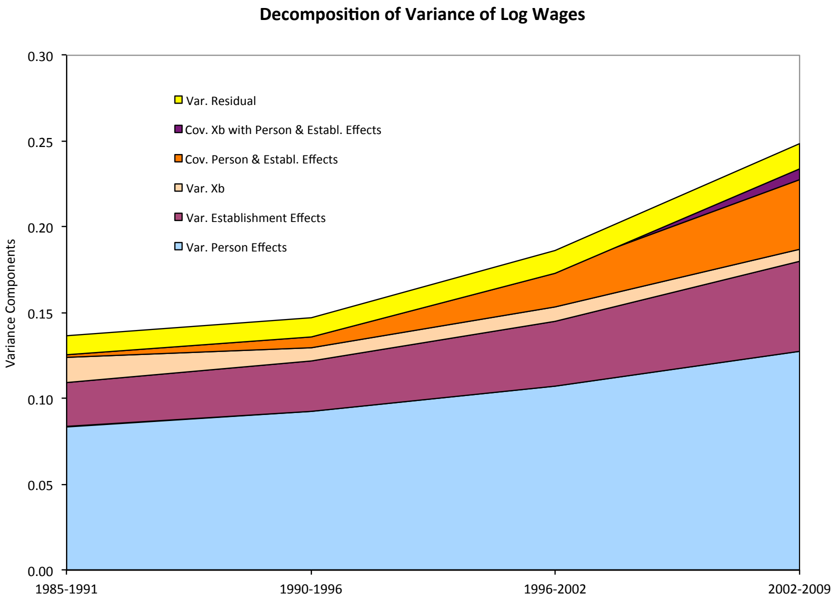
$$\ln w_{it} = a_t + b_t S_i + \lambda_t \overline{S}_{J(i,t),t} + e_{it}$$

and we can estimate the sorting index from the regression

$$\overline{S}_{J(i,t),t} = d_t + c_t S_i + \eta_{it}$$


Mundlak Decomposition of Return to Education
Returns to Own/Co-worker Schooling
Education Sorting Index
0.14
0.10
0.06
0.02
1
0.8
0.6
0.4
0.2
OLS (left scale)
Within-est.
(left scale)
Return to coworker
schooling (left scale)
Sorting index
(right scale)
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009

Variance Decomposition (CHK, 2013)



Are AKM-style estimates credible?

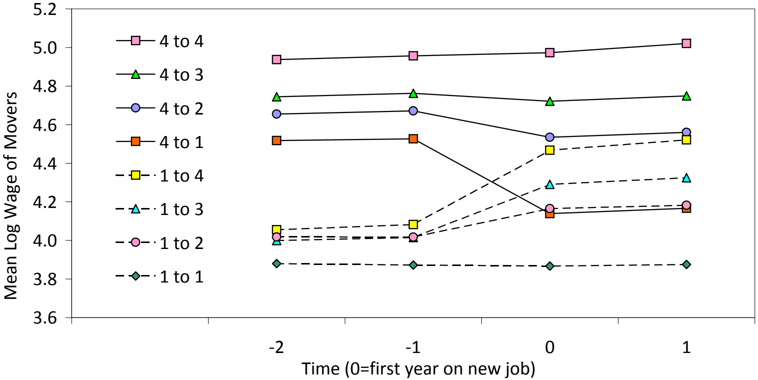
- Additive Separability: proportional markup/down for all workers
- Exogeneous mobility: no selection on time-varying errors or match component

$$P\left(J\left(i,t\right)=j|\alpha_i,\psi,\varepsilon_{i1},...,\varepsilon_{iT}\right)=P\left(J\left(i,t\right)=j|\alpha_i,\psi\right)$$

- Statistical issues: fixed effect estimates inconsistent in short panels

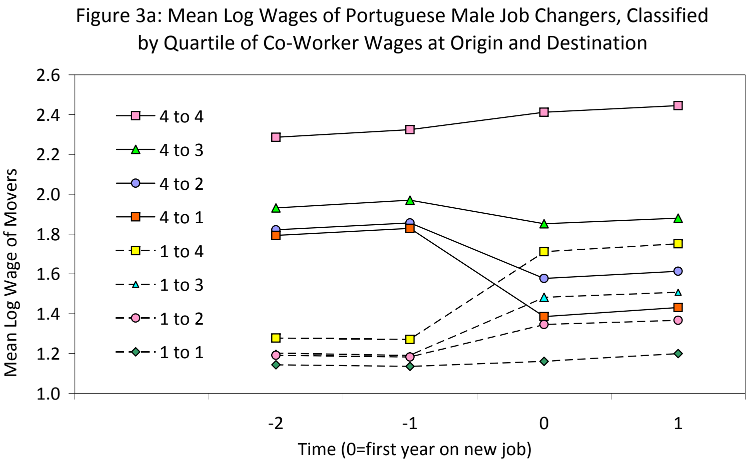
Event-studies (CHK, 2013)

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.

Event-studies (CCK, 2015)



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.

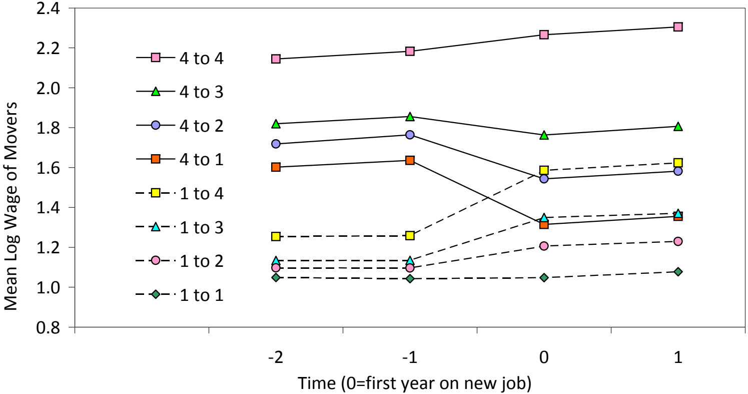
Mobility Directed in Portugal too (CCK, 2015)

Appendix Table B2: Wages of Job Changes for Movers with 2+ Years of Data Before/After Job Change

Origin/ destination quartile	Number Changes (1)	Pct. Of Changes (2)	Mean Log Real Wages of Movers: 2 years before (3)	1 year before (4)	1 year after (5)	2 years after (6)	3 Year Change (%) Raw (7)	Adjusted* (8)	(Std Err) (9)
Males									
1 to 1	13,787	43.2	1.14	1.14	1.16	1.20	5.6	0.5	(0.5)
1 to 2	9,139	28.7	1.19	1.18	1.35	1.37	17.6	11.6	(0.6)
1 to 3	6,283	19.7	1.20	1.19	1.48	1.51	30.6	23.9	(0.7)
1 to 4	2,682	8.4	1.28	1.27	1.71	1.75	47.3	39.0	(1.2)
2 to 1	7,293	21.2	1.34	1.35	1.22	1.27	-6.5	-12.0	(0.6)
2 to 2	12,326	35.8	1.37	1.38	1.40	1.42	5.0	-0.8	(0.6)
2 to 3	10,356	30.0	1.41	1.42	1.54	1.57	15.9	9.3	(0.5)
2 to 4	4,496	13.0	1.49	1.49	1.81	1.84	35.3	27.0	(0.9)
3 to 1	4,356	11.9	1.49	1.52	1.24	1.30	-19.4	-25.6	(0.7)
3 to 2	8,835	24.2	1.54	1.55	1.45	1.48	-5.8	-12.2	(0.6)
3 to 3	15,107	41.3	1.61	1.63	1.65	1.67	6.4	-0.3	(0.5)
3 to 4	8,246	22.6	1.73	1.75	1.94	1.97	24.7	16.0	(0.7)
4 to 1	1,634	5.4	1.79	1.83	1.39	1.43	-36.2	-43.3	(1.6)
4 to 2	3,245	10.7	1.82	1.86	1.58	1.61	-20.9	-28.1	(1.2)
4 to 3	6,589	21.7	1.93	1.97	1.85	1.88	-5.2	-13.1	(0.9)
4 to 4	18,830	62.1	2.29	2.32	2.41	2.45	15.9	6.1	(0.9)

Event-studies (CCK, 2015)

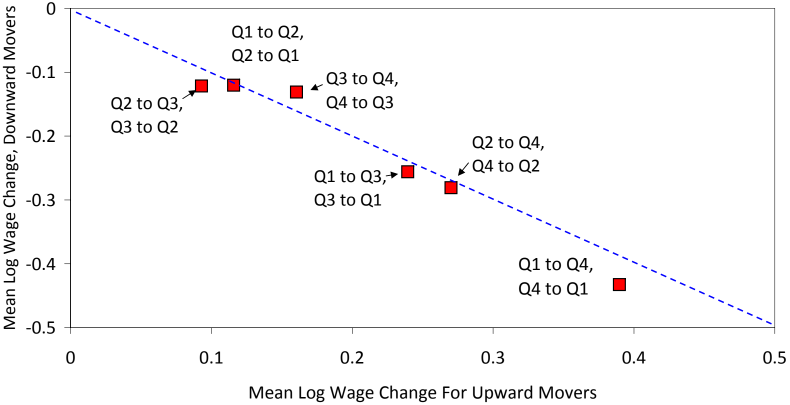
Figure 3b: Mean Wages of Portuguese Female Job Changers, Classified by Quartile of Co-Worker Wages at Origin and Destination



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.

Symmetry Plot (CCK, 2015)

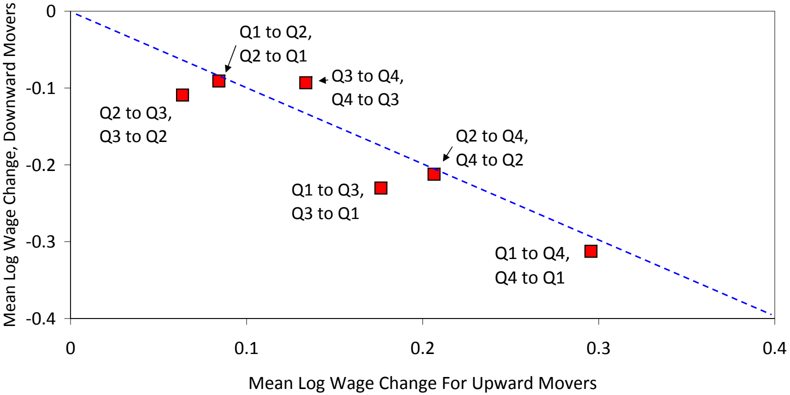
Figure 4a: Test for Symmetry of Regression-Adjusted Wage Changes of Portuguese Male Movers Across Coworker Wage Quartiles



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.

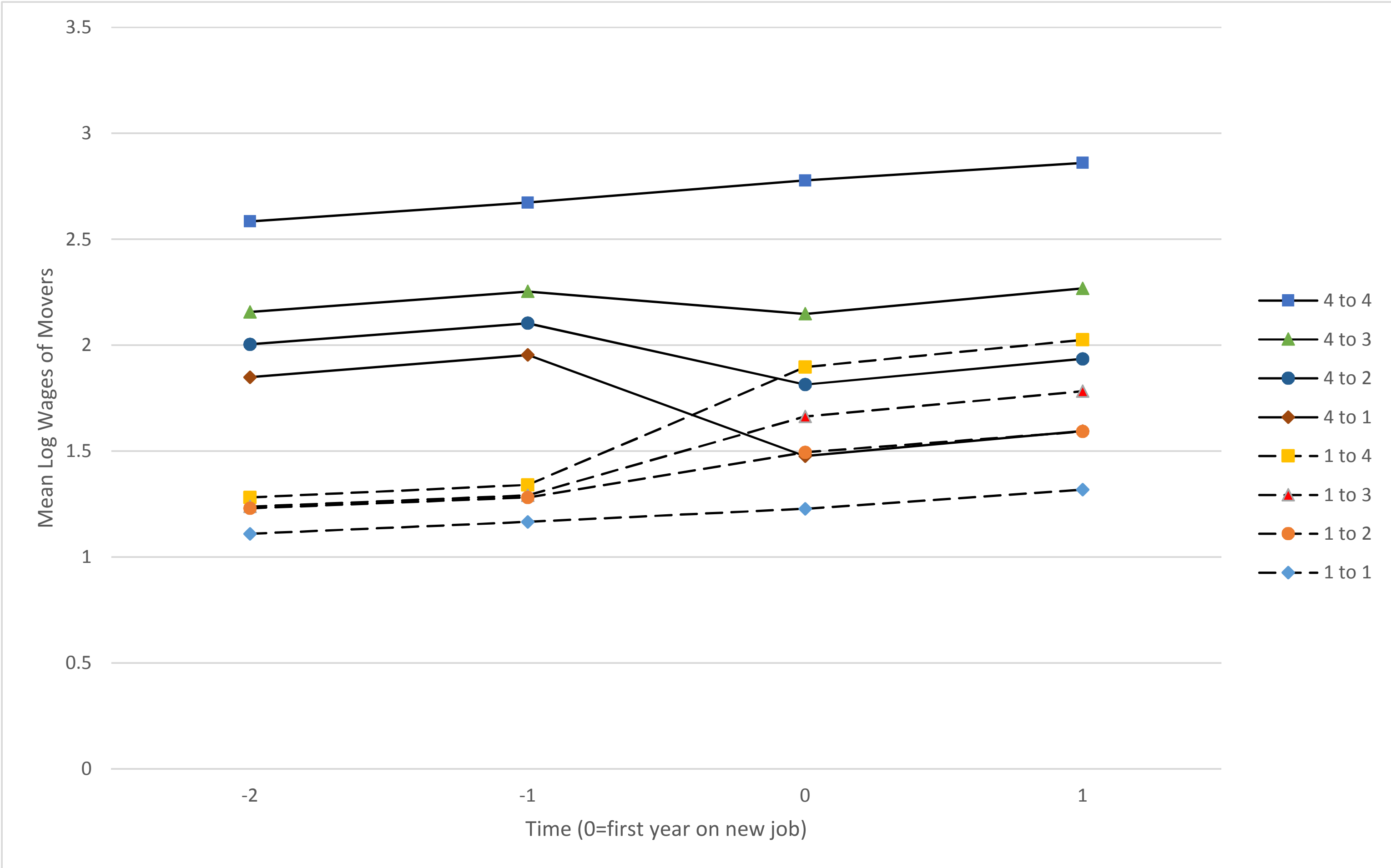
Symmetry Plot (CCK, 2015)

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.

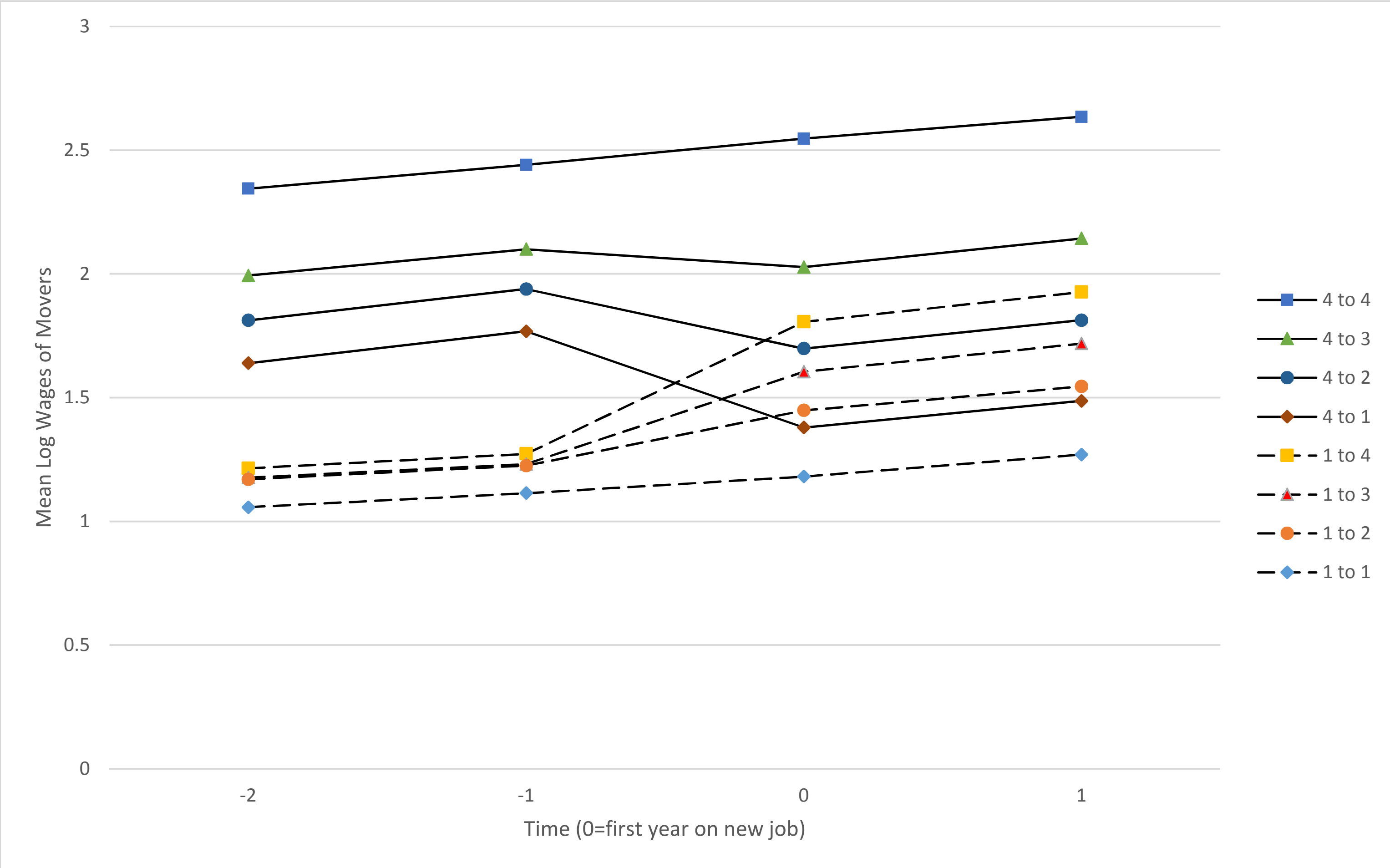
Mean Log Wages of White Race Job Changers, Classified by Quartile of Mean Co-Worker Wage at Origin and Destination Firm



Notes:

Figure shows mean wages of white race workers at multi-race firms who changed jobs in 2004-2011 and held the preceding job for 2 or more years, and the new job for 2 or more years. Each job is classified into quartiles based on mean log wage of co-workers (quartiles are based on co-worker wages in last year on old job and first year on new job).

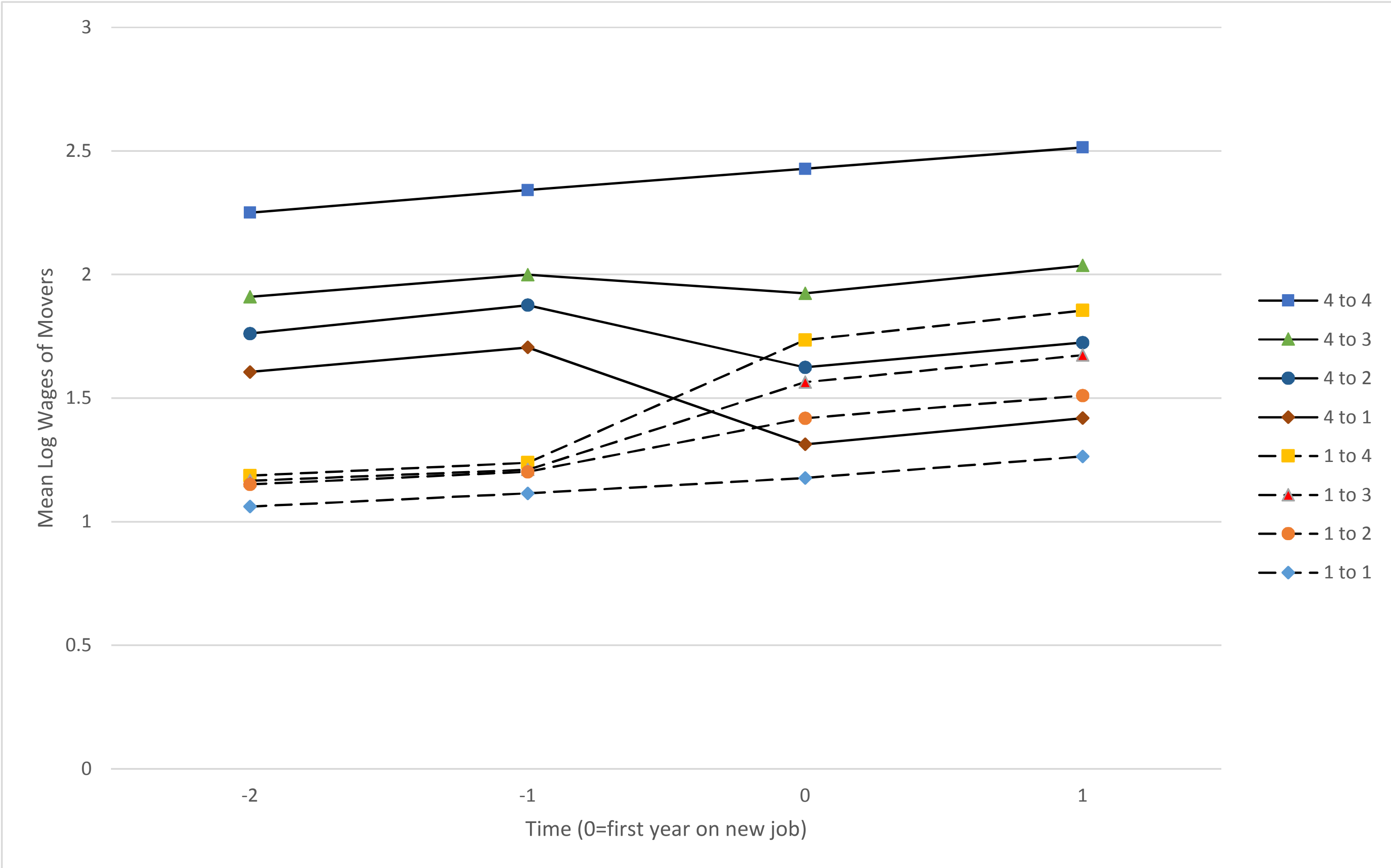
Mean Log Wages of Mixed Race Job Changers, Classified by Quartile of Mean Co-Worker Wage at Origin and Destination Firm



Notes:

Figure shows mean wages of mixed race workers at multi-race firms who changed jobs in 2004-2011 and held the preceding job for 2 or more years, and the new job for 2 or more years. Each job is classified into quartiles based on mean log wage of co-workers (quartiles are based on co-worker wages in last year on old job and first year on new job).

Mean Log Wages of Black Race Job Changers, Classified by Quartile of Mean Co-Worker Wage at Origin and Destination Firm

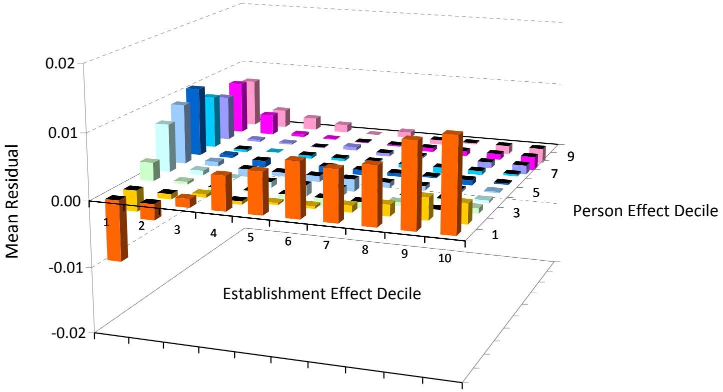


Notes:

Figure shows mean wages of black race workers at multi-race firms who changed jobs in 2004-2011 and held the preceding job for 2 or more years, and the new job for 2 or more years. Each job is classified into quartiles based on mean log wage of co-workers (quartiles are based on co-worker wages in last year on old job and first year on new job).

Separability Plot (CHK, 2013)

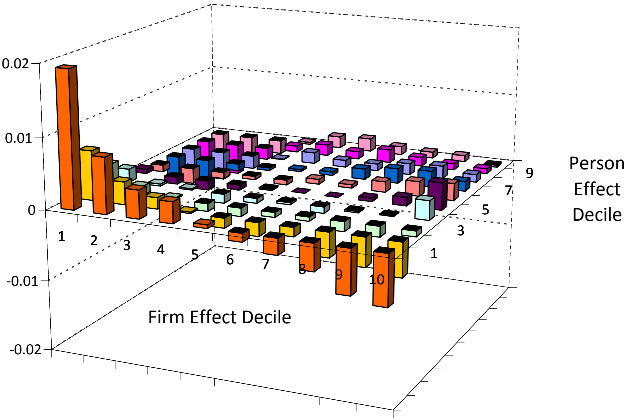
Figure 5: Mean Residuals by Person/Establishment Deciles,
German Male Workers 2002-09



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.

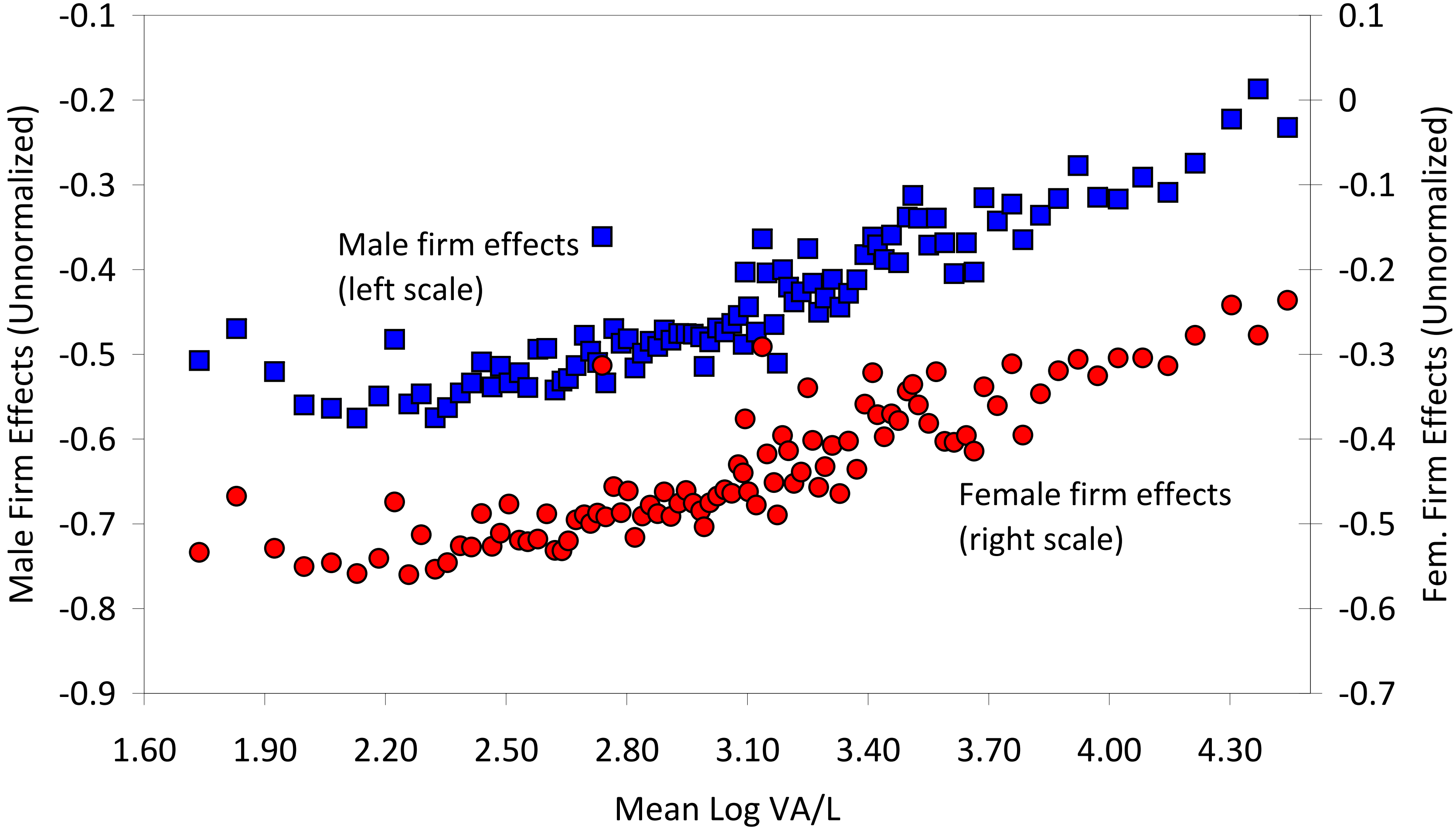
Separability Plot (CCK, 2015)

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.

A Model of Imperfect Competition

- 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...

Setup

- 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
  - $\{\varepsilon_{iLj}, \varepsilon_{iHj}\} \sim EV1(.)$ capture heterogeneity in valuations

Market Structure

- 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 (λ_H, λ_L) are constants

Firm-specific supply

- Iso-elastic type-specific supply curves:

$$\begin{aligned}\ln L_j(w_{Lj}) &= \ln(L\lambda_L) + \beta_L \ln w_{Lj} + a_{Lj} \\ \ln H_j(w_{Hj}) &= \ln(H\lambda_H) + \beta_H \ln w_{Hj} + a_{Hj},\end{aligned}$$

- 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)

Wages

- Choosing (w_{jH}, w_{jL}) yields standard "mark down" formula:

$$\begin{aligned} w_{Lj} &= \frac{\beta_L}{1+\beta_L} T_j f_L \mu_j \\ w_{Hj} &= \frac{\beta_H}{1+\beta_H} T_j f_H \mu_j \end{aligned}$$

  where $\mu_j \equiv MC \overset{opt}{=} MR$

- Example: $\beta_L = \beta_H = 9 \Rightarrow$ workers paid 90% of MRP

Special Case: Linear Production, Fixed Output Price

- Production function:

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

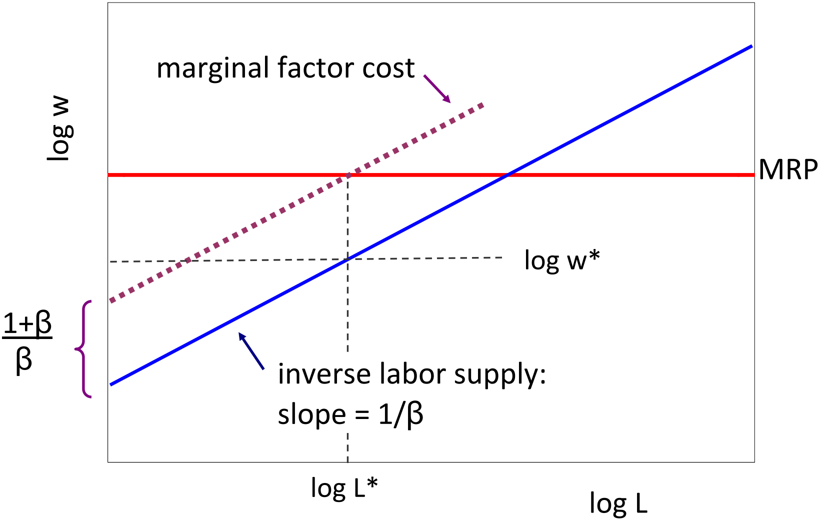
- Equilibrium Wages:

$$\begin{aligned} w_{Lj} &= \frac{\beta_L}{1+\beta_L}(1-\theta)T_j P_j^0 \\ w_{Hj} &= \frac{\beta_H}{1+\beta_H}\theta T_j P_j^0 \end{aligned}$$

- 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)

Equilibrium Wages and Employment

Figure 8: Equilibrium Wages and Employment



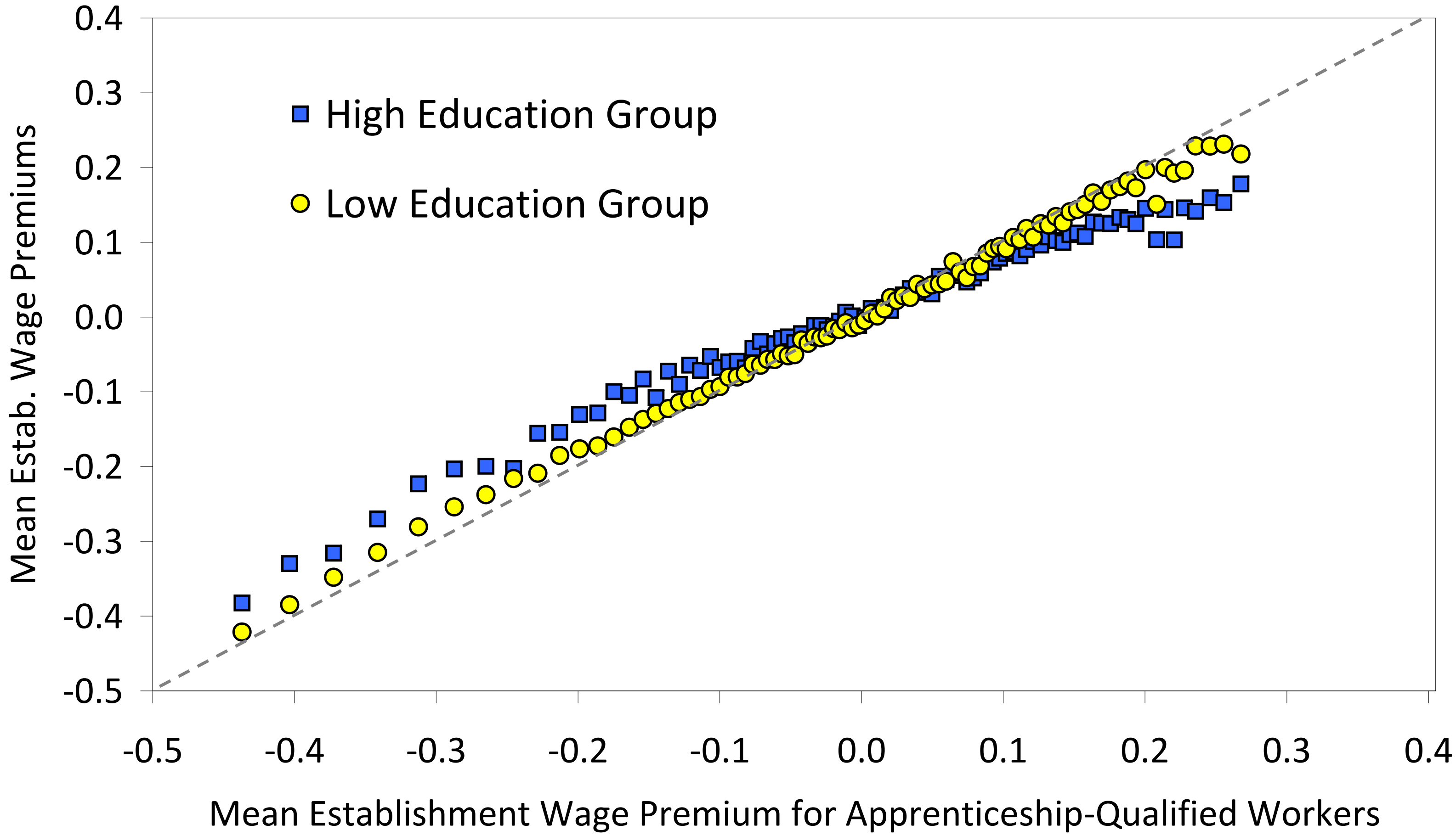
AKM Interpretation

$$\ln w_{jH} = \underbrace{\ln \frac{\beta_H}{1+\beta_H} + \ln 1 - \theta}_{\text{Person Eff}} + \underbrace{\ln T_j P_j^0}_{\text{Firm Eff}}$$

$$\ln w_{jL} = \underbrace{\ln \frac{\beta_L}{1+\beta_L} + \ln \theta}_{\text{Person Eff}} + \underbrace{\ln T_j P_j^0}_{\text{Firm Eff}}$$

- 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 σ_T^2,$\sigma_{P^0}^2$
  - Possible group differences due to diffs in $\beta' s$ (Robinson, 1933)

Figure 10: Establishment Wage Premiums for High and Low Education Groups vs. Premium for Appenticeship-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

Relative Wages / Employment

- 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: $MR_j = \left(1 - \frac{1}{\varepsilon}\right) P_j^0 Y_j^{-1/\varepsilon}$
- Wages become:

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

- 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):

$$
\psi_j \approx \frac{\varepsilon}{\varepsilon + \overline{\beta}_j} \ln \frac{P_j^0}{\overline{P}} + \frac{\varepsilon - 1}{\varepsilon + \overline{\beta}_j} \ln \frac{T_j}{\overline{T}}
$$

"Rent-sharing" elasticities

- Letting $\overline{\beta_j} = \beta_L \kappa_j + \beta_H (1 - \kappa_j)$, $\kappa_j = \frac{(1-\theta)L_j}{(1-\theta)L_j + \theta H_j}$, we have:

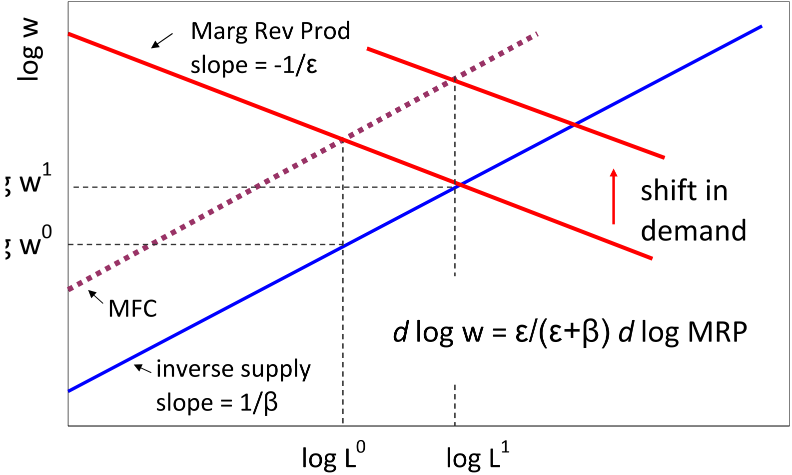
$$\frac{\partial \ln w_{Lj}}{\partial \ln P_j^0} = \frac{\partial \ln w_{Hj}}{\partial \ln P_j^0} = \frac{\varepsilon}{\varepsilon + \overline{\beta_j}}$$

$$\frac{\partial \ln w_{Lj}}{\partial \ln T_j} = \frac{\partial \ln w_{Hj}}{\partial \ln T_j} = \frac{\varepsilon - 1}{\varepsilon + \overline{\beta_j}}$$

- 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 $\overline{\beta_j} \to \infty$, $\frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to 0$ (competitive labor market)
    - As $\overline{\beta_j} \to 0$, $\frac{\partial \ln w_{Lj}}{\partial \ln T_j} \to \frac{\varepsilon - 1}{\varepsilon}$ (fixed labor supply)

- Suppose $\overline{\beta_j} = 9$, $\varepsilon = 1.5$. Then $\frac{\partial \ln w_{Lj}}{\partial \ln P_j^0} = .14$, $\frac{\partial \ln w_{Lj}}{\partial \ln T_j} = .047$
- "Rent-sharing" elasticity will be weighted average of these two based upon variance-covariance of shocks to $\left(P_j^0, T_j\right)$

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



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:

$$\begin{aligned}\left(1+\frac{1}{\sigma}\beta_L\right)\ln w_{Lj} &= \ln\left(\frac{\beta_L}{1+\beta_L}\right) + \ln(1-\theta) - \frac{1}{\sigma}a'_{Lj} + \Gamma_j \\ \left(1+\frac{1}{\sigma}\beta_H\right)\ln w_{Hj} &= \ln\left(\frac{\beta_H}{1+\beta_H}\right) + \ln\theta - \frac{1}{\sigma}a'_{Hj} + \Gamma_j\end{aligned}$$

- AKM-decomp holds when $\beta_L \approx \beta_H$. Otherwise it only holds locally within skill groups.

A new prediction

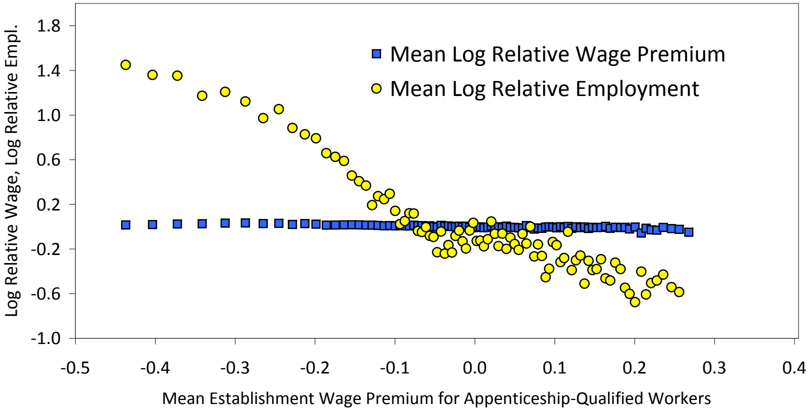
- Usual inverse relationship between relative quantities and wages now holds at firm-level:

$$\frac{\partial \ln(H_j/L_j)}{\partial \ln P_j^0} = -\sigma \frac{\partial \ln(w_{Hj}/w_{Lj})}{\partial \ln P_j^0}$$

- Firm-level evidence on what is usually considered a macro phenomenon?

Relative Quantities and Prices: Low vs. Medium

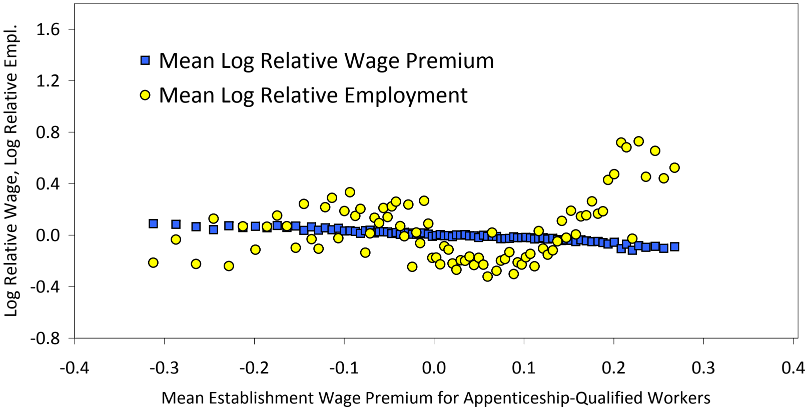
Figure 11: Relative Wages and Relative Employment of Low-Education Workers vs. Wage Premium for Apprenticeship-Qualified Workers



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.

Relative Quantities and Prices: High vs. Medium

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 θ vary in addition to TFP!

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

$$\begin{aligned} \psi_j^L &= \ln(1-\theta_j) + \ln T_j P_j^0 \\ \psi_j^H &= \ln \theta_j + \ln T_j P_j^0 \end{aligned}$$

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

$$\frac{Cov[\psi_j^L, \psi_j^H]}{Var[\psi_j^H]} < 1$$

- Alternate explanation for imperfect correlation of firm effs across groups

"SBTC" shocks (full version)

- 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:

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

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

- TFP-like variation induces negative correlation, while "pure" TFP-constant component induces positive correlation
- Expect *under-estimate* of σ from regression of relative wages on relative quantities

Final Thoughts

- 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