

# Identifying Labor Market Sorting with Firm Dynamics

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- Broad interest in how agents match in markets (Becker, 1973)
- Positive vs. negative sorting
  - Marriage markets
  - Labor markets
- Sorting crucial for understanding unobserved wage inequality
  - Worker heterogeneity
  - Differences in firm pay
  - Sorting amplifies or dampens unobserved wage inequality

- Inherently difficult to identify unobserved heterogeneity and sorting (Abowd, Kramarz, and Margolis (1999), Eeckhout and Kircher (2011))
- Conflicting evidence on sign and strength of sorting
- Current approaches assume fixed firm types
- Firm dynamics important feature of the labor market
- Firm dynamics impact incentives for sorting
- **This Paper:**  
**Identification of sorting with changing firm types**

- Structural search and matching model with **changing firm types**
- How firms adjust the quality of their workforce as they expand/contract is informative about sorting
- Estimate model with indirect inference
  - German social security data
  - Info on ~5000 establishments and all their employees
- Decompose sources of wage variation

# Search and Matching

- Discrete time and random search
- Workers and firms are heterogenous in productivity
- Agents meet each other at random with some probability
- Upon meeting, agents decide whether to match or keep searching for a better partner
- $\Rightarrow$  Both agents have opportunity cost of matching
- Workers search off and on-the-job

# Production Function

- Workers differ in productivity  $x$
- Firms differ in productivity  $y$
- Production function  $f(x, y) = f_1 (x^{1/\rho} + y^{1/\rho})^\rho$
- Higher types produce more  $f_x(x, y) > 0, f_y(x, y) > 0$
- $\rho > 1 \Rightarrow$  Positive sorting (high types match with high types)
- $\rho < 1 \Rightarrow$  Negative sorting (inputs substitutes)

- Firms are subject to idiosyncratic productivity shocks
- Firms expand and contract employment
- After shocks: Some worker types better matched, some worse
- Which workers are better matched depends on complementarity parameter  $\rho$

- Measure worker quality with their average incomes (worker fixed effect)
- Study firm dynamics to identify complementarities in production:

## **Positive Sorting:**

Expanding firms:

⇒ *upgrade* worker types

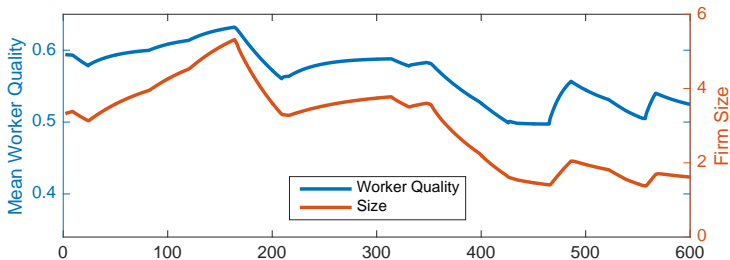
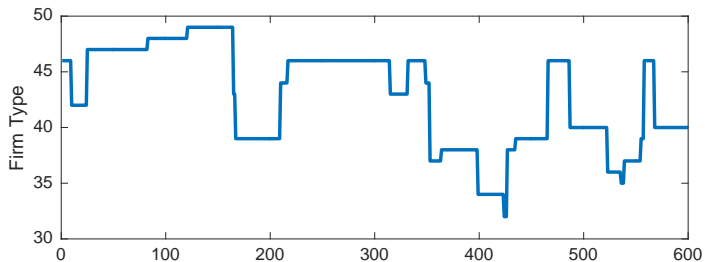
## **Negative Sorting:**

Expanding firms:

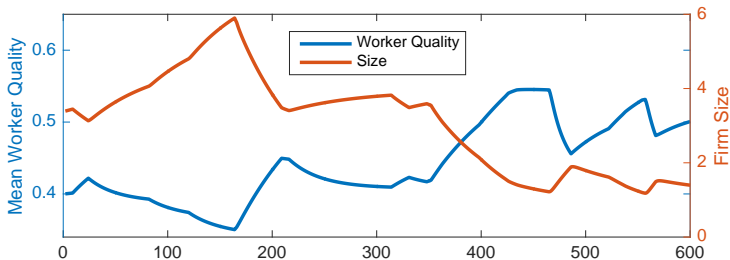
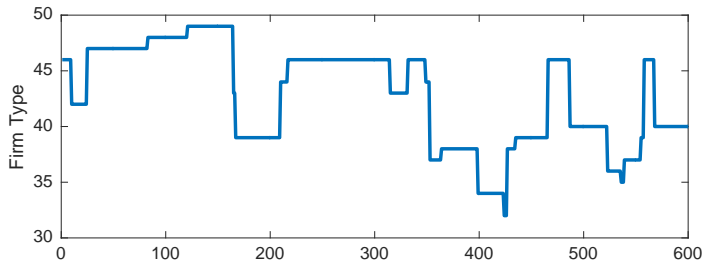
⇒ *downgrade* worker types



# Firm Dynamics with Positive Sorting ( $\rho = 2$ )

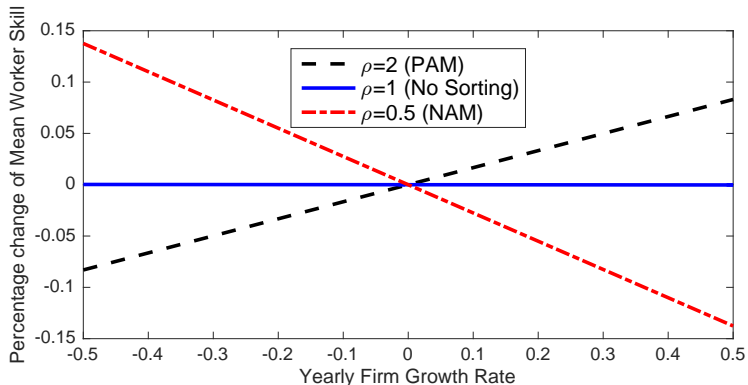


# Firm Dynamics with Negative Sorting ( $\rho = 0.5$ )



$$\Delta\% \overline{Wquality}_{jt} = \alpha + \gamma * firm\_growth_{jt} + \epsilon_{jt}$$

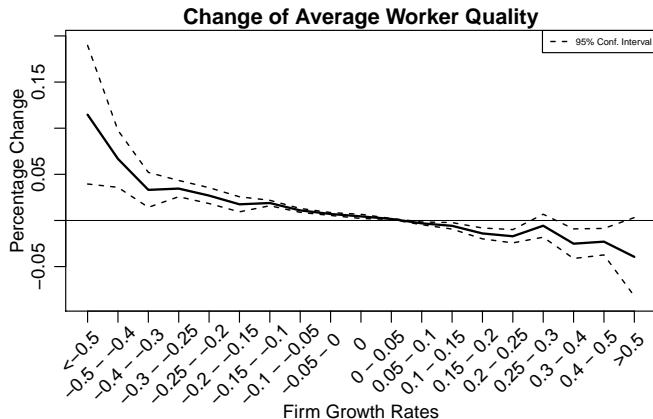
$\Delta\% \overline{Wquality}_{jt}$  : Percentage change in average workforce quality in firm  $j$  during year  $t$



# Reorganization of Worker Quality

$$\Delta\% \overline{Wquality}_{jt} = \alpha + \sum_{i=2}^{19} \gamma_i * D_{growthbin_{jt}}^i + \beta X_{jt} + \epsilon_{jt}$$

$X_{jt}$ : Year, 3-digit industry and year  $\times$  industry



# Reorganization of Worker Quality

$$\Delta\% \overline{Wquality}_{jt} = \alpha + \gamma * firm\_growth_{jt} + \beta X_{jt} + \epsilon_{jt}$$

$\hat{\gamma}$  consistently **negative**  $\Rightarrow$  negative assortative matching

<i>firm_growth</i>	-0.099	-0.100	-0.061	-0.062	-0.084	-0.077
SE	0.016	0.016	0.015	0.013	0.009	0.010
<b>Controls:</b>						
Industry	x	x	x	x	x	x
Year	x	x	x	x	x	x
Industry x Yr.	x	x	x	x	x	x
Size		x				
Age		x				
Sample	Baseline	Baseline	Size>190	Age>15	3 Yr. Chg.	5 Yr. Chg.
N	19981	19981	6437	10060	15590	11756
Adj. $R^2$	0.380	0.383	0.573	0.650	0.347	0.271

Reorganization by Industry: [here](#)

Table: Target Moments

Target Moment	Data	Model
Hire rate	0.024	0.025
Unemployment rate	0.082	0.082
Job-to-job transition rate	0.009	0.009
Job filling rate	0.388	0.388
Mean worker type distribution	0.460	0.478
Stdev. of worker type distribution	0.228	0.260
Stdev. of empl. weighted growth rates	0.123	0.123
Emp. weighted autocorr. of firm size	0.996	0.996
Size distribution P75	0.110	0.110
Regression Slope Coeff.	-0.099	-0.099

Notes: Size distribution P75 refers to the share of employment in the 75 percent smallest firms.

Table: Estimated Parameters

Parameters	Symbol	Value
<b>Complementarity</b>	$\rho$	<b>0.644</b>
Worker dist. location	$\mu_x$	-0.252
Worker dist. scale	$\sigma_x$	0.709
Meeting rate workers	$\lambda_w$	0.166
Job-to-job meeting rate	$\lambda_e$	0.024
Job destruction rate	$d$	0.015
Job creation cost, scale	$c_0$	19.197
Job creation cost, convexity	$c_1$	1.101
Firm shocks, frequency	$\phi$	0.035
Firm shocks, range	$\bar{y}$	0.140

Notes: Confidence Interval on  $\rho$ : [0.616,0.677]

# Estimation Result

- $\Rightarrow$  Weak negative sorting:  $\text{Corr}(x,y) = -0.078$
- Hiring high type workers is expensive
- If firms can substitute technology for worker productivity  
 $\Rightarrow$  Negative sorting to be expected
- $\rho = 0.644 \Rightarrow$  Worker and firm types are substitutes



# Sources of Wage Variation

- Wages are determined by 4 factors:
  - i Worker type  $x$
  - ii Firm productivity  $y$  (At the time of bargaining)
  - iii Bargaining Position  $b$  (At the time of bargaining)
  - iv Sorting
- Compute counterfactual economies without these source
- $\Rightarrow$  Estimate contribution of each source taking general equilibrium effects into account

Table: Sources of Wage Dispersion

	Only firm heterogeneity
Stdev.	0.071
Contribution	19.6

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Contribution	19.6	31.7

# Variance Decomposition

Table: Sources of Wage Dispersion

	Only firm heterogeneity	+bargaining positions	+ Worker heterogeneity
Stdev.	0.071	0.186	0.444
Contribution	19.6	31.7	71.3

# Variance Decomposition

Table: Sources of Wage Dispersion

	Only firm heterogeneity	+bargaining positions	+ Worker heterogeneity	+Sorting $\rho = 0.644$
Stdev.	0.071	0.186	0.444	0.362
Contribution	19.6	31.7	71.3	-22.7

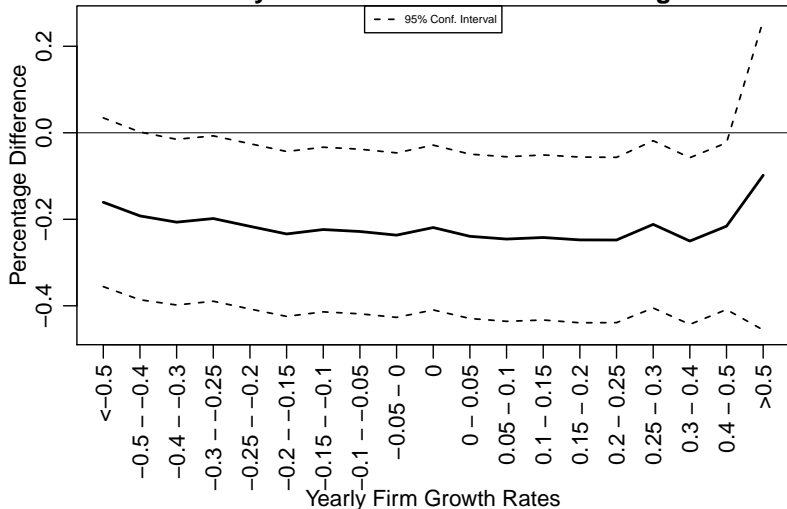
- Develop approach to identify sorting with changing firm types
- Use structural estimation to study wage inequality in Germany
- Estimate negative sorting in Germany
- Worker heterogeneity plays the largest role in wage variation
- Sorting significantly dampens wage dispersion

John M Abowd, Francis Kramarz, and David N Margolis. High wage workers and high wage firms. Econometrica, 67(2):251–333, 1999.

Gary S Becker. A theory of marriage: Part i. The Journal of Political Economy, pages 813–846, 1973.

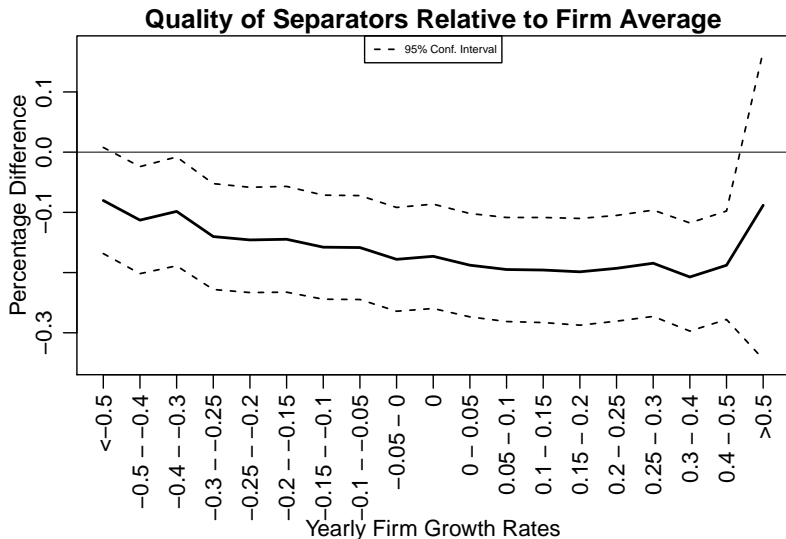
Jan Eeckhout and Philipp Kircher. Identifying sorting in theory. The Review of Economic Studies, page rdq034, 2011.

## Quality of Hires Relative to Firm Average





# Worker Flows - Separators



# Worker Quality Adjustments by Industry

Table: Worker Quality Adjustments by Industry

Industry	Point Estimate	Standard Error
Agriculture, hunting, forestry	-0.169	0.034
Mining, quarrying	-0.062	0.025
Manufacturing	-0.097	0.008
Construction, Utilities	-0.071	0.013
Wholesale & retail, hotels	-0.085	0.025
Transport, communications, finance	-0.059	0.011
Real Estate, renting, business activities	0.076	0.121
Education	-0.063	0.013
Community, social, personal service	-0.202	0.022

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