JAQ of All Trades:
Job-Worker Mismatch and Firm Productivity

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Motivation

Large dispersion in productivity between firms, even within narrow industries (Syverson 2011, JEL)

What can explain this dispersion?
- Capital
- Materials
- Skills
- Worker quality (Fox and Smeets 2011, IIR)
- Management practices (Bloom and Van Reenen 2007, QJE)

Our paper

Question: How important are job-worker matches for productivity?

Problem: How do we measure "job assignment quality" (JAQ)?

Approach:

    1. Develop a new measure that can be recovered from LEED using ML

    2. Using Swedish LEED:

        a) Showed that JAQ is related to career progression and wages

        b) Show that JAQ positively correlates with productivity, competition and ownership

        c) Show that changes in management leads to changes in JAQ

Contribution

Novel measure of firm-level mismatch between workers and tasks. Can be built from **any** matched employer-employee data set:

- no need for surveys (Bloom and Van Reenen 2007; Bloom, Brynjolfsson, et al.2019)

- no need for expert evaluations (Lise and Postel-Vinay 2020; Guvenen et al 2020)

Benchmark based on ML algorithm rather than:

- standards set by leading management consulting firm (Bloom and Van Reenen 2007)

- average characteristics of senior employees (Fredriksson et al. 2018)

So what?

1. Deeper understanding of drivers of productivity dispersion and the role of managers in firms

2. Provide novel measures of mismatch useful for several literatures

JAQ is relevant for

Productivity Literature

- LEED analogue of the "HR management practices" (Bloom and Van Reenen 2007, QJE). No need for surveys. Applicable at individual, firm, industry and country level.

- Job-worker mismatch matters for productivity

Labor/Organizational Economics

- Testing theories of mismatch in labor markets on a wide scale

- "What has been done for wages can now be done for match quality"

Corporate Finance

- Can study how corporate governance impacts HR practices of firms

- Importance of managers for allocating workers to correct jobs

- More broadly: investments, valuation and human capital

JAQ is relevant for

Industrial Organization

- New measure of human capital related merger synergies

Education Economics

- JAQ at the individual level provides novel measure of mismatch and how it varies in the panel (can study e.g. over- and under provision of education in detail)

Macroeconomics

- Understanding reallocation and matching over the business cycle (cleansing effects of recessions)

Public economics

- Understanding the effects of taxes on match quality and allocation of workers to the public sector

What is JAQ?

The idea behind JAQ

Firms/managers:

- Map CVs into jobs to maximize productivity (possibly as a result of **directed search** by workers across **heterogeneous firms**)

- Informational frictions and costs of implementing better matches mean that managers differ in their ability to discover the optimal mapping (resulting in firm heterogeneity)

- We want to *obtain this mapping from observed data*

Approach:

- Idea is that this mapping can be inferred from observed allocations of workers to jobs

- Since noise in how well managers map CVs to jobs, we can use "benchmarks" firms to minimize this noise

- We can then use ML to **predict** the most probable job allocation for each worker

- ML is motivated here because this task is too complex for multinomial logits

The idea behind JAQ

- Two measure of JAQ at the worker level
    - eJAQ: Predicted job is equal to observed job (dummy)
    - pJAQ (suitability): Probability that predicted job is observed job relative to other possible jobs (ranges from 0 to highest predicted probability)

- Firm level JAQ
    - Average over worker level JAQ

Recovering predicted job assignments

1. Double-sorting of firms in 9 classes

- median size: 30-50,51-250, 250+

- industry: manufacturing, wholesale and retail, real estate, renting and business activities

2. Estimate different mappings from workers' characteristics to jobs using the top 10% of firms by value added per employee in 2010 within each class

3. Predict allocation of workers to jobs for remaining firms

4. Identify matches or mismatches relative to the predicted allocations

Data

Data

Sample

- LEED for 2001-2010 (LISA 1990-2010), SSYK 3-digit occupations

- Firms with 30-6000 employee that report assets and sales

- Manufacturing, real estate, renting and b.a., wholesale and retail (62% firms/70% employment)

- 9k firms, 1.5M workers

CVs

- Age, gender, location and immigrant status, education level, specialization, GPA and school

- Past work experience (LM experience, mobility, tenure, unemployment days, varied work experience, job experience)

Firm observables

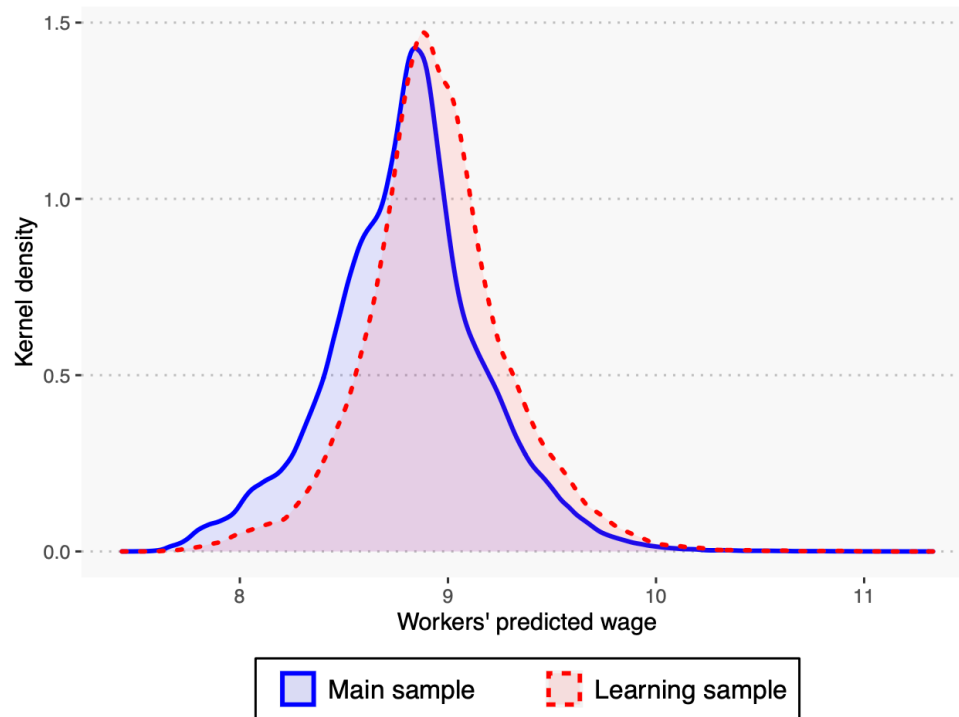- Age, industry, size, assets, ownership etc.

Common support

Figure 1: Common support of worker characteristics in the main and the learning samples

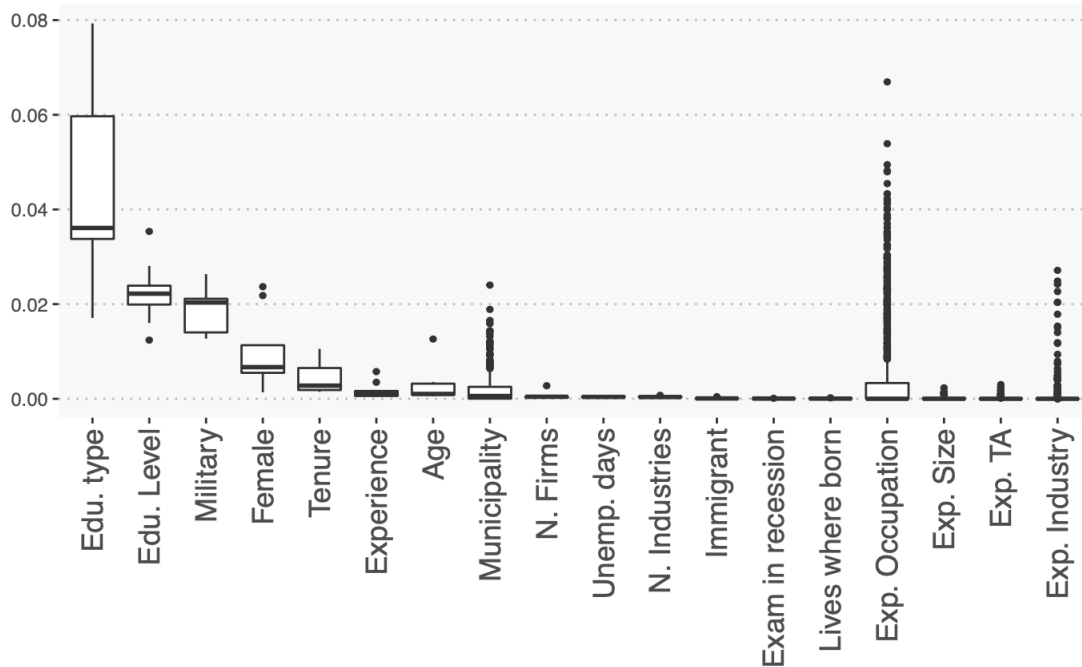# Generic human capital more important than specific

Figure 2: Importance of workers' features in the random forest algorithm, by size-industry bins

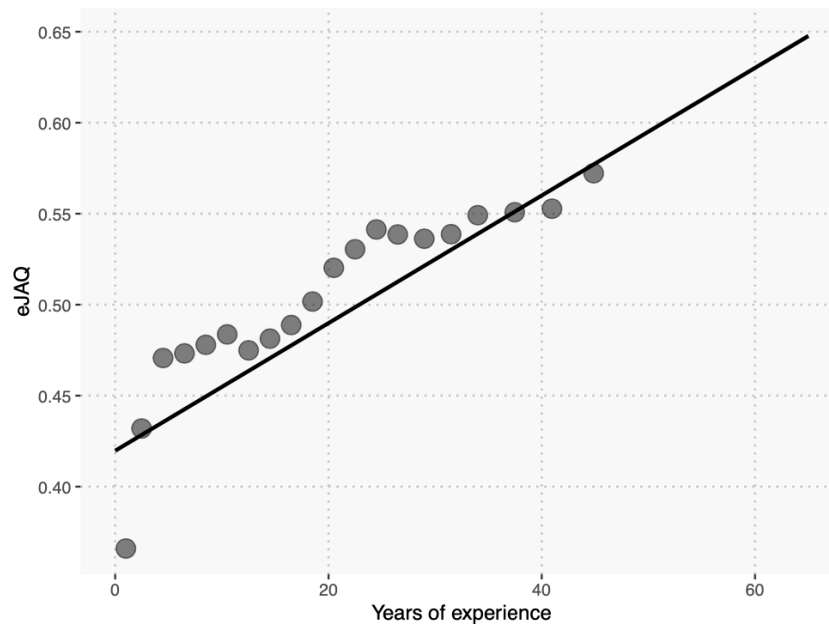# Evaluating JAQ

JAQ over a workers career

Figure 3: **Worker-level job allocation quality (*eJAQ*) by labor market experience**

Goodness of fit goes from 35% to 57% over 50 years

JAQ: earnings and separations

|	Log(labor earnings)				Separation indicator			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A								
eJAQ	0.026	0.026	0.019	0.020	-0.012	-0.011	-0.026	-0.009
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)
Panel B								
pJAQ	0.047	0.054	0.043	0.053	-0.071	-0.070	-0.163	-0.083
	(0.001)	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)	(0.002)	(0.012)
Year and job FE	✓	✓	✓	✓	✓	✓	✓	✓
Worker controls	✓	✓			✓	✓		
Industry FE		✓				✓		
Firm controls		✓				✓		
Worker FE			✓	✓			✓	✓
Firm FE				✓				✓
Observations	5,901,551	5,901,551	5,901,551	5,526,718	4,484,975	4,481,150	4,484,975	4,262,039

In line with -2% estimate of Fredriksson et al (2018)

JAQ and Firms

JAQ and productivity
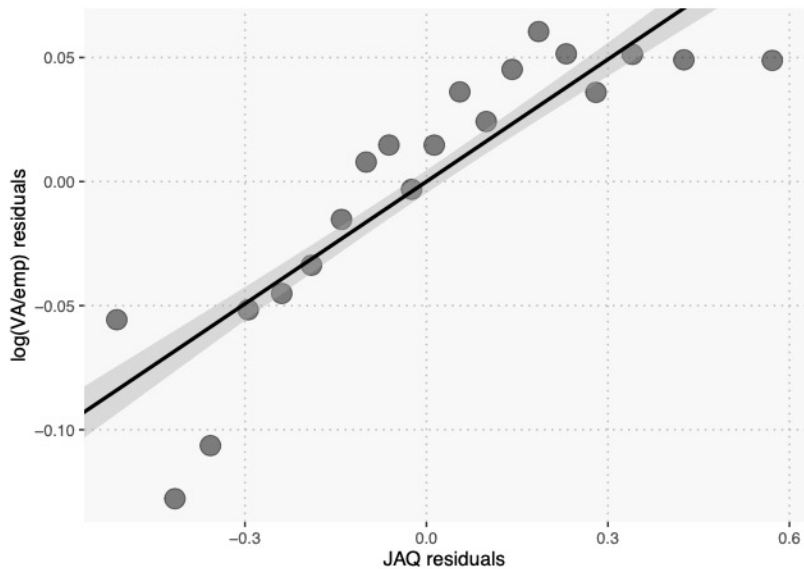
Controls: Year and Industry FE
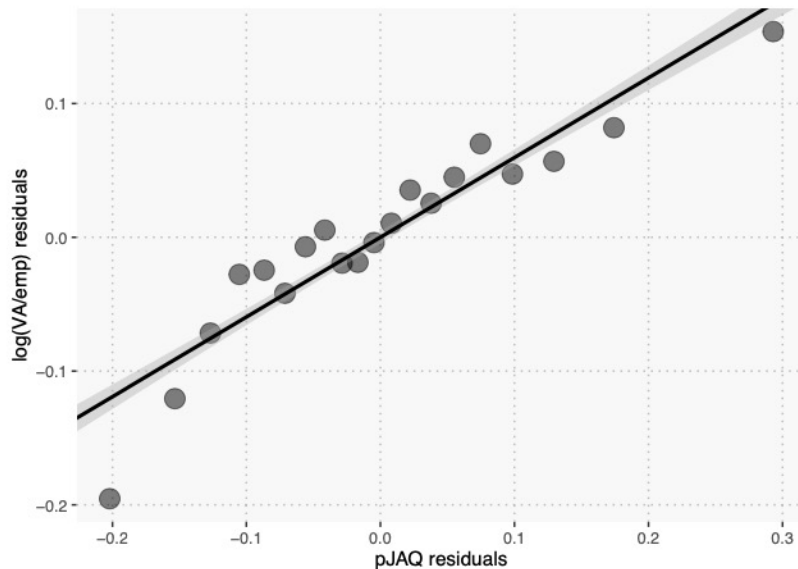
Controls: Year and Industry FE

JAQ and productivity

	Log(sales/emp) (1)	Log(VA/emp) (2)	OROA (3)	Log(sales/emp) (4)	Log(VA/emp) (5)	OROA (6)
Panel A						
JAQ	0.374	0.180	-0.008	0.095	0.072	0.003
	(0.022)	(0.014)	(0.005)	(0.013)	(0.010)	(0.005)
log(cap/emp)				0.414	0.237	-0.020
				(0.012)	(0.009)	(0.002)
log(emp)				0.003	-0.004	-0.003
				(0.007)	(0.005)	(0.002)
Share emp w/ college				0.110	0.338	0.013
				(0.031)	(0.022)	(0.010)
Industry dummies				✓	✓	✓
Year dummies	✓	✓	✓	✓	✓	✓
Municipality dummies	✓	✓	✓	✓	✓	✓

- One-SD increase in JAQ (0.32) is associated with a **12%** increase in sales per employee

- Bloom et al. 2019: One-SD increase in score is associated with **26.2%** rise in sales per employee

JAQ: competition and ownership

	JAQ		pJAQ		JAQ		pJAQ	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lerner index (2-year lagged)	0.003 (0.000)	0.003 (0.000)	0.003 (0.000)	0.002 (0.000)				
Family firm					-0.021 (0.007)	-0.002 (0.007)	-0.029 (0.003)	-0.014 (0.003)
Share emp. w/ college		0.057 (0.019)		0.108 (0.010)		0.108 (0.016)		0.112 (0.009)
Year dummies	✓	✓	✓	✓	✓	✓	✓	✓
Industry dummies		✓		✓		✓		✓
Firm controls		✓		✓		✓		✓
Observations	33,254	33,254	33,254	33,254	48,116	47,350	48,116	47,350
No. Firms	6,269	6,269	6,269	6,269	7,875	7,763	7,875	7,763
y Mean	0.507	0.507	0.222	0.222	0.433	0.434	0.188	0.188
y St. Dev.	0.300	0.300	0.136	0.136	0.320	0.319	0.137	0.137

JAQ and Managers

JAQ and managers

- Split *JAQ* into:
  1. R&F-*JAQ*: quality of rank-and-file employees' assignment to jobs
  2. M-*JAQ*: quality of managers' allocation to their jobs
- Estimate the following model:

$$\text{R\&F-}JAQ_{ft} = \alpha_f + \lambda_t + \beta\text{M-}JAQ_{ft} + \gamma X_{ft} + \epsilon_{ft},$$

where

α_f = firm effects

λ_t = year effects

X_{ft} = firm controls (age, family firm, state-owned, listed status, dummy for the presence of a human resources manager, log number of employees and log of total assets)

JAQ of managers matters for R&F workers

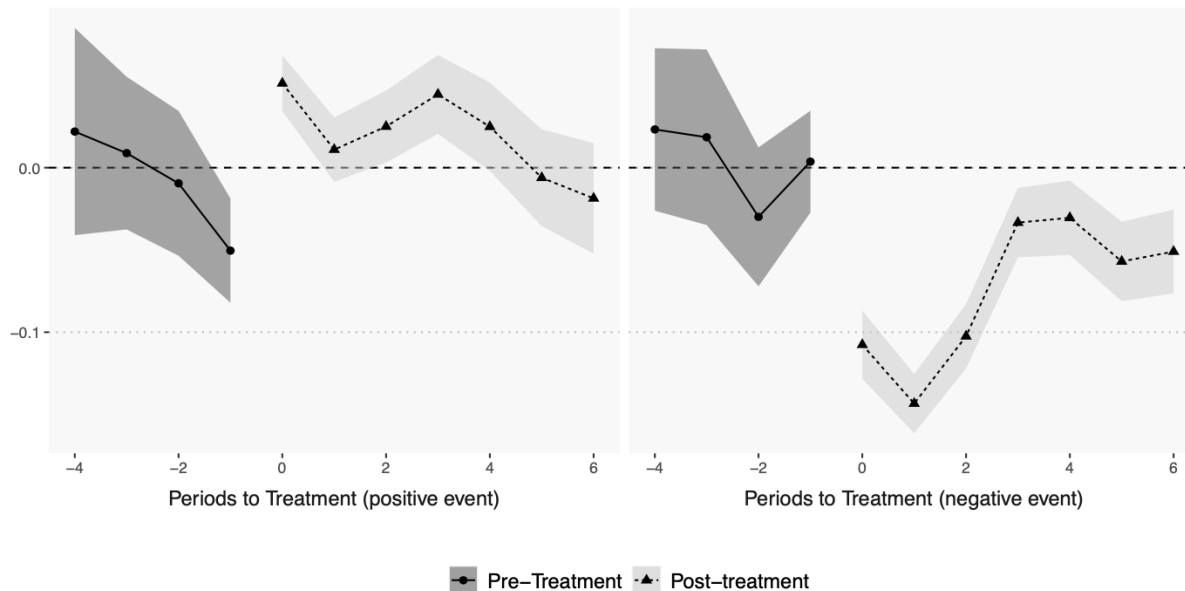|	R&F-JAQ					
	(1)	(2)	(3)	(4)	(5)	(6)
M-JAQ	0.201	0.127	0.127	0.121	0.068	0.065
	(0.007)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Manager exp		0.018	0.017		0.008	0.008
		(0.002)	(0.002)		(0.002)	(0.002)
Industry FEs			✓			✓
Municipality FEs			✓			✓
Year FEs	✓	✓	✓	✓	✓	✓
Firm FEs		✓	✓		✓	✓
Firm controls			✓			✓
Observations	36,230	36,230	36,206	22,821	22,821	22,807
No. Firms	7,680	7,680	7,679	6,454	6,454	6,452

- 10 ppt increase in M-JAQ => 1.3-2ppt increse in R&F JAQ

- Top management only in columns 4,5,6 => coefficientes halved => middle management also matters

JAQ of managers matters for productivity

	Log(Sales/emp) (1)	Log(VA/emp) (2)	Log(Sales/emp) (3)	Log(VA/emp) (4)	Log(Sales/emp) (5)	Log(VA/emp) (6)
M-JAQ	0.208 (0.018)	0.140 (0.014)	0.153 (0.014)	0.085 (0.012)	0.103 (0.016)	0.066 (0.012)
Managers exp					0.030 (0.004)	0.012 (0.004)
Industry FEs	No	No	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35,971	35,823	35,971	35,823	35,971	35,823
No. Firms	7,592	7,559	7,592	7,559	7,592	7,559
y Mean	7.408	6.163	7.408	6.163	7.408	6.163
y St. Dev.	0.779	0.577	0.779	0.577	0.779	0.577

- Managerial quality accounts for most of the correlation between worker-job matching and productivity

JAQ and managerial turnover

Positive event: 14 ppt increase in RF-JAQ

Negativ event: 13 ppt decrease in RF-JAQ

2/3 of the effects come from reallocation of **retained** workers

Additional analyses

Additional requested analyses

- Hiring vs allocating already hired workers

- Internal promotions and match quality

- Correlation with management quality data from the World Management Survey

- On-the-job training and match quality

Summary

Question: How important are job-worker matches for productivity?

Approach:

1. **Develop a new measure** that can be recovered from LEED using ML
2. **Using Swedish LEED**:
   a) Showed that eJAQ is related to career progression and wages
   b) Showed that JAQ positively correlates with productivity (about **50%** as large effect as management practices), competition and ownership
   c) Show that changes in management leads to changes in JAQ among workers (**2/3** is reallocation of retained workers)

So what?

1. Deeper understanding of drivers of productivity dispersion

2. Provide novel measures of mismatch useful for several literatures in economics and finance