Recruitment Policies, Job-Filling Rates and Matching Efficiency

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Recruitment and the labor market

- Much research on workers' search intensity and implications for job-finding rates

  Theory: Mortensen (1977), Pissarides (1984), Postel-Vinay and Robin (2004), Lentz (2010)
  Empirics: Shimer (2004), Krueger and Mueller (2010), Faberman and Kudlyak (2017), Faberman et al. (2017)

- Comparably less research on firms' search strategies and job-filling rates

- Yet recruitment behavior matters for
  - Aggregate matching efficiency
  - Match quality and job mobility
  - Labor market policy
  - Firm dynamics

Starting point

- Job-filling rates vary systematically across firms.
- Fast-growing firms in the U.S. fill a greater proportion of their vacancies.

  (Davis, Faberman & Haltiwanger, 2013)
- Recruiting intensity can help accounting for cyclical shifts of matching efficiency

  (Elsby, Michaels & Ratner, 2015; Gavazza, Mongey & Violante, 2018)

Why do job-filling rates vary systematically across firms?

- Search effort
- Wage policies
- Hiring standards

Without appropriate micro data the impact of these factors cannot be properly assessed.

Contribution of this paper

1. Use linked survey-administrative data to measure (i) search effort, (ii) wage policies, and (iii) hiring standards and relate them to hiring rates.

2. Develop an equilibrium search model with these three recruitment margins.

3. Quantitative analysis exploring regional$\times$skill variation
    a. Role of recruiting intensity for matching efficiency
    b. Impact of labor market policy on recruiting intensity (and thereby, on job-finding rates)

Literature

Recruitment and vacancies (Empirics)

Barron & Bishop (1985), van Ours & Ridder (1992), Burdett & Cunningham (1998), Davis, Faberman & Haltiwanger (2012, 2013), Faberman & Menzio (2017), Modestino, Shoag & Ballance (2016), Marinescu & Wolthoff (2020), Mueller et al. (2020).

Hiring and macroeconomics

Acharya & Wee (2017), Gavazza, Mongey & Violante (2018), Kaas & Kircher (2015), Leduc & Liu (2017), Sedlacek (2014), Chugh & Merkl (2016), Wolthoff (2017), Elsby & Gottfried (2019).

Directed search

Moen (1997), Garibaldi & Moen (2010).

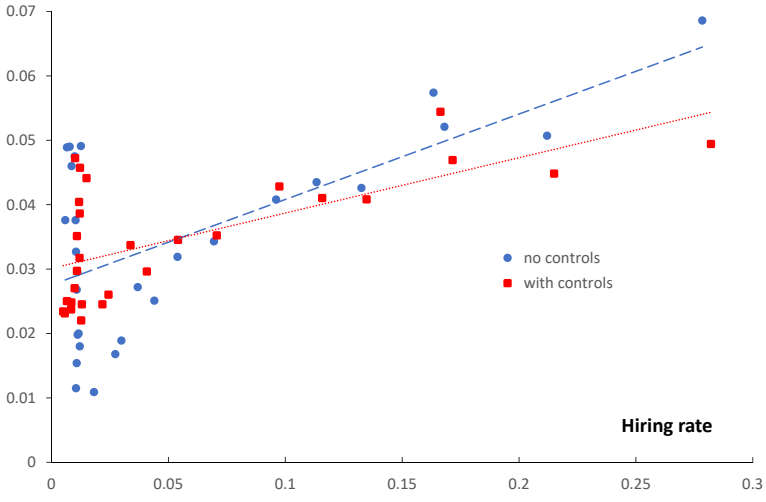
JVS data

- *Job Vacancy Survey (JVS)* of Germany's Institute for Employment Research (IAB)
- First part of the survey provides vacancy stock and other information
  (∼13-15,000 establishments per year).
- Second part of the survey provides detailed information on the **last case of hiring**
  (∼9-10,000 establishments per year).
- Establishment IDs available since 2010.
  ⇒ Linking with individual employment spells
  (*Integrated Employment Biographies, IEB*)

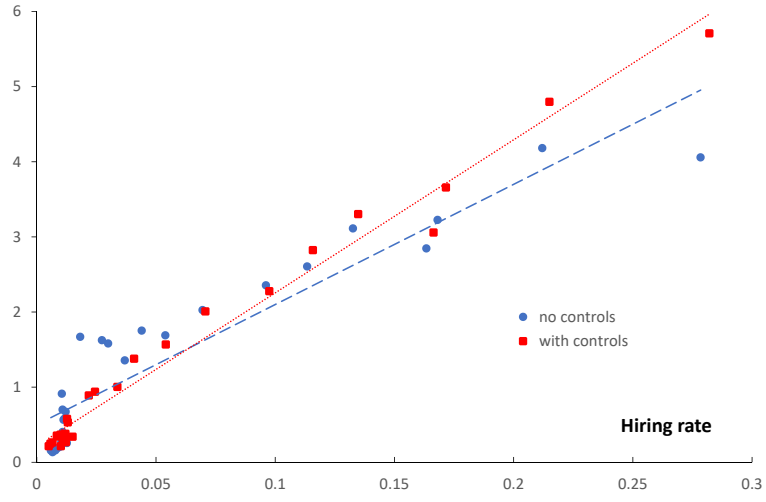
Vacancy yield variation in German data

$$\underbrace{\frac{H}{E}}_{\text{Hiring rate}} = \underbrace{\frac{V}{E}}_{\text{Vacancy rate}} \cdot \underbrace{\frac{H}{V}}_{\text{Vacancy yield}}$$

Vacancy rate



Vacancy yield



Note: Dots are weighted averages conditional on employment growth of an establishment.
Controls: Industry, size and age.

Vacancy yield varies with hiring rate, as in JOLTS data (Davis et al. 2013) ▸ Hiring composition ▸ Hiring rate

Recruitment information from the JVS

- **Search channels:** Number of search channels
  $\Rightarrow$ federal employment agency, headhunters, networks of personal contacts, internal hiring, formal job postings
- **Geographical scope of search:** Whether search was restricted to the local or national labor market or extended to the international market
- **Wage concessions:** Whether the employer had to pay more than expected
- **Qualification/experience mismatch:** Whether the hired worker's (i) qualification or (ii) experience was lower than expected for the position

Recruitment information from the IEB

- For all (male, full-time, age 23-55) workers employed in JVS establishments, estimate wage regressions

$$\ln w_{it} = f_i + g_{j(i)} + \delta_t + \beta X_{it} + \eta_{it}$$

- **IEB wage premium** is the average residual wage of new hires (H_{jt}) in establishment j:

$$\hat{w}_{jt} = \frac{1}{H_{jt}} \sum_{i \in H_{jt}} \hat{\eta}_{it}.$$

- **IEB selectivity** is the difference between the average fixed effects of new hires (H_{jt}) and the rest of the workforce (N_{jt}) in establishment j:

$$\tilde{s}_{jt} = \frac{1}{H_{jt}} \sum_{i \in H_{jt}} f_i - \frac{1}{N_{jt}} \sum_{i \in N_{jt}} f_i.$$

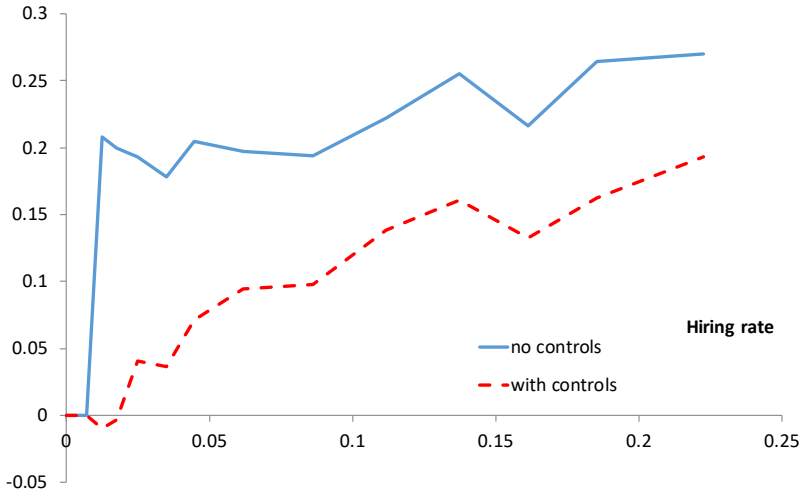
Recruitment indices

Define **recruitment index variables** as averages of the following underlying variables (all demeaned and standardized)

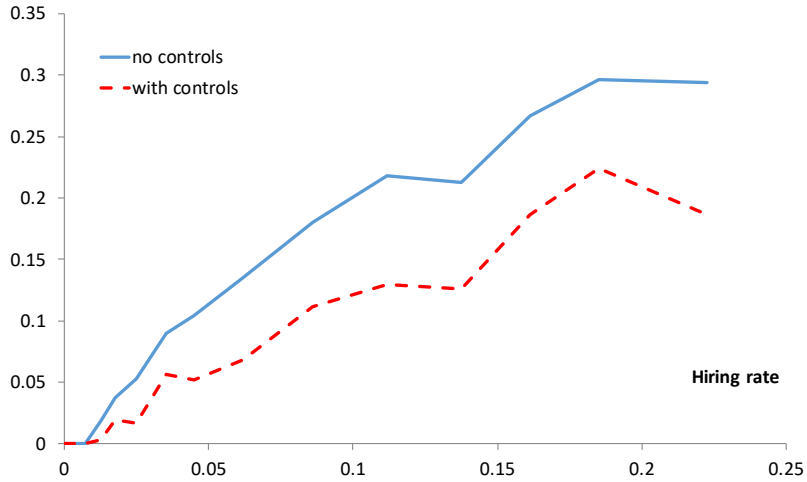
Search effort	▶ JVS "Number of search channels" (0-5) ▶ JVS "International recruitment" (0-1)
Wage generosity	▶ IEB wage premium ▶ JVS "Wage concessions" (0-1)
Hiring standards	▶ IEB selectivity ▶ JVS "No qualification mismatch" (0-1) ▶ JVS "No experience mismatch" (0-1)

Recruitment indices by varying hiring rates

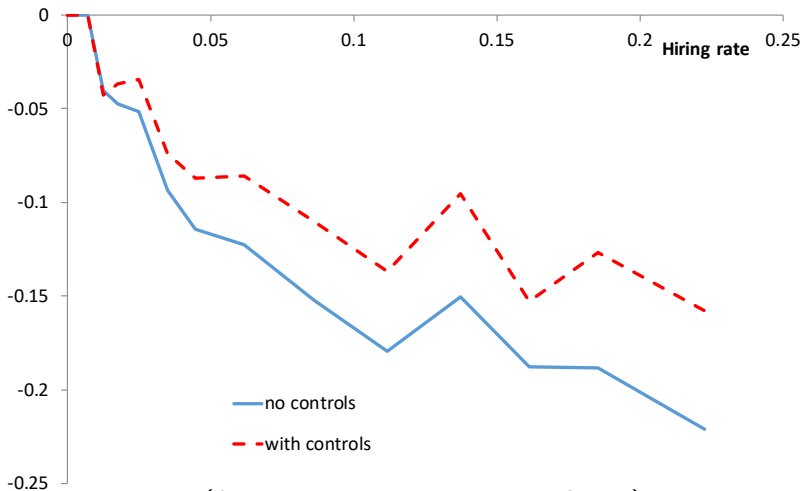
Search effort



Wage generosity



Hiring standards



Controls: Size, age, industry, restrictions (financial, demand, workforce), job requirements, occupation, year

▸ All variables

Recruitment policies and matching efficiency

- How do different dimensions of recruitment intensity contribute to aggregate matching efficiency?
- Do they matter for the impact of labor market policy?

$\Longrightarrow$ Directed search model, calibrated to reflect cross-sectional relationships

Model framework

- Continuous time, discount rate r, steady state

Firms

- Unit mass of risk neutral firms, entry/exit rate δ
- Firms operate multiple projects, only hire for new projects
- New projects arrive at flow rate χ, productivity $p \sim \Pi(.)$
- At flow rate ν, a fraction $\psi \sim \Psi(.)$ of all jobs in a firm are destroyed.

Workers

- $\bar{L}$ of risk neutral workers, unemployment income b
- Separation rate $s \equiv \delta + \nu \mathbb{E}\psi$
- No search on-the-job

Model framework

Search and matching

- Firms post (flat) wage contracts
- Meetings in submarkets indexed by unemployment-to-effective-vacancy ratio λ
- Firms' meeting rate $m(\lambda)$ per effective vacancy ($m' > 0$, $m'' < 0$)
- Workers' meeting rate $m(\lambda)/\lambda$
- Match-specific productivity $x \sim G(.)$
- Output $p \cdot x$

Firm's problem

- Firms choose
  - Vacancies V at cost $c_V(V)$ $(c_V', c_V'' > 0)$
  - **Search effort** e at cost $c_e(e)$ $(c_e', c_e'' > 0)$
    $\Rightarrow$ Effective vacancies eV
  - **Hiring standards** $\tilde{x}$ and **wage postings** $w(x)$, $x \geq \tilde{x}$
- A firm with new project p maximizes the flow profit value

$$\underbrace{m(\lambda)eV \int_{\tilde{x}}}_{\text{Hires flow}} \underbrace{\frac{px - w(x)}{r+s}}_{\text{pdv of profits}} dG(x) - C_V(V) - Vc_e(e) \ ,$$

subject to $\lambda = \Lambda(\tilde{x}, w(.))$ (workers' optimal search)

Workers' search

- Unemployed workers' Bellman equation

$$rU = b + \underbrace{\max_{\tilde{x},w(.),\lambda} \frac{m(\lambda)}{\lambda} \int_{\tilde{x}} \frac{w(x) - rU}{r+s} \, dG(x)}_{\equiv \rho \text{ (flow value of search)}}$$

- Queue lengths $\lambda = \Lambda(\tilde{x}, w(.))$ satisfy

$$\frac{m(\lambda)}{\lambda} \int_{\tilde{x}} \frac{w(x) - rU}{r+s} \, dG(x) \leq \rho \quad , \quad \lambda \geq 0 \text{ (c.s.)}$$

▸ Equilibrium definition

Cross-sectional variation

- Firms with more productive projects (higher p) choose
  - More vacancies V_p
  - Higher search effort e_p
  - Lower hiring standards $\tilde{x}_p$
  - Higher meeting rate $m(\lambda_p)$ (via wage offers)

▸ Details

- The job-filling rate can be decomposed

$$q_p \equiv \frac{H_p}{V_p} = \underbrace{e_p}_{\text{Search effort}} \cdot \underbrace{m(\lambda_p)}_{\text{Wages}} \cdot \underbrace{(1 - G(\tilde{x}_p))}_{\text{Hiring standards}}$$

- Relate hiring rates, vacancy yields and recruitment policies
  $\Rightarrow$ Theoretical counterparts of previous empirical relationships.

Calibration

Objective

Explore variation of matching efficiency across 36 **local labor markets** (3 skills $\times$ 12 regions) during 2010–2018.

Parameterization

- Functional forms: $m(\lambda) = m_0 \lambda^{\mu}$, $c_V(V) = c_V V^{\Phi}$, $c_e(e) = c_e e^{\gamma}$, $G(x) = 1 - (x_0/x)^{\alpha}$, $\Pi(p) = (p/\bar{p})^{\eta}$.
- Further parameters: r, δ, s, b, χ.
- Introduce orthogonal hiring shocks with std.dev. σ.

Local and global parameters

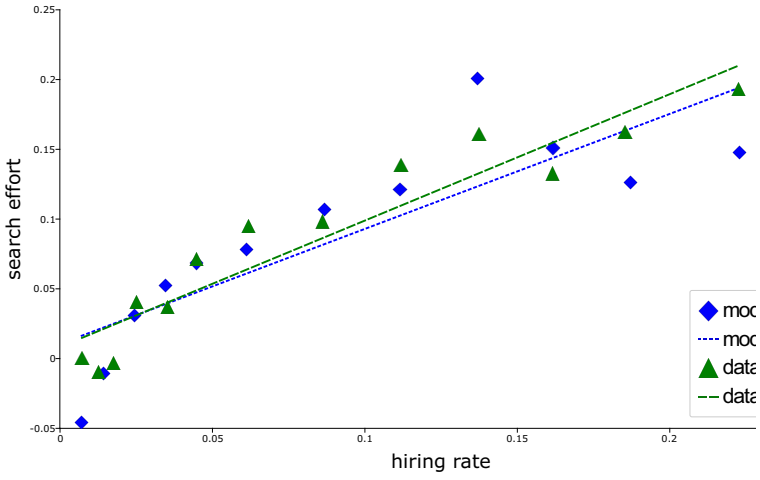
- Market-specific parameters: $\bar{p}_m$, b_m, $\bar{L}_m$, δ_m, ν_m, η_m.
- These are set to match job-finding rates, mean wages, size of workforce, separation/exit rates, CV of search costs
- All other parameters are set uniformly across markets.

Parameters and model fit

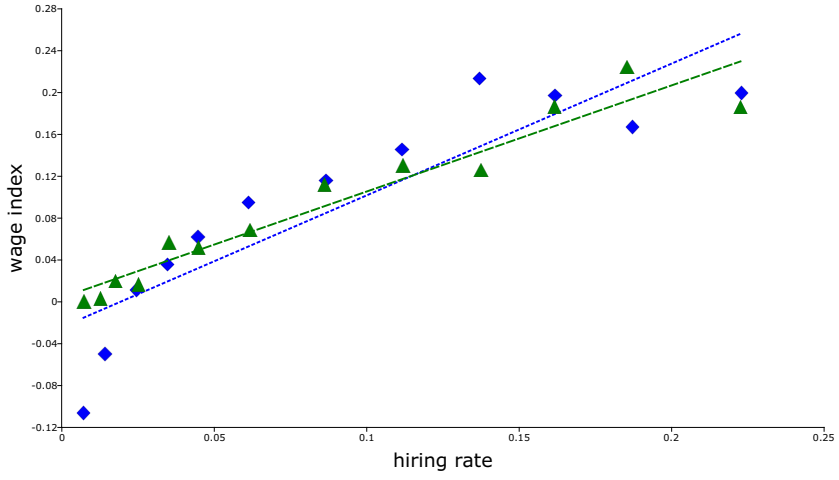
(a) Market-specific parameters (inner loop)			
Parameter		Mean Value	Explanation/Target
Labor force (normalized)	$\bar{L}_m$	7.11	Workers per establishment
Job destr. arrival rate	ν_m	9.3%	Unemployment rates
Exit rate	δ_m	0.27%	1/3 of separations due to exit
Productivity upper bound	$\bar{p}_m$	308.3	Job-finding rates
Productivity shape	η_m	1.20	CV search costs
Unemployment income	b_m	0.49	Wages (mean normalized to 1)
(b) Global parameters (inner loop)			
Parameter		Value	Explanation/Target
Interest rate	r	0.34%	4% annual real rate
Mean job destruction	$\bar{\psi}$	0.0574	Job destruction distribution
Vacancy cost scale	c_V	7,548.1	0.12 vacancies per establishment
Matching fct. elasticity	μ	0.121	Average replacement rate 46%
Matching fct. scale	m_0	0.01	Normalized (see text)
Search effort scale	c_e	1.0	Normalized (see text)
Match prod. Pareto scale	x_0	0.01	Normalized (see text)
(c) Global parameters (outer loop)			
Parameter		Value	Explanation/Target
Vacancy cost elasticity	Φ	5.89	Slope vacancy yield wrt hiring rate
Search effort elasticity	γ	4.19	Slope search effort wrt hiring rate
Match prod. Pareto shape	α	3.16	Slope hiring standards wrt hiring rate
Std.dev. hiring shocks	σ	2.26	Slope wages wrt hiring rate
Arrival rate prod. shocks	χ	1.11	Employment growth $[-0.01, 0.01]$
(d) Targets for estimation			
Statistics		Data	Model
Slope vacancy yield wrt hiring rate		16.0	15.8
Slope search effort wrt hiring rate		0.91	0.88
Slope selectivity wrt hiring rate		-0.54	-0.39
Slope wages wrt hiring rate		1.01	1.30
Share employment growth $[-0.01, 0.01]$		0.80	0.82

Model fit: Recruitment indicators and hiring rates

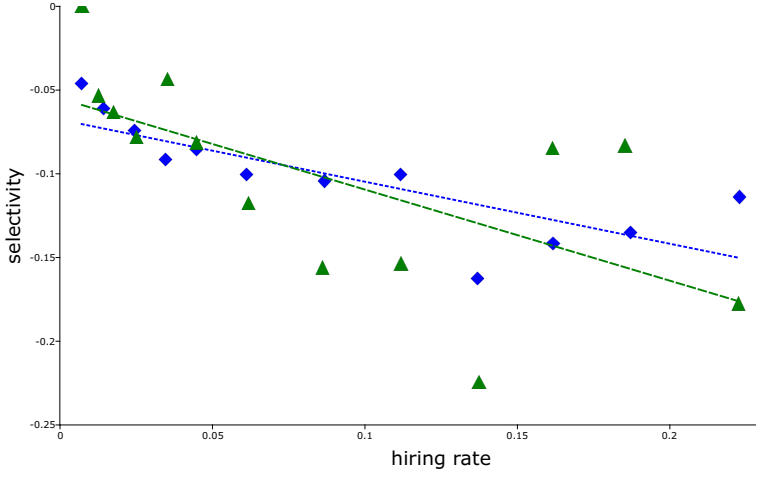
(a) **Search effort**



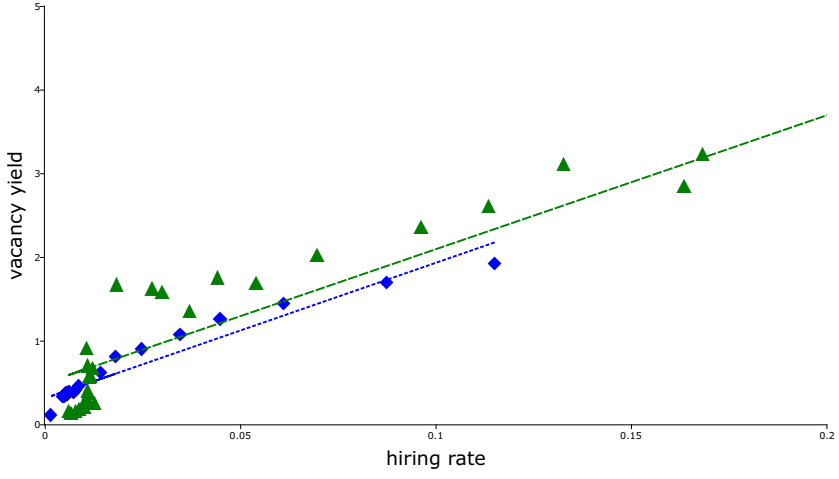
(b) **Wage generosity**



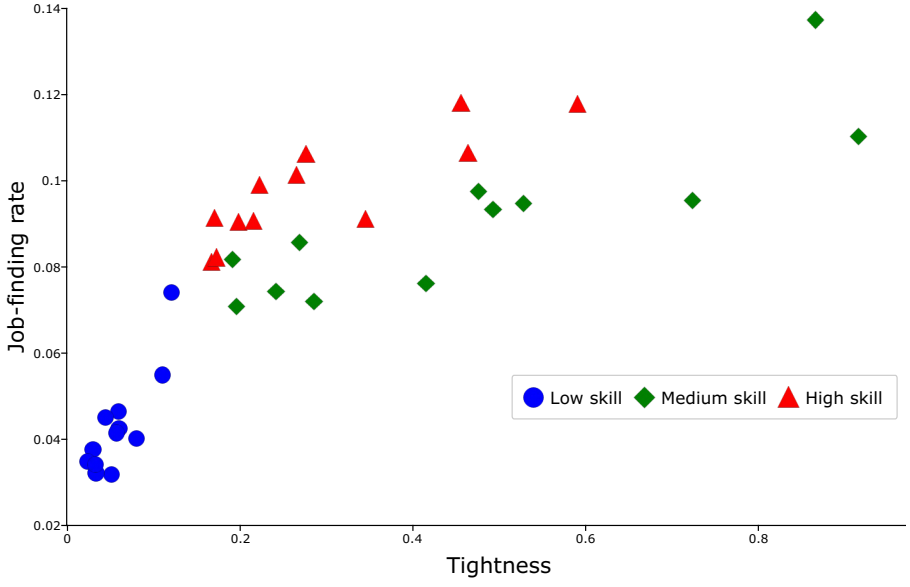
(c) **Match-specific selectivity**

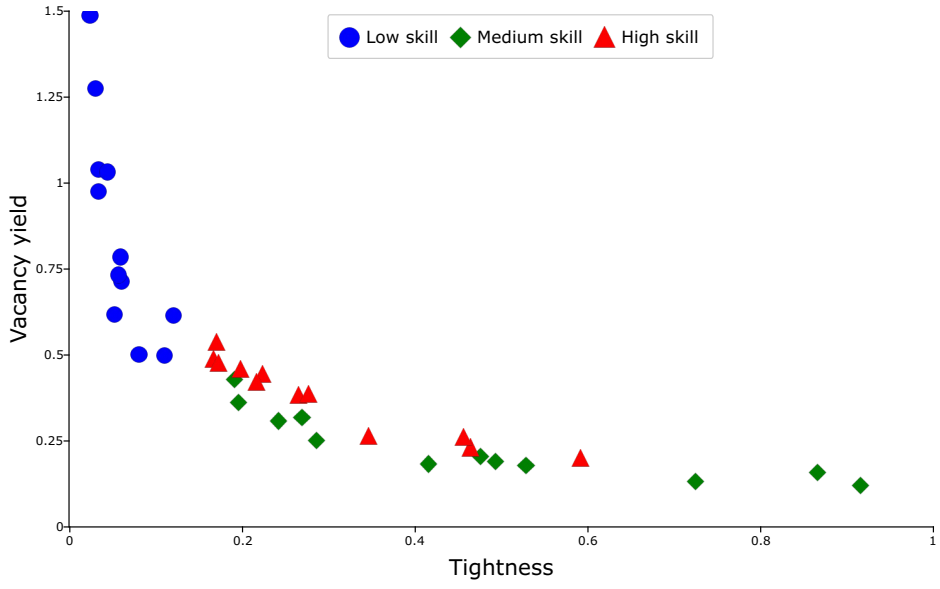


(d) **Vacancy yield**



Job-finding rates, vacancy yields and labor market tightness (data)





Variation across 36 local labor markets (2010-2018)

Variation across labor markets

- How does recruitment contribute to matching efficiency?
- Decomposition of the job-finding rate

$$\frac{H}{U} = \underbrace{m_0\left(\frac{\bar{V}}{U}\right)^{1-\mu}}_{\text{Tightness}} \cdot \underbrace{\bar{e}^{1-\mu}}_{\substack{\text{Search}\\ \text{effort}}} \cdot \underbrace{\frac{\bar{m}}{m(U/(\bar{e}\bar{V}))}}_{\substack{\text{Wage}\\ \text{dispersion}}} \cdot \underbrace{\int (1-G(\bar{x}_p))\frac{m(\lambda_p)e_pV_p}{\bar{m}\bar{e}\bar{V}}\, d\Pi(p)}_{\text{Selectivity}}$$

with

$$\bar{V} \equiv \int V_p \, d\Pi(p)$$

$$\bar{e} \equiv \int e_p \frac{V_p}{\bar{V}} \, d\Pi(p)$$

$$\bar{m} \equiv \int m(\lambda_p)\frac{e_pV_p}{\bar{e}\bar{V}} \, d\Pi(p)$$

Variance decomposition of job-finding rate

Total variance 0.184	Tightness	Search effort	Wage dispersion	Selectivity
Tightness	0.657	0.032	0.002	-0.382
Search effort	0.032	0.004	0.000	-0.013
Wage dispersion	0.002	0.000	0.000	-0.001
Selectivity	-0.382	-0.013	-0.001	0.250

- Most of the variation due to tightness and selectivity.
- But selectivity *reduces* matching efficiency in tighter markets. This is because workers' job prospects and reservation wages are higher in these markets.
- Consistent with positive cross-market correlation of job-finding rates and the hiring standards index.

Relative contributions to the variation of job-finding rates across local labor markets ▸ Across regions ▸ Across skills

Effect of labor market policy - Hartz reforms

- Impact of a decrease of the UI replacement rate from 57% to 46%.

Change in log points (average across local labor markets)

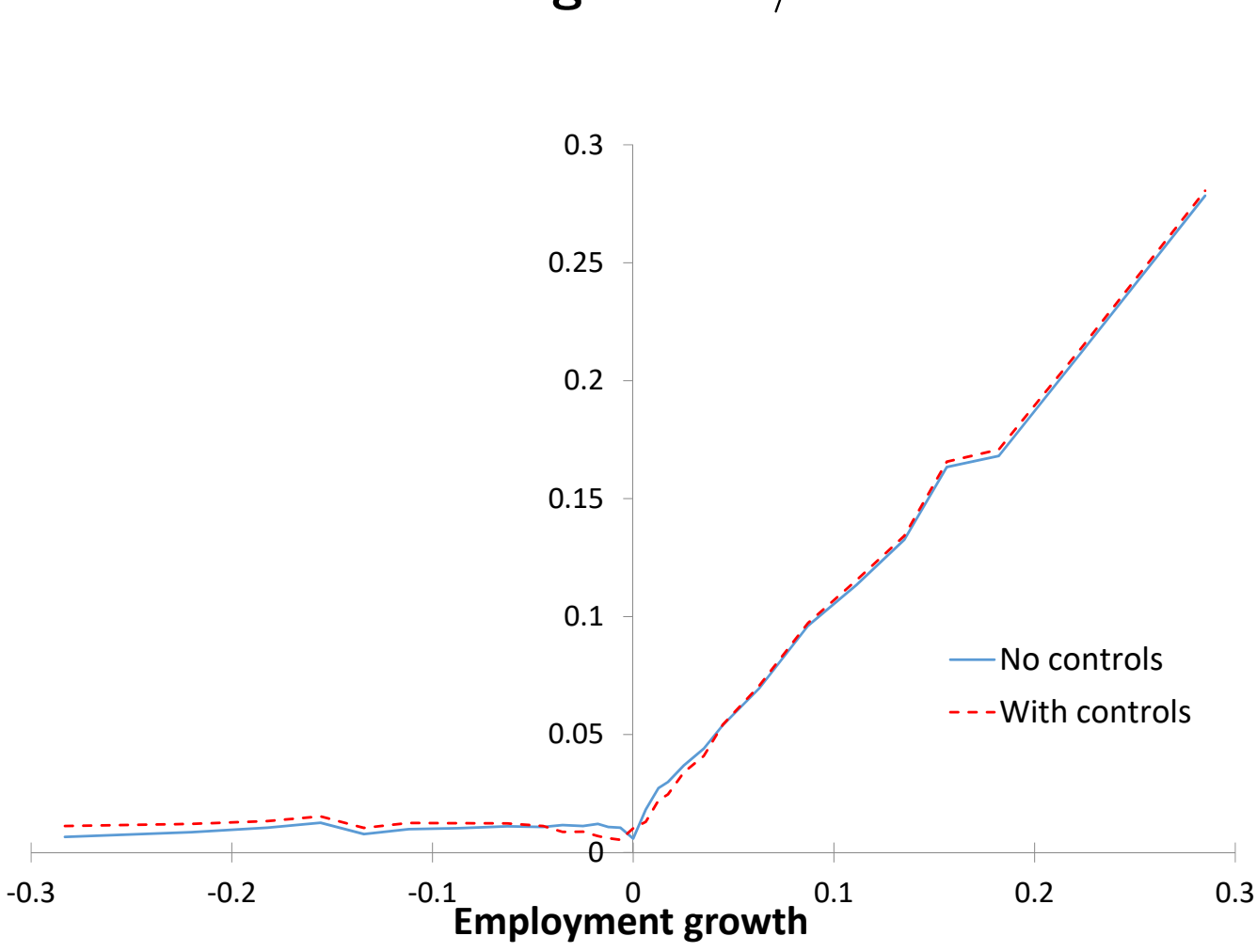
	JFR	Tightness	Search effort	Selectivity
Total	0.317	0.223	0.007	0.086
Low skill	0.554	0.346	0.021	0.187
Medium skill	0.234	0.189	0.001	0.044
High skill	0.161	0.135	0.000	0.026

- Market tightness and selectivity are the two dominant forces that shift the job-finding rate.
- These two factors go in the same direction.
- Selectivity relatively more important in low-skill labor markets.

Conclusions

- Search effort, hiring standards and wages all vary systematically with hiring rates.
- Directed search model, calibrated to match firm-level variation of hiring rates, vacancy yields and recruitment policies.
- Results:
  - Hiring standards most important for matching efficiency.
  - Firms are more selective in tighter markets.
  - Hiring standards amplify impact of UI changes, particularly in low-skill markets
  - Search effort (or differences in wage policies) play a minor role.

Hiring rate versus employment growth



Controls: Industry and establishment size

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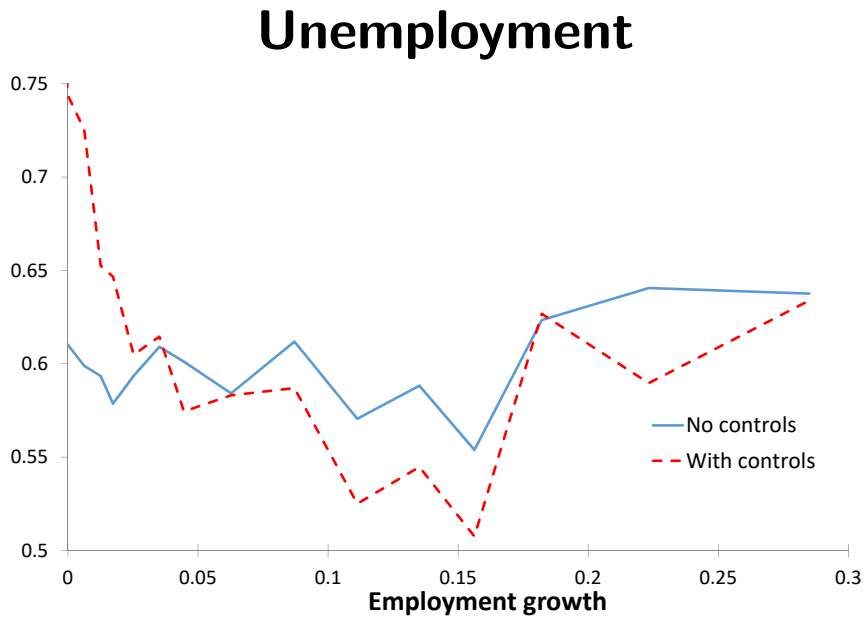
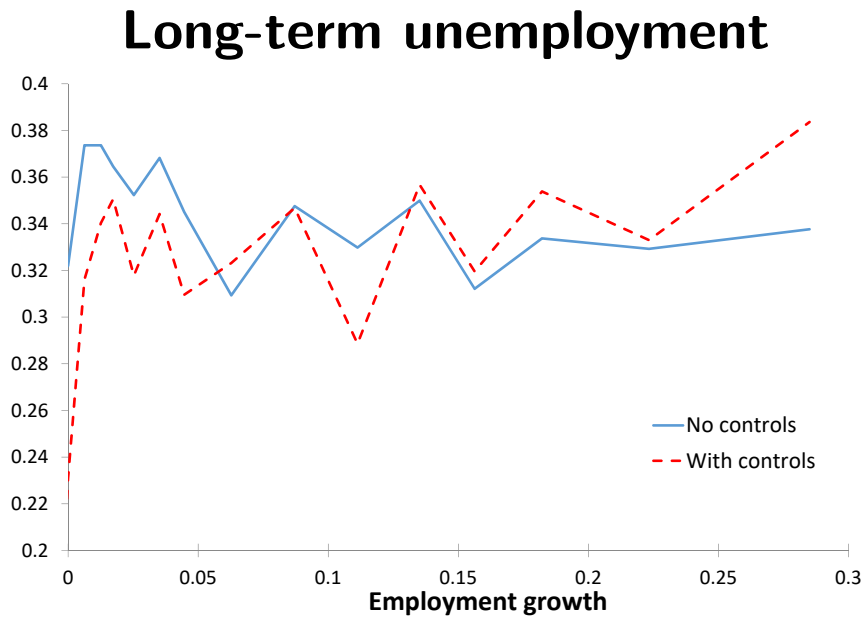
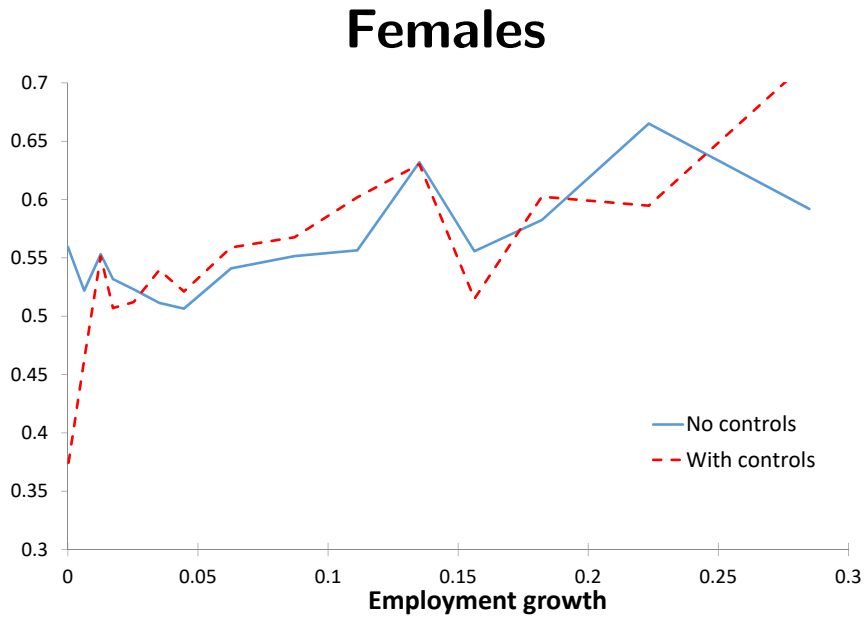
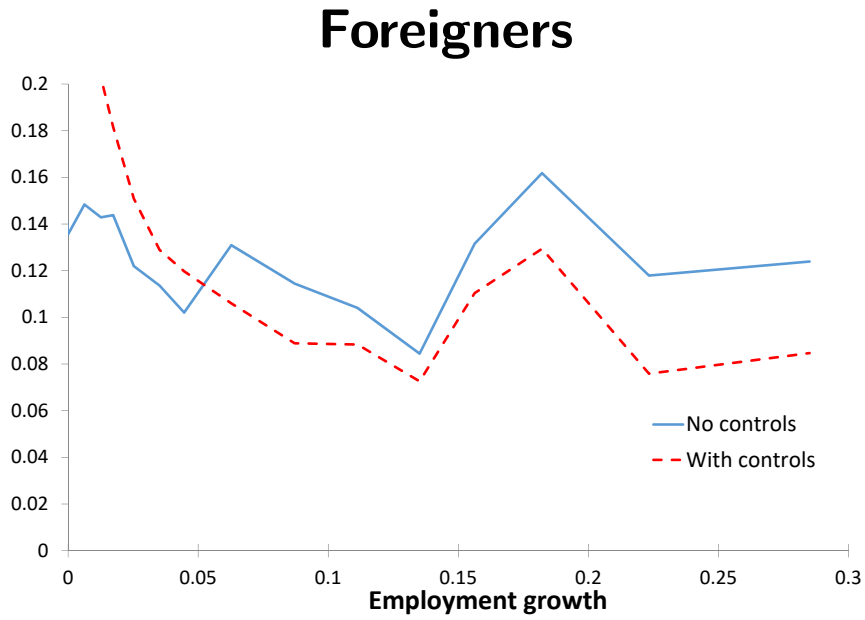
Composition of hires (I)

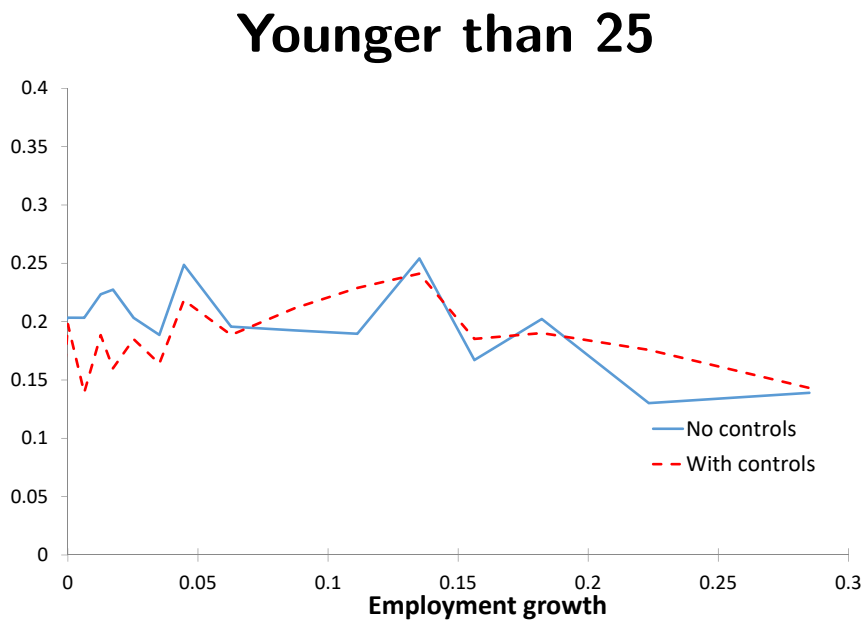


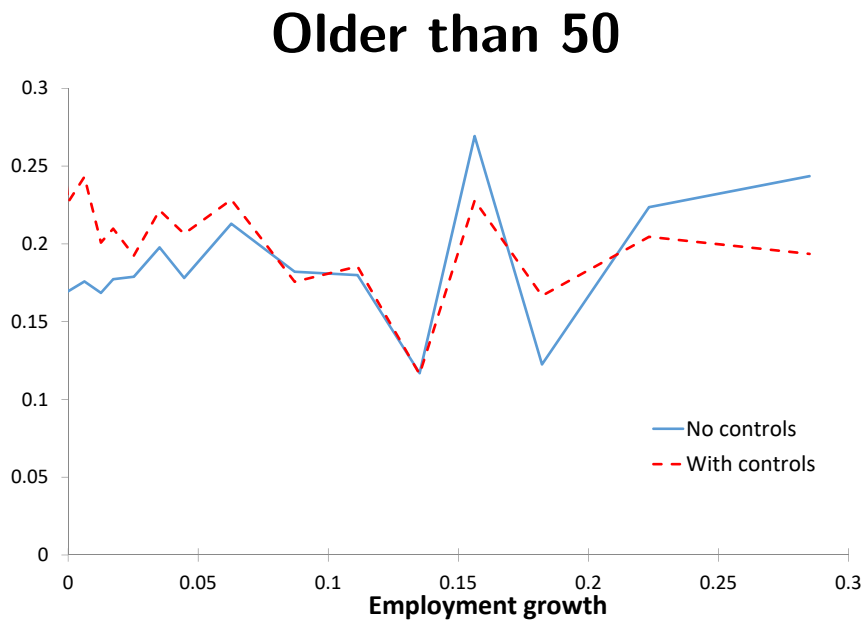






Composition of hires (II)





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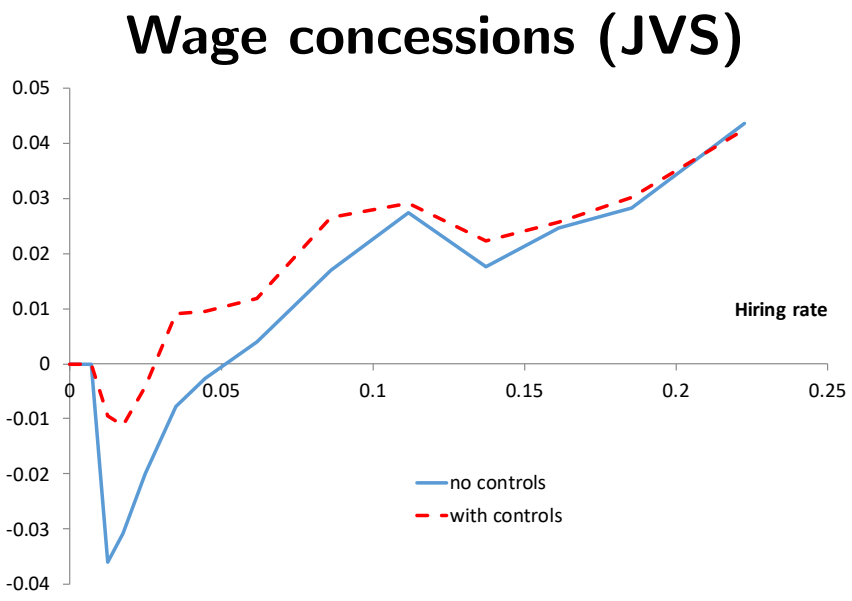
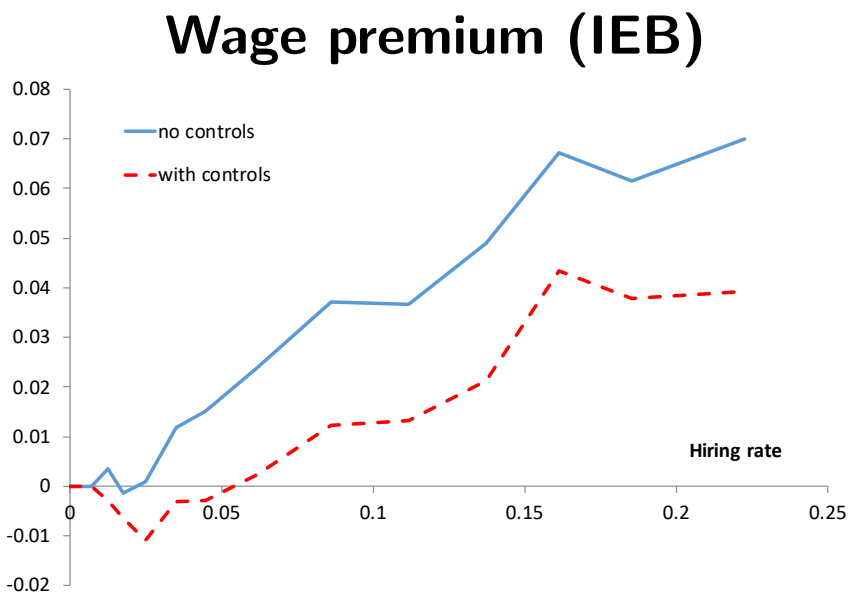
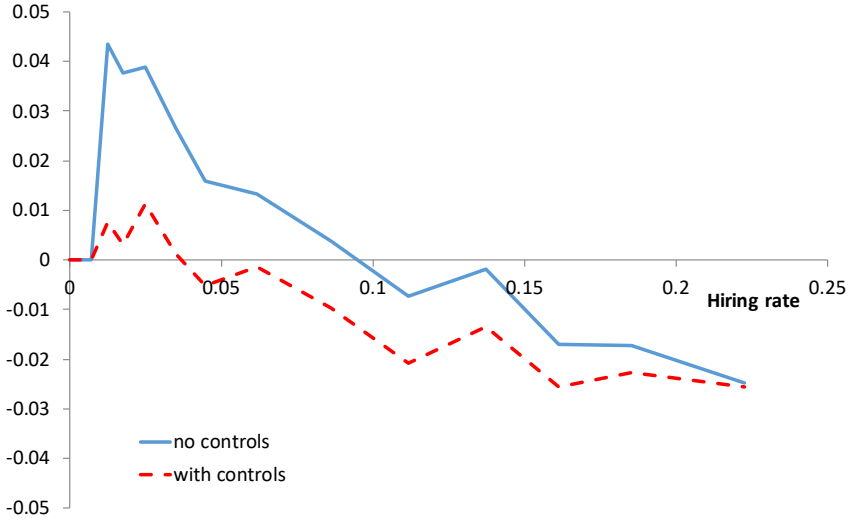
Recruitment variables by varying hiring rates (I)



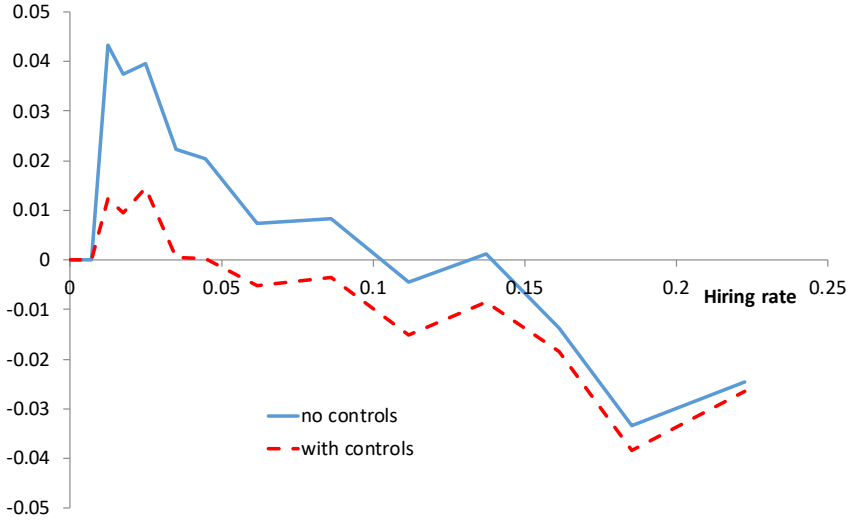


Recruitment variables by varying hiring rates (II)

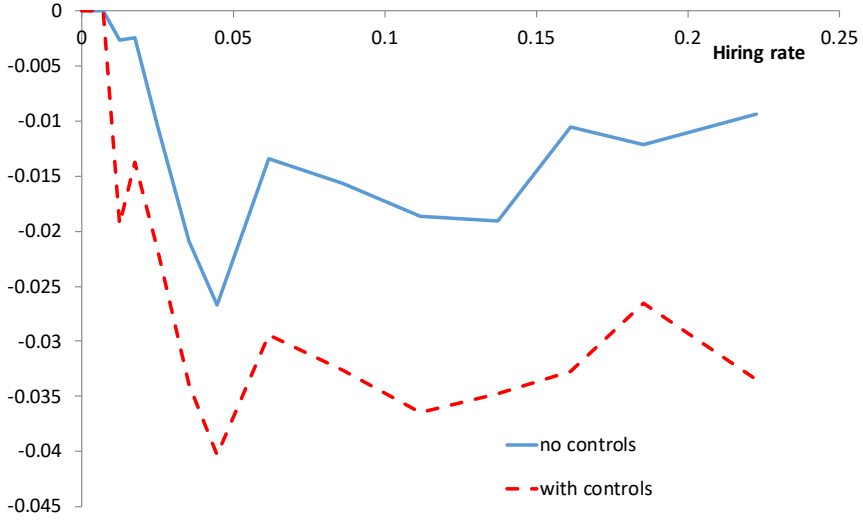
No qualification mismatch (JVS)



No experience mismatch (JVS)

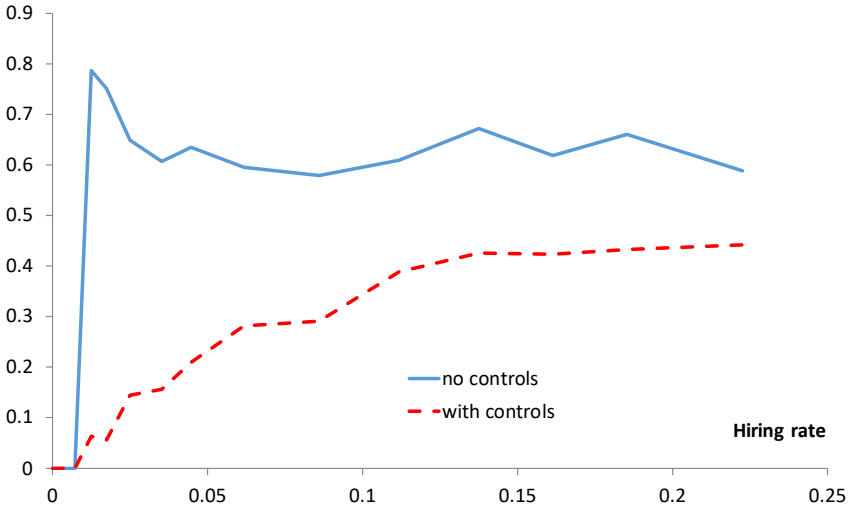


Selectivity (IEB)

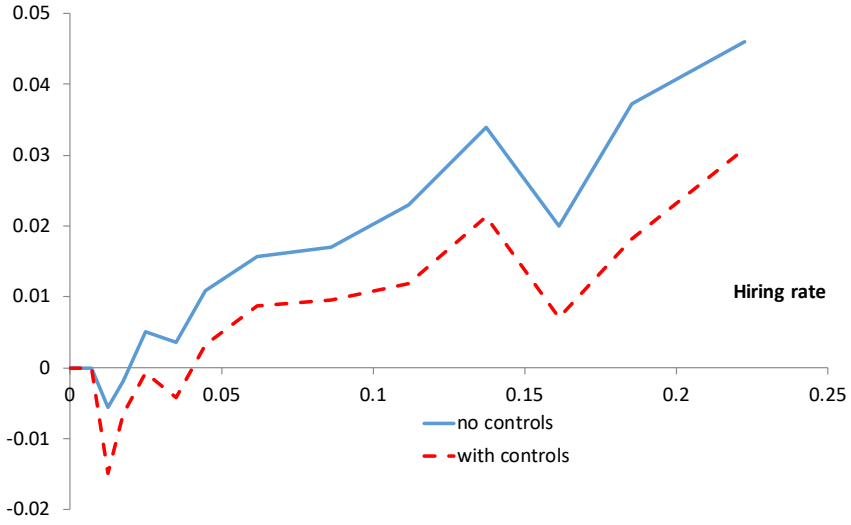


Recruitment variables by varying hiring rates (III)

Number of search channels (JVS)



International recruitment (JVS)



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Stationary competitive search equilibrium

Describes vacancies V_p, search effort per vacancy e_p, job postings $(\tilde{x}_p, w_p(x))$ for all firms with current project productivity $p \in P$, queue lengths in submarkets for different postings, defined by Λ, search value for unemployed workers ρ, and unemployment rate u such that

1. Firms maximize expected profits: For all projects with productivity $p \in P$, vacancies V_p, recruiting intensity e_p and job postings $(\tilde{x}_p, w_p)$ maximize

$$\max_{} eVm(\lambda) \int_{\tilde{x}} \frac{px - w(x)}{r + s} \, dG(x) - c_V(V) - Vc_e(e)$$

   subject to $\lambda = \Lambda(\tilde{x}, w)$.

2. Workers search optimally: For all postings $(\tilde{x}, w) \in Z$ and $\lambda = \Lambda(\tilde{x}, w)$,

$$\bar{\rho}(\tilde{x}, w, \lambda) \leq \rho \ , \ \lambda \geq 0 \ ,$$

   with complementary slackness. Furthermore,

$$\sum_{p \in P} \pi_p V_p e_p \lambda_p \leq u\bar{L} \ , \ \rho \geq 0 \ ,$$

   with complementary slackness.

3. Stationary unemployment rate:

$$(1 - u)\bar{L}(s + \delta) = \sum_{p \in P} \pi_p (1 - G(\tilde{x}_p)) m(\lambda_p) e_p V_p \ .$$

Characterization

First-order conditions

- Negative relation between p and $\tilde{x}$:

$$p\tilde{x} = b + \rho \ .$$

- Negative relation between $\tilde{x}$ and λ $\quad (\uparrow p \rightarrow \uparrow w)$:

$$\rho = m'(\lambda)\frac{b+\rho}{r+s}\int_{\bar{x}} \frac{x}{\bar{x}} - 1 \ dG(x) \ .$$

- Positive relation between λ and e $\quad (\uparrow p \rightarrow \uparrow e)$:

$$c'_e(e) = \rho\frac{m(\lambda) - \lambda m'(\lambda)}{m'(\lambda)} \ .$$

- Positive relation between e and V $\quad (\uparrow p \rightarrow \uparrow V)$:

$$c'_V(V) = ec'_e(e) - c_e(e) \ .$$

Decomposition

- The relative contributions of wages, hiring standards and search effort on the variation of the vacancy yield can be expressed as

$$\frac{dq}{q} = \frac{de}{e} + \frac{m'(\lambda)\lambda}{m(\lambda)} \cdot \frac{d\lambda}{\lambda} - \frac{G'(\tilde{x})\tilde{x}}{1 - G(\tilde{x})} \cdot \frac{d\tilde{x}}{\tilde{x}} \ .$$

- After some transformation

$$\frac{dq}{q} = \frac{dp}{p}(1-\epsilon_{\Phi,\tilde{x}})\left\{\frac{1}{(1-\epsilon_{m,\lambda})\epsilon_{c'_e,e}} + \frac{\epsilon_{m,\lambda}}{-\epsilon_{m',\lambda}} + \frac{G'(\tilde{x})\tilde{x}}{(1-G(\tilde{x}))(1-\epsilon_{\Phi,\tilde{x}})}\right\},$$

where $\epsilon_{f,i}$ to denote the elasticity of function f with respect to variable i and

$$\Phi(\tilde{x}) \equiv \int_{\tilde{x}} [x - \tilde{x}] \ dG(x) = \int_{\tilde{x}} [1 - G(x)] \ dx$$

.

- The elasticities of (i) the matching function, (ii) the match-specific productivity distribution, and (iii) search costs matter for the respective contributions of wages, hiring standards and effort.

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Variation across labor markets (total and by skill group)

	Variance JFR	Tightness	Search effort	Wage dispersion	Selectivity
Total	0.184	167.4%	12.2%	0.4%	-80.1%
Low skill	0.059	142.4%	3.8%	0.1%	-46.2%
Medium skill	0.038	222.2%	-1.3%	0.4%	-121.2%
High skill	0.015	207.4%	20.0%	2.8%	-130.2%

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Variation across skill groups

	JFR	Tightness	Search effort	Wage dispersion	Selectivity
Medium skill	0.760	0.822	0.134	0.001	-0.198
High skill	0.846	1.707	0.100	0.004	-0.965

Average log differences to low skill labor markets

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