Aggregate Recruiting Intensity

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- Large and persistent decline in A_t in the last recession
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- Q1: How much of the decline in A_t is accounted for by ARI?

Micro data (Davis-Faberman-Haltiwanger, 2013)

- In the cross-section, fast growing firms fill vacancies more quickly
- Q2: What is the transmission mechanism from macro shocks to ARI?

Firm-level hiring technology

$$\begin{aligned} \text{Random-matching model} \quad h_{it} &= q_t v_{it} \\ \text{+ recruiting intensity} \quad h_{it} &= q_t e_{it} v_{it} \end{aligned}$$

- JOLTS vacancies - v_{it}
  - BLS: *"Specific position that exists... for start within 30-days... with active recruiting from outside the establishment"*

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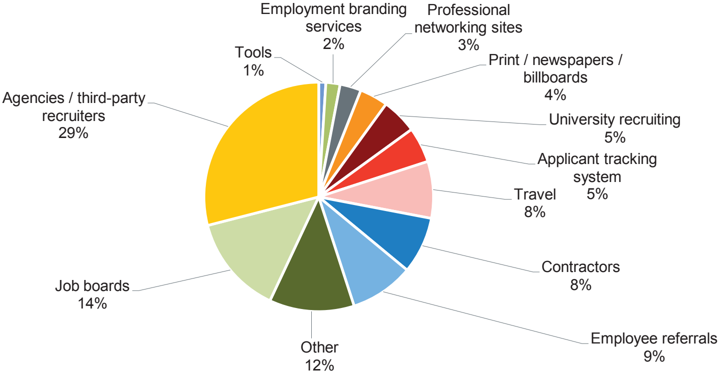
- Recruitment intensity - e_{it}
  1. Shifts the filling rate (or yield) of an open position
  2. Costly on a per vacancy basis
  - An outcome of expenditures on recruiting activities

Recruiting cost by activity



Bersin and Associates, *Talent Acquisition Factbook* (2011)

- Average cost per hire (at 100+ employee firms): $3,500

From firm-level to aggregate recruiting intensity

- Aggregation

$$H_t = q_t \int e_{it} v_{it} \, d\lambda_t^h = q_t V_t^*$$

- Aggregate matching function

$$H_t = V_t^{*\alpha} U_t^{1-\alpha} = \Phi_t V_t^{\alpha} U_t^{1-\alpha}$$

- Aggregate recruiting intensity

$$\Phi_t = \left[\frac{V_t^*}{V_t}\right]^\alpha = \left[\int e_{it} \left(\frac{v_{it}}{V_t}\right) d\lambda_t^h\right]^\alpha$$

Transmission mechanism: two channels

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1. **Composition**: macro shock $\rightarrow$ shift in hiring rate distribution

$$\downarrow \frac{h}{n} = \bar{q} \downarrow e \downarrow \frac{v}{n}$$

- Slow-growing firms recruit less intensively
- Great Recession - large decline in firm entry

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2. **Slackness**: macro shock $\rightarrow$ slacker labor market

$$\frac{\bar{h}}{n} = \uparrow q \downarrow e \downarrow \frac{v}{n}$$

- Firms substitute away from costly hiring measures
- Great Recession - large decline in market tightness

Model

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Firm dynamics

- Operate DRS technology
- Idiosyncratic persistent productivity shocks
- Endogenous entry and exit

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- Borrowing secured by collateral (macro shock)
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Labor market frictions

- Random matching with homogeneous workers (no OJS)
- Recruiting effort e and vacancies v are costly

Value functions

Let $\mathbb{V}(n, a, z)$ be the present discounted value of dividends of a firm with employment n, net-worth a, and productivity z

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- Exit exogenously or endogenously

$$\mathbb{V}(n,a,z) \quad = \quad \zeta a + (1-\zeta) \max \left\{ a \, , \, \mathbb{V}^i(n,a,z) \right\}$$

- Fire or hire

$$\mathbb{V}^i(n,a,z) = \max \left\{ \mathbb{V}^f(n,a,z) \, , \mathbb{V}^h(n,a,z) \right\}$$

Value functions - Firing

$$
\begin{aligned}
\mathbb{V}^f(n,a,z) &= \max_{n' \leq n,k,d} \quad d + \beta \int_{\mathcal{Z}} \mathbb{V}(n',a',z')\Gamma(z,dz') \\
& s.t. \\
d + a' &= \left(zn'^{\nu}k^{1-\nu}\right)^{\sigma} + (1+r)a - \omega n' - (r+\delta)k - \chi \\
k &\leq \varphi a \\
d &\geq 0
\end{aligned}
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- Define debt: $b := k - a$

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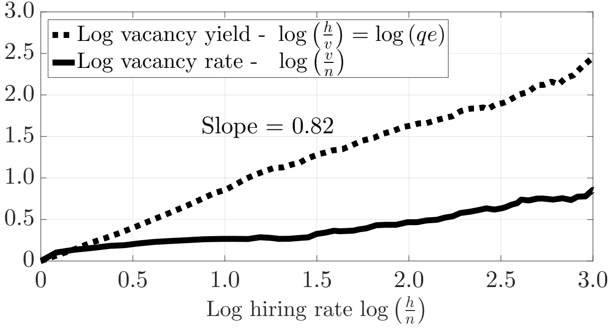
- Define debt: $b := k - a$
- Firms make take-leave offers: $\omega =$ flow value of leisure

Value functions - Hiring

$$
\begin{aligned}
\mathbb{V}^h(n,a,z) &= \max_{v>0, e>0, k, d} d + \beta \int_{\mathcal{Z}} \mathbb{V}(n',a',z')\Gamma(z,dz') \\
& \quad s.t. \\
d + a' &= \left(z n'^{\nu} k^{1-\nu}\right)^{\sigma} + (1+r)a - \omega n' - (r+\delta)k - \chi - C(e,v,n) \\
n' - n &= q(\theta^*) e v \\
k &\leq \varphi a \\
d &\geq 0
\end{aligned}
$$

Reverse engineering the hiring-cost function



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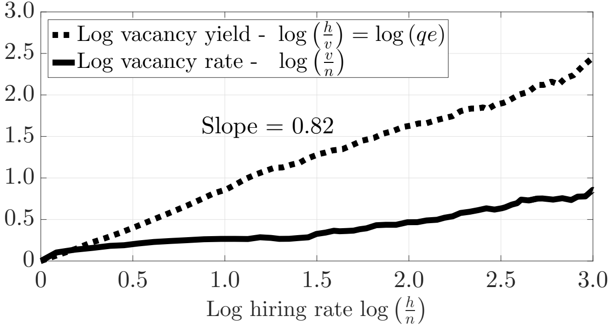
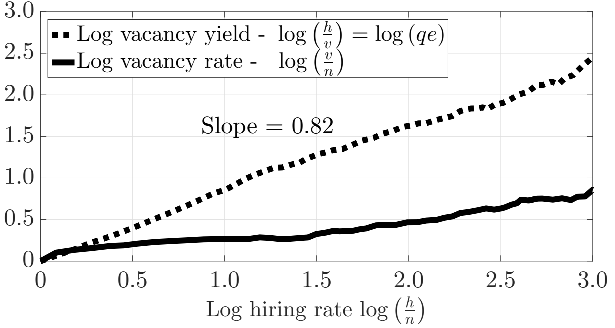


$$C(e,v,n) = \underbrace{\left[\frac{\kappa_1}{\gamma_1} e^{\gamma_1} + \frac{\kappa_2}{\gamma_2+1}\left(\frac{v}{n}\right)^{\gamma_2}\right]}_{\text{Cost per vacancy}} v, \quad \gamma_1 \geq 1, \gamma_2 \geq 0$$

Reverse engineering the hiring-cost function



$$\log e = \text{Const.} - \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q\left(\theta^*\right) + \frac{\gamma_2}{\gamma_1 + \gamma_2} \log\left(\frac{h}{n}\right)$$

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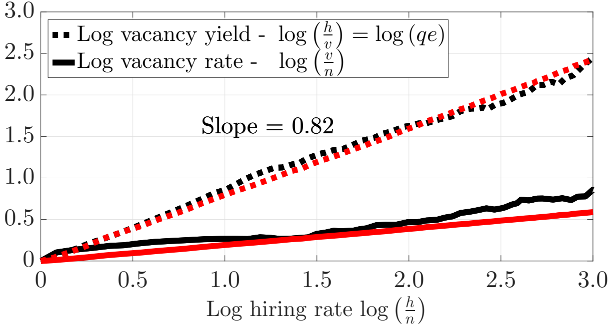

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Value functions - Entry

- Initial wealth: Household allocates a_0 to λ_0 potential entrants
- Productivity: Potential entrants draw $z \sim \Gamma_0(z)$
- Entry: Choice to become incumbent and pay χ_0 start-up costs

$$\mathbb{V}^e(a_0, z) = \max \left\{ a_0 \, , \, \mathbb{V}^i \left(n_0, a_0 - \chi_0, z \right) \right\}$$

Selection at entry based only on productivity z

Life cycle: slow growth b/c of fin. constraints and convex hiring costs

▸ Equilibrium

Parameter values set externally

Parameter		Value	Target
Discount factor (monthly)	β	0.9967	Ann. risk-free rate = 4%
Mass of potential entrants	λ_0	0.02	Meas. of incumbents = 1
Size of labor force	$\bar{L}$	24.6	Average firm size = 23
Elasticity of matching function wrt V_t	α	0.5	JOLTS

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Add to the model

- Heterogeneity in DRS $\sigma \in \{\sigma_L, \sigma_M, \sigma_H\}$

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Calibration strategy

1. Worker flows and labor share
2. Distribution of firm size and firm growth rates
3. Micro-evidence on job-filling and vacancy-posting
4. Entry and exit
5. Leverage for young firms and for aggregate economy

Parameter values estimated internally

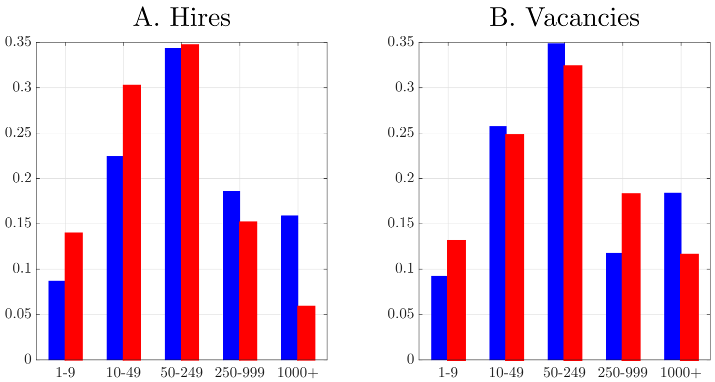
Parameter		Value	Target	Model	Data
Flow of home production	ω	1.000	Monthly separation rate	0.033	0.030
Scaling of match. funct.	$\bar{\Phi}$	0.208	Monthly job-finding rate	0.411	0.400
Prod. weight on labor	ν	0.804	Labor share	0.627	0.640
Midpoint DRS in prod.	σ_M	0.800	Employment share $n < 50$	0.294	0.306
High-Low spread in DRS	$\Delta\sigma$	0.094	Employment share $n \geq 500$	0.430	0.470
Mass - Low DRS	μ_L	0.826	Firm share $n < 50$	0.955	0.956
Mass - High DRS	μ_H	0.032	Firm share $n \geq 500$	0.004	0.004
Std. dev. of z shocks	ϑ_z	0.052	Std. dev. ann. emp. growth	0.440	0.420
Persistence of z shocks	ρ_z	0.992	Mean Q4 emp. / Mean Q1 emp.	75.16	76.00
Mean $z_0 \sim Exp(\bar{z}_0^{-1})$	$\bar{z}_0$	0.390	$\Delta \log z$: Young vs. Mature	-0.246	-0.353
Cost elasticity wrt e	γ_1	1.114	Elasticity of vac. yield wrt g	0.814	0.820
Cost elasticity wrt v	γ_2	4.599	Ratio vac. yield: $n < 50 / n \geq 50$	1.136	1.440
Cost shifter wrt e	κ_1	0.101	Hiring cost (100+) / wage	0.935	0.927
Cost shifter wrt v	κ_2	5.000	Vacancy share $n < 50$	0.350	0.370
Exogenous exit probability	ζ	0.006	Five year survival rate	0.497	0.500
Entry cost	χ_0	9.354	Annual entry rate	0.099	0.102
Operating cost	χ	0.035	Share of job destruction by exit	0.210	0.340
Initial wealth	a_0	10.000	Start-up Debt to Output	1.361	1.280
Collateral constraint	φ	10.210	Aggregate Debt to Assets	0.280	0.350

Non-targeted moments

Moment	Model	Data	Source
Aggregate dividend / profits	0.411	0.400	NIPA
Employment share: $growth \in (-2.00, -0.20)$	0.070	0.076	Davis et al. (2010)
Employment share: $growth \in (-0.20, 0.20]$	0.828	0.848	Davis et al. (2010)
Employment share: $growth \in (0.20, 2.00)$	0.102	0.076	Davis et al. (2010)
Employment share: $Age \leq 1$	0.013	0.028	BDS
Employment share: $Age \in (1, 10)$	0.309	0.212	BDS
Employment share: $Age \geq 10$	0.678	0.760	BDS

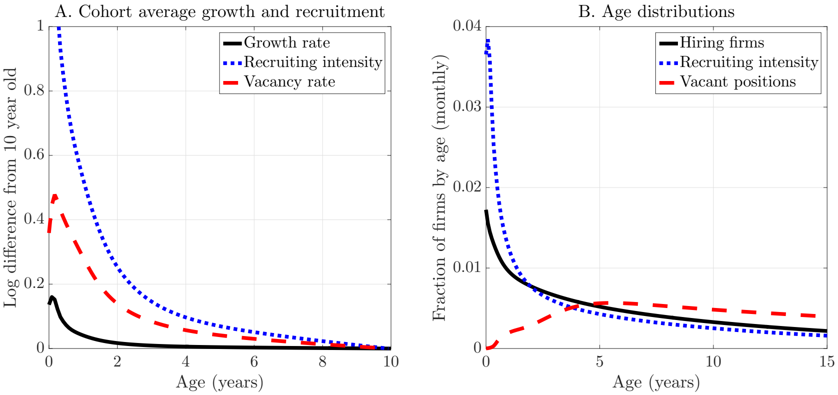
▸ Fig. Average firm lifecycle (i) size, (ii) job creation, (iii) fraction constrained, (iv) leverage

Hire and vacancy shares by size class



Model Data - JOLTS 2002-2007

Vacancy and recruitment intensity by age



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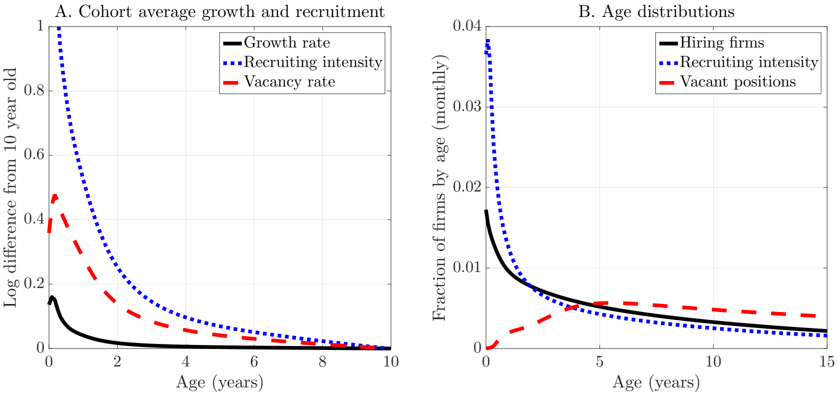

- Young firms exert more recruiting effort in the model
- US? No firm-age in JOLTS. But true, e.g., in Austrian micro-data

Transition dynamics experiments

Trace transitional dynamics of the economy in response to:

- Tightening of financial constraint $\downarrow \varphi$
- Size of shock: match max drop in output (Fernald, 2015)
  - Requires 75% drop in φ
- Persistence of shock: match half-life of output decline of 3 years
  - Monthly persistence of φ shock of 0.97

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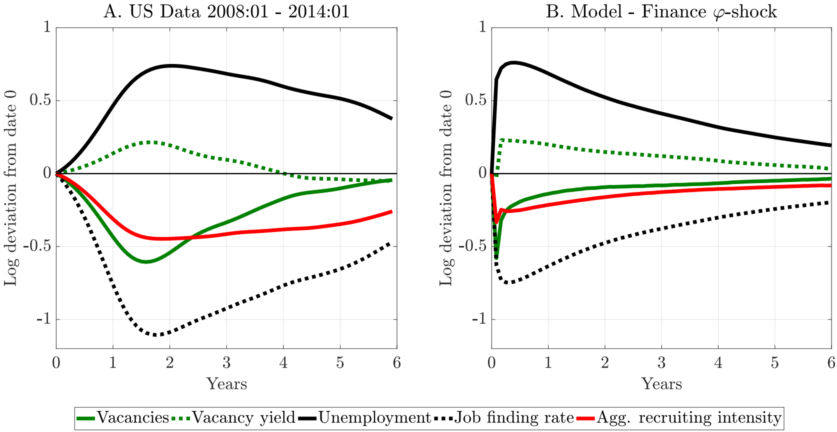
In the paper: examine also productivity shock

▸ Fig. Macro variables (i) output, (ii) debt/output, (iii) labor productivity, (iv) entry

Transition dynamics in labor market



▸ Fig. Labor wedge

Impulse response for Φ

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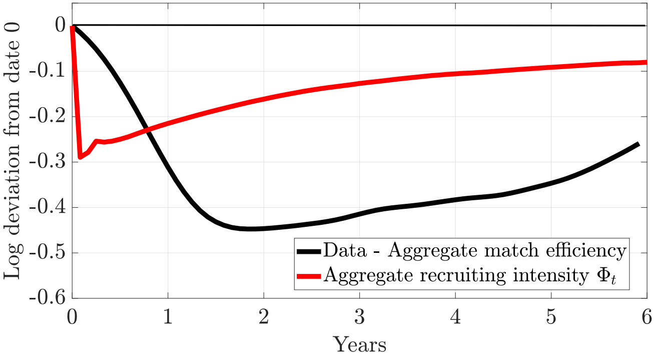


Result I:

- Recruiting intensity accounts for $\approx 1/3$ of decline in match efficiency
- Less persistence than empirical match efficiency

Decomposing Φ_t

Recruiting effort policy

$$e = \text{Const.} \times q\left(\theta^*\right)^{-\frac{\gamma_2}{\gamma_1+\gamma_2}} \times \left(\frac{h}{n}\right)^{\frac{\gamma_2}{\gamma_1+\gamma_2}}$$

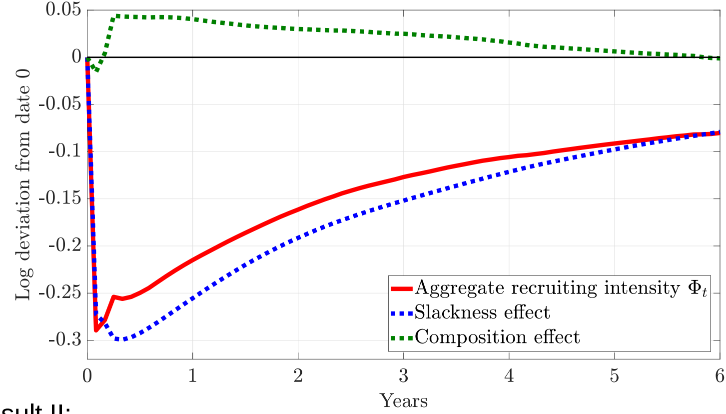
Aggregate recruiting intensity

$$\Phi = \left[\int e\left(\frac{v}{V}\right) d\lambda^h\right]^\alpha$$

Decomposition

$$\Delta \log \Phi = \underbrace{-\alpha \frac{\gamma_2}{\gamma_1+\gamma_2} \Delta \log q(\theta^*)}_{\text{Slackness effect}} + \underbrace{\alpha \Delta \log \left[\int \left(\frac{h}{n}\right)^{\frac{\gamma_2}{\gamma_1+\gamma_2}} \left(\frac{v}{V}\right) d\lambda^h\right]}_{\text{Composition effect}}$$

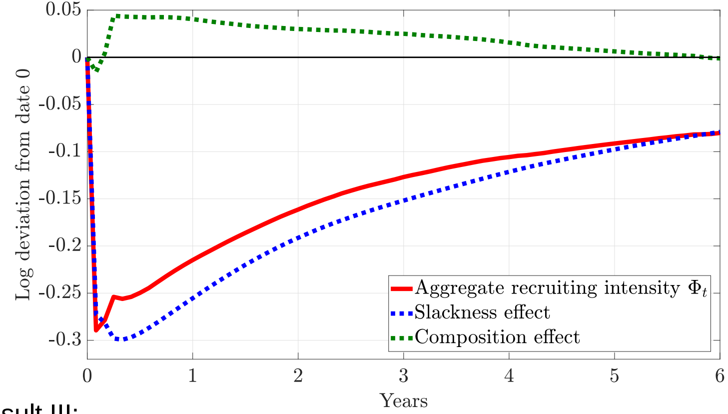
Decomposing Φ_t



Result II:

- Slackness effect is dominant

Decomposing Φ_t



Result III:

- Composition effect is roughly zero
- Why? Constrained vs. unconstrained firms

Understanding vacancy yields by size

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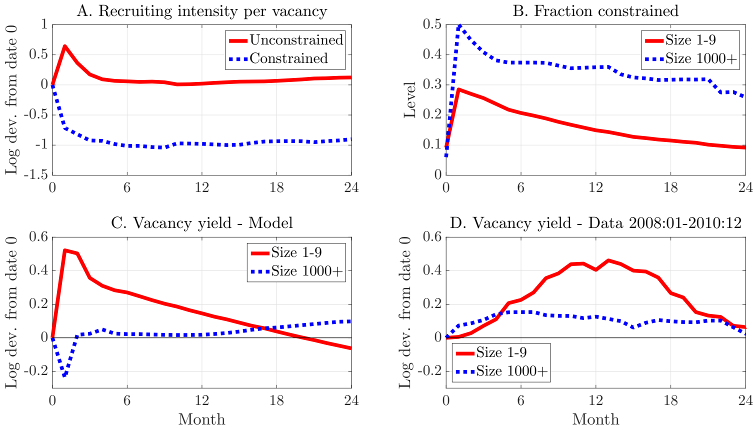

Result IV

- Constrained high-scale firms explain flat vacancy yields of large firms

Summary

Results

I. Recruiting intensity explains 1/3 of decline in match efficiency

II. Dominant: Slack labor markets reduce need for costly recruiting

III. Strong GE forces limit the role of the composition effect

IV. Constrained high-scale firms explain vacancy yields by size

Summary

Results

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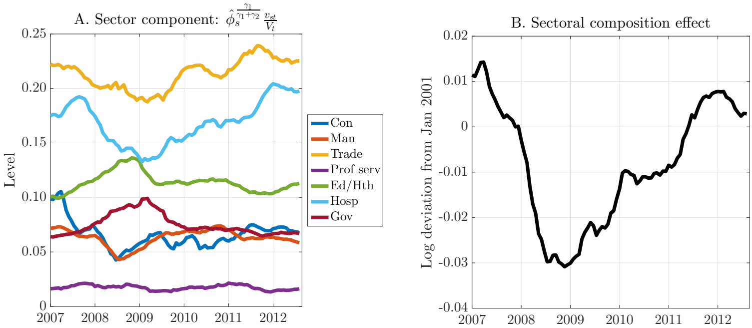
Extensions

1. Sectoral composition plays sizable role
2. Construct an easy-to-measure index of aggregate recruiting intensity
3. Relationship to Kaas & Kircher (2015)

1. Sectoral composition



Result

- Sectoral composition effect adds 15% to decline in Φ_t $(0.20 \rightarrow 0.23)$
- It adds some persistence too
- Driven by (i) Hospitality, (ii) Construction, (iii) Manufacturing

2. Approximate index of aggregate recruiting intensity

DFH provide an easy-to-compute index of aggregate recruiting intensity

$$\log \Phi_t = \log(H_t/V_t) - \log q_t$$

$$\frac{d \log \Phi_t}{d \log(H_t/N_t)} = \frac{d \log(H_t/V_t)}{d \log(H_t/N_t)} - \frac{d \log q_t}{d \log(H_t/N_t)}$$

(a) Use firm-level elasticity for first term, $\xi = 0.82$

(b) Assume second term is small

$$\frac{d \log \Phi_t}{d \log(H_t/N_t)} \approx \xi$$

$$d \log \Phi_t^{DFH} = \xi \times d \log(H_t/N_t)$$

2. Approximate index of aggregate recruiting intensity

Return to model based decomposition

$$\log \Phi_t = \underbrace{-\alpha \frac{\gamma_2}{\gamma_1 + \gamma_2} \log q(\theta_t^*)}_{\text{slackness effect}} + \underbrace{\alpha \log \left[\int \left(\frac{h_{it}}{n_{it}} \right)^{\frac{\gamma_2}{\gamma_1 + \gamma_2}} \left(\frac{v_{it}}{V_t} \right) d\lambda_t^h \right]}_{\text{composition effect}}$$

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GMV

(a) Model tells us the composition effect is approximately zero

$$d \log \Phi_t^{GMV} = \alpha \frac{\gamma_2}{\gamma_1+\gamma_2} \times (1-\alpha) \times d \log \theta_t^*$$

(b) Elasticity of θ_t^* to θ_t from transition dynamics

$$d \log \Phi_t^{GMV} = \alpha \frac{\gamma_2}{\gamma_1+\gamma_2} \times (1-\alpha) \underbrace{\varepsilon_{\theta^*,\theta}}_{\approx 1.5} \times d \log \theta_t$$

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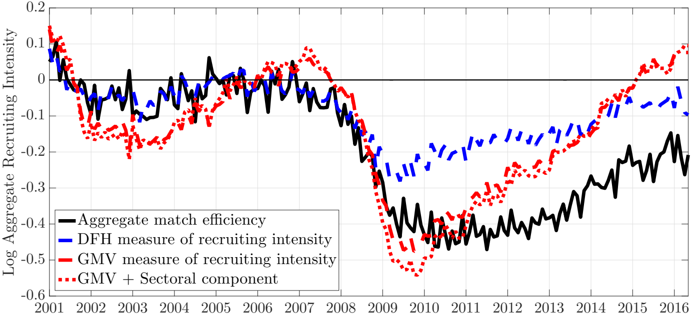

3. Relation to Kaas Kircher (2015)

KK model

$$\Phi_t^{KK} = \int \frac{q(\theta_{mt})}{\bar{q}(\theta_t)} \frac{v_{mt}}{V_t} \, dm$$

The reason why [recruiting intensity] is pro-cyclical in our model is that q is concave, and the cross-sectional dispersion in θ_{mt} is counter-cyclical

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Our model

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Dispersion effect is present but small

- φ_t shock delivers 45% increase in SD of growth rates, as in data

$\downarrow$ Φ_t, since $\frac{\gamma_2}{\gamma_1+\gamma_2} < 1$ but close to 1

Equilibrium

- Aggregate state $S_t = (\lambda_t, U_t, Z_t, \varphi_t)$

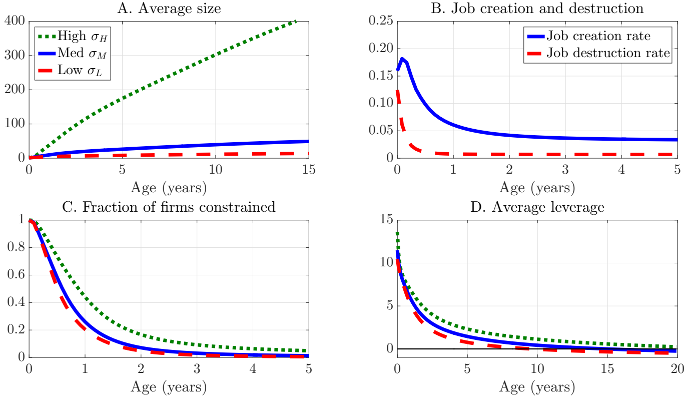
1. Measure of firms evolves via decision rules and z process
2. Labor market flows are equalized at θ_t^*: $U_{t+1}^{flows} = U_{t+1}^{demand}$

$$\begin{aligned} U_{t+1}^{flows} &= U_t - H(\theta_t^*, S_t) + F(\theta_t^*, S_t) - \lambda_{e,t} n_0 \\ U_{t+1}^{demand} &= \bar{L} - \int n'\left(n, a, z, S_t\right) \, d\lambda_t \end{aligned}$$

- Stationary equilibrium: measure is stationary, and $S = (\lambda, U, Z, \varphi)$

Back

Average life cycle of firms in the model



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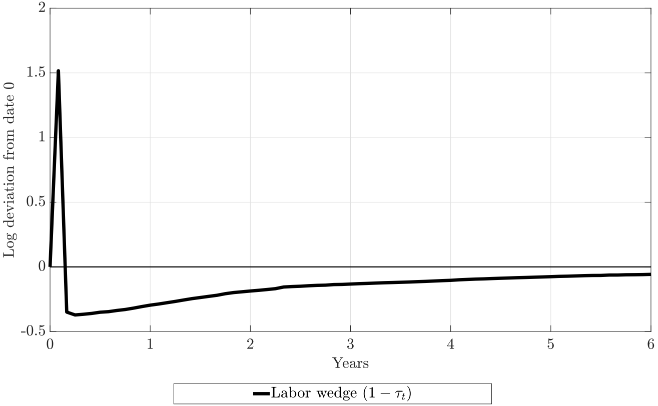
Labor wedge - Financial shock



$$1 - \tau_t = N_t^{1+\varphi} \frac{C_t}{Y_t}$$

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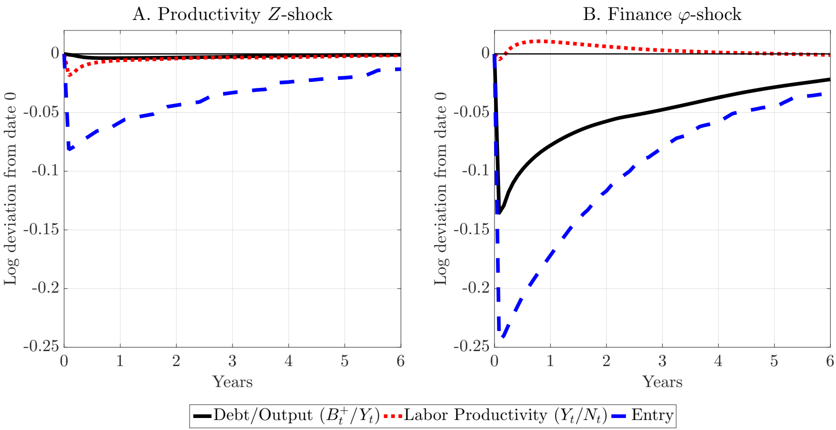
Transition dynamics - Macro



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