A Congestion Theory of Unemployment Fluctuations

Yusuf Mercan
U Melbourne

Benjamin Schoefer
UC Berkeley & NBER

Petr Sedláček
UNSW & CEPR

February 2022

LAEF
Labor Markets and Macroeconomic Outcomes

Why is job creation so unattractive in recessions?

We propose a congestion theory of unemployment fluctuations, based on two facts:

1. in recessions, *more* unemployed find jobs
2. limited capacity of firms to absorb increases in unemployment by expanding hiring
    - Congestion: diminishing returns in new hires' jobs (or convex hiring costs)

⇒ Countercyclical congestion (extra procyclicality of productivity in new jobs)

Provides a unified explanation for a range of macroeconomic patterns:

- strong amplification and propagation in the labor market
- relative cyclicality of new-hire wages (alternative calibration target)
- countercyclical labor wedge
- countercyclical earnings losses from job displacement and labor market entry
- ... all while featuring realistic insensitivity of hiring to policy changes such as UI

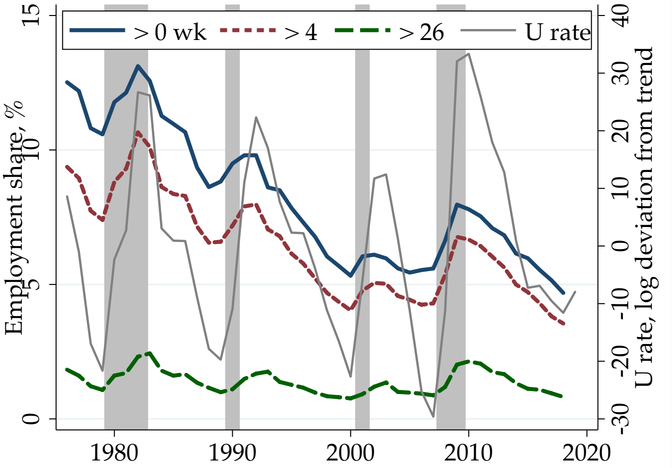
Outline

1. Empirical evidence
   - countercyclical shift of employment towards recently unemployed workers
   - congestion in hiring
2. Model structure
   - congestion mechanism
   - embed in a standard DMP model
   - calibrate to IRF of u and/or new hires' relative wage cyclicality
3. Business cycle performance
   - volatility and comovement of labor market variables
   - estimate congestion unemployment
4. Three additional macroeconomic applications
   - labor wedge, earnings losses, sensitivity to policy changes

1. Empirical evidence

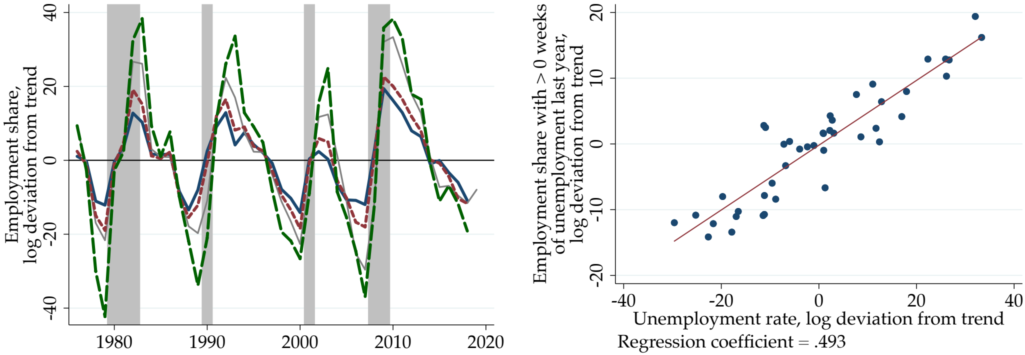
Countercyclical hiring out of unemployment and congestion in hiring

1. Employment share of workers with recent unemployment



CPS-ASEC (1976-2019): # of weeks workers spent in unemployment in previous year

1. Employment share of workers with recent unemployment

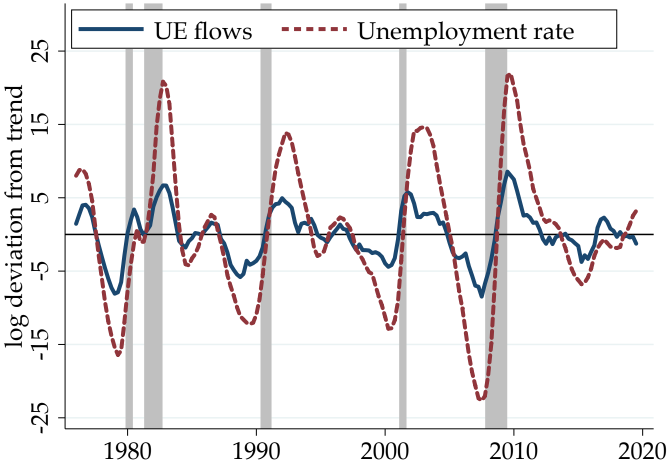


CPS-ASEC (1976-2019): # of weeks workers spent in unemployment in previous year

1. Flow origins of shifts in employment distribution

Unemployment-to-employment (UE) flows are strongly countercyclical

- see e.g. Burda and Wyplosz (1992), Fujita and Ramey (2009), Elsby et al. (2013)

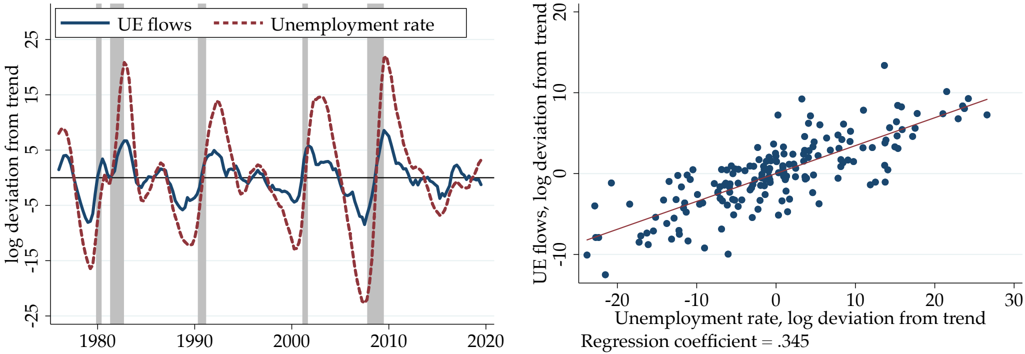


CPS (1976-2019): quarterly average of monthly UE flows, log deviations from trend

1. Flow origins of shifts in employment distribution

Unemployment-to-employment (UE) flows are strongly countercyclical

- see e.g. Burda, Wyplosz (1992), Fujita, Ramey (2009), Elsby et al. (2013)



CPS (1976-2019): quarterly average of monthly UE flows, log deviations from trend

Why are UE flows countercyclical?

Use steady state expressions for unemployment, $u = \delta/(\delta + f)$, and UE flows $= f \cdot u$

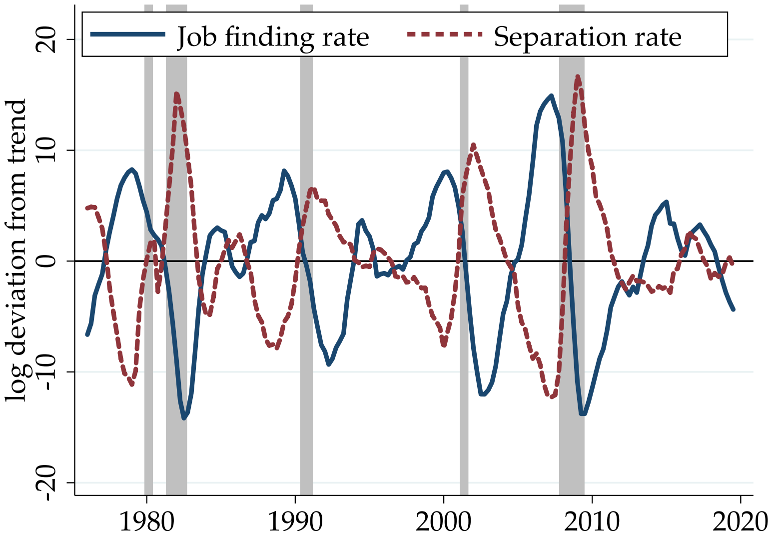
- δ: separation probability, f: job finding probability

$$\frac{dUE}{UE} = \frac{df}{f} + \frac{du}{u} \rightarrow \frac{dUE/UE}{du/u} = \frac{1}{(1-u)\left[-1 + \frac{d\delta/\delta}{df/f}\right]} + 1$$

Relative cyclicality of δ and f is key in explaining cyclicality of UE:

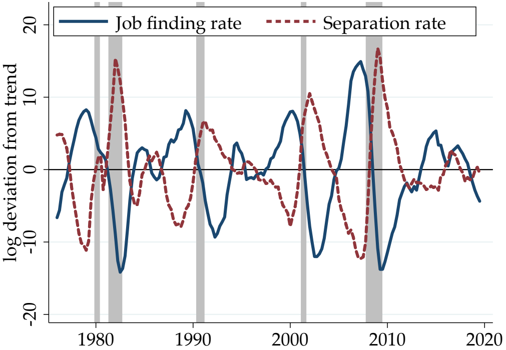
- if $\frac{d\delta/\delta}{df/f} = 0$, then $\frac{dUE/UE}{du/u} = -\frac{u}{1-u} \rightarrow$ UE flows are *procyclical*
- if $\frac{d\delta/\delta}{df/f} < -\frac{u}{1-u}$, then $\frac{dUE/UE}{du/u} > 0 \rightarrow$ UE flows are *counter*cyclical

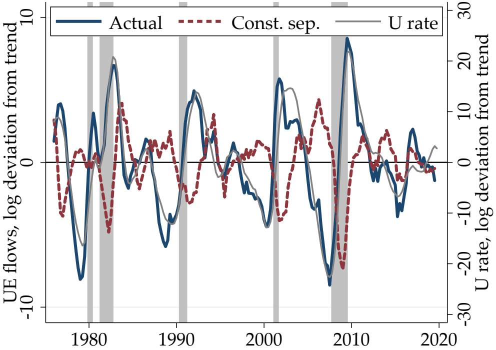
Cyclicality of job finding and separation probabilities



more OECD

Cyclicality of job finding and separation probabilities





more OECD

2. Limited capacity to absorb increases in unemployment by hiring

Congestion (in hiring): Firms' limited capacity to absorb "pure" unemployment increases

- i.e. increases in unemployment that leave fundamentals (productivity) unchanged

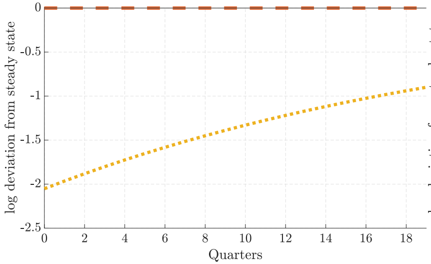
Intuition from standard search model

- hiring depends on fundamentals (e.g. productivity), but market size is irrelevant
- rise in unemployed, with unchanged productivity, (immediately) hired away

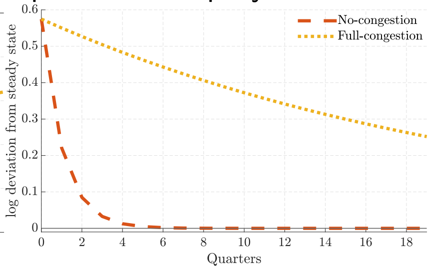
Dynamics after "pure" increase in unemployment (consider one-time exogenous $\uparrow EU$):

- $u' = u - f(\bar{\theta})u + \uparrow EU$: no congestion ($v$ moves 1-to-1 with u, i.e. $\theta = v/u$ fixed)
- $u' = u - \overline{UE} + \uparrow EU$: full congestion (economy absorbs fixed $\overline{UE}$ at a time)

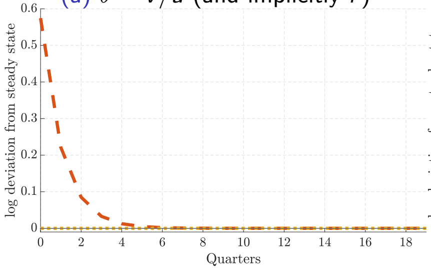
2. Response of labor market to “pure” unemployment increase



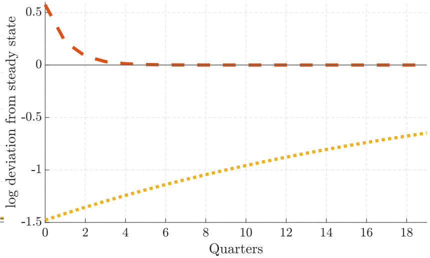
(a) $\theta = v/u$ (and implicitly f)



(b) u



(c) $UE = f \cdot u$

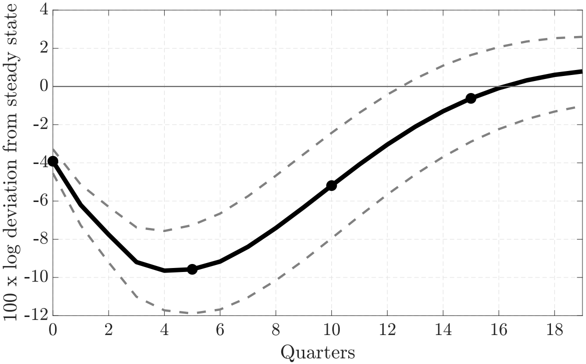


(d) v

2. Response of labor market to "pure" unemployment increase

Estimate VAR: $\mathbf{y_t} = [\ln ALP_t, \ln \delta_t, \ln \theta_t]$

- ALP = average labor productivity, δ = EU probability, θ = labor market tightness
- Cholesky identification: response to δ keeps ALP fixed upon impact ALP?
- IRF of labor market tightness $\theta = v/u$ to separation rate shock:



2. Model

Main idea

Main idea

Use standard Diamond-Mortensen-Pissarides (DMP) model, but

- incorporate diminishing returns to cohorts of new hires

Within this framework

- in recessions, UE flows increase (as separations increase) (empirical fact 1)

→ diminishing marginal product of new hires—our congestion mechanism!

→ discourages job creation (empirical fact 2)

Modeling choice for the mechanism:

Imperfect substitution b/w workers with different labor market experiences

- skill accumulation, career steps, internal labor markets, etc...

Main idea

Imperfect substitution between workers with different types of labor market experience

$$Y = z\left(\sum_{k=1}^{K} \alpha_k n_k^{\sigma}\right)^{1/\sigma}$$

- z: aggregate (total factor) productivity
- k: particular type of labor market experience (e.g. job ladder, skill, ...)
- n_k: # of workers of type k
- α_k: relative productivity
- σ: guides diminishing returns (elasticity of substitution: $\frac{1}{1-\sigma}$)
  - $\sigma = 1$: "no congestion" (standard) model
  - $\sigma < 1$: model featuring congestion in hiring

Main idea

Relative supply of worker types matters for productivity:

$$p_k = \frac{\partial Y}{\partial n_k} = \alpha_k n_k^{\sigma-1} \frac{Y}{\sum_{l=1}^{K} \alpha_l n_l^{\sigma}}$$

In recessions, when UE flows rise

$\rightarrow$ recently unemployed become relatively abundant in employment (empirical fact 1)

$\rightarrow$ depressed marginal product of new hires

$\rightarrow$ discouraged job creation (empirical fact 2)

Countercyclical congestion reinterprets recessions: why does unemployment rise?

- Standard question: Why do firms hire so little?
- Our answer:

  Firms are actually (gross) hiring more—the jobs to be filled by the unemployed are already crowded.

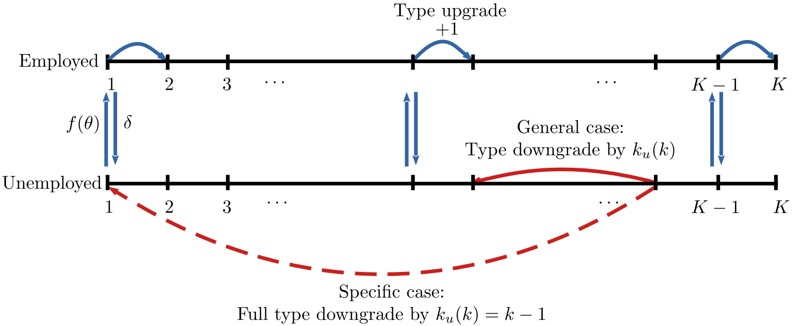
2. Model

Details

Worker heterogeneity and congestion

Worker "types"

- $k \in \mathcal{K} = \{1, ..., K\}$: particular worker types
- employed workers move up one level each period: $k_{t+1} = k_t + 1$
- unemployed workers move down $k_u(k)$ levels each period: $k_{t+1} = k_t - k_u(k_t)$
  - $k_u(k) \in \{0, 1, ..., k-1\}$ nests no-, full- and partial-downgrading more



Worker heterogeneity and congestion

Worker "types"

- $k \in \mathcal{K} = \{1, ..., K\}$: particular worker types
- employed workers move up one level each period: $k_{t+1} = k_t + 1$
- unemployed workers move down $k_u(k)$ levels each period: $k_{t+1} = k_t - k_u(k_t)$
  - $k_u(k) \in \{0, 1, ..., k-1\}$ nests no-, full- and partial-downgrading more

Congestion

- final good produced combining intermediate goods (n_k): $Y = z \left(\sum_{k=1}^{K} \alpha_k n_k^{\sigma} \right)^{1/\sigma}$
- intermediate goods produced by "firms" using linear technology
- competitive market prices of intermediate goods: $p_k = \frac{\partial Y}{\partial n_k} = \alpha_k n_k^{\sigma-1} \frac{Y}{\sum_{l=1}^{K} \alpha_l n_l^{\sigma}}$

Everything that follows mirrors "standard" search model

Environment and timing

Environment

- workers hired by intermediate-goods firms in frictional labor market
  - random search, matches occur according to $M(u, v)$, $f(\theta) = M/u$ and $q(\theta) = M/v$
  - worker-firm matches separate with time-varying probability δ
- final goods firm buys intermediate-inputs in perfectly competitive market
- wages are determined by period-by-period Nash bargaining, no wage rigidity
- free entry of intermediate-goods firms

Timing

- aggregate shocks: productivity and separation rate, (z, δ), materialize
- separated workers join unemployment pool, active matches produce
- employed upgrade, unemployed downgrade types and thereafter matching occurs

Worker and firm value functions

Value of employment and of unemployment for type-k worker

$$W_{k,t} = w_{k,t} + \beta \mathbb{E}_t \left[(1-\delta_{t+1}) W_{k+1,t+1} + \delta_{t+1} U_{k+1,t+1} \right],$$

$$U_{k,t} = b + \beta \mathbb{E}_t \left[f(\theta_t)(1-\delta_{t+1}) W_{k-k_u(k),t+1} + \left(1 - f(\theta_t)(1-\delta_{t+1})\right) U_{k-k_u(k),t+1} \right]$$

$w_{k,t}$: wage of type-k worker, b: flow value of unemployment

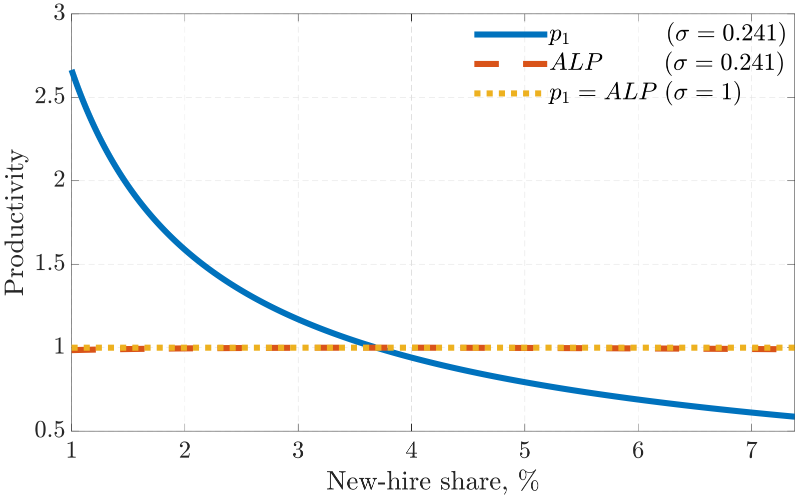
Value of a job filled with type-k worker and of unfilled job

$$J_{k,t} = p_{k,t} - w_{k,t} + \beta \mathbb{E}_t \left[(1-\delta_{t+1}) J_{k+1,t+1} + \delta_{t+1} V_{t+1} \right],$$

$$V_t = -\kappa + q(\theta_t) \beta \mathbb{E}_t \left[(1-\delta_{t+1}) \frac{u_{k,t}}{u_t} J_{k-k_u(k),t+1} + \delta_{t+1} V_{t+1} \right]$$

κ: flow cost of having an open vacancy

Productivity and size of hiring cohort



Model mechanism and alternatives

Congestion occurs because recently unemployed become abundant in recessions

- fall in marginal product slows further hiring (despite free entry)
- depends on distribution of types in (un-)employment (and σ)

Alternative: what if not all new hires cause congestion?

- Extension in paper: only $1 - x$ cause congestion:

$$Y = z\left[(1-x)\left(\sum_{k=1}^{K}\alpha_k^c (n_k^c)^\sigma\right)^{1/\sigma} + x\left(\sum_{k=1}^{K}\alpha_k^{nc} n_k^{nc}\right)\right]$$

$\rightarrow$ isomorphic to our baseline, subject to "iso-congestion" reparameterization of σ

visualiation

Alternative: what if hiring is slowed by increased costs?

- $\kappa(UE_t)' > 0$: gives similar amplification, but misses a range of other results
- Related: Hall (2005), Petrosky-Nadeau (2014), Coles and Kelishomi (2018), Engbom (2020)

3. Business cycle performance

Sources of amplification and congestion unemployment

Parameterization

"Standard" features parametrized in "standard" fashion (Shimer, 2005) more

- in particular, b s.t. replacement rate of 40 percent (i.e. high fundamental surplus)

Worker heterogeneity

- $K = 160$: absorbing "max type" until separation
- $k_u(k) = k - 1$: full downgrading (but recall robustness w.r.t. no-congestion hires)
- α_k: s.t. $p_k = p = 1$ for all k (all types have same surplus in steady state)

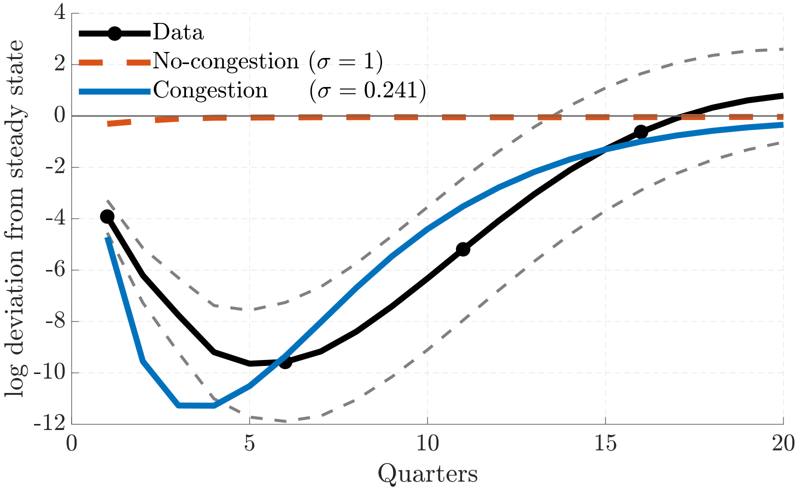
Aggregate shocks

- z and δ: target volatility and persistence of ALP and UE/E in data
  - UE/E crucial for congestion mechanism
  - Robustness in paper: match δ directly

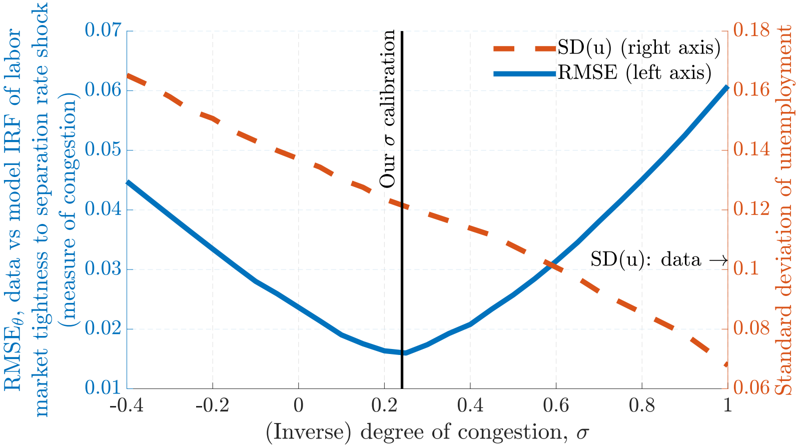
Congestion parameter σ

- match limited capacity to absorb unemployed (IRF of θ w.r.t. δ)
- Robustness/validation: new hires' wage cyclicality

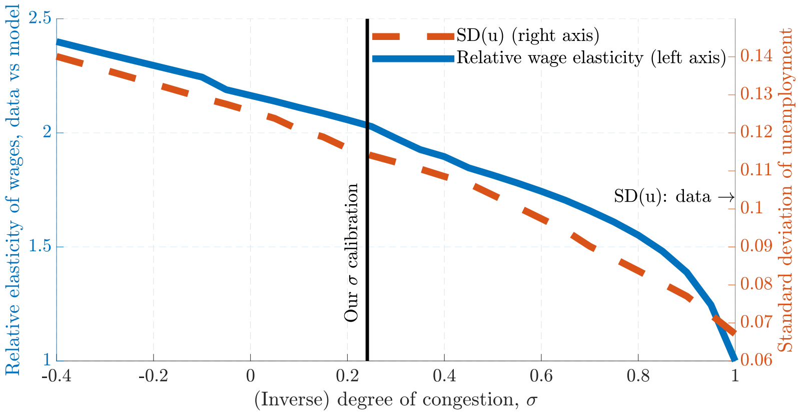
Parameterizing σ: IRF of θ w.r.t δ



Parametrizing σ: Congestion and amplification



Parameterizing σ: Excess cyclicality of new-hire wages

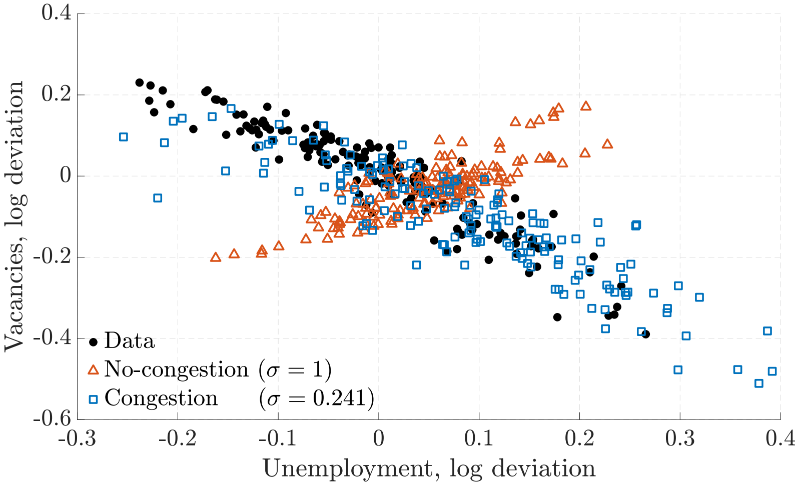


Model performance: Business cycle statistics

	ALP	f	δ	u	v	θ	UE/E	MPL
				data				
$s.d.(x)$	0.010	0.053	0.067	0.104	0.127	0.229	0.067	*NA*
$corr(u,x)$	−0.11	−0.93	0.85	1	−0.94	−0.98	0.83	*NA*
				baseline model ($\sigma = 0.241$)				
$s.d.(x)$	0.010	0.059	0.122	0.121	0.102	0.207	0.067	0.055
$corr(u,x)$	−0.46	−0.92	0.74	1	−0.72	−0.94	0.87	−0.86
				standard model ($\sigma = 1$) *without separation shocks*				
$s.d.(x)$	0.010	0.005	0.000	0.004	0.014	0.016	0.003	0.010
$corr(u,x)$	−0.65	−0.65	0.00	1	−0.49	−0.65	−0.27	−0.65
				standard model ($\sigma = 1$) *with separation shocks*				
$s.d.(x)$	0.010	0.005	0.073	0.055	0.046	0.017	0.054	0.010
$corr(u,x)$	−0.50	−0.62	0.91	1	0.96	−0.62	0.70	−0.50

full table more

Model performance: Beveridge curve



Sources of amplification

Surplus relevant for hiring in "standard" model (S) and in congestion model (S_1)

$$S_t = z_t - b + \beta \mathbb{E}_t (1 - \delta_{t+1})(1 - f(\theta_t)\phi) S_{t+1}$$

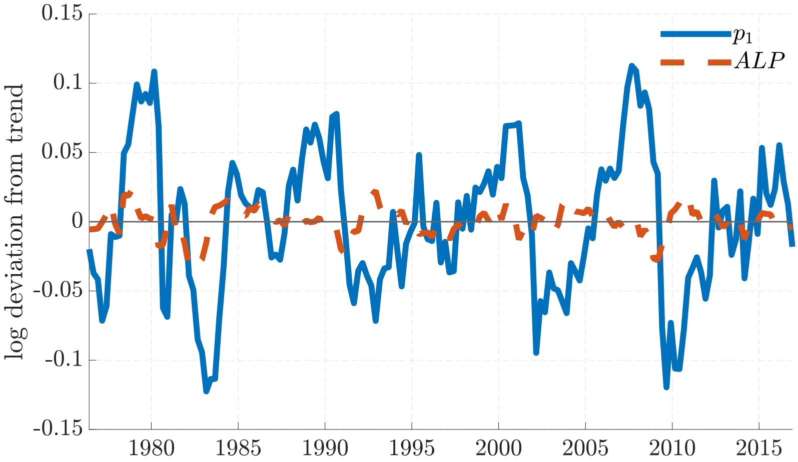
$$S_{1,t} = p_{1,t} - b + \beta \mathbb{E}_t [(1 - \delta_{t+1})(S_{2,t+1} - f(\theta_t)\phi S_{1,t+1})]$$

Differences between standard and our congestion model

- flow productivity channel: $sd(p_1) > sd(z)$
- cohort channels: continuation values have different dynamics
  - continuing in employment entails upgrading to $S_{2,t+1}$
  - falling into unemployment entails downgrading to $S_{1,t+1}$

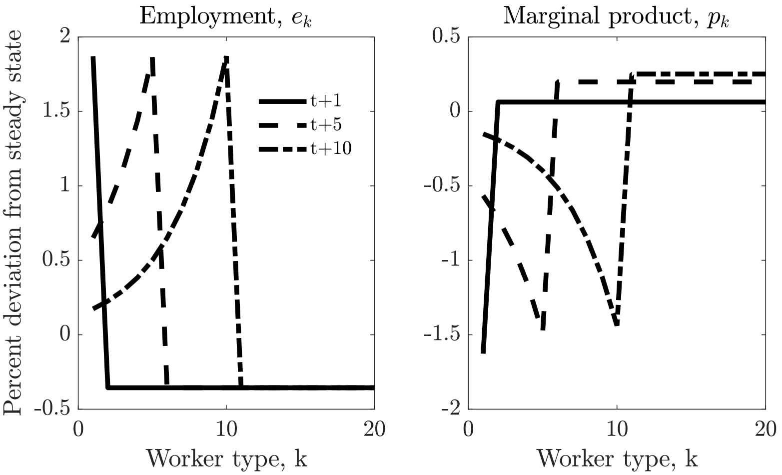
Sources of amplification: Flow productivity channel

Use data on ALP and UE/E to construct p_1



Sources of amplification: Cohort channels

IRFs of employment distributions to a one-time positive δ shock



Sources of amplification: Quantification

$$S_{1,t} = p_{1,t} - b + \beta\mathbb{E}_t[(1-\delta_{t+1})S_{2,t+1} - f(\theta_t)(1-\delta_{t+1})\phi S_{1,t+1}]$$

$$S_{1,t} = \underbrace{z_t - b + \beta\mathbb{E}_t\Big[(1-\delta_{t+1})(1-f(\theta_t^{st})\phi)S_{t+1}^{st}\Big]}_{\text{(i) No-congestion model surplus}} + \underbrace{S_t^* - S_t^{st}}_{\text{(ii) Flow productivity channel}}$$

$$+\underbrace{\beta\mathbb{E}_t\Big[(1-\delta_{t+1})(1-f(\theta_t)\phi)\left(S_{2,t+1} - S_{t+1}^*\right)\Big]}_{\text{(iii) Present value channel (cohort effect of ``upgrading'')}}$$

$$+\underbrace{\beta\mathbb{E}_t\Big[(1-\delta_{t+1})f(\theta_t)\phi\left(S_{2,t+1} - S_{1,t+1}\right)\Big]}_{\text{(iv) Outside option channel (cohort effect of ``downgrading'')}}$$

$S_t^{st} = z_t - b + \beta\mathbb{E}_t\Big[(1-\delta_{t+1})(1-f(\theta_t^{st})\phi)S_{t+1}^{st}\Big]$ & θ_t^{st}: no-congestion surplus & θ

$S_t^* = p_{1,t} - b + \beta\mathbb{E}_t\left[(1-\delta_{t+1})(1-f(\theta_t)\phi)S_{t+1}^*\right]$: match surplus with $p_{1,t}$

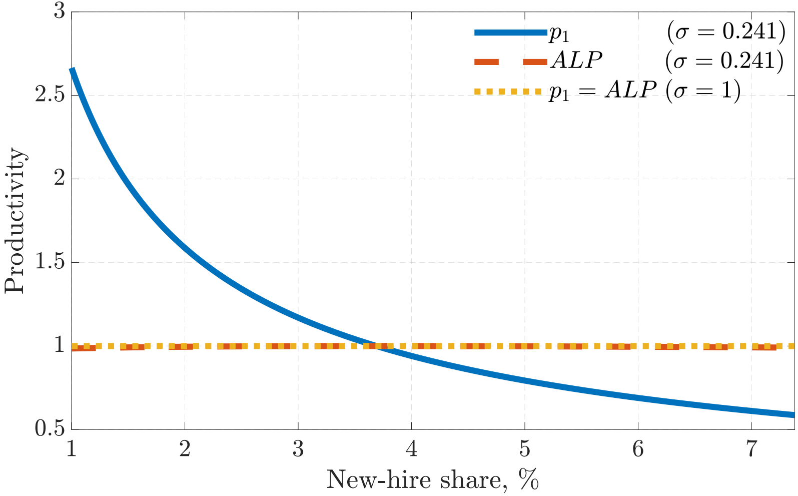
Sources of amplification: Quantification

Variation in counterfactual labor market tightness ($\widetilde{\theta}$) driven by

- (i) no-congestion model surplus
- (ii) flow productivity channel
- (iii) present value channel
- (iv) outside option channel

		Standard deviation	Contribution to total
No-congestion model	(i)	0.019	0.049
+ Flow productivity channel	(i)+(ii)	0.052	0.162
+ Present value channel	(i)+(ii)+(iii)	0.178	0.851
+ Outside option channel	(i)+(ii)+(iii)+(iv)	0.207	1

Congestion unemployment: Historical decomposition



Congestion unemployment: Historical decomposition

Unemployment fluctuations driven solely by congestion: congestion unemployment

$$S^c_{k,t} = p_{k,t} \cdot \frac{\bar{z}}{z_t} - b + \beta \mathbb{E}_t (1 - \bar{\delta}) S^c_{k+1,t+1} - \beta \mathbb{E}_t (1 - \bar{\delta}) f(\theta^c_t) \phi S^c_{1,t+1} \; \forall k.$$

- S^c_k: surplus variation only due to congestion

$$\kappa = q(\theta^c_t) \beta \mathbb{E}_t (1 - \bar{\delta}) S^c_{1,t}$$

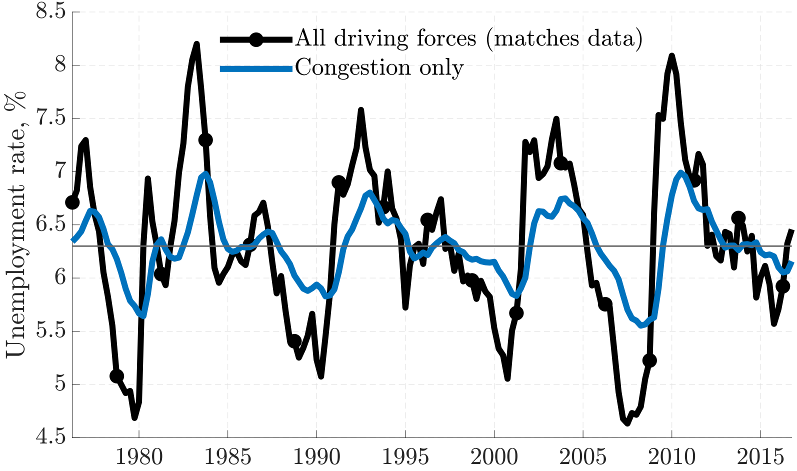
- θ^c: variation in labor market tightness only due to congestion

$$u^c_{t+1} = (1 - f(\theta^c_t)) u^c_t + \bar{\delta}(1 - u^c_t)$$

- u^c: congestion unemployment

Congestion unemployment: Historical decomposition

Use data on ALP and UE/E to estimate time-path of entire model (Kalman filter)



4. Additional applications

Congestion and three macroeconomic regularities

Macroeconomic implications of congestion

1. Business cycle accounting: the labor wedge
   - countercyclical in the data and attributed to "household side"
2. Costs of entering labor market and of displacement
   - large and countercyclical in the data
3. Sensitivity to labor market policies
   - relatively low, hard to square with high labor market volatility

1. The labor wedge

The labor wedge is defined as $MPL_t(1-\tau_t) = MRS_t$

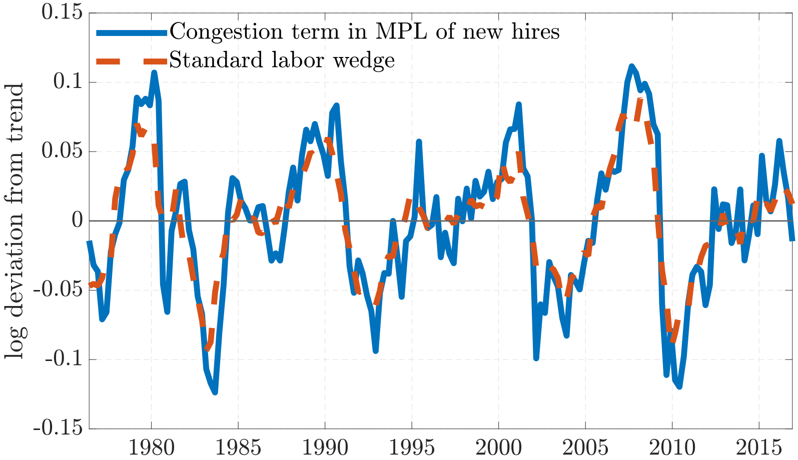
- estimates in data show a *cyclical* labor wedge
  - see e.g. Hall (1997), Chari, Kehoe, McGrattan (2007), Shimer (2009)
- moreover, fluctuations in labor wedge assigned mainly to "household" (MRS) side
  - should focus on how MRS deviates from real wage (e.g. Karabarbounis, 2014)

Extend our baseline model to include capital ($\widetilde{K}$): $Y = z\widetilde{K}^a \left(\left[\sum_{k=1}^{K} \alpha_k n_k^\sigma \right]^{\frac{1}{\sigma}} \right)^{1-a}$

- considering the (spot) productivity of new hires p_1 only

$$\underbrace{p_1}_{\text{allocative/new hires' MPL}} = \underbrace{(1-a)\frac{Y}{N}}_{\text{standard MPL}} \underbrace{\frac{\alpha_1 s_1^{\sigma-1}}{\sum_{k=1}^{K} \alpha_k s_k^\sigma}}_{\text{labor wedge (congestion term)}} = MRS$$

1. The labor wedge: Congestion as a resolution?



2. Countercyclical costs of job displacement and labor market entry

Large and persistent

... earnings losses from graduating in recessions (e.g. Kahn, 2010, Schwandt and von Wachter, 2019)

- graduation costs: skill mismatch, employer quality (e.g. Oreopoulos et al., 2012)

... and countercyclical displacement costs (e.g. Davis and von Wachter, 2011)

- driven by wage drops, employer "quality" (e.g. Schmieder et al., 2019)

Level of costs explained through various theories

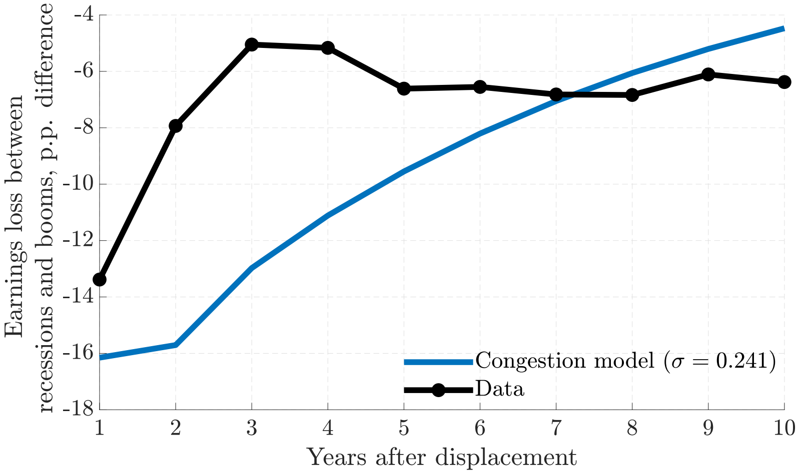
- displacement costs: fall off a job ladder (e.g. Jarosch, 2015, Jung and Kuhn, 2018)

Our model speaks to the cyclicality of these costs

- not well understood in existing literature

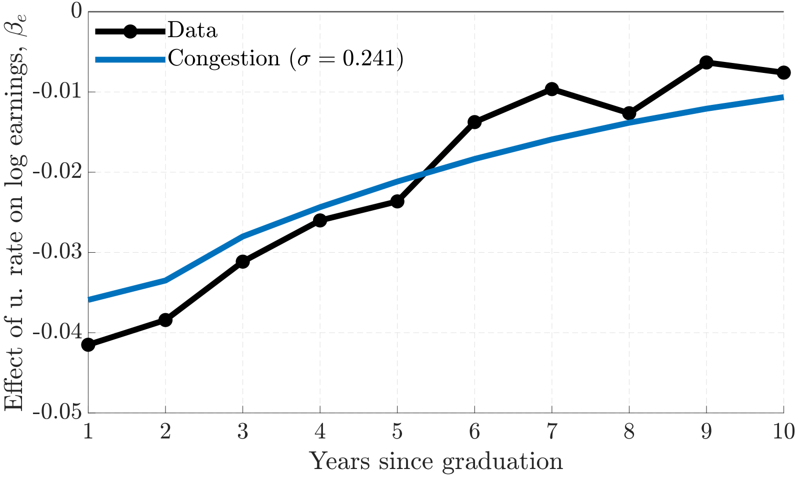
2. Costs of displacement

Davis and von Wachter (2011): earnings losses in recessions relative to booms



2. Costs of labor market entry

Schwandt and von Wachter (2019): earnings losses of new hires and unemployment



2. Costs of displacement and labor market entry

Our model offers a basic explanation

- ◦ relatively large cohorts of new hires are abundant in employment
- $\rightarrow$ pushes down their wages (reflecting marginal products)
- $\rightarrow$ cohort effects make these initial conditions long-lasting

The above mechanism is broadly consistent with the available evidence

- ◦ earnings losses linked to persistent wage declines
- ◦ driven primarily by a shift towards jobs of "lower quality"
  - ◦ Schmieder et al (2019) and Schwandt and von Wachter (2019)

3. Sensitivity to labor market policies

Costain and Reiter (2008): search models have a hard time

- simultaneously matching labor market volatility
- ... and sensitivity of the labor market to changes in policies
- estimate long-run elasticity of u w.r.t. b of $\epsilon_{u,b} \in (2, 3.5)$

In our model, labor market volatility is not generated by low fundamental surplus

- instead, countercyclical congestion makes labor market variables volatile
- implied long-run elasticity of u w.r.t. b of $\epsilon_{u,b} \approx 2.6$

Conclusion

Conclusion: A congestion theory of unemployment fluctuations

Two key empirical facts

1. employment shifts towards recently unemployed in downturns
2. unemployment increases not absorbed quickly, even with unchanged fundamentals

We propose a model consistent with the above facts

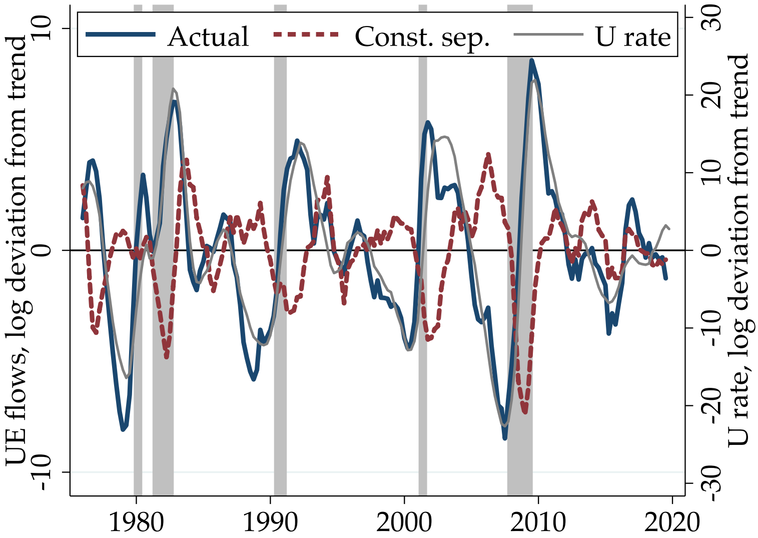
- worker types are imperfect substitutes
- abundant types see their marginal productivity fall, discouraging their hiring
- congestion is a strong amplification mechanism

Our baseline model sheds new light on a range of macroeconomic patterns

- labor market variables over the business cycle
- relative wage cyclicality of new hires
- countercyclical labor wedge
- countercyclical costs of displacement and labor market entry
- low sensitivity of labor market variables to labor market policies

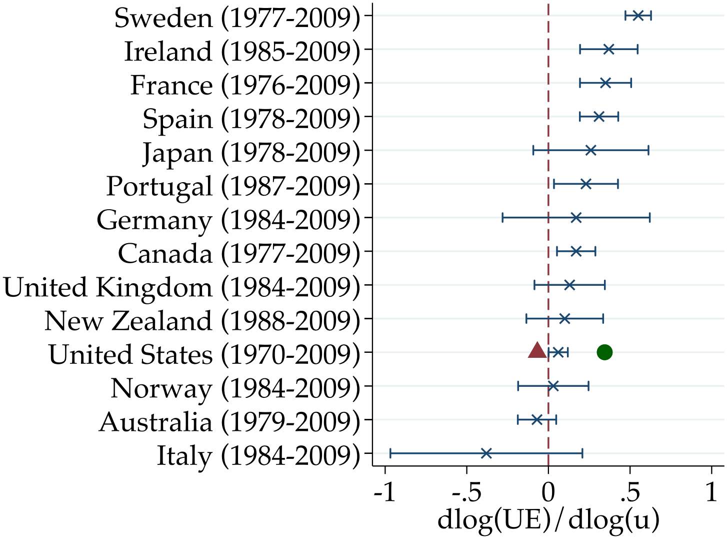
Thanks

UE flows: observed and counterfactual (constant separations)

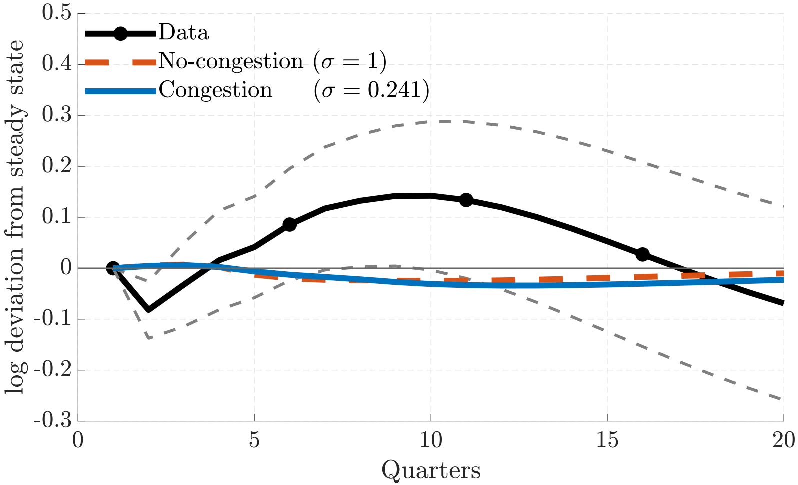


Back

UE Flows in the Data: OECD

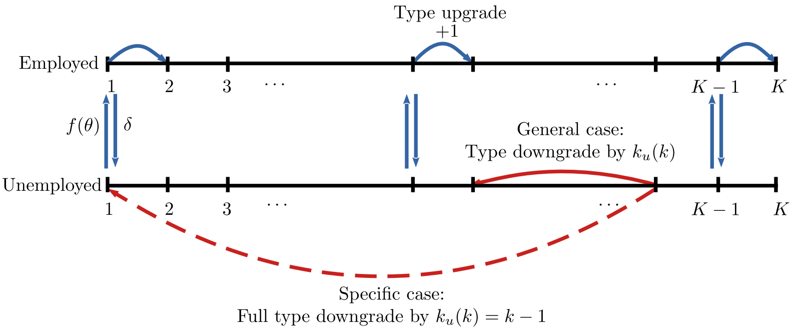


Response of labor markets to “pure” unemployment increase



Back

Worker type and (un-)employment evolution



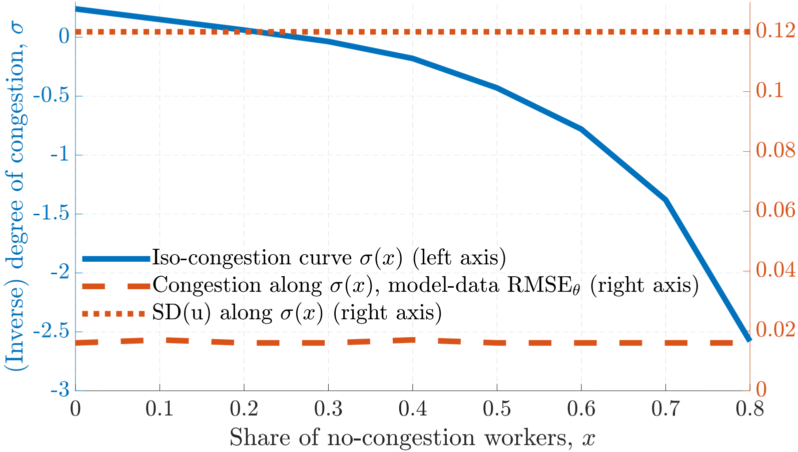
Laws of motion for (un-)employment

$$u_{k-k_u(k),t} = (1 - f(\theta_{t-1}))u_{k,t-1} + \delta_t e_{k-k_u(k),t} \text{ for } k \in \mathcal{K}$$

$$e_{k-k_u(k),t} = (1 - \delta_{t-1})e_{k-k_u(k)-1,t-1} + f(\theta_{t-1})u_{k,t-1} \text{ for } k \in \mathcal{K}$$

Back

Iso-congestion model



back

Full set of parameter values

	Parameter	Value		Target/Source	Data	Model
		Congestion	*No congestion*			
β	Discount factor	0.99		Annual interest rate	0.04	0.04
μ	Matching elasticity	0.72		Shimer (2005)	0.72	0.72
$\overline{m}$	Matching efficiency	0.57		Job finding probability	0.57	0.57
η	Bargaining power	0.72		Hosios condition	0.72	0.72
b	Unemployment flow value	0.39		Avg. replacement rate	0.40	0.40
κ	Vacancy posting cost	0.21		Normalization $\theta = 1$	–	1.00
$\overline{z}$	Productivity shock, mean	1		Normalization	–	1.00
σ_z	Productivity shock, st. dev.	0.008		St. dev. of ALP	0.010	0.010
ρ_z	Productivity shock, persistence	0.956		Persistence of ALP	0.74	0.69
$\overline{\delta}$	Separation shock, mean	0.037		Unemployment rate	0.063	0.063
σ_δ	Separation shock, st. dev.	0.107	0.080	St. dev. of UE/E	0.067	0.067
ρ_δ	Separation shock, persistence	0.709	0.670	Persistence of UE/E	0.84	0.74
$\rho_{\delta,z}$	Correlation of shocks to z and δ	-0.505	-0.560	corr(ALP, δ)	-0.41	-0.41
σ	Elasticity of substitution b/w workers	0.241	1	Impulse response of θ to δ, see IRF Figure		
α_k	Relative productivities of worker types	see Appendix		$p_k = 1$ for all k		

back

Model Performance: Full business cycle statistics

	ALP	f	δ	u	v	θ	UE/E	p_1
				Panel A: Data				
Standard deviation	0.010	0.053	0.067	0.104	0.127	0.229	0.067	*NA*
Autocorrelation	0.75	0.87	0.77	0.93	0.93	0.94	0.84	*NA*
Correlation matrix								
f	0.04	1						
δ	−0.41	−0.71	1					
u	−0.11	−0.93	0.85	1				
v	0.30	0.87	−0.87	−0.94	1			
θ	0.22	0.92	−0.87	−0.98	0.99	1		
UE/E	−0.17	−0.72	0.57	0.83	−0.72	−0.78	1	
				Panel B: Congestion Model				
Standard deviation	0.010	0.059	0.122	0.121	0.102	0.207	0.067	0.055
Autocorrelation	0.69	0.90	0.53	0.84	0.86	0.90	0.74	0.75
Correlation matrix								
f	0.44	1						
δ	−0.41	−0.51	1					
u	−0.46	−0.92	0.74	1				
v	0.35	0.92	−0.16	−0.72	1			
θ	0.34	1.00	−0.51	−0.94	0.91	1		
UE/E	−0.44	−0.93	0.39	0.87	−0.88	−0.94	1	
p_1	0.49	0.95	−0.43	−0.86	0.90	0.95	−0.97	1

back

Model Performance: Full business cycle statistics

	ALP	f	δ^{imp}	u	v	θ	UE/E	p_1
	Panel A: Congestion Model - Calibrating to UE/E							
Standard deviation	0.010	0.059	0.122	0.121	0.102	0.207	0.067	0.055
Autocorrelation	0.69	0.90	0.53	0.84	0.86	0.90	0.74	0.75
Correlation matrix								
f	0.44	1						
δ	-0.41	-0.51	1					
u	-0.46	-0.92	0.74	1				
v	0.35	0.92	-0.16	-0.72	1			
θ	0.34	1.00	-0.51	-0.94	0.91	1		
UE/E	-0.44	-0.93	0.39	0.87	-0.88	-0.94	1	
p_1	0.49	0.95	-0.43	-0.86	0.90	0.95	-0.97	1
	Panel B: Congestion Model - Calibrating to δ							
Standard deviation	0.010	0.041	0.084	0.086	0.077	0.144	0.052	0.054
Autocorrelation	0.69	0.92	0.62	0.87	0.82	0.92	0.76	0.75
Correlation matrix								
f	0.36	1						
δ	-0.41	-0.43	1					
u	-0.42	-0.88	0.77	1				
v	0.20	0.88	0.04	-0.56	1			
θ	0.36	1.00	-0.43	-0.90	0.87	1		
UE/E	-0.31	-0.91	0.52	0.89	-0.72	-0.91	1	
p_1	0.47	0.92	-0.55	-0.88	0.73	0.91	-0.97	1