Job Search, Job Findings and the Role of Unemployment Insurance History

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December 2022

Introduction

Standard search theory suggests:

1. Relative gain from searching $\uparrow$ $\rightarrow$ Job search intensity $\uparrow$
   - Workers with unemployment insurance (UI) should search less than those without UI
2. Job search intensity $\uparrow$ $\rightarrow$ Job finding probability $\uparrow$
   - Workers with UI should find jobs at a slower rate

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First, this paper presents new empirical findings:

- Current UI recipients search harder than those who never received UI but have a lower job finding rate
- Former UI recipients search harder than those who never received UI but have a lower job finding rate

This Paper

To account for these empirical findings, I construct a search and matching model with endogenous search intensity, and

- Job/interview censoring
- Inefficient job search

I then study the implications on

- Labour market dynamics
- Unemployment persistence
- Effects of UI extensions (the Great Recession)

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- Effects of UI extensions (the Great Recession)

Main findings: Job censoring + inefficient job search

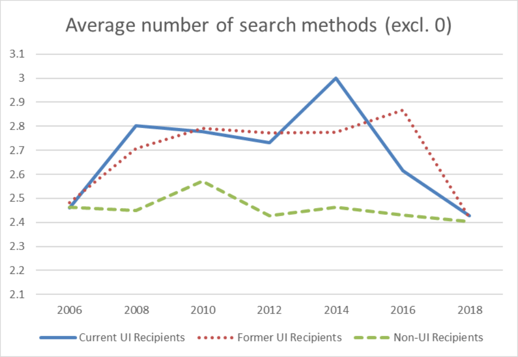
1. dampen labour market fluctuations and UI effects
2. increase unemployment persistence

Literature

- Job search of employed vs non-employed: Faberman, Mueller, Şahin and Topa (2020)
- Job search and unemployment duration: Faberman and Kudlyak (2019)
- Job search and its cyclicality: Shimer (2004), DeLoach and Kurt (2013), Gomme and Lkhagvasuren (2015), Mukoyama, Patterson and Şahin (2018), Leyva 2018
- UI and job findings:
  - Rothstein (2011), Fujita (2011), Aaronson, Mazumder, and Schechter (2010), Valletta and Kuang (2010), Farber and Valletta (2011), Mazumder (2011), Nakajima (2012), and Barnichon and Figura (2014)
  - Hagedorn, Karahan, Manovskii, and Mitman (2019), Mitman and Rabinovich (2020), Rujiwattanapong (2022)
- The persistence of unemployment and worker heterogeneity: Ahn and Hamilton (2019), Hornstein (2012), Ravn and Sterk (2017)

Data: Search Intensity

$\equiv$ number of job search methods used



NB: Non-UI recipients = those who never received UI

Source: CPS monthly data & January supplements

- Current and former UI recipients search harder than those never received UI

Average number of methods, including 0 | W/o passive methods | List of methods

What explains search intensity?

	Dependent variable: Search intensity
Current UI recipient	0.167***
	(0.037)
Former UI recipient	0.151***
	(0.046)
Unemp. duration (quartic)	✓
Worker characteristics	✓
Time fixed effect	✓
State fixed effect	✓
Great Recession	✓
R^2	0.3235

- Linear regression coefficients (* p$<$0.05, ** p$<$0.01, *** p$<$0.001)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (6,567 obs.)
- Excluding 0 search methods
- Worker characteristics include: race, education, gender, age (quartic), occupation, industry, and recall expectation More regressors

Search Intensity

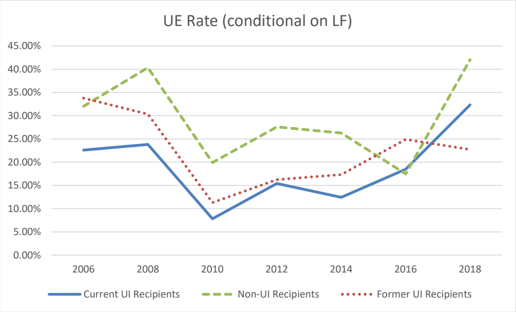
- Both current and former UI recipients *search harder* than those never receiving UI
- Current UI recipients: they must show they have been actively looking for jobs – UI eligibility and monitoring purpose
- Former UI recipients: they now really want to be employed(?)
- How does this translate into job finding probability?

▸ Share of unemployment by types

Data: Job Finding Probability

≡ monthly transition rates from unemployment to employment

- Conditional on being in the labour force next period



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Source: CPS monthly data & January supplements

- Those never receiving UI find jobs the quickest
- Current UI recipients are the *slowest* to find jobs
  - Recall that they search *most* intensively!

▸ Unconditional on LFP

What explains the job finding probability?

	Dependent variable: Job finding probability	
Current UI recipient	-0.087***	-0.100***
	(0.014)	(0.014)
Former UI recipient	-0.019	-0.035**
	(0.018)	(0.018)
Unemp. duration (quartic)	✓	
Long-term unemployed		✓
Search methods used	✓	✓
Worker characteristics	✓	✓
Time fixed effect	✓	✓
State fixed effect	✓	✓
Great Recession	✓	✓
R^2	0.0801	0.0819

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* p<0.05, ** p<0.01, *** p<0.001)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,109 obs.)
- Worker characteristics include: race, education, gender, age (quartic), occupation, industry, recall expectation, search methods
- Excluding workers exiting the labour force next period

▸ More regressors
▸ Results unconditional on LFP ▸ Control for search methods

Job Findings, Job Search and UI History

- Workers who never received UI find jobs faster than those who have received UI
- This holds after controlling for
  - Search methods used
  - Total number of methods (search intensity)
  - Unemployment duration

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- Potential explanations
  1. Inefficient search with UI history *(today)*
     - Current UI recipients may decline interviews/offers more often than those without UI
     - Over time, job search efficiency drops
  2. Unobserved heterogeneity: *(in progress)*
     - Those with ex ante lower probability of exiting unemployment represent the majority of those with UI history
     - Require endogenous UI take-up

Model Setup: Static

- Time is discrete, runs forever
- Economy is populated by a continuum of workers of mass one and a large continuum of firms:
  - Infinitely-lived, risk neutral, ex ante identical

Workers:

- Either employed (E) or unemployed
- Unemployment statuses:
  1. Insured unemployed: UI
  2. Formerly-insured unemployed: UIx
  3. Uninsured unemployed: UU

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- Firms: Either matched with one worker or unmatched

- Output of a worker-firm match is $y = z$ (TFP)

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Utility flows:

- Employed workers: wage w (Nash bargaining)
- *UU* and *UIx* workers: leisure flow h
- *UI* workers: UI benefit b + leisure flow h

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Firms:

- If unmatched: vacancy posting costs κ each period
- If matched: produce and earn y, pay wage w and lump-sum tax τ

Model Setup: Static

Meetings: workers and firms meet via a meeting function:

- $M(s,v) = \frac{sv}{(s^\ell + v^\ell)^{\frac{1}{\ell}}}; \ell > 0$: CRS, concave
  - v = number of vacancies
  - s = aggregate search intensity
    = number of searchers augmented by effective search intensity
- Meeting $\not\rightarrow$ 100% Matching
  - *UI* workers *optimally* censor interviews/offers at rate γ^{UI}

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- $\gamma^{UIx} \in (0,1)$: search efficiency of UIx relative to UU

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Job filling rate: $\frac{M(s,v)}{v} \equiv q$

Model Setup: Static

- UI exhaustion: *UI* workers exhaust their benefits at rate $\phi \in (0, 1)$ and become *UIx* (formerly insured)
  - $Pr(UI \rightarrow UI \ \ |\text{stay unemployed}) = 1 - \phi$
  - $Pr(UI \rightarrow UIx \ |\text{stay unemployed}) = \phi$

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- UI eligibility: Upon job separation, a fraction $\psi \in (0, 1)$ of employed workers become uninsured (UU), i.e.
  - $Pr(E \rightarrow UI\ |\text{separation}) = 1 - \psi$
  - $Pr(E \rightarrow UU|\text{separation}) = \psi$

- UI budget: Balanced each period by taxing producing firms

Value Functions: Unemployed

Respectively for the (1) insured, (2) formerly insured and (3) uninsured:

$$U^{UI} = \max_{\gamma^{UI}} b + h \underbrace{- c^{UI}(\gamma^{UI} \underline{s}^{UI})}_{\text{disutility from censoring}}$$

$$+ \beta \left[\underbrace{p^{UI}}_{Pr(UI \to E)} W^{UI} + (1 - p^{UI}) \Big((1 - \phi) U^{UI} + \underbrace{\phi}_{\text{Pr(UI exhausted)}} U^{UIx} \Big) \right]$$

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U^{UIx} &= \max_{s^{UIx}} \; h \underbrace{- c^{UIx}(s^{UIx})}_{\text{disutility from search}} + \beta \Big[p^{UIx} W^{UIx} + (1 - p^{UIx}) U^{UIx} \Big]
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$$U^{UU} = \max_{s^{UU}} \; h - c^{UU}(s^{UU}) + \beta\left[p^{UU} W^{UU} + (1 - p^{UU})U^{UU}\right]$$

- $W^j \equiv$ value of being employed given previous status $j \in \{UI, UIx, UU\}$
- $p^{UI} = \gamma^{UI}\, \underline{s}^{UI} p$ (recall $\underline{s}^{UI}$ is fixed)
- $p^{UIx} = \gamma^{UIx} s^{UIx} p$
- $p^{UU} = s^{UU} p$
- Search cost/disutility function $c^j(\cdot)$ differs by types $j \in \{UI, UIx, UU\}$
- $c'(\cdot) > 0, c''(\cdot) > 0$

Optimal Search/Job Censoring

Search inefficiency discourages workers from searching harder:

- *Convex* search cost vs. job finding prob. *linear* in search effort

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\frac{\partial c^{UIx}(s^{UIx})}{\partial s^{UIx}} &= \beta \cdot \gamma^{UIx} \cdot p \cdot (W^{UIx} - U^{UIx})
\end{aligned}$$

- For $\gamma^{UIx} \in (0,1)$, in order to obtain $s^{UIx} \geq s^{UU}$ (empirically consistent)
  $\rightarrow$ marginal cost of search of $UIx \leq$ that of UU
  (analogous for UI workers)

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  $\rightarrow$ marginal cost of search of *UIx* $\leq$ that of *UU*
  (analogous for *UI* workers)

UI workers' job censoring (γ^{UI}):

- Compare the job meeting rate given $\underline{s^{UI}}$ vs. optimal s^{UI*}
  - s^{UI*} : what *UI* workers would have optimally exerted
- $\gamma^{UI}\ \underline{s^{UI}}p \equiv s^{UI*}p$

Optimal Search: Quadratic search cost

Assume $c^j(s) = a^j \cdot s^2$ à la Christensen et al (2015)
Optimal search intensity: FOCs:

$$\frac{\partial c^{UU}(s^{UU})}{\partial s^{UU}} = 2a^{UU}s^{UU} \quad = \qquad \beta \cdot p \cdot (W^{UU} - U^{UU})$$

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$$\frac{\partial c^{UIx}(s^{UIx})}{\partial s^{UIx}} = 2a^{UIx}s^{UIx} = \beta \cdot \gamma^{UIx} \cdot p \cdot (W^{UIx} - U^{UIx})$$

- For simplicity, assuming $\frac{W^{UIx}-U^{UIx}}{W^{UU}-U^{UU}} \approx 1$
- With $\gamma^{UIx} \in (0,1)$, in order to obtain $s^{UIx} = s^{UU}$

  $\rightarrow \frac{a^{UIx}}{a^{UU}} = \gamma^{UIx} < 1$

- If $s^{UIx} > s^{UU} \rightarrow \frac{a^{UIx}}{a^{UU}} < \gamma^{UIx} < 1$

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$\rightarrow$ Assume *UIx* workers face smaller search cost than do *UU* workers

$\rightarrow$ *UIx* workers search harder but exit unemployment more slowly

$\rightarrow$ Unemployment persistence

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→ With search inefficiency, *UIx* is less desirable for *UI* workers.

→ *UI* workers optimally censor job interviews **less often** than when there is no search inefficiency

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→ With search inefficiency, *UIx* is less desirable for *UI* workers.

  → *UI* workers optimally censor job interviews **less often** than when there is no search inefficiency

  → Weaker responses from *UI* workers to changes in aggregate conditions (incl. UI extensions)

  → Dampening labour market fluctuations

Value Functions: Employed, Matched and Unmatched Firm

The value functions of employed workers with previous status $j \in \{E, UI, UIx, UU\}$:

$$W^j = w^j + \beta\Big[\underbrace{(1-\delta)}_{\text{Pr(match survives)}} W^E + \underbrace{\delta}_{\text{Pr(match destroyed)}} \Big((1-\psi)U^{UI} + \underbrace{\psi}_{\text{Pr(not taking up UI)}} U^{UU}\Big)\Big]$$

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The value function of an unmatched firm, assuming free entry, is:

$$0 = -\kappa + \beta q \left[\frac{\gamma^{UI} \underline{s}^{UI} u^{UI} J^{UI} + \gamma^{UIx} s^{UIx} u^{UIx} J^{UIx} + s^{UU} u^{UU} J^{UU}}{\gamma^{UI} \underline{s}^{UI} u^{UI} + \gamma^{UIx} s^{UIx} u^{UIx} + s^{UU} u^{UU}} \right]$$

Back to value functions for unemployed workers

Wage

- Wages are negotiated using a generalised Nash bargaining rule
- Workers with previous employment status $j \in \{E, UI, UU, UIx\}$ receive

$$w^j \quad = \quad \text{argmax} \left(WS^j\right)^{\mu} \left(J^j\right)^{(1-\mu)}$$

- $\mu =$ worker's bargaining power
- $WS^j =$ Surplus of employed workers with history j
- Total match surplus $S^j \equiv WS^j + J^j$

$\rightarrow$ $WS^j = \mu S^j$ and $J^j = (1-\mu)S^j$

Stochastic Model

- Very few *UIx* workers in the steady state
- More interesting to study a recession together with UI extensions
    - The Great Recession in the US
    - UI extensions from standard 26 weeks to (up to) 99 weeks

- 3 additional ingredients:
    - Aggregate productivity (z) as an $AR(1)$ process
      $\ln z_t = \rho_z \ln z_{t-1} + \varepsilon_t; \quad \varepsilon_t \sim N(0, \sigma_z^2)$

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  - Match-specific productivity (m)
    - Redrawn every period with probability λ from an exogenous distribution $F(m)$
      $\rightarrow$ Output of a match: $y = m \times z$
      $\rightarrow$ UI benefit $b(m) \uparrow$ with m

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  - State-dependent UI extension: $\phi(u)$

Stochastic Model: UI Extensions

State-dependent UI extension:

- via UI exhaustion rate, $Pr(UI \to UIx)$, as a function of unemployment

$$\phi(u_t) = \begin{cases} \phi & \text{when } u_t < \bar{u} \\ \phi_L & \text{when } u_t \geq \bar{u} \end{cases}$$

- Assume $\phi_L < \phi \quad \leftrightarrow \quad \frac{1}{\phi_L} > \frac{1}{\phi}$
- Recall $\frac{1}{\phi(u_t)}$ = expected UI duration
- $\bar{u}$ = threshold above which UI extension is triggered
- Consistent with UI extension policies in the US (countercyclical)

Stochastic Model: Policy Functions

Joint worker-firm surplus varies with

- $m(+)$: match-specific productivity
- $z(+)$: total factor productivity
- $u(-)$: unemployment rate (UI extension policy)
  $+$ cross-sectional distribution of workers (to predict u')

Stochastic Model: Policy Functions

Joint worker-firm surplus varies with

- $m(+)$: match-specific productivity
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- if $< 0 \rightarrow$ endogenous job separation/rejection
- if $> 0 \rightarrow$ endogenous job formation/retention

Stochastic Model: Policy Functions

Joint worker-firm surplus varies with

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- $u(-)$: unemployment rate (UI extension policy)
  $+$ cross-sectional distribution of workers (to predict u')
- if $< 0 \rightarrow$ endogenous job separation/rejection
- if $> 0 \rightarrow$ endogenous job formation/retention

Search intensity/censoring varies with

- $z(+)$: total factor productivity
- $u(-)$: unemployment rate (UI extension policy - for UI workers)
  $+$ cross-sectional distribution of workers (to predict u')
- $b(m)(-)$: UI benefit amount (for UI workers)
- $m(+)$: match-specific productivity (for E workers)

Stochastic Model: Value Functions: Unemployed

- Define ω as the set of state variables
- For $j \in \{UIx, UU\}$:

$$
\begin{aligned}
U^j(\omega) \quad = \quad & \max_{s^j(\omega)} \quad h - c^j(s^j(\omega)) \\
& + \beta E_{m'\omega'|\omega}\left[p^j(\omega) \underbrace{\max\left\{ W^j(m';\omega'), U^j(\omega') \right\}}_{\text{job formation/rejection decision}} + (1 - p^j(\omega)) U^j(\omega') \right]
\end{aligned}
$$

Stochastic Model: Value Functions: Unemployed

- Define ω as the set of state variables
- For $j \in \{UIx, UU\}$:

$$U^j(\omega) = \max_{s^j(\omega)} h - c^j(s^j(\omega)) + \beta E_{m'\omega'|\omega}\left[p^j(\omega)\underbrace{\max\left\{W^j(m';\omega'), U^j(\omega')\right\}}_{\text{job formation/rejection decision}} + (1 - p^j(\omega))U^j(\omega')\right]$$

- For UI workers with benefit $b(\tilde{m})$:

$$U^{UI}(\tilde{m}, \omega) = \max_{\gamma^{UI}(\tilde{m},\omega)} b(\tilde{m}) + h - c^{UI}(\gamma^{UI}(\tilde{m},\omega)\underline{s^{UI}}) + \beta E_{m'\omega'|\omega}\Big[p^{UI}(\tilde{m},\omega)\max\Big\{W^{UI(\tilde{m})}(m';\omega'), \ldots \underbrace{(1-\phi(u))(1-\xi)}_{\text{keep UI} \mid \text{meeting a firm}} U^{UI}(\tilde{m},\omega') + \underbrace{(\phi(u) + (1-\phi(u))\xi)}_{\text{lose UI} \mid \text{meeting a firm}} U^{UIx}(\omega')\Big\} + (1 - p^{UI}(\tilde{m},\omega))\Big((1-\phi(u))U^{UI}(\tilde{m},\omega') + \phi(u)U^{UIx}(\omega')\Big)\Big]$$

$\xi \equiv \Pr(\text{losing UI eligibility} \mid \text{rejecting job offers})$

Stochastic Model: Value Function: Employed

- The value of a type-i employed worker with last period's employment status and associated benefit level $j \in \{E(\tilde{m}), UI(\tilde{m}), UIx, UU\}$:

$$
\begin{aligned}
W^{j}(m;\omega) \quad = \quad & \max_{s^E(m;\omega)} \quad w^{j}(m;\omega) - c^E(s^E(m;\omega)) + \beta E_{\omega'|\omega}\Big[\\
& (1-\delta)(1-\lambda)\Big[(1-p^E(m;\omega)(1-F(m)))W^{E(m)+}(m;\omega') \\
& + p^E(m;\omega)(1-F(m))E_{m'|m'>m}[W^{E(m)+}(m';\omega')]\Big] \\
& + (1-\delta)\lambda E_{m'}\Big[(1-p^E(m;\omega)(1-F(m')))W^{E(m)+}(m';\omega') \\
& + p^E(m;\omega)(1-F(m'))E_{m''|m''>m'}[W^{E(m)+}(m'';\omega')]\Big] \\
& + \delta\Big((1-\psi)U^{UI}(m,\omega') + \psi U^{UU}(\omega')\Big)\Big]
\end{aligned}
$$

$$
W^{E(m)+}(m';\omega') \equiv \max\{W^{E(m)}(m';\omega'), (1-\psi)U^{UI}(m,\omega') + \psi U^{UU}(\omega')\}
$$

Value function: Matched firms

Stochastic Model: Free Entry

- The value of an unmatched firm is

$$
\begin{aligned}
V(\omega) \quad = \quad & -\kappa + \beta q(\omega) E_{\omega'|\omega}\Big[\ldots \\
& \sum_m \zeta^E(m;\omega)(1-F(m)) E_{m'|m'>m}[J^{E(m)+}(m';\omega')] \\
& + \sum_m \zeta^{UI}(m,\omega) E_{m'}[J^{UI(m)+}(m';\omega')] \\
& + \zeta^{UU}(\omega) E_{m'}[J^{UU+}(m';\omega')] + \zeta^{UIx}(\omega) E_{m'}[J^{UIx+}(m';\omega')]\Big]
\end{aligned}
$$

where

$$
\begin{aligned}
\zeta^E(m) &= \frac{(1-\lambda)s^E(m)E(m) + \lambda f(m)\sum_m s^E(m)E(m)}{s} \\
\zeta^{UI}(m) &= \frac{\gamma^{UI}(m)\underline{s}^{UI}u^{UI}(m)}{s}; \quad \zeta^{UU} = \frac{s^{UU}u^{UU}}{s}; \quad \zeta^{UIx} = \frac{s^{UIx}u^{UIx}}{s} \\
s &= \sum_m \left((1-\lambda)s^E(m)E(m) + \lambda f(m)\sum_m s^E(m)E(m) + \gamma^{UI}(m)\underline{s}^{UI}u^{UI}(m)\right) \\
& \quad + s^{UU}u^{UU} + s^{UIx}u^{UIx}
\end{aligned}
$$

- Free entry condition implies $V(\omega) = 0, \forall\omega$

Stochastic Model: Equilibrium Definition

A recursive competitive equilibrium is characterised by

- **value functions** $\{W^j(m;\omega), U^{UI}(m,\omega), U^{UU}(\omega), U^{UIx}(\omega), J^j(m;\omega), V(\omega)\}$ for $j \in \{E(\tilde{m}), UI(\tilde{m}), UU, UIx\}$;
- **market tightness** $\theta(\omega)$;
- **search policy** $\{s^{E(\tilde{m})}(m;\omega), s^{UI}(m,\omega), s^{UU}(\omega), s^{UIx}(\omega)\}$;
- **wage functions** $w^j(m;\omega)$ for $j \in \{E(\tilde{m}), UI(\tilde{m}), UU, UIx\}$;

such that, given initial distribution of workers, government's policy $\{\tau(\omega), \phi(\omega)\}$ and law of motion for z:

1. Value functions and the market tightness satisfy the Bellman equations for workers and firms, and the free entry condition
2. Search decisions satisfy the FOCs for optimal search intensity
   FOCs for search
3. Wage functions satisfy the FOCs for the Nash bargaining rule
4. UI's budget constraint is satisfied
5. The distribution of workers evolves according to the transition equations, consistent with the maximising behaviour of agents
   transitions

Calibration

- I calibrate a subset of parameters (13) to the US economy during 1948-2007 (SMM) including
  - Search cost parameters: a^{UI}, a^{UIx}
  - Meeting function parameter
  - Match-specific productivity parameters
  - TFP-related parameters
  - UI-related parameters

- Other parameters are from the literature
- From Gruber (1997), set $b(m)$ and h to imply
  - 10% consumption drop from E to UI (receiving $b(m) + h$); $\forall m$
  - 24% consumption drop from E to $\{UIx, UU\}$ (receiving h)
  - Given 50% replacement rate

Other fitted parameters Other fixed parameters

Targeted Moments

Moment	Data	Baseline	$\gamma^{UIx} = 1$
$\mathrm{E}(u)$	0.0583	0.0569	0.0577
$\mathrm{E}(\rho_{UE})$	0.4194	0.4414	0.4286
$\mathrm{E}(\rho_{EU})$	0.0248	0.0252	0.0251
$\mathrm{E}(\rho_{EE})$	0.0320	0.0322	0.0320
$\mathrm{E}(u_{dur})$	15.416	11.251	13.063
$\mathrm{E}(u^{UI})$	0.0290	0.0302	0.0327
$\mathrm{std}(u)$	0.1454	0.1123	0.1453
$\mathrm{std}(\rho_{UE})$	0.0999	0.1035	0.1402
$\mathrm{std}(\rho_{EU})$	0.0890	0.0517	0.0641
$\mathrm{std}(LP)$	0.0131	0.0106	0.0104
$\mathrm{corr}(LP, LP_{-1})$	0.7612	0.7609	0.7593
$\mathrm{E}(\rho_{UE}^{UIx}/\rho_{UE}^{UU})$	0.7983	0.8112	1
$\mathrm{E}(\rho_{UE}^{UI}/\rho_{UE}^{UU})$	0.6461	0.6234	0.6007

- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // ρ_{EE}: job-to-job transition rate
  u_{dur}: mean unemployment duration (weeks) // LP: output per worker (quarterly)

- Relative job finding rates more realistic w.r.t. scenario w/o search inefficiency ($\gamma^{UIx} = 1$)

Labour Market Fluctuations

Moment	Data	Baseline	$\gamma^{UIx} = 1$
std(u)	0.1454	0.1123	0.1453
		(77%)	(99%)
std(ρ_{UE})	0.0999	0.1035	0.1402
		(103%)	(140%)
std(ρ_{EU})	0.0890	0.0517	0.0641
		(58%)	(72%)
std(u_{dur})	6.9327	5.6412	6.1954
		(81%)	(90%)

- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // u_{dur}: mean unemployment duration (weeks)

- In parentheses, percent w.r.t. empirical counterpart
- Labour market fluctuations dampened by 10-35% w.r.t. scenario w/o search inefficiency for *UIx* workers: particularly job finding rate
  - ∵ In baseline, *UI* workers less responsive to shocks + try to exit unemployment more quickly

Labour Market Persistence

Autocorrelation coefficients for 1-month lag

Moment	Data	Baseline	$\gamma^{UIx} = 1$
$\text{corr}(u, u_{-1})$	0.9921	(100%)	(99%)
$\text{corr}(\rho_{UE}, \rho_{UE,-1})$	0.9510	(103%)	(103%)
$\text{corr}(\rho_{EU}, \rho_{EU,-1})$	0.9616	(98%)	(98%)
$\text{corr}(udur, udur_{-1})$	0.9965	(100%)	(99%)

- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // u_{dur}: mean unemployment duration (weeks)

- $\gamma^{UIx} = 1$: No search inefficiency for *UIx* workers
- Little difference for 1-month lag

Persistence in levels

Labour Market Persistence

Autocorrelation coefficients for 12-month lag

Moment	Data	Baseline	$\gamma^{UIx} = 1$
$\text{corr}(u, u_{-12})$	0.7302	(82%)	(65%)
$\text{corr}(\rho_{UE}, \rho_{UE,-12})$	0.8119	(69%)	(60%)
$\text{corr}(\rho_{EU}, \rho_{EU,-12})$	0.7850	(30%)	(6%)
$\text{corr}(udur, udur_{-12})$	0.9220	(80%)	(69%)

- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // u_{dur}: mean unemployment duration (weeks)

- $\gamma^{UIx} = 1$: No search inefficiency for *UIx* workers
- Baseline noticeably performs better, esp. the persistence of unemployment and job findings

▸ Persistence in levels

Labour Market Persistence

Autocorrelation coefficients for 24-month lag

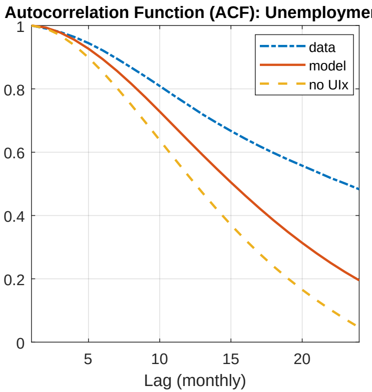
Moment	Data	Baseline	$\gamma^{UIx} = 1$
$\text{corr}(u, u_{-24})$	0.4783	(38%)	(4%)
$\text{corr}(\rho_{UE}, \rho_{UE,-24})$	0.6468	(20%)	(6%)
$\text{corr}(\rho_{EU}, \rho_{EU,-24})$	0.7138	(8%)	(0.1%)
$\text{corr}(udur, udur_{-24})$	0.7909	(47%)	(30%)

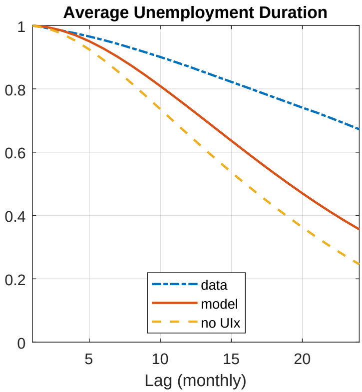
- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // u_{dur}: mean unemployment duration (weeks)

- $\gamma^{UIx} = 1$: No search inefficiency for *UIx* workers
- Baseline fares much better especially for the persistence of unemployment

▸ Persistence in levels

Persistence of Unemployment





"no UIx": a model w/o search inefficiency amongst *UIx* workers

- Search inefficiency improves the persistence of unemployment and its duration
    - Simply by construction + partly due to its dampening effects
- But can still improve, particularly for unemployment duration

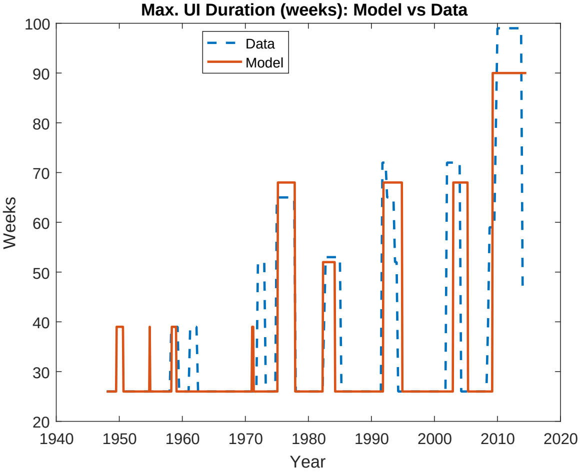
Application to the Great Recession in the US

- I apply the model to the US economy (1948-2014) by feeding in:

1. Historical UI extensions:
   - Extension generosity varies with each recession
   - Exogenous changes in ϕ_L to match observed changes in UI extension policies
   - Agents rationally expect whether $\phi(u)$ will be ϕ or ϕ_L based on current u
   - Agents assume ϕ_L never changes its value until observed otherwise
   - Timings of extensions still endogenous - triggered when $u > \bar{u}$

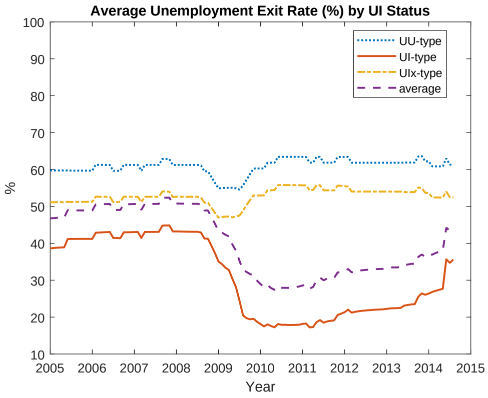
2. A series of productivity shocks that match the deviations of output (GDP per capita) from HP trend

UI Extensions



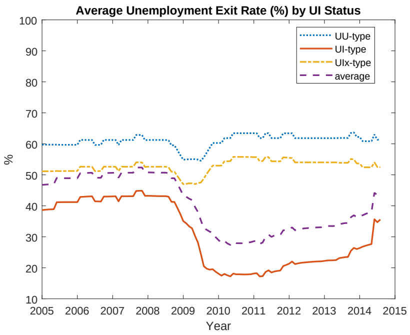
- UI extension triggered by high unemployment rate above 6%
- The Great Recession: Emergency Unemployment Compensation (EUC08) + Extended Benefits programmes

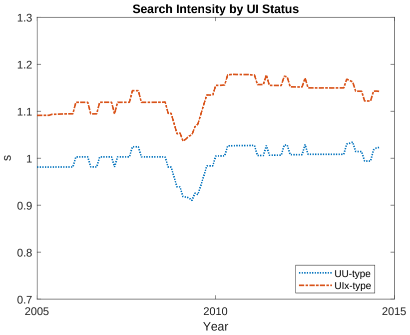
Job Finding Rates by UI Status/History



- Those never received UI find a job faster than former UI recipients
  - Despite lower search intensity
- Current UI recipients slowest to find a job: Job rejections

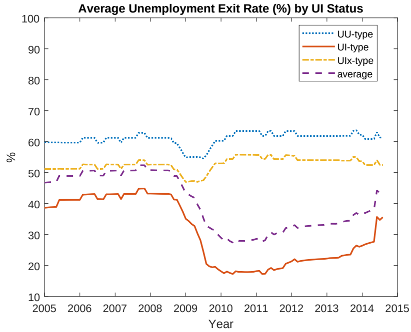
Search intensity

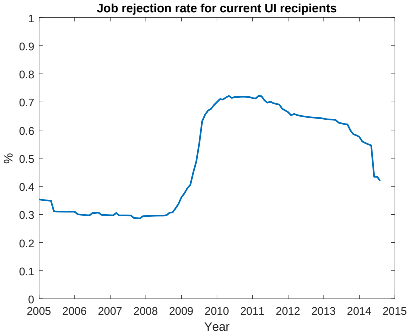




- UIx's search inefficiency ($\gamma^{UIx} = 0.72$) is set such that $s^{UIx}/s^{UU} = 1.12$ in the steady state
- NB: $\underline{s^{UI}}$ is 1.13

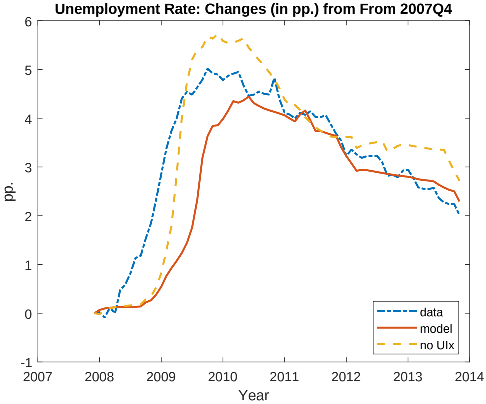
Job Censoring





- Current UI recipients' job rejection rate ($1 - \gamma^{UI}$): 37% on average
  - increases with UI extensions
  - varies with z and benefit amount $b(m)$
  - Faberman, Mueller, Şahin and Topa (2020): Unemployed workers reject 47% of best offers (52% of all offers)
- The role of unobserved heterogeneity?

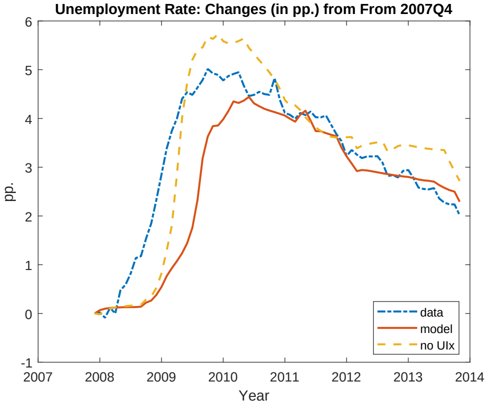
Unemployment



"no UIx" denotes a model w/o search inefficiency amongst *UIx* workers

- Search inefficiency dampens the fluctuations in unemployment

Unemployment

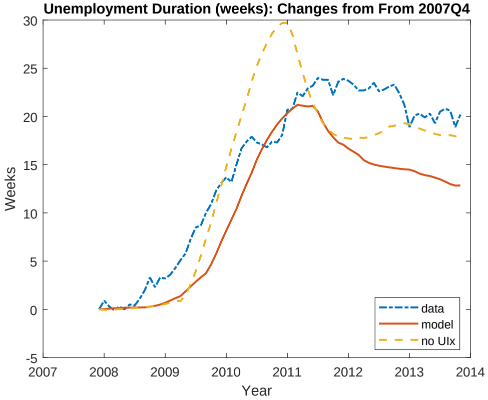


"no UIx" denotes a model w/o search inefficiency amongst *UIx* workers

- Search inefficiency dampens the fluctuations in unemployment
- Baseline model: UI extensions account for 2pp↑ in unemployment
- No search inefficiency: overestimating the UI effect by 0.9pp (≊50%)

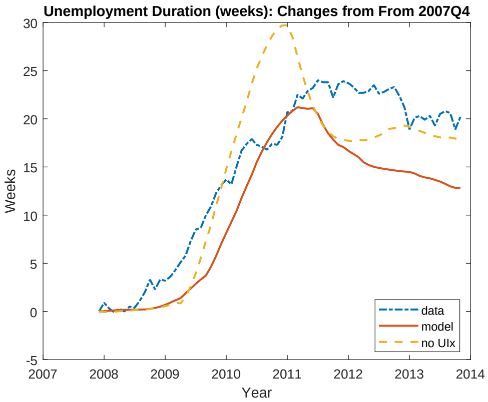
▸ Unemployment Duration ▸ Insured Unemployment Rate ▸ Longer horizon

Average Unemployment Duration



- Search inefficiency dampens the response

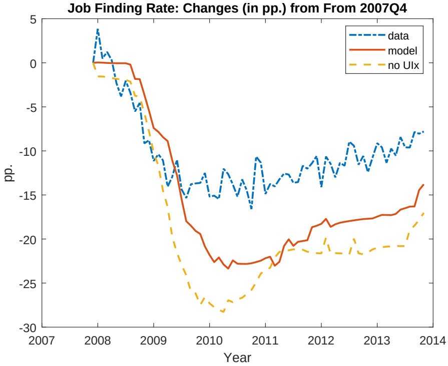
Average Unemployment Duration



- Search inefficiency dampens the response
- Baseline: UI extensions account for ↑ 16 weeks in unemp. duration
- No search inefficiency: overestimating the UI effect by 9 wks (≊56%)

▸ Go back to TGR's Unemployment Rate

Job Findings

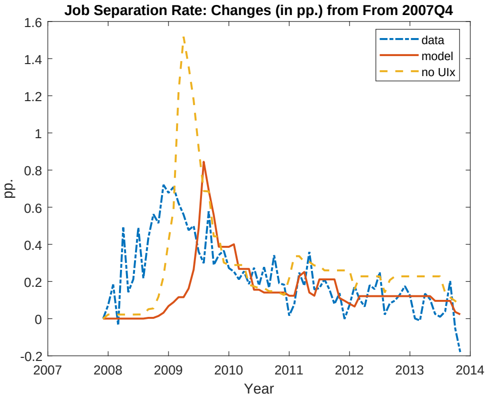


"no UIx" denotes a model w/o search inefficiency amongst *UIx* workers

- Baseline model somewhat overshoots (negatively)
  - NB: negative trend in data
- But more moderate than a model without inefficient search where
  - No cost associated with being *UIx*
    $\rightarrow$ *UI* workers reject even more jobs when UI is generous

Job Separation Longer horizon

Job Separations



- Baseline model: realistic magnitude, but lagged response
- model without inefficient search: heavily overestimating job separations ($> 100\%$)

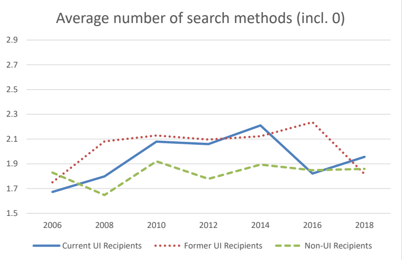
▸ Back to TGR's Job Findings

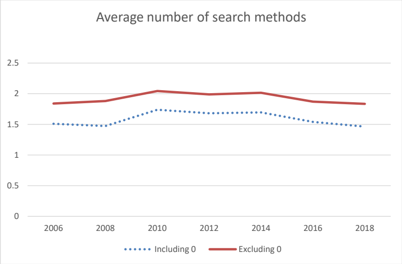
Conclusion

- This paper proposes a drop in search efficiency and job censoring to reconcile the high search intensity but yet low job finding rate for workers with UI history
- I find that this dampens the labour market fluctuations and the effects of UI extensions
- Accounting for UI history and search efficiency improves the persistence of unemployment
- Unobserved heterogeneity will be important for the effects of UI extensions but other results still apply

Thank you

Data: Search Intensity (only active methods)



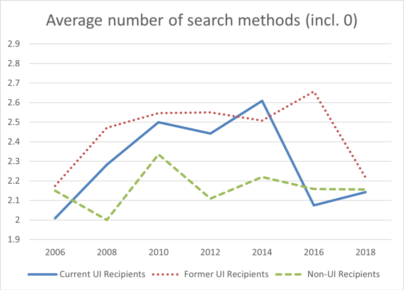


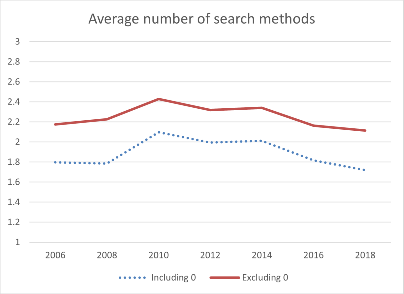
Non-UI recipients = those who never received UI

Source: CPS monthly data & January supplements

Back to average number of methods excl 0

Data: Search Intensity



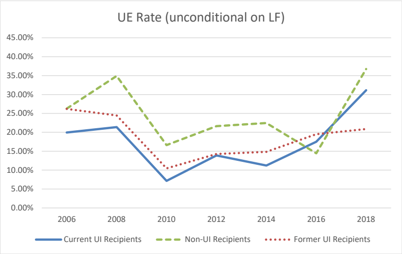


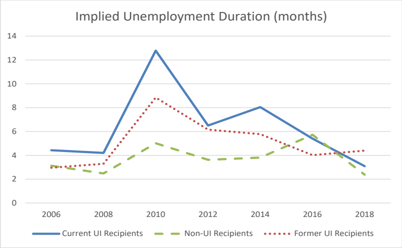
Non-UI recipients = those who never received UI

Source: CPS monthly data & January supplements

Back to average number of methods excl 0

Data: Job Finding Rate and Expected Unemployment Duration





NB: Non-UI recipients = those who never received UI

Source: CPS monthly data & January supplements

Back to conditional UE rate

Data: Job Finding Rate (uncond. on LFP)

Table: **Dependent variable: Job Finding Probability**

	(1)	(2)	(3)	(4)
Have received UI	-0.061***		-0.060***	
	(0.012)		(0.012)	
Current UI recipient		-0.076***		-0.078***
		(0.012)		(0.012)
Former UI recipient		-0.024		-0.021
		(0.015)		(0.015)
Long-term unemployed	-0.062***	-0.071***		
	(0.011)	(0.012)		
Unemp. duration (weeks)			-0.001***	-0.001***
			(0.000)	(0.000)
Great Recession ('10-'12)	-0.064***	-0.059***	-0.063***	-0.056***
	(0.011)	(0.011)	(0.011)	(0.011)
Worker characteristics	✓	✓	✓	✓
R^2	0.0775	0.0801	0.0784	0.0819

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* p<0.05, ** p<0.01, *** p<0.001)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,729 obs.)
- Worker characteristics include race, education, gender, age (quadratic), time trend (linear), occupation, industry, search method dummies
- Excluding 0 number of search methods

Back to regression results with conditional on LFP

Data: Job Finding Rate

Table: **Dependent variable: Job Finding Probability**

	(1)	(2)	(3)	(4)
Number of search methods	-0.009*	-0.009*	-0.009*	-0.009*
	(0.005)	(0.005)	(0.005)	(0.005)
Have received UI	-0.085***		-0.085***	
	(0.013)		(0.013)	
Current UI recipient		-0.104***		-0.105***
		(0.014)		(0.014)
Former UI recipient		-0.034**		-0.031*
		(0.017)		(0.018)
Long-term unemployed	-0.066***	-0.078***		
	(0.013)	(0.013)		
Unemp. duration (weeks)			-0.001***	-0.001***
			(0.000)	(0.000)
Great Recession ('10-'12)	-0.077***	-0.070***	-0.075***	-0.067***
	(0.013)	(0.013)	(0.013)	(0.013)
Worker characteristics	✓	✓	✓	✓
R^2	0.0775	0.0801	0.0784	0.0819

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* $p<0.05$, ** $p<0.01$, *** $p<0.001$)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,109 obs.)
- Worker characteristics include race, education, gender, age (quadratic), time trend (linear), occupation, industry
- Excluding 0 number of search methods and workers exiting the labour force next period

Back to regression results with conditional on LFP

Data: UO Rate

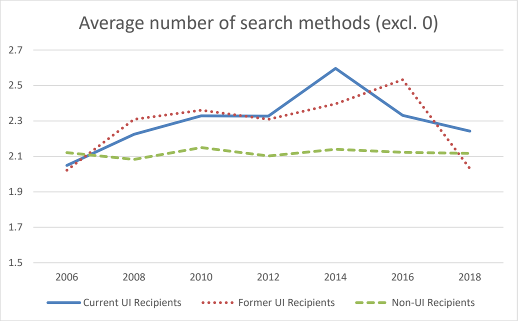
Table: **Dependent variable: UO Transtion Rate (not filled)**

	(1)	(2)	(3)	(4)
Have received UI	-0.061***		-0.060***	
	(0.012)		(0.012)	
Current UI recipient		-0.076***		-0.078***
		(0.012)		(0.012)
Former UI recipient		-0.024		-0.021
		(0.015)		(0.015)
Long-term unemployed	-0.062***	-0.071***		
	(0.011)	(0.012)		
Unemp. duration (weeks)			-0.001***	-0.001***
			(0.000)	(0.000)
Great Recession ('10-'12)	-0.064***	-0.059***	-0.063***	-0.056***
	(0.011)	(0.011)	(0.011)	(0.011)
Worker characteristics	✓	✓	✓	✓
R^2	0.0775	0.0801	0.0784	0.0819

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* p<0.05, ** p<0.01, *** p<0.001)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,109 obs.)
- Worker characteristics include race, education, gender, age (quadratic), time trend (linear), occupation, industry, search method dummies
- Excluding 0 number of search methods

Back to regression results with conditional on LFP

Data: Search Intensity



NB: Non-UI recipients = those who never received UI

Source: CPS monthly data & January supplements

- Search intensity measured by the number of active job search methods (6 answers max.) of unemployed workers
- Excluding 0 search methods (workers expecting a recall)
- Current and former UI recipients generally search harder than those never received UI

▸ Search methods (active+passive) ▸ Average number of methods, including 0 ▸ List of possible methods

Job Search Methods

1. Contacted employer directly/interview(*)
2. Contacted public employment agency(*)
3. Contacted private employment agency
4. Contacted friends or relatives
5. Contacted school/university empl center(*)
6. Sent out resumes/filled out application(*)
7. Checked union/professional registers
8. Placed or answered ads
9. Other active
10. Looked at ads
11. Attended job training programs/courses
12. Nothing
13. Other passive

Back to average number of methods excl 0

Stochastic Model: Value functions: Firms

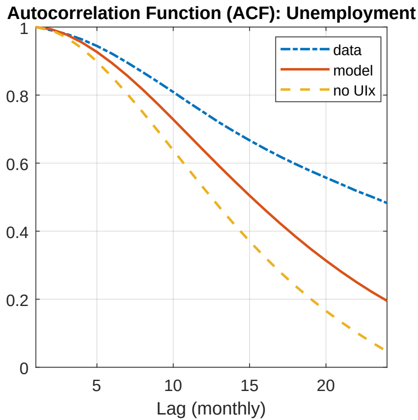
- The value of a matched firm with type-i worker whose work history is $j \in \{e(\tilde{m}), UI(\tilde{m}), UU\}$ is

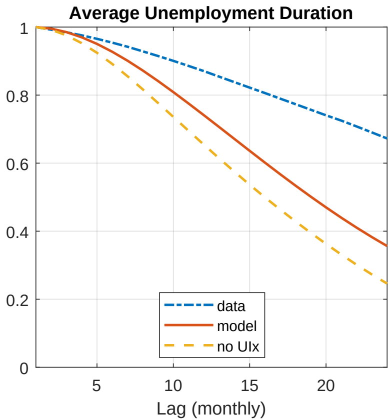
$$
\begin{aligned}
J_i^j(m;\omega) \quad = \quad & y_i(m;\omega) - w_i^j(m;\omega) - \tau(\omega) + \beta E_{\omega'|\omega}\Big[\ldots \\
& (1-\delta)(1-\lambda)\Big[(1-p_i^e(m;\omega)(1-F(m)))J_i^{e(m)+}(m;\omega')\Big] \\
& +(1-\delta)\lambda E_{m'}\Big[(1-p_i^e(m;\omega)(1-F(m')))J_i^{e(m)+}(m';\omega')\Big] \\
& +\delta V(\omega')\Big]
\end{aligned}
$$

- $J_i^{e(m)+}(m';\omega') \equiv \max\{J_i^{e(m)}(m';\omega'), V(\omega')\}$

Back to value function for the employed

Persistence of Unemployment (from 1950s)

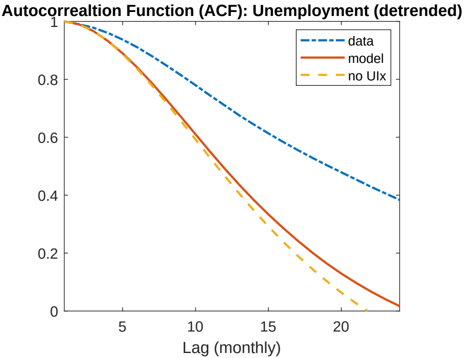


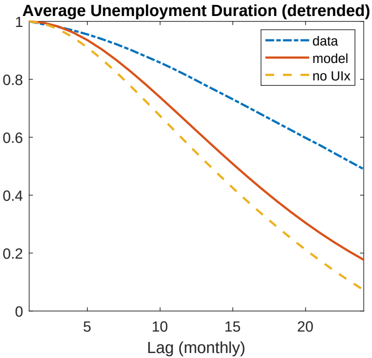


- Small role for UI history on unemployment persistence
- UI history more important for persistence of unemployment duration
- Note: Data not detrended

Back to ACF during TGR

Persistence of Unemployment - detrended (from 1950s)

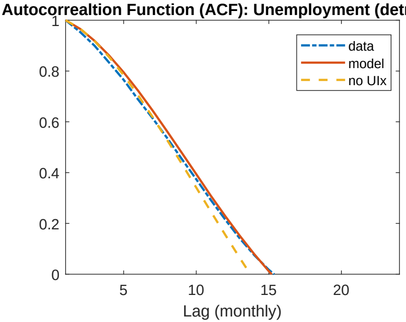


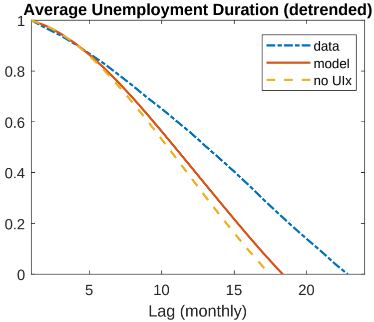


- UI history (slightly) more important when detrended
- Focus on persistence in cyclical fluctuations
- Next: what about during the Great Recession?

Back to ACF during TGR

Persistence of Unemployment (from the Great Recession) - detrended



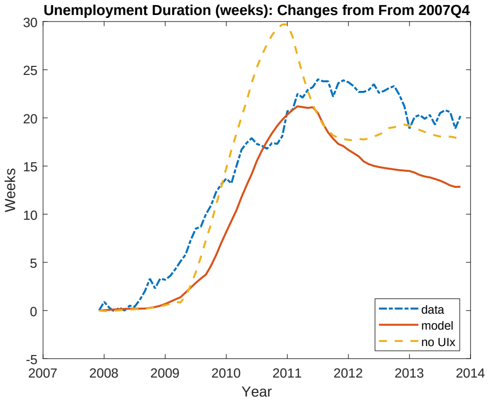


(Similar to raw data)

- Benchmark matches the unemployment persistence well
- Still too low for unemployment duration

▸ Back to ACF during TGR

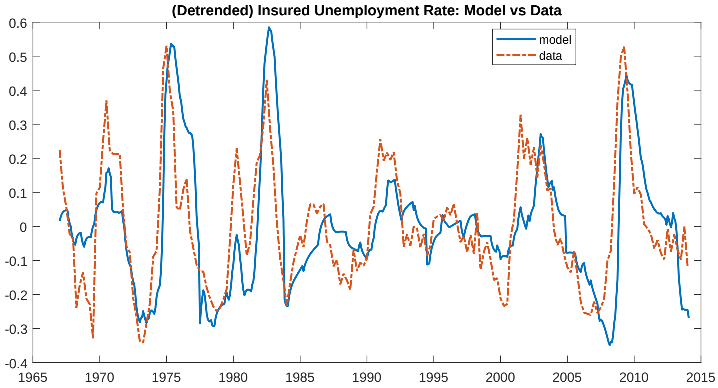
Average Unemployment Duration



- Milder response with UI history
- Model without UI history overshoots again
- Note: positive trend in data

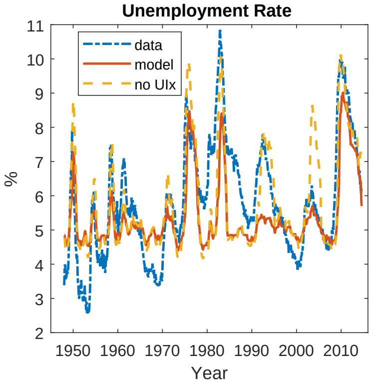
Go back to TGR's Unemployment Rate

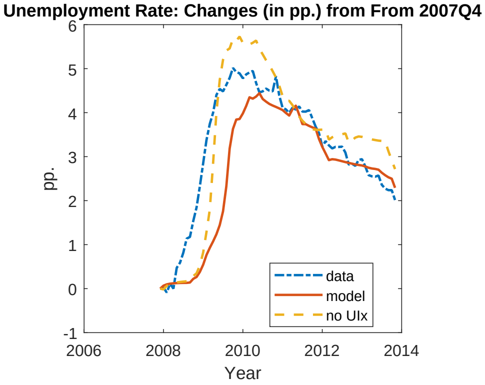
Insured Unemployment Rate



Go back to TGR's Unemployment Rate

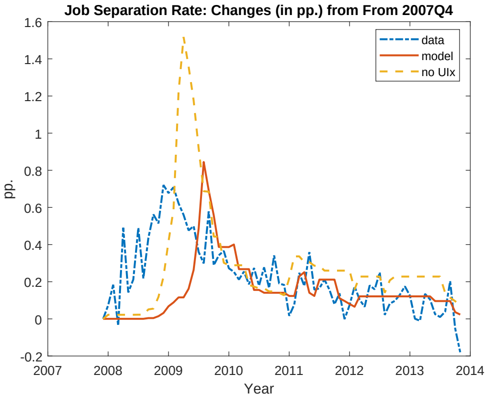
Unemployment: Longer Horizon





Go back to TGR's Unemployment Rate

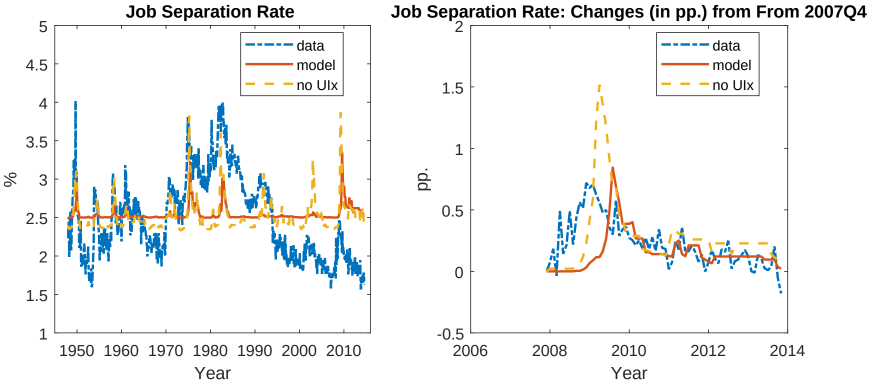
Job Separations



- Both models overshoot job separations
- Smaller magnitude with UI history
- Note: trends in the data again

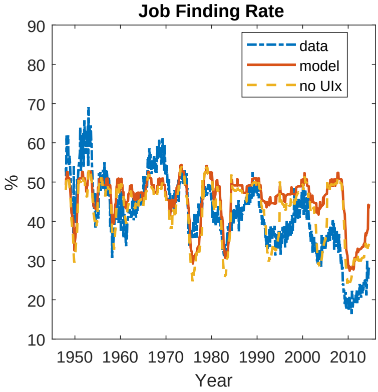
Back to TGR's Job Findings

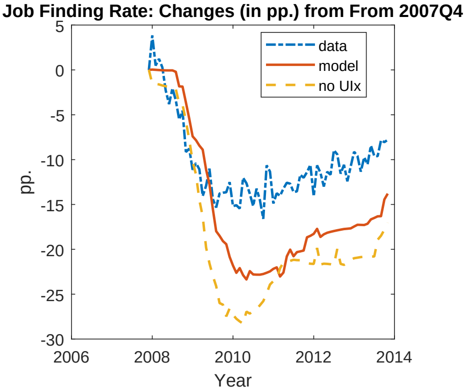
Job Separations: Longer Horizon



▸ Back to TGR's Job Findings

Job Finding: Longer Horizon





Back to TGR's Job Findings

Fitted parameters (monthly)

Parameter	Description	Value
ℓ	Matching function	0.51
δ	Exogenous separation	0.023
λ	Redrawing new m	0.50
ψ	Losing UI after becoming unemp.	0.49
ξ	Losing UI after meeting firm	0.50
a^E	Search cost function	0.15
a^{UIx}	Search cost function	0.0717
a^{UI}	Search cost function	0.0622
$\underline{m}$	Lowest match-specific prod.	0.396
β_1	Match-specific prod. distribution	2.55
β_2	Match-specific prod. distribution Dist. of m	5.26
ρ_z	Persistence of TFP	0.9562
σ_z	Standard deviation of TFP shocks	0.0075

Moments to match

- Mean and SD of unemployment, *UE* and *EU* transition rates, and average unemployment duration
- Persistence and SD of labour productivity, correlation between output and labour productivity, mean insured unemployment, and mean job-to-job transition rate
- $M(s,v) = sv/\left(s^\ell + v^\ell\right)^{1/\ell}$

Back to the Setup

Fixed parameters (monthly)

- $b(m)$ and h imply consumption drop of 24% for u^{UU} and 10% for u^{UI} at 50% replacement rate (Gruber 1997)

Parameter	Description	Value	Source/Remarks
β	Discount factor	0.9967	Annual interest rate of 4%
κ	Vacancy posting cost	0.0392	Fujita & Ramey (2012)
μ	Worker's bargaining power	0.5	Den Haan, Ramey & Watson (2000)
ϕ	UI exhaustion rate	1/6	6 months max UI duration, ETA
ϕ_{L1}	UI exhaustion rate	1/9	9 months max UI duration, ETA
ϕ_{L2}	UI exhaustion rate	1/12	12 months max UI duration, ETA
ϕ_{L3}	UI exhaustion rate	1/16	16 months max UI duration, ETA
ϕ_{L4}	UI exhaustion rate	1/21	21 months max UI duration, ETA
$\bar{u}$	UI policy threshold	0.06	ETA
a^{UU}	Search cost function	0.1116	Normalisation
d_u, d_e	Search cost function	1	Christensen et al (2004), Yashiv (2000)
h	Leisure flow	0.5835	Gruber (1997)
γ^{UIx}	Search inefficiency of UIx	0.72	Relative search intensity of UIx wrt UU, CPS

▸ Fitted parameters ▸ Benefit Levels and Match Quality Distribution ▸ Back to the Setup

Empirical Evidence

- A large drop in the job finding rate in states with longer maximum UI duration (24 p.p. drop from 2008 to 2010)
- Maximum UI duration in Dec 2013:
  73 weeks in high-UI states, 40 weeks in low-UI states

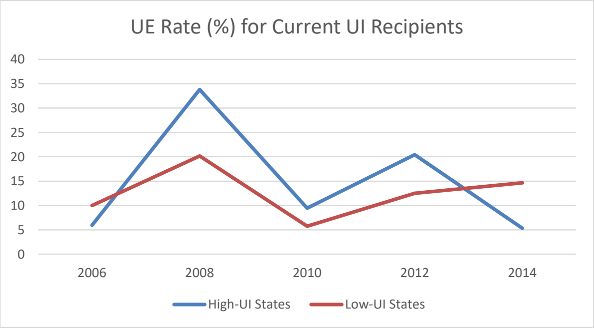


Figure: Unemployment-to-Employment (UE) Transition Rate by UI Durations

Source: CPS Basic Monthly Data and CPS Displaced Worker, Employee Tenure, and Occupational Mobility Supplement

Back to UU rate

Empirical Evidence

Who are more likely to be long-term unemployed? UI recipients are!

- In the Great Recession: Current UI recipients
- In normal times: Exhausted UI recipients

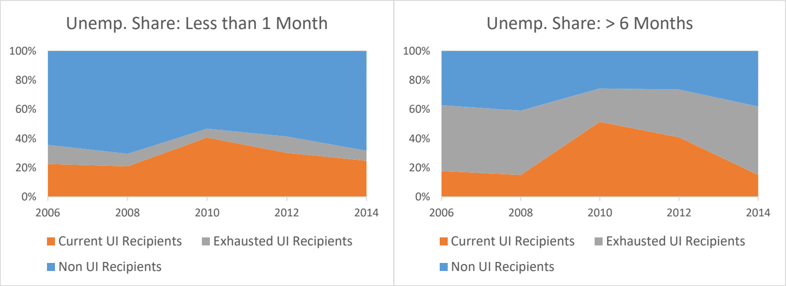
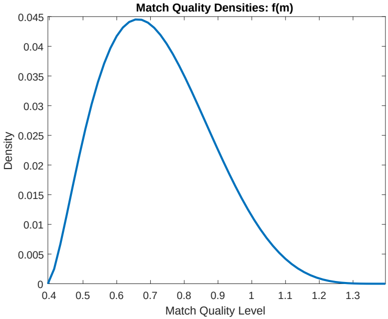


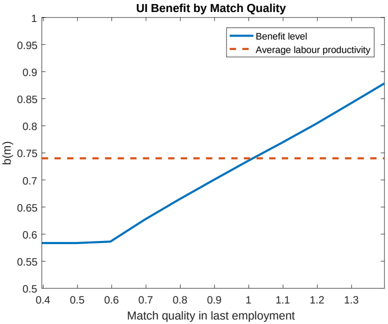
Figure: Shares of Unemployment For 2 Duration Bins By UI Status

Source: CPS Basic Monthly Data and CPS Displaced Worker, Employee Tenure, and Occupational Mobility Supplement Back to Search Intensity

Benefit Levels and Match Quality

- The distribution of match quality is crucial for the heterogeneity of the unemployment exit rates amongst u^{UI}





Back to calibration

Dependent variable: Number of search methods

	(1)	(2)	(3)	(4)
Have received UI	0.173***		0.166***	
	(0.034)		(0.035)	
Current UI recipient		0.176***		0.167***
		(0.037)		(0.037)
Former UI recipient		0.156***		0.151***
		(0.046)		(0.046)
Long-term unemployed	0.006	0.012		
	(0.034)	(0.035)		
U duration			0.009	0.009
			(0.007)	(0.007)
U duration^2			-0.000	-0.000
			(0.000)	(0.000)
U duration^3			0.000	0.000
			(0.000)	(0.000)
U duration^4			-0.000	-0.000
			(0.000)	(0.000)
Great Recession	0.060*	0.058*	0.057*	0.055
(2010-2012)	(0.033)	(0.034)	(0.033)	(0.034)
R^2	0.3231	0.3230	0.3236	0.3235

- Linear regression coefficients (* $p<0.05$, ** $p<0.01$, *** $p<0.001$)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (6,567 obs.)
- Excluding 0 search methods
- Other regressors include: worker characteristics (race, education, gender, age (quartic), occupation, industry, and recall expectation), linear time trend and state fixed effects

Back to intro: search intensity

Dependent variable: Number of search methods

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- Other regressors include: worker characteristics (race, education, gender, age (quartic), occupation, industry, and recall expectation), linear time trend and state fixed effects

Model ▶ FOCs

◂ Back to Model: Equilibrium

$$
\begin{aligned}
c^{E'}(s^{E(\tilde{m})}(m;\omega)) &= -\beta(1-\delta)M(\theta(\omega))E_{\omega'|\omega}\Big[\ldots \\
&\quad (1-\lambda)(1-F(m))\Big(WS^{E(m)+}(m;\omega') - E_{m'|m'>m}[WS^{E(m)+}(m';\omega \\
&+ \lambda E_{m'}\Big[(1-F(m'))(WS^{E(m)+}(m';\omega') - E_{m''|m''>m'}[WS^{E(m)+}(m' \\
c^{UI'}(\gamma^{UI(m)}(\omega)) &= \beta M(\theta(\omega))E_{m'\omega'|\omega}\Big[\max\{WS^{UI(m)}(m';\omega'),0\}\ldots \\
&\quad -\xi(1-\phi)US(m,\omega')\Big] \\
c^{UU'}(s^{UU}(\omega)) &= \beta M(\theta(\omega))E_{m'\omega'|\omega}\Big[\max\{WS^{UU}(m';\omega'),0\}\Big] \\
c^{UIx'}(s^{UIx}(\omega)) &= \beta M(\theta(\omega))E_{m'\omega'|\omega}\Big[\max\{WS^{UIx}(m';\omega'),0\}\Big]
\end{aligned}
$$

Dependent variable: Job Finding Probability

	(1)	(2)	(3)	(4)
Have received UI	-0.082***		-0.067***	
	(0.013)		(0.013)	
Current UI recipient		-0.100***		-0.087***
		(0.014)		(0.014)
Former UI recipient		-0.035**		-0.019
		(0.018)		(0.018)
Long-term unemployed	-0.064***	-0.076***		
	(0.013)	(0.013)		
U duration			-0.015***	-0.014***
			(0.003)	(0.003)
U duration^2			0.000***	0.000***
			(0.000)	(0.000)
U duration^3			-0.000***	-0.000***
			(0.000)	(0.000)
U duration^4			0.000***	0.000**
			(0.000)	(0.000)
Great Recession	-0.077***	-0.070***	-0.069***	-0.061***
(2010-2012)	(0.013)	(0.013)	(0.013)	(0.013)
R^2	0.0784	0.0819	0.0775	0.0801

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* $p<0.05$, ** $p<0.01$, *** $p<0.001$)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,109 obs.)
- Other regressors include: worker characteristics (race, education, gender, age (quartic), occupation, industry, recall expectation, search methods), linear time trend and state FE
- Excluding zero search methods and workers exiting the labour force next period

▸ Results unconditional on LFP ▸ Control for search methods ▸ Back to UE rates

Dependent variable: Job Finding Probability

	(1)	(2)	(3)	(4)
Have received UI	-0.082***		-0.067***	
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Current UI recipient		-0.100***		-0.087***
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Results unconditional on LFP
Control for search methods

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Great Recession	-0.077***	-0.070***	-0.069***	-0.061***
(2010-2012)	(0.013)	(0.013)	(0.013)	(0.013)
R^2	0.0784	0.0819	0.0775	0.0801

- Linear probability model (dependent variable = 1 if a worker moves from unemp. to emp., = 0 if remaining unemployed) (* $p<0.05$, ** $p<0.01$, *** $p<0.001$)
- CPS monthly data and January supplements: every 2 years between 2006-2018 (4,109 obs.)
- Other regressors include: worker characteristics (race, education, gender, age (quartic), occupation, industry, recall expectation, search methods), linear time trend and state FE
- Excluding zero search methods and workers exiting the labour force next period

▸ Results unconditional on LFP ▸ Control for search methods

Dependent variable: Job Finding Probability

	(1)	(2)	(3)	(4)
Have received UI	-0.082***		-0.067***	
	(0.013)		(0.013)	
Current UI recipient		-0.100***		-0.087***
		(0.014)		(0.014)
Former UI recipient		-0.035**		-0.019
		(0.018)		(0.018)
Long-term unemployed	-0.064***	-0.076***		
	(0.013)	(0.013)		
U duration			-0.015***	-0.014***
			(0.003)	(0.003)
U duration^2			0.000***	0.000***
			(0.000)	(0.000)
U duration^3			-0.000***	-0.000***
			(0.000)	(0.000)
U duration^4			0.000***	0.000**
			(0.000)	(0.000)
Great Recession	-0.077***	-0.070***	-0.069***	-0.061***
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Results unconditional on LFP
Control for search methods

Model ▶ Transitions I: Unemployment

◂ Back to Model: Equilibrium

$$
\begin{aligned}
u_{t+1}^{UI}(m) \quad = \quad & \underbrace{(1-\psi)\rho_{eu,t}(m)e_t^{post}(m)}_{\text{separated match, not losing UI}} \\
& + \underbrace{(1-\phi_t)(1-p_t^{UI}(m))u_t^{UI}(m)}_{\text{no meeting, not losing UI}} \\
& + \underbrace{\chi_t^{UI}(m)(1-\phi_t)(1-\xi)p_{it}^{UI}(m)u_t^{UI}(m)}_{\text{bad meeting, not losing UI}}
\end{aligned} \tag{1}
$$

$\chi_t^{UI}(\tilde{m})$ is the rate the meetings with $u^{UI}(\tilde{m})$ are unproductive. Namely, $\chi_t^{UI}(\tilde{m}) = \int \mathbf{1}\{S_t^{UI(\tilde{m})}(m) \leq 0\} f(m) dm$.

Model ▶ Transitions I: Unemployment (Cont.)

◂ Back to Model: Equilibrium

$$
\begin{aligned}
u_{t+1}^{UU} &= \underbrace{\phi_t(1-p_t^{UI}(m))u_t^{UI}(m)}_{\text{no meeting, losing UI}} + \underbrace{\chi_t^{UI}(m)\Big(\phi_t+(1-\phi_t)\xi\Big)p_t^{UI}(m)u_t^{UI}(m)}_{\text{bad meeting, losing UI}} \\
&\quad +(1-\rho_{ue,t}^{UU})u_t^{UU} + \underbrace{\psi\rho_{eu,t}e_t^{post}}_{\text{separated match, losing UI}} \\
u_{t+1} &= \sum_m u_{t+1}^{UI}(m) + u_{t+1}^{UU}
\end{aligned}
$$

$\chi_t^{UI}(\tilde{m})$ is the rate the meetings with $u^{UI}(\tilde{m})$ are unproductive. Namely, $\chi_t^{UI}(\tilde{m}) = \int \mathbf{1}\{S_t^{UI(\tilde{m})}(m) \leq 0\} f(m)dm$.

Model ▶ Transitions II: Employment

◂ Back to Model: Equilibrium

$$
\begin{aligned}
e_{m,it+1} \quad = \quad & \Bigg((1-\delta)(1-\lambda)(1-p^e_{m,it}+p^e_{m,it}F(m))e_{m,it} \\
& +(1-\delta)(1-\lambda)f(m)\sum_{m'<m} p^e_{m',it}e_{m',it} \\
& +(1-\delta)\lambda f(m)\sum_{m'}(1-p^e_{m',it}+p^e_{m',it}F(m))e_{m',it} \\
& +(1-\delta)\lambda(\sum_{m'<m} f(m'))f(m)\sum_{m'} p^e_{m'i,t}e_{m',it}\Bigg)\mathbf{1}\{S^e_{m,\omega_{it+1}}>0\} \\
& +\sum_{\tilde{m}} f(m)(u^{UI}_{it}(\tilde{m})p^{UI}_{it}(\tilde{m}))\mathbf{1}\{S^{UI(\tilde{m})}_{m,\omega_{it+1}}>0\} \\
& +f(m)(u^{UU}_{it}p^{UU}_{it})\mathbf{1}\{S^{UU}_{m,\omega_{it+1}}>0\}
\end{aligned}
$$

The sum in the 2nd and 4th lines is over employed workers with match qualities worse than m who hence make a job-to-job transition.

Model ▶ Transitions III: Job Separation Rate

◂ Back to Model: Equilibrium

$$
\begin{aligned}
\rho_{eu,t}(m) &= \begin{cases} \delta & \text{if } S^e_{m,\omega_{t+1}} > 0, \\ 1 & \text{otherwise} \end{cases} \\
\rho_{eu,t} &= \frac{\delta \int_{\{m:S^e_{m,t+1}>0\}} e^{post}_{m,t}\, dm + \int_{\{m:S^e_{m,t+1}\leq 0\}} e^{post}_{m,t}\, dm}{e_t} \\
(&\equiv \rho^{exo}_{eu,t} + \rho^{endo}_{eu,t})
\end{aligned}
$$

$$
\begin{aligned}
\text{where} \quad e^{post}_{m,t} &\equiv (1-\lambda)(1 - p^e_{m,t} + p^e_{m,t}F(m))e_{m,t} \\
&+(1-\lambda)f(m)\sum_{m'<m} p^e_{m',t}e_{m',t} \\
&+\lambda f(m)\sum_{m'}(1 - p^e_{m',t} + p^e_{m',t}F(m))e_{m',t} \\
&+\lambda(\sum_{m'<m} f(m'))f(m)\sum_{m'} p^e_{m',t}e_{m',t}
\end{aligned}
$$

Model ▶ Transitions IV: Job Finding Rate

◂ Back to Model: Equilibrium

For $j = \{UI(\tilde{m}), UU\}$

$$\rho^j_{ue,t} = \int \rho^j_{ue,t}(m) f(m) dm$$

$$\rho_{ue,t} = \frac{\sum_{\tilde{m}}(u_t^{UI(\tilde{m})}\rho_{ue,t}^{UI(\tilde{m})}) + u_t^{UU}\rho_{ue,t}^{UU}}{u_t^{UI} + u_t^{UU}}$$

$$\text{where} \quad \rho^j_{ue,t}(m) = \begin{cases} p^j_{\omega_t} & \text{if } S^j_{m',\omega_{t+1}} > 0, \\ 0 & \text{otherwise} \end{cases}$$

Job-to-job transition rate is

$$\rho^{ee}_{m,t} = (1-\delta)\Big((1-\lambda)p^e_{m,t}(1-F(m))E_{m'>m}[\mathbf{1}\{S^{e(m)}_{m',\omega_{t+1}} > 0\}] + \lambda \sum_{m'} p^e_{m,t} f(m')(1-F(m'))E_{m''>m'}[\mathbf{1}\{S^{e(m)}_{m'',\omega_{t+1}} > 0\}]\Big)$$

$$\rho^{ee}_t = \frac{\sum_m \rho^{ee}_{m,t} e_{m,t}}{e_t}$$

Labour Market Persistence

Moment	Data	Baseline	$\gamma^{UIx} = 1$
$\text{corr}(u, u_{-1})$	0.9921	0.9939	0.9919
$\text{corr}(\rho_{UE}, \rho_{UE,-1})$	0.9510	0.9862	0.9844
$\text{corr}(\rho_{EU}, \rho_{EU,-1})$	0.9616	0.9409	0.9406
$\text{corr}(udur, udur_{-1})$	0.9965	0.9970	0.9946
$\text{corr}(u, u_{-12})$	0.7302	0.6003	0.4775
$\text{corr}(\rho_{UE}, \rho_{UE,-12})$	0.8119	0.5607	0.4939
$\text{corr}(\rho_{EU}, \rho_{EU,-12})$	0.7850	0.2300	0.0541
$\text{corr}(udur, udur_{-12})$	0.9220	0.7347	0.6367
$\text{corr}(u, u_{-24})$	0.4783	0.1789	0.0219
$\text{corr}(\rho_{UE}, \rho_{UE,-24})$	0.6468	0.1242	0.0399
$\text{corr}(\rho_{EU}, \rho_{EU,-24})$	0.7138	0.0565	0.0090
$\text{corr}(udur, udur_{-24})$	0.7909	0.3690	0.2413

- ρ_{UE}: job finding rate // ρ_{EU}: job separation rate // u_{dur}: mean unemployment duration (weeks) // $\gamma^{UIx} = 1$: no drop in search efficiency

- No difference for one month lag

Back to Persistence in Percent