A Quantitative Theory of Time-Consistent Unemployment Insurance

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The views expressed in this presentation are those of the authors and do not necessarily represent the views of the Federal Reserve System or the Federal Reserve Banks.
Unemployment Insurance (UI) Extensions in the U.S.

- In the U.S. unemployment insurance (UI) is provided to unemployed workers for a finite duration (typically up to 26 weeks)

- Potential duration extended during recessions (implemented since 1970s)
  - Longer durations during economic downturn and high unemployment
  - Extensions implemented gradually by Congress (discretionary policy)
Figure: Potential UI duration and Unemployment during Great Recession

Recession Dec 2007 - Jun 2009

UI duration (weeks)

Unemployment rate

Time

Max. UI duration (weeks)

Unemployment rate (%)
Unemployment Insurance (UI) Extensions in the U.S.

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- Potential duration extended during recessions (implemented since 1970s)
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- Two groups of literature on UI extension
  - evaluate effects of extension
  - optimal UI extensions with policy commitment
Time-Inconsistency Problem

- Trade-offs of UI extension
  - Pro: Provides insurance to more unemployed workers
  - Con: Lowers search incentive by unemployed, higher future unemployment
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- Time-inconsistency problem
  - Today: promise benefits expire tomorrow $\rightarrow$ higher search, lower unemployment
  - Tomorrow: extends benefit $\rightarrow$ insurance to more unemployed, higher welfare


**Time-Inconsistency Problem**

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- **Time-inconsistency** problem
  - Today: promise benefits expire tomorrow $\rightarrow$ higher search, lower unemployment
  - Tomorrow: extends benefit $\rightarrow$ insurance to more unemployed, higher welfare

- As such, govt always has incentive to deviate from pre-determined plan
  - Optimal UI in literature assumes govt has commitment
  - In reality, likely no commitment, esp. in recession
This Paper

- **Time-consistent** UI policy in a standard labor market environment
  - Can be implemented by government *without* assuming commitment, i.e. *discretionary* policy

- **Question**: ‘Does time-consistent UI policy look like U.S.?’
  - Extensions during recessions consistent with U.S. pattern

- **Question**: ‘How does government’s policy commitment matter?’
  - With policy commitment (Ramsey), UI duration is **shorter** in steady state, and **shortened** in recessions
Literature

- Optimal UI with gov’t commitment + business cycle
  - We look at *time-consistent* policies under *no commitment*

- Other time-consistent policy
  - First application of time-consistent concept to UI and labor market search

- Evaluate UI benefit extensions
  - As an application of our model
Model
Environment

Standard search-and-matching model

- Infinitely-lived workers differ by employment and benefit status
  - $1 - u$: employed earn wages, no search, exogenous separation from work
  - $u$: unemployed consume home goods, costly job search, finding rate proportional to search
  - $u^1$: benefit-eligible unemployed receive benefits

- Firm: risk neutral, pays fixed cost to post vacancy

- Aggregate states: $\mathcal{O} = (z, u, u^1)$, $u > u^1$
  - exogenous: productivity $z$ follows AR(1) process
  - endogenous: unemployment $u$, measure of benefit-eligible unemployed $u^1$
Government Policy

- Given current states, government chooses current policies to maximize current and future worker welfare.
Government Policy

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- Benefit level $b$ given to benefit-eligible unemployed workers.

- Probability $d$ unemployed with benefits yesterday keeps eligibility.
  - Same probability for all eligible unemployed.
  - If lost benefits today, not eligible until re-qualifies through work.
  - Max. potential (Expected) duration from today is $1/(1 - d)$.
Government Policy

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  - If lost benefits today, not eligible until re-qualifies through work
  - Max. potential (Expected) duration from today is $1/(1 - d)$

- Lump-sum tax $\tau$ to balance budget
Timing of Events

Aggregate states: $\mathcal{O} = (z, u, u^1)$

Receive benefits: $u^1_d$

Search, vacancy posting

Separation

Production consumption

Today's search affects unemployment tomorrow

Expectation of future UI policy affects today's search

Today's duration policy ($d$) changes proportion of unemployed on benefits

Pei & Xie
**Timing of Events**

Aggregate states: \( \mathcal{O} = (z, u, u^1) \)

- Today’s search affects unemployment tomorrow
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Aggregate states: \( \mathcal{O} = (z, u, u^1) \)

- Today’s search affects unemployment tomorrow
- Expectation of future UI policy affects today’s search
- Today’s duration policy \((d)\) changes proportion of unemployed on benefits
Preference and Technology

- Worker’s preferences:
  \[ U(c, s) = u(c) - v(s) \]
  utility from consumption - disutility from search

- Linear production technology: productivity \( z \)
  - Wages are exogenous function of \( z \) and UI duration: \( w = W(z, d) \)

- Matching technology: number of new matches is
  \[ M(V, I) \]
  total firm vacancy, total search by unemp’ed
  - Market tightness: \( \theta = V/I \). Vacancy-filling rate: \( q(\theta) \). Job-finding rate: \( sf(\theta) \)
Life-time utility maximizers, take UI policy \((b, d)\) as given.

Unemployed without benefit search \((s^0)\) until

\[
\nu_s(s^0) = f(\theta)\beta \mathbb{E} [V^e(O') - V^0(O')]
\]

where

- \(\nu_s(s^0)\) is the marginal cost of searching for work without benefits,
- \(f(\theta)\beta \mathbb{E} [V^e(O') - V^0(O')]\) is the marginal gain from searching.

Proposition: Unemployed workers with benefits search less \((s^1 < s^0)\) if the expected future duration of UI is lower. 

Longer expected future UI duration \((d')\) lowers search \((s^1)\).
Workers

- Life-time utility maximizers, take UI policy \((b, d)\) as given

- Unemployed without benefit search \((s^0)\) until

\[
\begin{align*}
\nu_s(s^0) &= f(\theta)\beta \mathbb{E} \left[ V^e(O') - V^0(O') \right] \\
\text{marginal cost} &= \\
\text{marginal gain}
\end{align*}
\]

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\text{marginal gain}
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\]

\[
\begin{align*}
\nu_s(s^1) &= f(\theta)\beta \mathbb{E}(1 - d') \left[ V^e(O') - V^0(O') \right] + f(\theta)\beta \mathbb{E}d' \left[ V^e(O') - V^1(O') \right] \\
\text{has benefit tomorrow} &= \\
\text{no benefit tomorrow}
\end{align*}
\]
Life-time utility maximizers, take UI policy \((b, d)\) as given

Unemployed without benefit search \((s^0)\) until

\[
v_s(s^0) = f(\theta)\beta\mathbb{E}[V^e(O') - V^0(O')] \\
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\text{marginal cost}
\]

Proposition

- Unemployed workers with benefits search less \((s^1 < s^0)\)
- Longer expected future UI duration \((d')\) lower search \((s^1)\)
Firms and Production

- Maximizes expected FDV of profits, take UI policy \((b, d)\) as given
- Free-entry of vacant firms, pays cost \(\kappa\) to post vacancy until

\[
\kappa = q(\theta) \beta \mathbb{E} \left[ \frac{z' - w'}{1 - \delta} \right] + \frac{\kappa}{q(\theta')} 
\]

\(\kappa\) marginal cost

\[
\begin{align*}
\text{future profit} & = z' - w' \\
\text{saved job posting cost} & = (1 - \delta) \frac{\kappa}{q(\theta')} \\
\text{marginal gain} &
\end{align*}
\]
Government’s Problem With Commitment (Ramsey)

Govt chooses at time 0 all future policies to maximize PDV of welfare

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t R(z_t, u_t, u_t^1, b_t, d_t, s_t^0, s_t^1)$$

time-t worker’s welfare

subject to private-sector optimality conditions, balanced budget for all time $t$

- assumes govt sticks to policies determined at time 0, otherwise cannot be implemented
Government's Problem Without Commitment

Given current states, govt chooses current policies \((b, d)\) and allocations, taking future policy rules as given

\[
\max \ R(z, u, u^1, b, d, s^0, s^1) + \beta \mathbb{E} \left[ G(z', u', u'^1) \right]
\]

subject to private-sector optimality, balanced budget for current period

- Equilibrium: today's govt and agents take future policy rules as given; today's policy rules coincide with the expected future policy rules
- The equilibrium (Markov-perfect equilibrium) is time-consistent
Intuitions: Effects of UI Extension

- Increases today’s share of unemployed workers with benefits
Intuitions: Effects of UI Extension

- Increases today’s share of unemployed workers with benefits
  - more redistribution (insurance effect) $\rightarrow$ raises today’s welfare
  - lowers average search (extensive search effect) $\rightarrow$ higher future unemployment
  - Workers expect future benefit extensions
    - less search incentive (intensive search effect) $\rightarrow$ higher future unemployment

Without commitment: higher today’s welfare vs higher future unemployment

With commitment: govt also considers ex ante effect of promised extension

Recall in worker’s problem, expected future extension lowers search promised extension lowers previous search and increases today’s unemployment
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- Workers expect **future** benefit extensions
  - less search incentive (intensive search effect)  $\rightarrow$  higher future unemployment

**Without commitment:** higher today’s welfare vs higher future unemployment

**With commitment:** govt also considers ex ante effect of **promised** extension

- **Recall** in worker’s problem, expected **future** extension lowers search
- promised extension lowers **previous** search and increases today’s unemployment
Intuition: UI Extension in Recessions

Lower productivity (exogenous)

Higher unemployment (endogenous)
Intuition: UI Extension in Recessions

Lower productivity (exogenous)
- Smaller loss from high future unemployment (smaller search effects)

Higher unemployment (endogenous)
- Extension benefits more people (larger insurance effect)
Intuition: UI Extension in Recessions

Lower productivity (exogenous)
- Smaller loss from high future unemployment (smaller search effects)
→ Without commitment: Lower productivity → Longer extensions

Higher unemployment (endogenous)
- Extension benefits more people (larger insurance effect)
→ Without commitment: Higher unemployment → Longer extensions
Intuition: UI Extension in Recessions

Lower productivity (exogenous)

- Smaller loss from high future unemployment (smaller search effects)

→ Without commitment: Lower productivity → Longer extensions

Higher unemployment (endogenous)

- Extension benefits more people (larger insurance effect)

→ Without commitment: Higher unemployment → Longer extensions

- **Promised** extension lowers search of more people (larger ex ante search effect)

→ With commitment: Shorter extensions or reduce UI duration
QUANTITATIVE ANALYSES
Calibration Strategy

- Calibrate model to match monthly U.S. labor market statistics

**Table: Key moments for calibration**

<table>
<thead>
<tr>
<th>Moments</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Monthly job separation rate</td>
<td>0.02</td>
</tr>
<tr>
<td>Wage elasticity wrt productivity</td>
<td>0.446</td>
</tr>
<tr>
<td>Wage change wrt one-week longer UI</td>
<td>{0, 0.02%}</td>
</tr>
<tr>
<td>Average monthly job-finding rate</td>
<td>0.4</td>
</tr>
<tr>
<td>% unemployed on UI</td>
<td>0.45</td>
</tr>
<tr>
<td>UI replacement ratio</td>
<td>40%</td>
</tr>
<tr>
<td>$\Delta$unemp duration/$\Delta$UI extension</td>
<td>0.16</td>
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<tr>
<td>(search effect only)</td>
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*calibrated parameters ➤ other moments*
Effects of Policy Commitment at Steady State

**Table:** Equilibrium steady state comparison

<table>
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<tr>
<th>Statistics</th>
<th>No commitment</th>
<th>With commitment</th>
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<tr>
<td>UI Duration (weeks)</td>
<td>27</td>
<td>15.8</td>
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<td>Unemployed worker search, $s^1$</td>
<td>0.29</td>
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<td>Proportion UI recipients</td>
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With commitment, the government considers ex ante search disincentive of long UI duration, so compared to no commitment → steady state UI duration is much shorter → search is much higher, fewer unemployed workers collecting benefits → unemployment lower.
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→ steady state UI duration is much shorter

→ search is much higher, fewer unemployed workers collecting benefits

→ unemployment lower
Effects of Policy Commitment: Impulse Response

Figure: Deviations from Steady states to 1% drop in productivity

No commitment (blue) vs With commitment (red)

<table>
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<tr>
<th>Statistics</th>
<th>Standard deviation</th>
</tr>
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<tr>
<td></td>
<td>No commitment</td>
</tr>
<tr>
<td>UI Duration (weeks)</td>
<td>5.69</td>
</tr>
<tr>
<td>Search, $s^1$</td>
<td>0.051</td>
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<tr>
<td>Unemployment, $u$</td>
<td>0.106</td>
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</table>
GREAT RECESSION
UI Extensions in the Great Recession

- Federal govt gradually extended max. potential UI duration to over 90 weeks

**Figure:** Examples of UI extension laws during the Great Recession

<table>
<thead>
<tr>
<th>Start date</th>
<th>Program extension of EUC08</th>
<th>End date</th>
<th>Additional Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul 2008</td>
<td>13 weeks for all states</td>
<td>Nov 2008</td>
<td>13</td>
</tr>
<tr>
<td>Nov 2008</td>
<td>Tier I: 20 weeks for all states Tier II: 13 weeks for states with TUR ≥ 6%</td>
<td>Mar 2009</td>
<td>33</td>
</tr>
<tr>
<td>Mar 2009</td>
<td>keep existing structure</td>
<td>Nov 2009</td>
<td>33</td>
</tr>
<tr>
<td>Nov 2009</td>
<td>Tier I - 20 weeks for all states Tier II: 14 weeks for all states Tier III: 13 weeks if states TUR ≥ 6% Tier IV: 6 weeks if states TUR ≥ 8.5%</td>
<td>Dec 2009</td>
<td>53</td>
</tr>
<tr>
<td>Dec 2009</td>
<td>keep existing structure</td>
<td>Aug 2010</td>
<td>53</td>
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</table>

- Does no-commitment UI policy generates similar extensions?
UI Extensions in the Great Recession

- Step 1: Create cross-state weighted measure of benefit duration as data counterpart (details)

Figure: Legislative (--) and Weighted (•--) UI durations
UI Extensions in the Great Recession

- Step 2: Feed shock paths into the model
  - Job separation rates taken from data
  - Productivity calibrated so that equilibrium unemployment series matches data

**Figure**: Shocks during Great Recession
Non-Commitment UI Policy in the Great Recession

Figure: UI Extensions in Great Recession: Data (black) vs Model (blue)

- UI extensions under govt without commitment match data well
- lower productivity $\rightarrow$ extension $\rightarrow$ higher unemployment $\rightarrow$ further extension
Great Recession: Comparison of UI Policy Regimes

Figure: No commitment (blue) vs With commitment (red) policies in Great Recession

- **With commitment**: shorten UI duration in recession → unemployment lower
- **Welfare gain** (of lifetime consumption) by adopting policy commitment
  - 0.11% if adopted before recession (2007 Dec)
  - 0.14% if at peak of recession (2010 Mar) – harder to be credible
Conclusion

- Time-consistent UI policy (no policy commitment) quantitatively consistent with UI extensions during Great Recession

- With policy commitment (Ramsey) govt reduces UI during recession, leads to lower unemployment and welfare gains

- Policy lessons:
  - Design of UI policy should account for government’s ability to commit
  - Commitment policy is tougher but better outcome overall. Might be hard to implement (unpopular), esp. during recessions
Historical UI Extensions during Recessions

Figure: UI duration (---) and unemployment (----) during recessions since 1970s
Take as given govt policy rules for $b, d$, per-unit job-finding prob $f(\theta)$

Aggregate states: $\mathcal{O} = (z, u, u^1)$

- Unemployed without benefit search $s^0$

\[
V^0(\mathcal{O}) = \max_{s^0} U(h - \tau, s^0) + f(\theta)s^0 \beta \mathbb{E} V^e(\mathcal{O}') + (1 - f(\theta)s^0) \beta \mathbb{E} V^0(\mathcal{O}')
\]

- Unemployed with benefit search $s^1$

\[
V^1(\mathcal{O}) = \max_{s^1} U(h + b - \tau, s^1) + f(\theta)s^1 \beta \mathbb{E} V^e(\mathcal{O}') + (1 - f(\theta)s^1) \beta \mathbb{E} \left[ d'V^0(\mathcal{O}') + (1 - d')V^1(\mathcal{O}') \right]
\]
Take as given government policy rules for $b, d$, job-filling probability $q(\theta)$

Aggregate states: $O = (z, u, u^1)$

- Producing firm gets profit $z - w(z)$

\[
J^e(O) = z - w(z) + \delta \underbrace{\beta E J^u(O')}_\text{match breaks} + (1 - \delta) \underbrace{\beta E J^e(O')}_\text{match stays}
\]

- Vacant firm posts job at fixed cost $\kappa$

\[
J^u(O) = -\kappa + q(\theta) \underbrace{\beta E J^e(O')}_\text{match formed} + (1 - q(\theta)) \underbrace{\beta E J^u(O')}_\text{no match}
\]
A Markov-perfect equilibrium is a set of value functions, government policy rules and private-sector decision rules such that for all $O = (z, u, u^1)$

- Given government policy rules, private-sector decision rules solve private-sector problems

- Given private-sector decision rules and future government policy rules, current government policy rules solve the government’s problem

- Policy rules obtained by solving government problem coincide with future government policy rules that the government problem takes as given

- Worker’s flow equations satisfied
**Table: Estimated effect of UI benefit extension on unemployment duration (micro-elasticity)**

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Source</th>
<th>Estimation methodology</th>
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<tbody>
<tr>
<td>∆UI dur → ∆unemp dur</td>
<td>Moffitt (1985)</td>
<td>Cross-state and time differences in UI duration</td>
</tr>
<tr>
<td>1 week → 0.16 weeks</td>
<td>Katz and Meyer (1990)</td>
<td>Simulated UI extension from 26 to 39 weeks</td>
</tr>
<tr>
<td>1 week → 0.16-0.20 weeks</td>
<td>Card and Levine (2000)</td>
<td>13 week extension in NJ in 1996 (non-recession)</td>
</tr>
<tr>
<td>13 weeks → 1 week</td>
<td>Valletta (2014)</td>
<td>Discrete hazard analysis; follow Rothstein (2011)</td>
</tr>
<tr>
<td>10 weeks → 1.5 weeks</td>
<td>Johnston and Mas (2016)</td>
<td>UI duration cut in MS in 2011; regression discontinuity</td>
</tr>
</tbody>
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Note: Estimates cited are the increase in individual (those who collect benefits) unemployment duration to a given increase in UI duration (e.g. 1 week, 13 weeks, 1 month).
### Calibrated Parameters

<table>
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<tr>
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<th>Values</th>
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<tr>
<td>$\delta$ U.S. job separation rate</td>
<td>0.02</td>
</tr>
<tr>
<td>$\kappa$ Vacancy posting cost</td>
<td>0.58</td>
</tr>
<tr>
<td>$\rho$ Persistence of productivity</td>
<td>0.968</td>
</tr>
<tr>
<td>$\sigma_\epsilon$ Std of innovation to productivity</td>
<td>0.006</td>
</tr>
<tr>
<td>$\epsilon_w$ Elasticity of wage wrt productivity</td>
<td>0.45</td>
</tr>
<tr>
<td>$\bar{w}$ Steady-state wage</td>
<td>0.977</td>
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<th></th>
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<tbody>
<tr>
<td>$h$ Value of nonmarket activity</td>
<td>0.59</td>
</tr>
<tr>
<td>$\chi$ Matching parameter</td>
<td>4.52</td>
</tr>
<tr>
<td>$\alpha$ Disutility of search</td>
<td>3.2</td>
</tr>
<tr>
<td>$\xi$ Prob. newly unemployed is benefit eligible</td>
<td>0.49</td>
</tr>
</tbody>
</table>
### Key Non-Target Moments

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average UI Duration</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Std dev of unemployment $u$</td>
<td>0.123</td>
<td>0.106</td>
</tr>
<tr>
<td>Std dev of vacancy posting $v$</td>
<td>0.142</td>
<td>0.142</td>
</tr>
<tr>
<td>Std dev of $v-u$ ratio</td>
<td>0.257</td>
<td>0.217</td>
</tr>
</tbody>
</table>
Markov UI Policy Functions

Figure: Markov equilibrium UI policy functions over total unemployment and productivity

Panel A: Over total unemployment, $u$

Panel B: Over productivity, $z$

Potential UI duration (weeks), $\frac{1}{1-d} \times 4$

Benefit level, $b$

Markov policy

Markov steady state
Markov UI Policy Functions: 3-D

Figure: Markov equilibrium UI policy functions in 3-D

Panel A: Over total and benefit-eligible unemployment

Panel B: Over total unemployment and productivity
Ramsey UI Policy Functions

Figure: Ramsey UI policy functions over total unemployment and productivity

Panel A: Over total unemployment $u$

Panel B: Over productivity $z$

Ramsey policy

Ramsey steady state
Effects of Policy Commitment: Impulse Response

Figure: Impulse Response (deviations from Steady states to 1% drop in productivity)

No commitment (blue) vs With commitment (red)
Constructing weighted measure of UI duration

- UI law during recession specifies maximum UI extension a state qualifies depending on unemployment.

- Use insured unemployment rate (IUR) and total unemployment rate (TUR) to determine whether state eligible for extended durations at any time.

- Use states’ total insured unemployed as the weight.

- Compute sum of weighted UI extension across all states.