A Macroeconomic Approach to Optimal Unemployment Insurance: Theory and Applications

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Baily-Chetty theory of optimal UI

- insurance-incentive tradeoff: UI provides a safety net but UI reduces job search and raises unemployment
- two aspects of the debate are missing:
  - sometimes jobs are unavailable
  - UI affects job creation
- problem: partial-equilibrium model
  - labor supply
  - fixed labor market tightness
In this paper:

- general-equilibrium model of optimal UI
  - labor supply and labor demand
  - equilibrium labor market tightness
- macroeconomic model captures three effects of UI:
  - UI may reduce job-search effort
  - UI may alleviate rat race for jobs in bad times
  - UI may raise wages and deter job creation
- application: optimal UI over the business cycle
A matching model of UI
UI program

- employed workers receive $c^e$
- unemployed workers receive $c^u$
- **replacement rate** $R$ measures generosity of UI:
  - $R \equiv 1 - (c^e - c^u)/w$
  - $R = \text{tax rate} + \text{benefit rate}$
  - workers keep fraction $1 - R$ of earnings
Labor market

- measure 1 of identical workers, initially unemployed
  - search for jobs with effort $e$
- measure 1 of identical firms
  - post $v$ vacancies to hire workers
- CRS matching function: $l = m(e, v)$
- labor market tightness: $\theta \equiv v/e$
Matching probabilities

- **vacancy-filling probability:**

\[ q(\theta) \equiv \frac{l}{v} = m \left( \frac{1}{\theta}, 1 \right) \]

- **job-finding rate per unit of effort:**

\[ f(\theta) \equiv \frac{l}{e} = m (1, \theta) \]

- **job-finding probability:**

\[ e \cdot f(\theta) < 1 \]
Matching cost: $\rho$ recruiters per vacancy

- **employees** = $\left[1 + \tau(\theta)\right] \cdot \text{producers}$

- **proof:**

  $l_{\text{employees}} = n_{\text{producers}} + \rho \cdot v_{\text{recruiters}}$

  $= n + \rho \cdot \frac{l}{q(\theta)}$

  $= \left[1 + \frac{\rho}{q(\theta) - \rho}\right] \cdot n$

  $\equiv 1 + \tau(\theta)$
Representative worker

- consumption utility $U(c)$, search disutility $\psi(e)$
- **utility gain from work:** $\Delta U \equiv U(c^e) - U(c^u)$
- solves $\max_e \{ U(c^u) + e \cdot f(\theta) \cdot \Delta U - \psi(e) \}$
- **effort supply** $e^s(\theta, \Delta U)$ gives optimal effort:
  $$\psi'(e^s(\theta, \Delta U)) = f(\theta) \cdot \Delta U$$
- **labor supply** $l^s(\theta, \Delta U)$ gives employment rate:
  $$l^s(\theta, \Delta U) = e^s(\theta, \Delta U) \cdot f(\theta)$$
Labor supply

\[ l_s(\theta, \Delta U) \]
Representative firm

- hires $l$ employees
  - $n = l/(1 + \tau(\theta))$ producers
  - $l - n$ recruiters
- production function: $y(n)$
- solves $\max_l \{y(l/(1 + \tau(\theta))) - w \cdot l\}$
- labor demand $l^d(\theta, w)$ gives optimal employment:
  $$y' \left(\frac{l^d}{1 + \tau(\theta)}\right) = (1 + \tau(\theta)) \cdot w$$
Labor demand

\[ l^d(\theta, w) \]

\[ l^s(\theta, \Delta U) \]
Labor-market equilibrium

- as in any matching model, need a price mechanism
  - general wage schedule: \( w = w(\theta, \Delta U) \)
- in equilibrium, \( \theta \) is such that supply = demand:
  \[
  l^s(\theta, \Delta U) = l^d(\theta, w(\theta, \Delta U))
  \]
- equilibrium tightness: \( \theta(\Delta U) \)
Labor-market equilibrium

\[ l^d(\theta, w(\theta, \Delta U)) \]

\[ l^s(\theta, \Delta U) \]
Sufficient-statistics formula for optimal UI
Government’s problem

choose $\Delta U$ to maximize welfare

$$SW = l \cdot U(c^e) + (1 - l) \cdot U(c^u) - \psi(e)$$

subject to the following constraints:

- budget constraint:
  $$y \left( \frac{l}{1 + \tau(\theta)} \right) = l \cdot c^e + (1 - l) \cdot c^u$$

- workers’ response: $e = e^s(\theta, \Delta U), \ l = l^s(\theta, \Delta U)$

- equilibrium constraint: $\theta = \theta(\Delta U)$
Condition for optimal UI

- express all the variables as a function of \((\theta, \Delta U)\)
- express social welfare as \(SW = SW(\theta, \Delta U)\)
- government solves \(\max_{\Delta U} SW(\theta(\Delta U), \Delta U)\)
- first-order condition:

\[
0 = \left. \frac{\partial SW}{\partial \Delta U} \right|_{\theta} + \left. \frac{\partial SW}{\partial \theta} \right|_{\Delta U} \cdot \frac{d\theta}{d\Delta U}
\]

Baily-Chetty formula \quad \text{correction term}
Optimal UI versus Baily-Chetty

- Baily-Chetty formula is valid if UI has no effect on $\theta$ or $\theta$ is efficient (that is, $\left.\frac{\partial SW}{\partial \theta}\right|_{\Delta U} = 0$)

- optimal UI departs from Baily-Chetty if UI affects $\theta$ and $\theta$ is inefficient (that is, $\left.\frac{\partial SW}{\partial \theta}\right|_{\Delta U} \neq 0$)

  - optimal UI $> \text{Baily-Chetty}$ iff UI brings $\theta$ closer to its efficient level

- government UI beneficial when Baily-Chetty invalid
Baily-Chetty formula

\[ R = R^* \left( \varepsilon^m, \frac{U'(c^u)}{U'(c^e)} \right) \]

- \( \varepsilon^m > 0 \): microelasticity of unemployment wrt UI
  - measures disincentive from search
- \( \frac{U'(c^u)}{U'(c^e)} > 1 \): ratio of marginal utilities
  - measures need for insurance
- \( R^* \) is decreasing in \( \varepsilon^m \)
- \( R^* \) is increasing in \( \frac{U'(c^u)}{U'(c^e)} \)
Microelasticity of unemployment
Microelasticity of unemployment

![Graph showing microelasticity of unemployment with labor market tightness on the y-axis and employment on the x-axis, with two lines representing LS, high UI and LS, low UI.](image)
Efficiency term $\frac{\partial SW}{\partial \theta} \bigg|_{\Delta U}$

- depends on several estimable statistics
  - $\tau(\theta)$: recruiter-producer ratio
  - $u$: unemployment rate
  - $1 - \eta$: elasticity of the job-finding rate $f(\theta)$
  - $\Delta U$: the utility gain from work
- indicates the state of the labor market
Efficiency term and efficient tightness

Efficiency term = 0

Social welfare $SW(\theta, \Delta U)$

θ*(ΔU)

Labor market tightness
Efficiency term and efficient tightness

Efficiency term < 0

Social welfare $SW(\theta, \Delta U)$

Labor market tightness

$\theta^*(\Delta U)$

$\theta > \theta^*$
Efficiency term and efficient tightness

\[ \text{efficiency term} > 0 \]

social welfare \( SW(\theta, \Delta U) \)

\[ \theta < \theta^* \quad \theta^*(\Delta U) \]

labor market tightness
Macroelasticity of unemployment

![Graph showing labor market tightness and employment](image)
Macroelasticity of unemployment

![Graph showing labor market tightness vs. employment with points LD and LS.](image-url)
Macroelasticity of unemployment

![Graph showing labor market tightness vs employment with LD and LS curves.](image)
$1 - \frac{\varepsilon^M}{\varepsilon^m}$ gives effect of UI on $\theta$

$d\theta > 0$
$1 - \varepsilon^M / \varepsilon^m$ gives effect of UI on $\theta$
$1 - \varepsilon^M / \varepsilon^m$ gives effect of UI on $\theta$
Optimal UI formula in sufficient statistics

\[ R = R^* \left( \varepsilon^m, \frac{U'(c^u)}{U'(c^e)} \right) + \left( 1 - \frac{\varepsilon^M}{\varepsilon^m} \right) \cdot \text{efficiency term} \]

- \( R \neq R^* \left( \varepsilon^M, \frac{U'(c^u)}{U'(c^e)} \right) \)
- \( \varepsilon^M \) alone is not useful for optimal UI
- efficiency term fluctuates with \( \theta \)
  - optimal UI over the business cycle
  - importance of \( 1 - \varepsilon^M / \varepsilon^m \)
Optimal UI over the business cycle: theory
## Three matching models

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<td>standard</td>
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<td>prod. function</td>
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<td>wage</td>
<td>bargaining</td>
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Standard model: $1 - \frac{\varepsilon^M}{\varepsilon^m} < 0$
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Rigid-wage model: \[ 1 - \frac{\varepsilon^M}{\varepsilon^m} = 0 \]
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Rigid-wage model: \[ 1 - \varepsilon^M / \varepsilon^m = 0 \]
Job-rationing model: $1 - \frac{\varepsilon^M}{\varepsilon^m} > 0$
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Cyclicality of optimal UI: theory

- **standard model: procyclical UI**
  - bargaining shocks $\rightarrow$ inefficient fluctuations
  - job-creation mechanism $\rightarrow 1 - \varepsilon^M / \varepsilon^m < 0$

- **rigid-wage model: acyclical UI**
  - no mechanism $\rightarrow 1 - \varepsilon^M / \varepsilon^m = 0$

- **job-rationing model: countercyclical UI**
  - productivity shocks $\rightarrow$ inefficient fluctuations
  - rat-race mechanism $\rightarrow 1 - \varepsilon^M / \varepsilon^m > 0$
Optimal UI over the business cycle: empirics
Direct evidence: \(1 - \frac{\varepsilon_M}{\varepsilon_m} > 0\)

- Levine [1993]: \(1 - \frac{\varepsilon_M}{\varepsilon_m} = 1 > 0\)
  - UI extensions in the US in 1980s
- Marinescu [2014]: \(1 - \frac{\varepsilon_M}{\varepsilon_m} = 0.3 > 0\)
  - UI extensions in the US during Great Recession
- Johnston & Mas [2015]: \(1 - \frac{\varepsilon_M}{\varepsilon_m} = 0\)
  - UI reduction in Missouri in 2011
- Lalive et al. [2015]: \(1 - \frac{\varepsilon_M}{\varepsilon_m} = 0.2 > 0\)
  - reform of UI system in Austria in the 1990s
Indirect evidence: $1 - \varepsilon^M / \varepsilon^m > 0$

- convincing evidence of rat-race mechanism
  - negative spillover of higher job search
  - Crepon et al. [2013], Burgess & Profit [2001]
- no evidence of job-creation mechanism
  - re-employment wages unaffected by UI
  - Card et al. [2007], Schmieder et al. [2015]
  - only exception is Hagedorn et al. [2013]
Recruiter-producer ratio $\tau(\theta)$

![Graph showing trends in recruiter-producer ratio from 1990 to 2010 with data from CES, JOLTS, and CPS.]
Elasticity of matching function $\eta$

$$\ln(\theta(t + 1)) - \ln(\theta(t))$$

$$\ln(f(t + 1)) - \ln(f(t))$$

$$1 - \eta = 0.34$$
Utility gain from work $\Delta U$

- extended empirical model: $\Delta U = \log\left(\frac{c^e}{c^h}\right) + Z$
- consumption drop upon unemployment: 19%
  - consumption drop for food: 7%
  - income elasticity of food consumption: 0.36
- nonpecuniary cost of unemployment: $Z = 45\%$
  - well-being surveys: 45% of yearly income
  - career choices [Borgschulte & Martorell 2015]
  - standard macro assumption: $Z < 0$
Efficiency term = 0: UI = Baily-Chetty
Efficiency term = 0: UI = Baily-Chetty
Efficiency term \(< 0\): UI \(< \) Baily-Chetty
Efficiency term $> 0$: UI $> \text{Baily-Chetty}$
Nonpecuniary cost of unemployment $Z$ is critical
Optimal UI over the business cycle: simulations of the job-rationing model
Large fluctuations of unemployment
Large fluctuations of tightness $\theta$
The microelasticity $\varepsilon^m$ is stable
The elasticity wedge $1 - \varepsilon^M / \varepsilon^m$ is positive.
The rat race is stronger in slumps

![Graph showing the relationship between technology and elasticity wedge. The graph indicates that in slumps, the rat race is strong, while in booms, it is weak.](Image)
The efficiency term changes sign
The optimal UI is countercyclical

\[ \text{Replacement rate} \]

\[ \text{Technology} \]

- **Optimal UI**
- **Constant UI**

- Slump
- Boom

58%
The optimal UI is countercyclical
Higher UI $\rightarrow$ slightly higher unemployment
Higher UI \(\rightarrow\) slightly higher unemployment