Optimal Unemployment Insurance over the Business Cycle

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Literature on Unemployment Insurance

- Optimal benefit level:
  - Baily ['78]
  - Chetty ['06]
- Optimal benefit levels over unemployment spell:
  - Shavell and Weiss ['79]
  - Hopenhayn and Nicolini ['97]
  - Shimer and Werning ['08]
- Optimal benefit levels over business cycle: –

Framework

- Model of equilibrium unemployment [Pissarides, '00]
- Risk-averse workers, no self-insurance
- Unobservable job-search efforts [Baily, '78]
- Recessions
  - real wage rigidity [Hall, '05]
- Job rationing [Michaillat, forthcoming]
  - real wage rigidity & downward-sloping demand for labor

▸ Diagram

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Why Job Rationing in Recessions?

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Overview of Results

In recessions, unemployment insurance (UI) should be

- constant?
- more generous?
- less generous?

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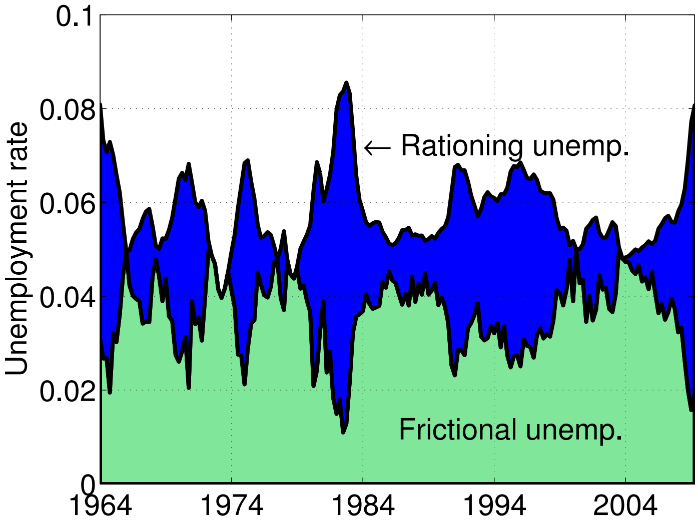
In recessions, unemployment insurance (UI) should be

- constant
- more generous: $\frac{\text{Consumption of unemployed}}{\text{Consumption of employed}} \uparrow$
- less generous

What Happens in Recessions?



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What Happens in Recessions?

- Marginal benefits:
  - insurance
  - correction for negative *rat-race externality*
- Marginal cost:
  - increase of aggregate unemployment

- UI

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What Happens in Recessions?

- Marginal benefits:
  - insurance $\rightarrow$
  - correction for negative *rat-race externality* $\uparrow$
- Marginal cost:
  - increase of aggregate unemployment $\downarrow$

- UI $\uparrow$

Diagram

Outline of the Paper

1. Optimal UI formula: $\tau = \tau(\epsilon^m, \epsilon^M, \text{risk aversion})$
   - $\tau = c^u/c^e$: replacement rate
   - in generic model of equilibrium unemployment
   - formula in *sufficient statistics*
2. Optimal UI over the business cycle
   - model of recessions and job rationing [Michaillat, forthcoming]
   - charaterize elasticities ϵ^m, ϵ^M over business cycle
   - prove: optimal τ increases in recessions
3. Extension to an infinite-horizon model
   - verify robustness of theoretical results
   - extensions: (1) optimal UI with deficit spending; (2) optimal duration of benefits

1. Optimal UI Formula: $\tau = \tau(\epsilon^m, \epsilon^M, \text{risk aversion})$

2. Optimal UI over the Business Cycle

3. Extension to an Infinite-Horizon Model

UI Program

- Government gives c^e to n employed workers
- Government gives c^u to $1 - n$ unemployed workers
- Budget constraint: $n \cdot w = n \cdot c^e + (1 - n) \cdot c^u$

One-Period Model with Matching Frictions

- Initial number of unemployed workers: u
- Job-search effort: e
- Job openings: o
- Number of matches: $h = m(e \cdot u, o)$
- Labor market tightness: $\theta \equiv o/(e \cdot u)$
- Vacancy-filling proba.: $q(\theta) = m\,(1/\theta, 1)$
- Job-finding proba.: $e \cdot f(\theta) = e \cdot m(1, \theta)$

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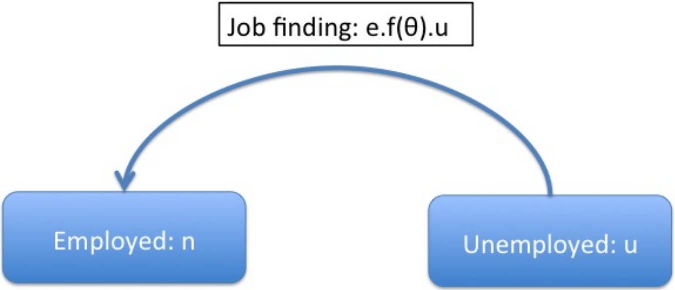

Unemployed Worker's Problem

- Given $\theta, \Delta v = v(c^e) - v(c^u)$, choose e to maximize

$$v(c^u) + e \cdot f(\theta) \cdot \Delta v - k(e)$$

- Utility-maximizing effort $e(\theta, \Delta v)$:

$$k'(e) = f(\theta) \cdot \Delta v$$

- Aggregate labor supply:

$$n^s(e(\theta, \Delta v), \theta) = (1 - u) + e(\theta, \Delta v) \cdot f(\theta) \cdot u$$

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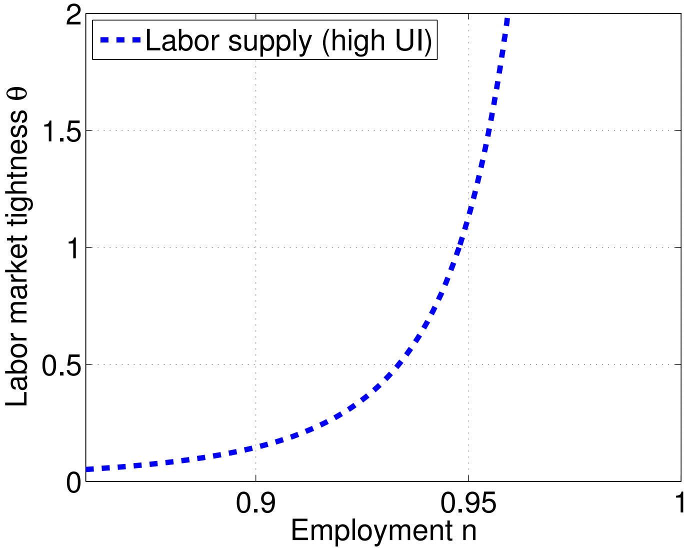
Response of Labor Supply to Lower UI



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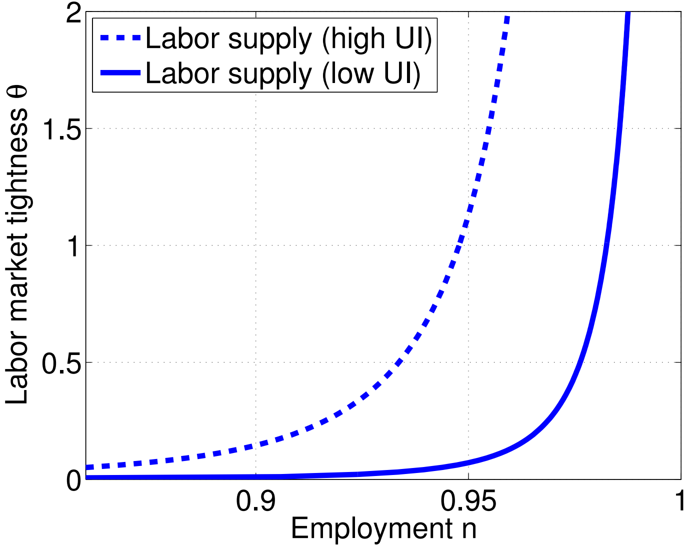

Government's Problem

Choose c^e, c^u to maximize

$$n \cdot v(c^e) + (1-n) \cdot v(c^u) - u \cdot k(e)$$

subject to:

- $\Delta v = v(c^e) - v(c^u)$
- budget: $n \cdot c^e + (1-n) \cdot c^u = n \cdot w$
- labor market dynamics: $n = (1-u) + u \cdot e \cdot f(\theta)$
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Micro-Elasticity ϵ^m

$$\epsilon^m \equiv \frac{\Delta c}{1-n} \cdot \left.\frac{\partial n^s}{\partial e}\right|_\theta \cdot \left.\frac{\partial e}{\partial \Delta c}\right|_\theta$$

- Response of individual job-search effort
- Elasticity used in the literature [Baily, '78]
- Interpretation: increase in probability of unemployment when individual UI increases

Macro-Elasticity ϵ^M

$$\epsilon^M \equiv \frac{\Delta c}{1-n} \cdot \frac{dn}{d\Delta c}$$

- Response of aggregate unemployment
- Interpretation: increase in aggregate unemployment when aggregate UI increases
- Macro-elasticity = micro-elasticity + unemployment change due to equilibrium adjustment of θ

$$\epsilon^M = \epsilon^m + \frac{\Delta c}{1-n} \cdot \frac{1+\kappa}{\kappa} \cdot \left(\left. \frac{\partial n^s}{\partial \theta} \right|_e \cdot \frac{d\theta}{d\Delta c} \right)$$

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Exact Optimal UI Formula

$$\frac{1}{n}\cdot\frac{\tau}{1-\tau}=\left[n+(1-n)\cdot\frac{v'(c^u)}{v'(c^e)}\right]^{-1}$$
$$\cdot\left\{\frac{n}{\epsilon^M}\cdot\left[\frac{v'(c^u)}{v'(c^e)}-1\right]+\frac{\Delta v}{v'(c^e)\cdot\Delta c}\cdot\frac{\kappa}{\kappa+1}\cdot\left[\frac{\epsilon^m}{\epsilon^M}-1\right]\right\}$$

Optimal UI Formula in Sufficient Statistics

$$\frac{\tau}{1-\tau} \approx \frac{\rho}{\epsilon^M} \cdot (1-\tau) + \frac{\kappa}{1+\kappa} \cdot \left[\frac{\epsilon^m}{\epsilon^M} - 1 \right] \cdot \left[1 + \frac{\rho}{2} \cdot (1-\tau) \right]$$

- τ: replacement rate c^u/c^e
- ρ: coefficient of relative risk aversion
- κ: elasticity of marginal disutility of effort
- ϵ^M: macro-elasticity of unemployment
- ϵ^m: micro-elasticity of unemployment

Building on the Baily ['78] Formula

$$\frac{\tau}{1-\tau} \approx \frac{\rho}{\epsilon^m}(1-\tau)$$

- Public economics: Baily ['78], Chetty ['06]
- Government budget constraint in general equilibrium
- Correction for equilibrium adjustment of θ, with first-order welfare effect:

$$\left.\frac{\partial n^s}{\partial \theta}\right|_e \cdot d\theta \propto \left[\epsilon^m - \epsilon^M\right]$$

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3. Extension to an Infinite-Horizon Model

A Model of Recessions and Job Rationing

- Given (θ, a), firm chooses $n \geq 1 - u$ to maximize

$$\underbrace{a \cdot n^{\alpha}}_{production} - \underbrace{\omega \cdot a^{\gamma}}_{wage} \cdot n - \underbrace{\frac{r \cdot a}{q(\theta)}}_{hiring\ \ cost} \cdot [n - (1 - u)]$$

- Profit-maximizing employment $n^d(\theta, a)$:

$$\alpha \cdot n^{\alpha - 1} = \omega \cdot a^{\gamma - 1} + \frac{r}{q(\theta)}$$

- Wage rigidity: $\gamma < 1$
- Diminishing marginal returns to labor: $\alpha < 1$

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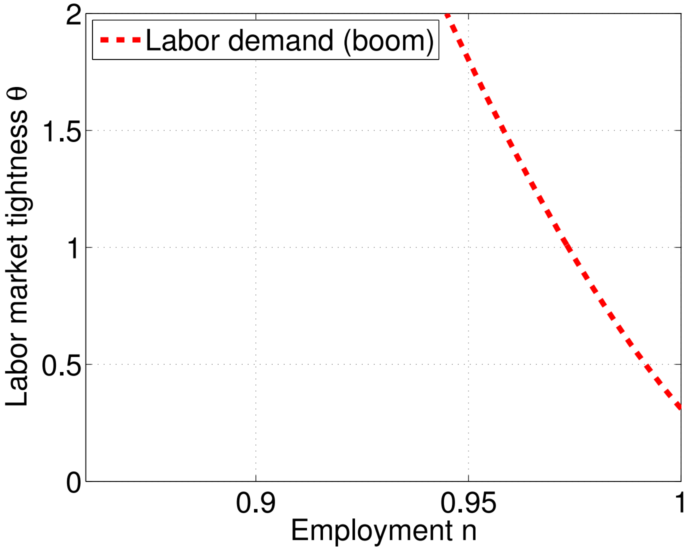
Labor Demand over the Business Cycle



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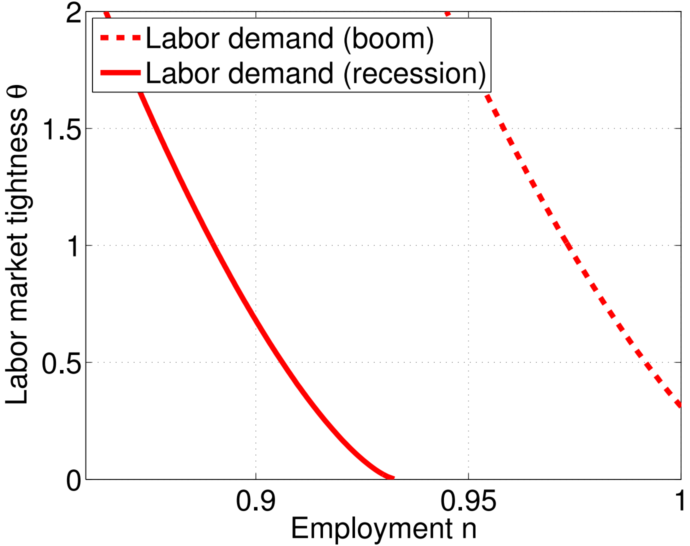

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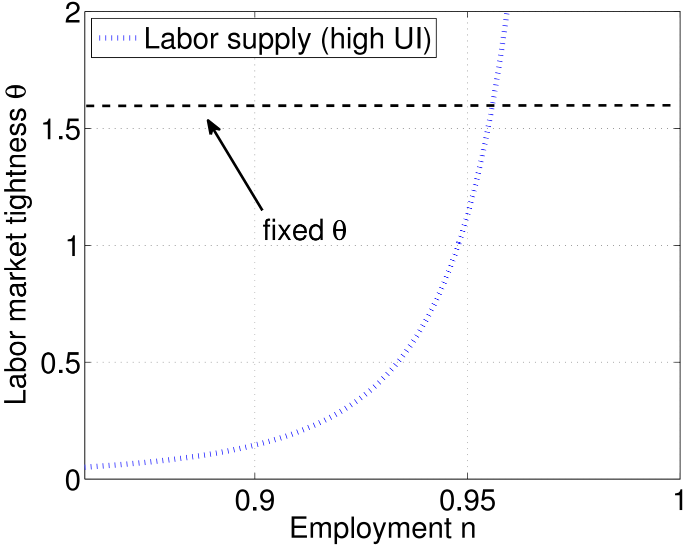

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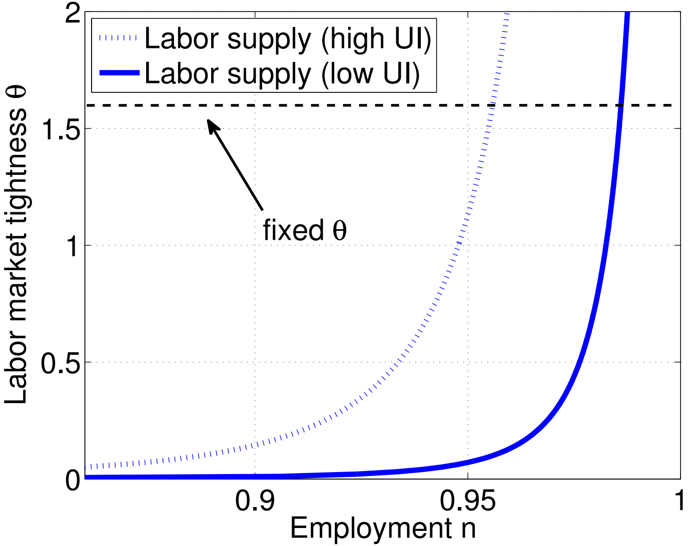

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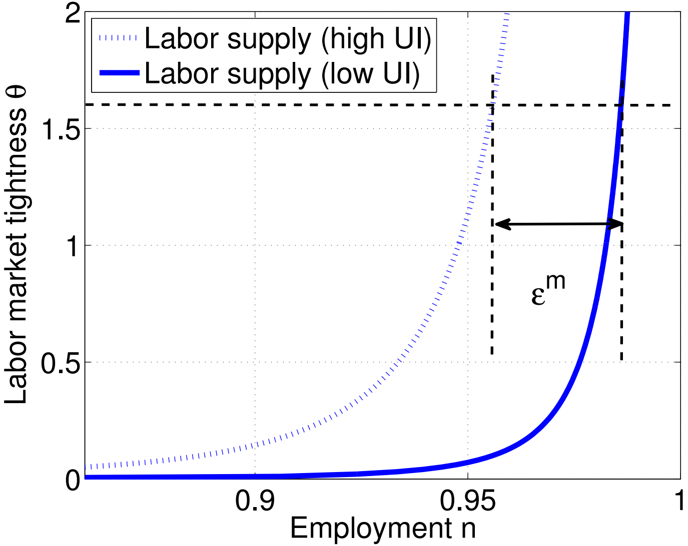
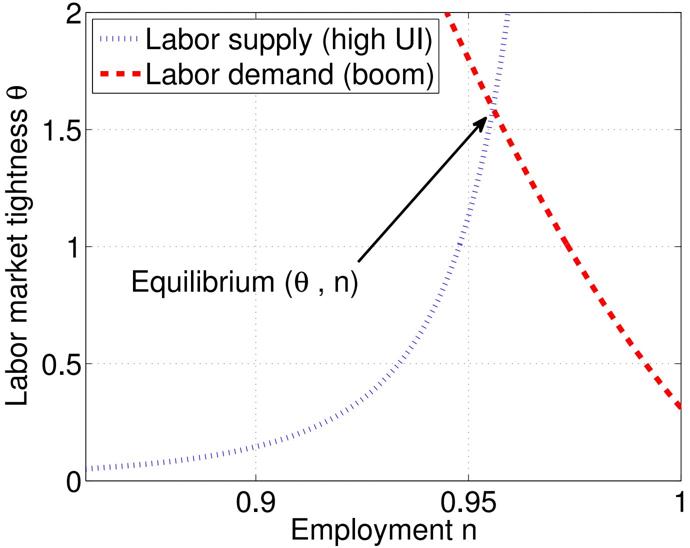


Our General-Equilibrium Model



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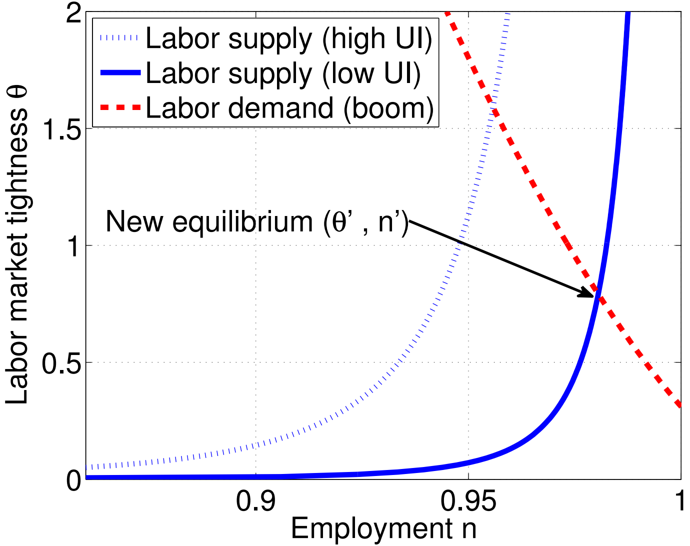

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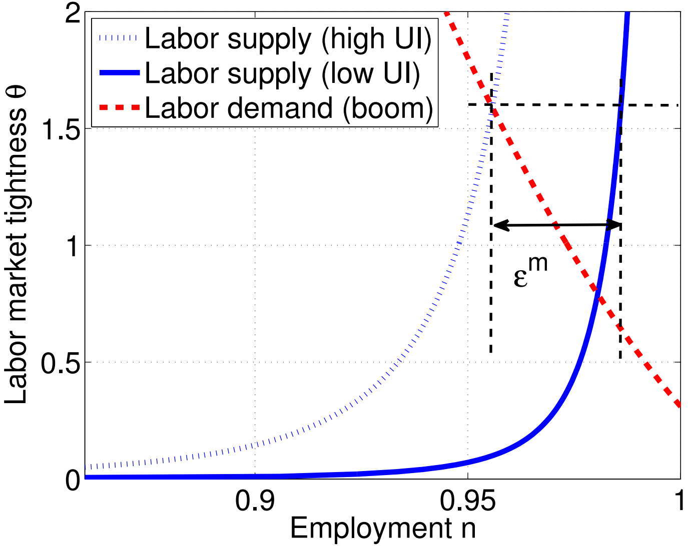

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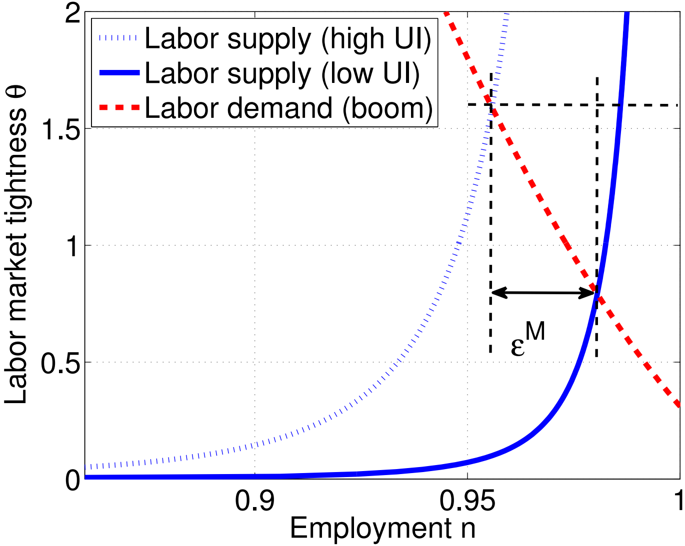

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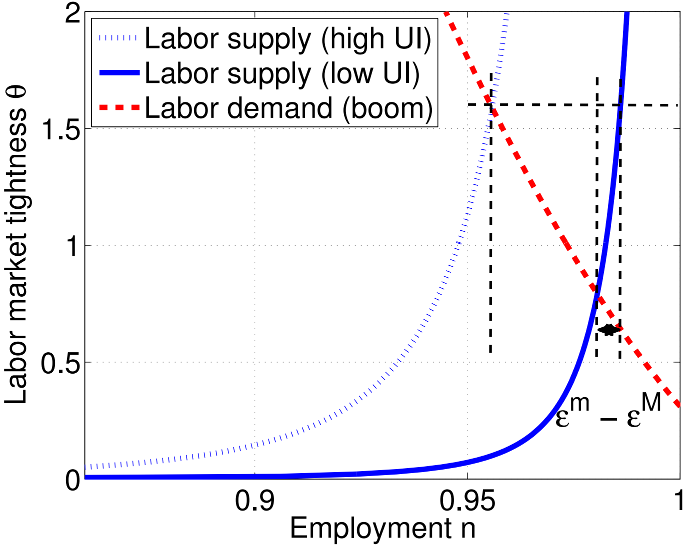

Micro-Elasticity $\epsilon^m >$ Macro-Elasticity ϵ^M

- Positive wedge between ϵ^m and ϵ^M:

$$\epsilon^m > \epsilon^M$$

- Estimable statistic:

$$\left[\epsilon^m - \epsilon^M\right] \propto \frac{\Delta c}{\theta} \cdot \frac{d\theta}{d\Delta c}$$

- Testable implication:
  - model with Nash bargaining [Pissarides, '00]:

$$\epsilon^m < \epsilon^M$$

  - model with rigid wages [Hall, '05]:

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Micro-Elasticity $\epsilon^m >$ Macro-Elasticity ϵ^M

- Positive wedge between ϵ^m and ϵ^M:

$$\epsilon^m > \epsilon^M$$

- Estimable statistic:

$$\left[\epsilon^m - \epsilon^M\right] \propto \frac{\Delta c}{\theta} \cdot \frac{d\theta}{d\Delta c}$$

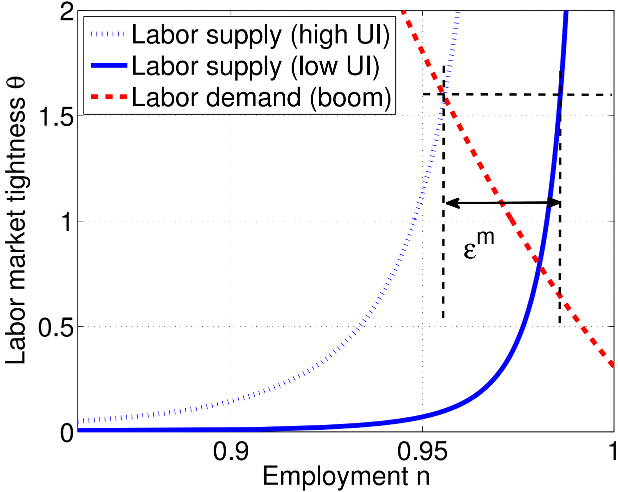
- Testable implication:
  - model with Nash bargaining [Pissarides, '00]:

$$\epsilon^m < \epsilon^M$$

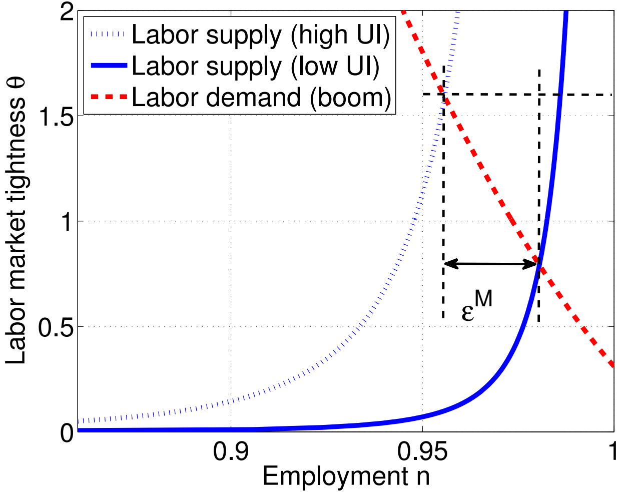
  - model with rigid wages [Hall, '05]:

$$\epsilon^m = \epsilon^M$$

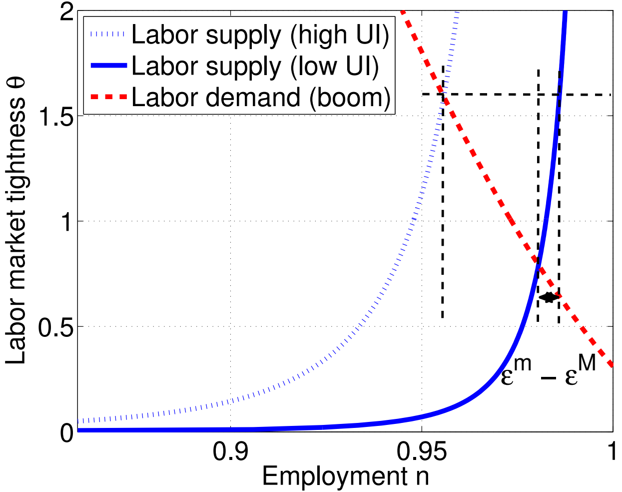
Effect of Lower UI in Expansion



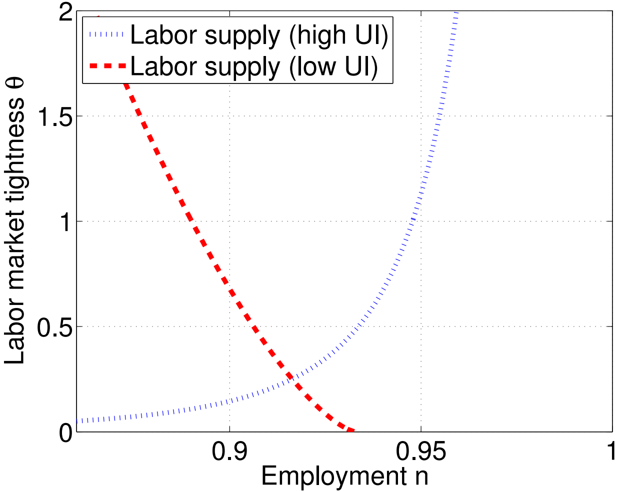
Effect of Lower UI in Expansion



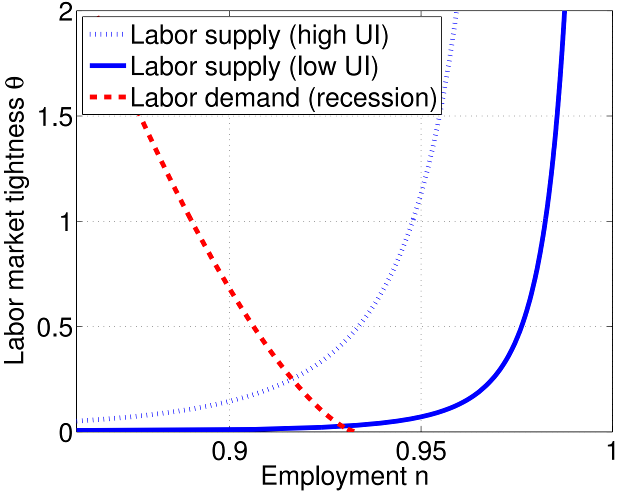
Effect of Lower UI in Expansion



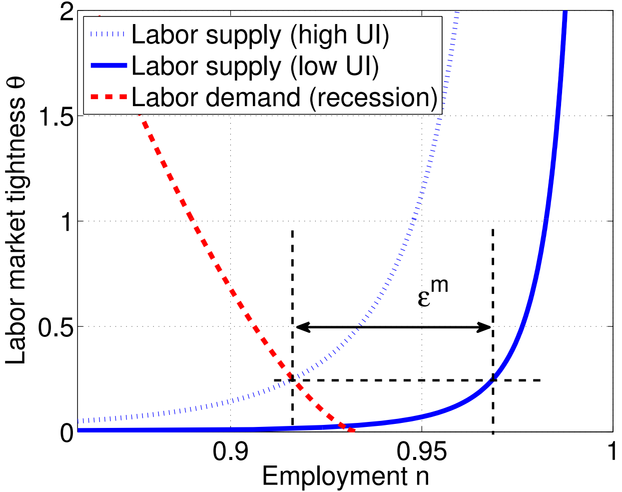
Effect of Lower UI in Recession



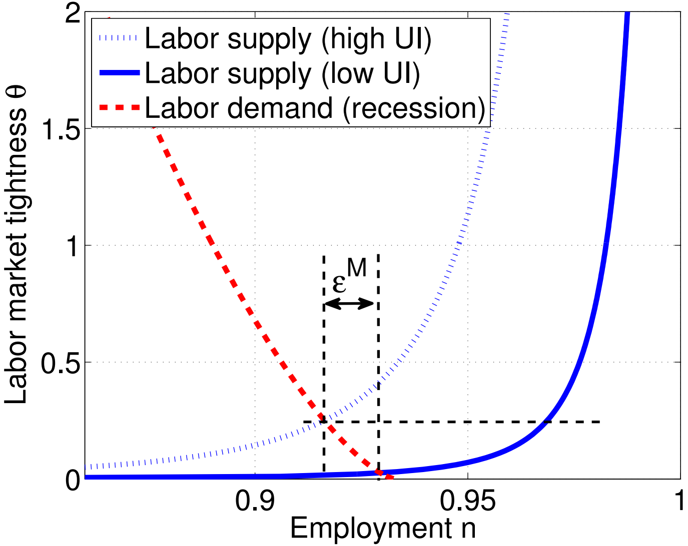
Effect of Lower UI in Recession



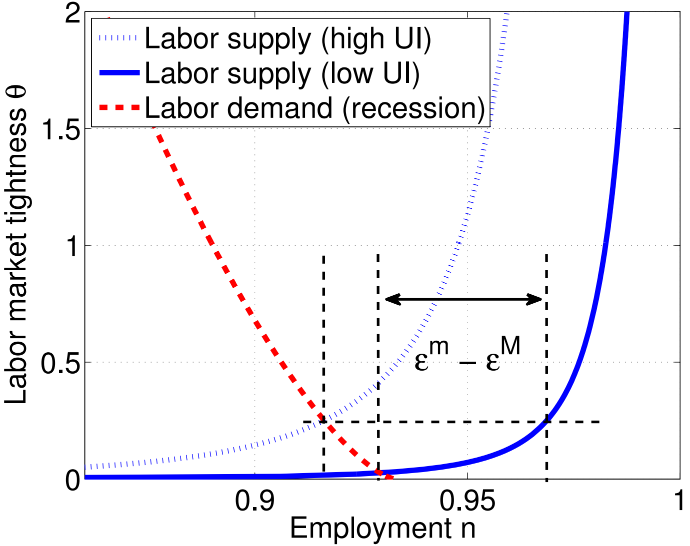
Effect of Lower UI in Recession



Effect of Lower UI in Recession



Effect of Lower UI in Recession



Cyclicality of Elasticities

- Assume: isoelastic utility functions, Cobb-Douglas matching function

- Wedge $\epsilon^m/\epsilon^M > 1$ is countercyclical :

$$\left.\frac{\partial\left(\epsilon^m/\epsilon^M\right)}{\partial a}\right|_\tau < 0$$

- Macro-elasticity ϵ^M is procyclical:

$$\left.\frac{\partial \epsilon^M}{\partial a}\right|_\tau > 0$$

Intuition for Optimal UI in Recession

$$\frac{\tau}{1-\tau} \approx \frac{\rho}{\epsilon^M} \cdot (1-\tau) + \frac{\kappa}{1+\kappa} \cdot \left[\frac{\epsilon^m}{\epsilon^M} - 1\right] \cdot \left[1 + \frac{\rho}{2} \cdot (1-\tau)\right]$$

- Small impact of UI on unemployment: $\epsilon^M \downarrow$
- Strong rat-race externality: $\epsilon^m / \epsilon^M \uparrow$
- $\tau \uparrow$: UI should be more generous

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Optimal Replacement Rate τ is Countercyclical

- $\tau = c^u / c^e$ captures generosity of UI
- Use exact optimal UI formula
- Prove: optimal UI is more generous in recessions:

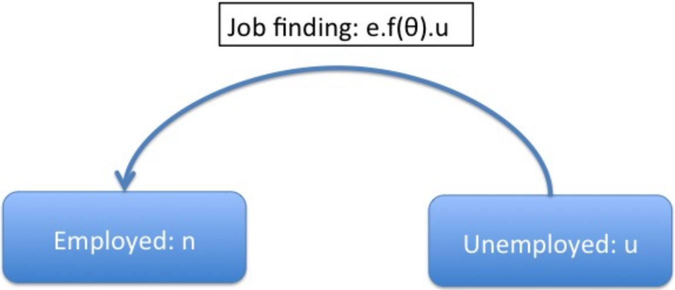
$$\frac{d\tau}{da} < 0$$

1. Optimal UI Formula: $\tau = \tau(\epsilon^m, \epsilon^M, \text{risk aversion})$

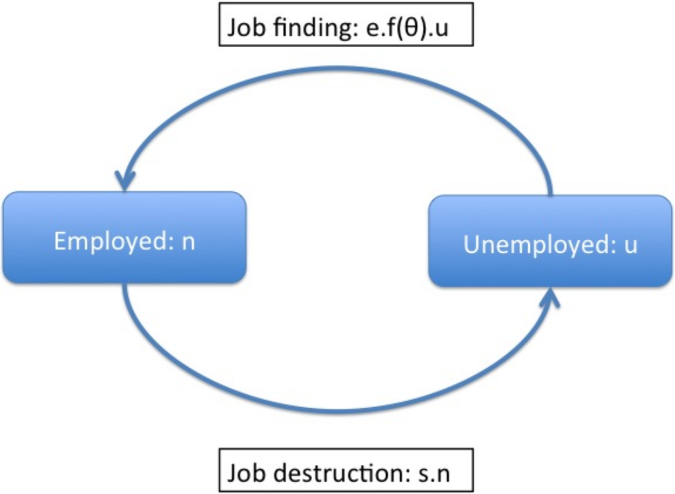
2. Optimal UI over the Business Cycle

3. Extension to an Infinite-Horizon Model

Flows of Workers



Flows of Workers



Stochastic Environment

- Fluctuations are driven by technology $\{a_t\}_{t=0}^{\infty}$.
- All workers receive the same c_t^e (if employed) and c_t^u (if unemployed) at time t
- Firm's, worker's, and government's decisions at time t are measurable wrt $a^t = (a_0, a_1, \ldots, a_t)$.
- Government can commit to policy.

Worker's Problem (Labor Supply)

- Given $\{a_t, \theta_t, c_t^e, c_t^u\}_{t=0}^{\infty}$,
- Choose job-search effort $\{e_t\}_{t=0}^{\infty}$
- To maximize expected utility:

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \delta^t \left\{(1 - n_t^s)v(c_t^u) + n_t^s v(c_t^e) - \left[1 - (1 - s)n_{t-1}^s\right] k(e_t)\right\}$$

- Subject to

$$n_t^s = \left[1 - (1 - s) \cdot n_{t-1}^s\right] \cdot e_t \cdot f(\theta_t) + (1 - s) \cdot n_{t-1}^s.$$

Firm's Problem (Labor Demand)

- Given $\{a_t, \theta_t, w_t\}_{t=0}^{\infty}$
- Choose hiring $\{h_t\}_{t=0}^{\infty}$
- To maximize expected profits:

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \delta^t \left\{ a_t \cdot \left(n_t^d\right)^{\alpha} - w_t \cdot n_t^d - \frac{r \cdot a_t}{q(\theta_t)} \cdot h_t \right\}$$

- Subject to:

$$n_t^d = (1 - s) \cdot n_{t-1}^d + h_t.$$

Equilibrium on the Labor Market

- Wage is indeterminate

$$w_t = \omega \cdot a_t^{\gamma}, \;\; \gamma < 1$$

- Tightness θ equalizes labor supply and labor demand

$$n_t \equiv n_t^s = n_t^d$$

Government's Problem

- Given $\{a_t\}_{t=0}^{\infty}$
- Choose consumptions $\{c_t^e, c_t^u\}_{t=0}^{\infty}$
- To maximize worker's expected utility

$$\mathbb{E}_0 \sum_{t=0}^{+\infty} \delta^t \left\{(1-n_t)v(c_t^u) + n_t v(c_t^e) - [1-(1-s)n_{t-1}]\, k(e_t)\right\}$$

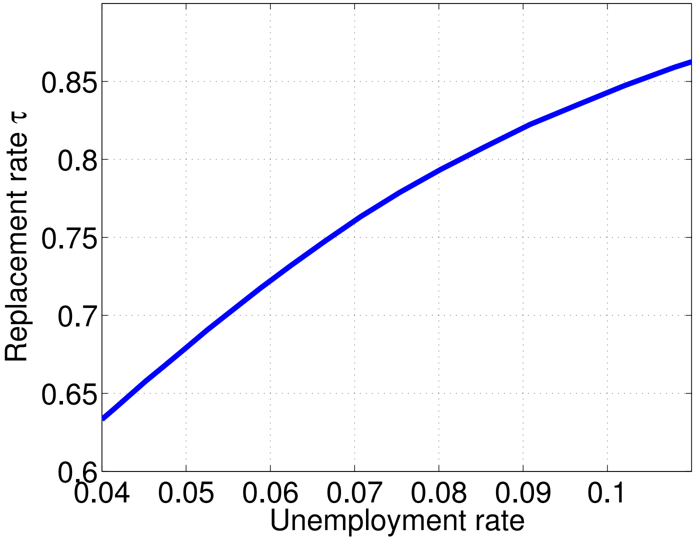
- Subject to worker's and firm's optimality conditions, equilibrium conditions, and budget constraints

$$n_t \cdot w_t = n_t \cdot c_t^e + (1-n_t) \cdot c_t^u.$$

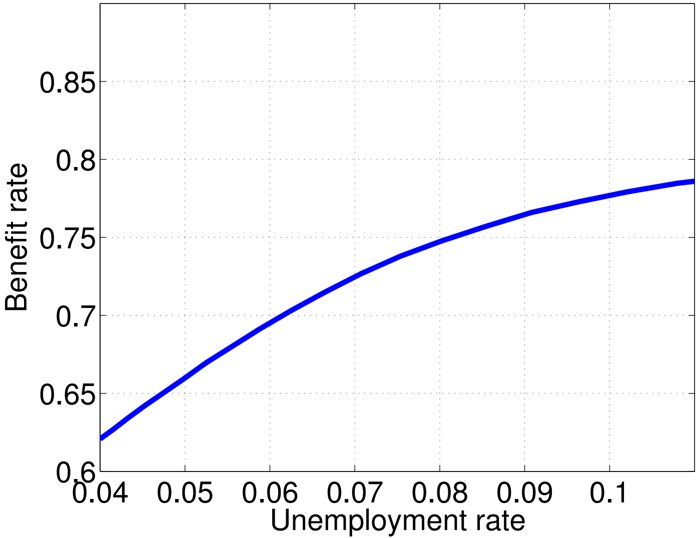
Calibration: US, weekly frequency

	Interpretation	Value	Source
ρ	Relative risk aversion	1	Chetty ['06]
γ	Real wage rigidity	0.5	Haefke et al. ['08], Pissarides ['09]
η	Effort-elasticity of matching	0.7	Petrongolo & Pissarides ['01]
s	Separation rate	0.95%	JOLTS, 2000–2010
ω_m	Effectiveness of matching	0.23	JOLTS, 2000–2010
r	Recruiting cost	0.21	Barron et al. ['97], Silva & Toledo ['09]
α	Marginal returns to labor	0.67	Matches labor share$=0.66$
ω	Steady-state real wage	0.67	Matches unemployment$=5.9\%$
κ	Curvature of disutility of effort	2.1	Matches Meyer ['90]
ω_k	Disutility of effort	0.58	Matches effort $=1$ for $t=7.65\%$, $b=60\%$

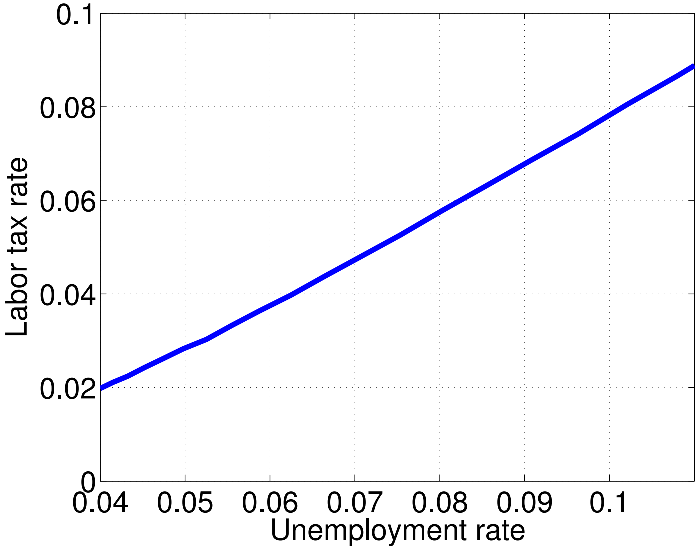
Steady State: Optimal Replacement Rate



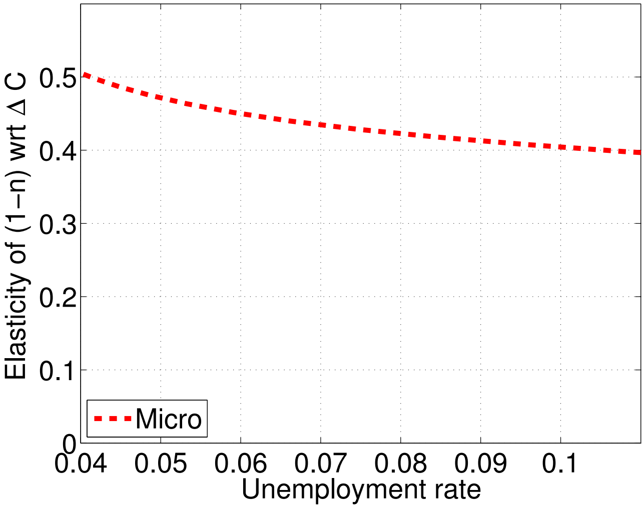
Steady State: Optimal Benefit Rate



Steady State: Optimal Labor Tax Rate

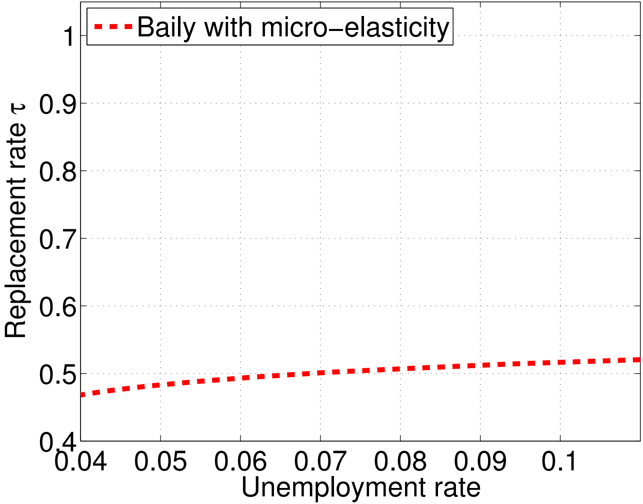


Comparison with Baily ['78] Formula



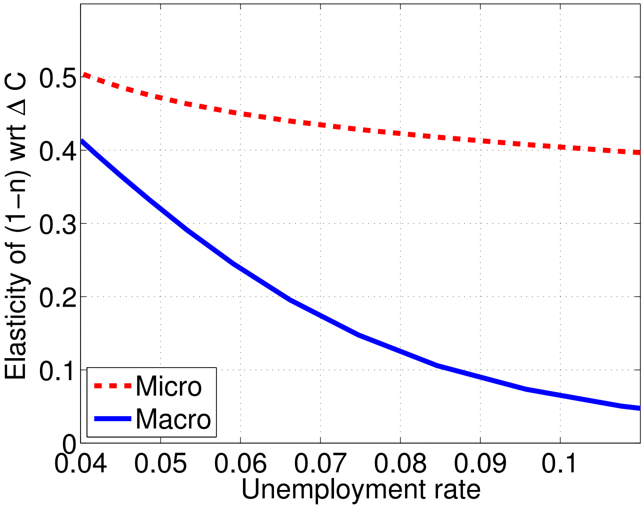
Optimal UI formula in infinite-horizon model

Comparison with Baily ['78] Formula



▸ Optimal UI formula in infinite-horizon model

Comparison with Baily ['78] Formula



‣ Optimal UI formula in infinite-horizon model

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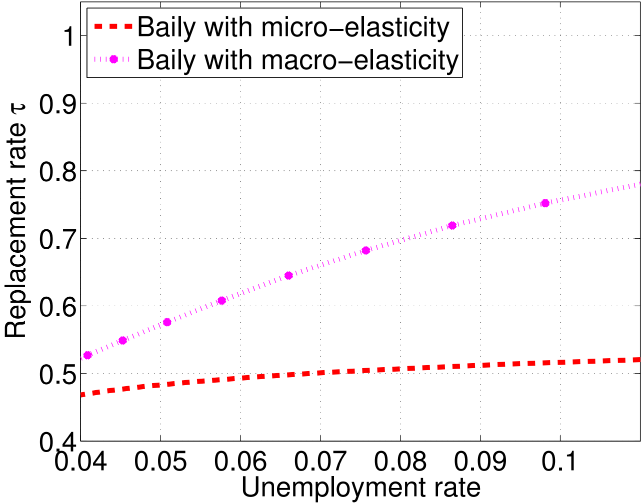

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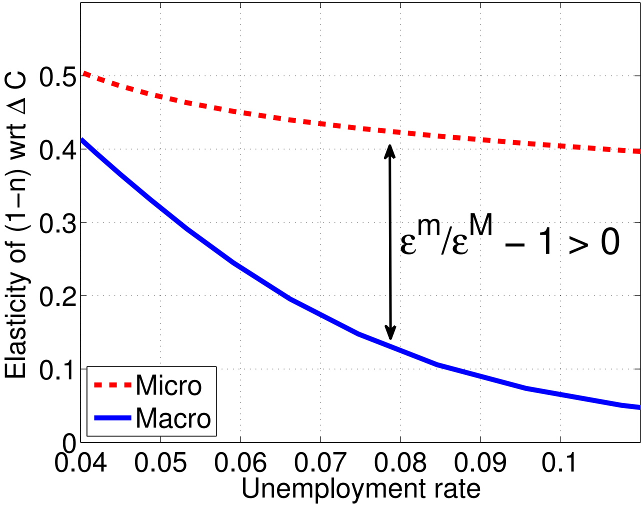

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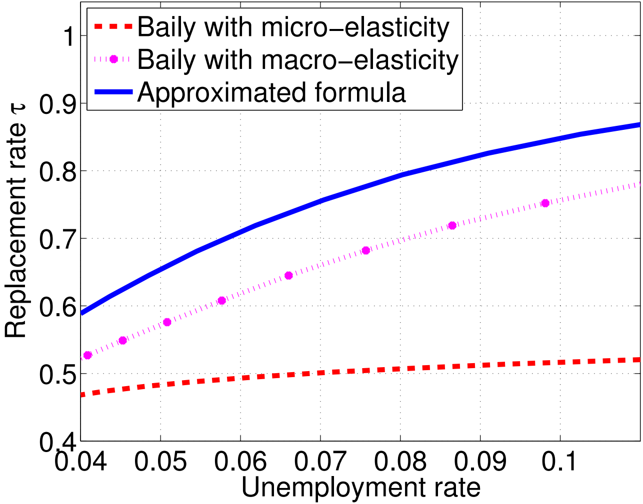

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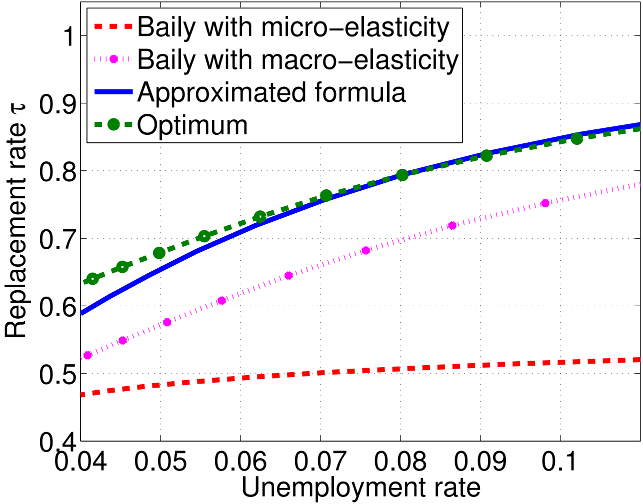
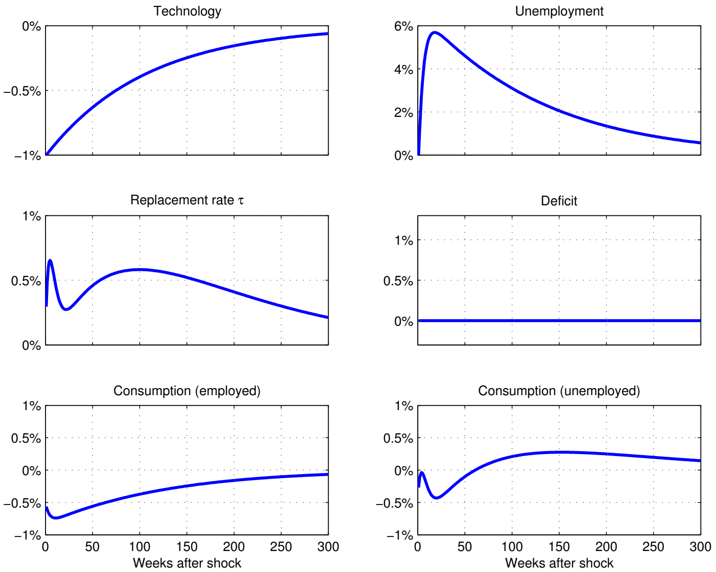


▸ Optimal UI formula in infinite-horizon model

Dynamics: Government Cannot Borrow



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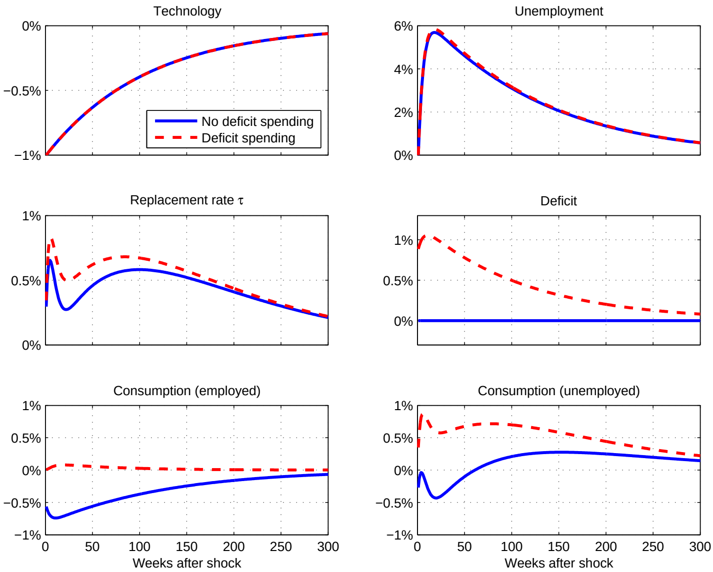
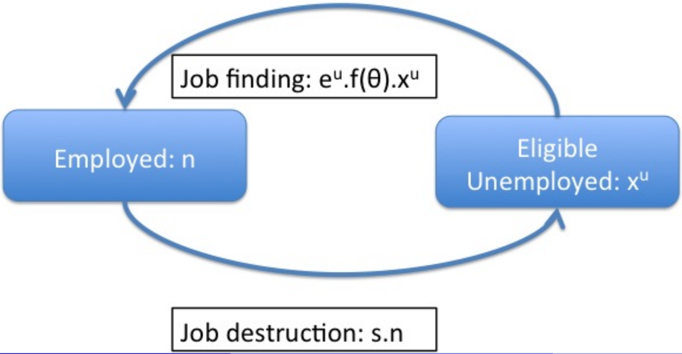
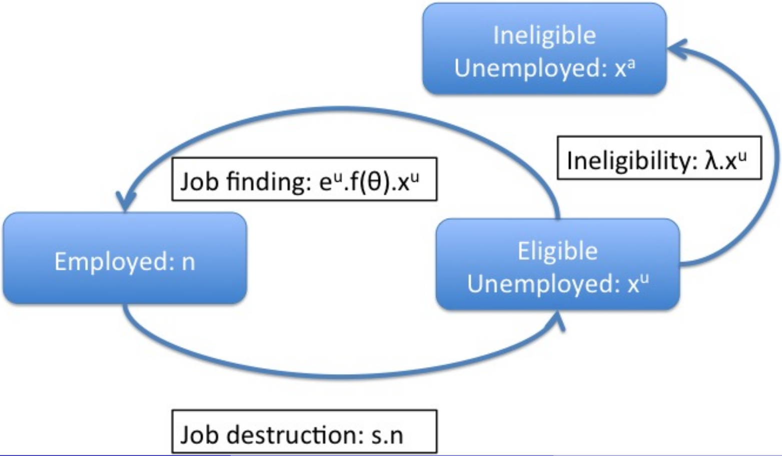


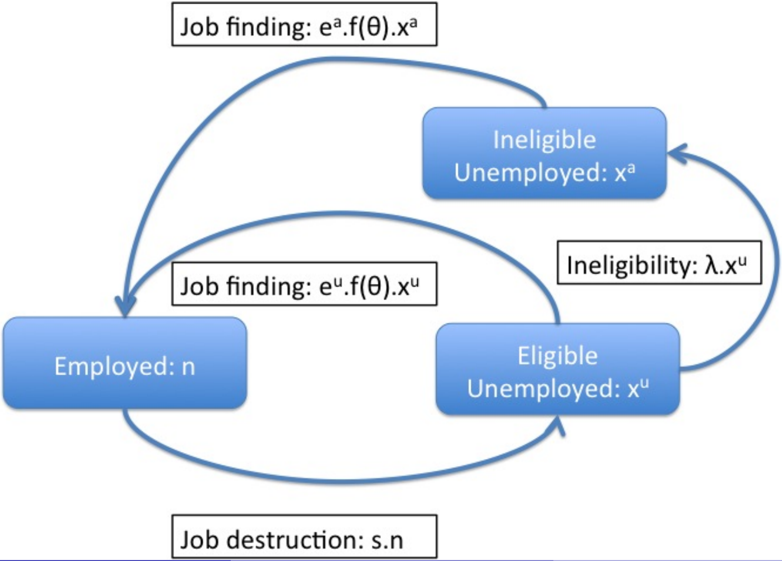
Flows of Workers: Finite-Duration Model



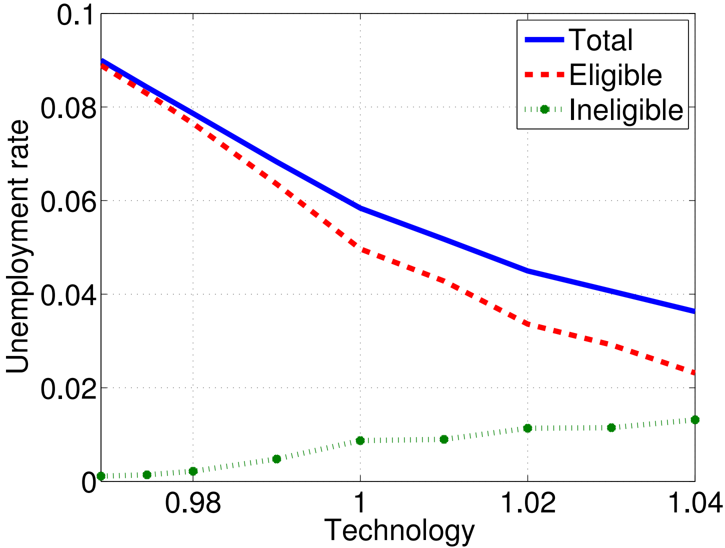
Flows of Workers: Finite-Duration Model



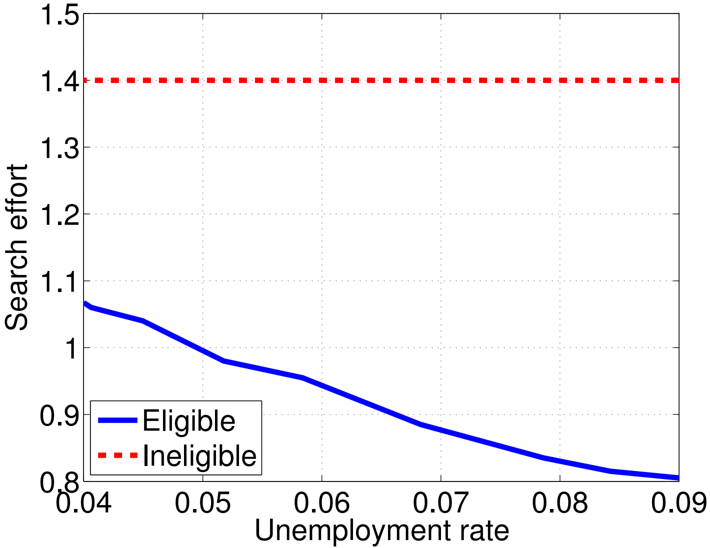
Flows of Workers: Finite-Duration Model



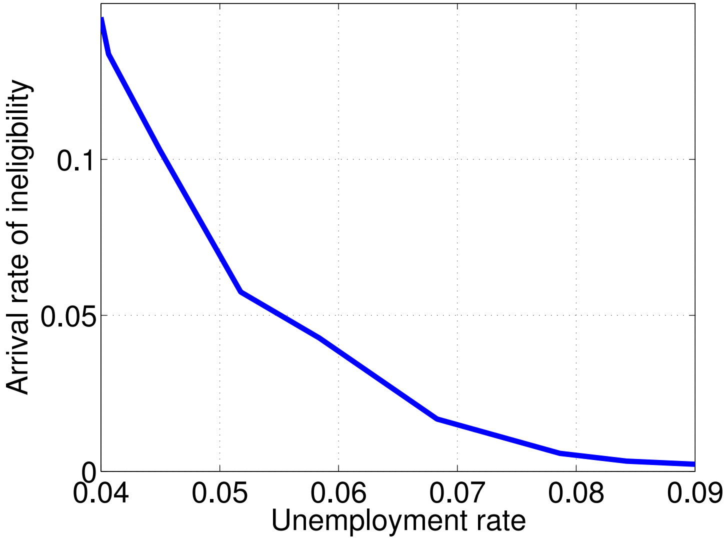
Optimal Composition of Unemployment



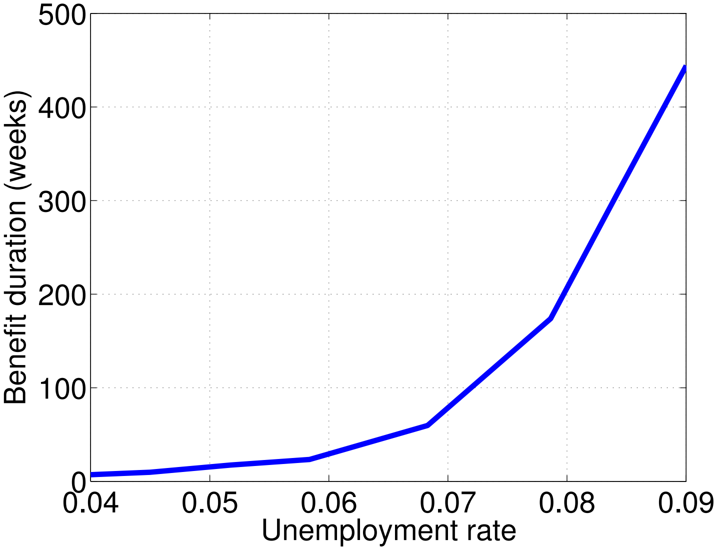
Optimal Job-Search Effort



Optimal Weekly Arrival Rate of Ineligibility



Optimal Expected Duration of Benefits

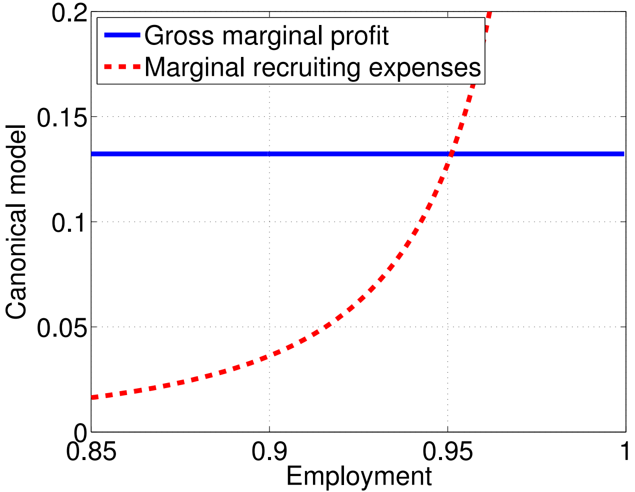


Next Step: Estimation of ϵ^m and ϵ^M

- Estimation of ϵ^m:
  - evidence for Germany: Schmieder et al. ['11]
  - our data: Continuous Wage & Benefit History (CWBH)
  - UI data for 7 US states, 1978–1983
  - regression kink design: use kink in schedule of UI benefits
  - details: Micro-elasticity
- Direct estimation of ϵ^M:
  - preliminary evidence: Notowidigdo & Kroft ['11]
  - but, very difficult
- Indirect estimation of ϵ^M: estimation of ϵ^m/ϵ^M
  - our data: Regional Extended Benefit Program (REBP)
  - Austria, 1988–1995
  - difference-in-difference: compare job-finding probability of non-treated in treated vs. non-treated regions
  - details: Macro-elasticity

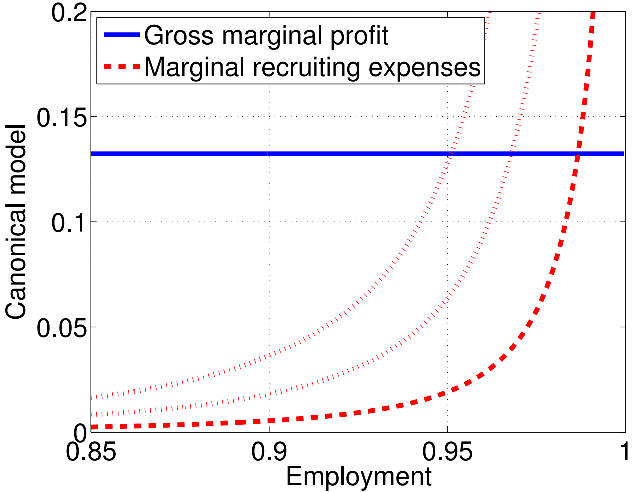
BACK-UP SLIDES

Equilibrium: Pissarides ['00] Model



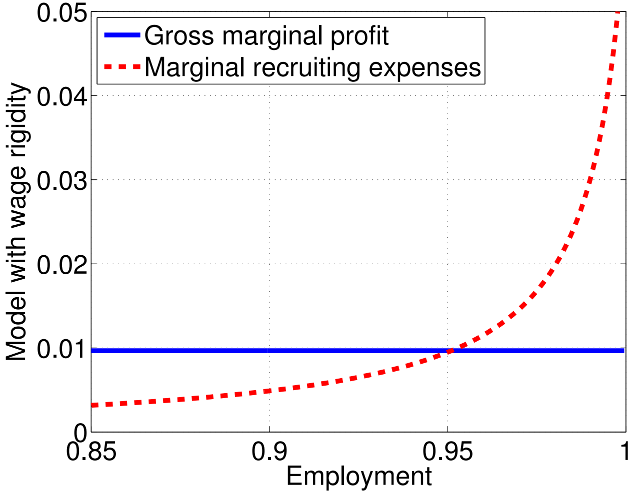
Return

Equilibrium: Pissarides ['00] Model



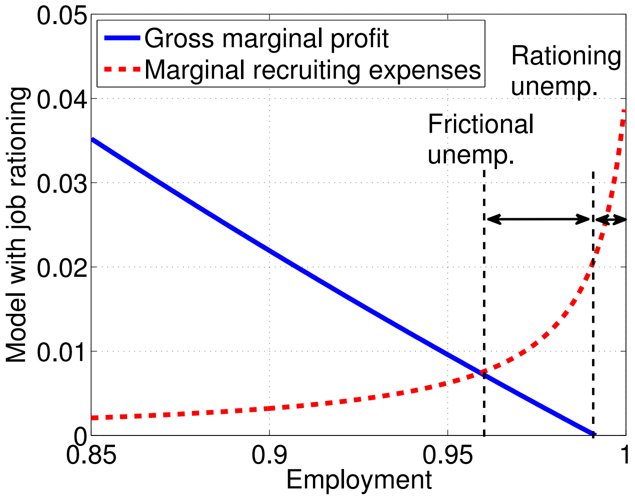
Return

Equilibrium: Hall ['05] Model



▸ Return

Equilibrium: with Job Rationing



Return

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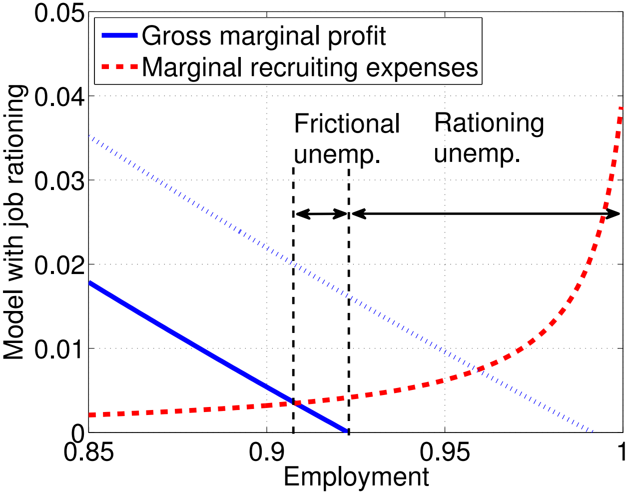


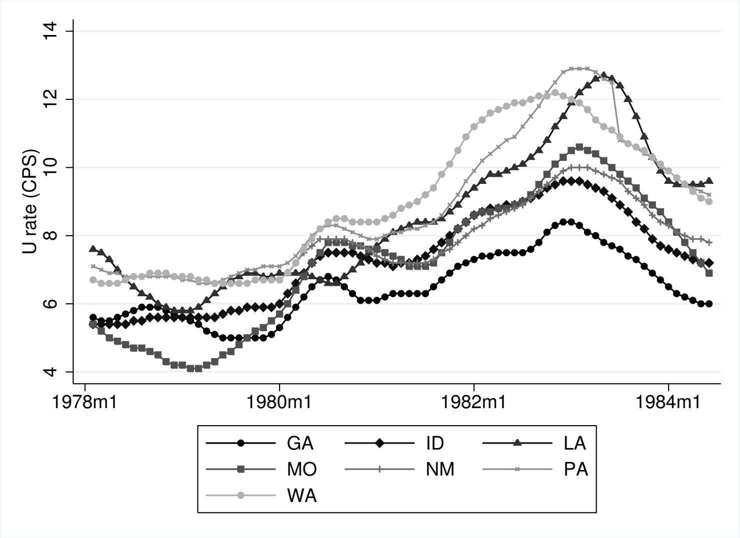
Return

Optimal UI Formula in Infinite-Horizon Model

$$\frac{\tau}{1-\tau} \approx \frac{\rho}{\epsilon^M} \cdot (1-\tau) + \frac{1+\kappa}{\kappa} \cdot \left[\frac{\epsilon^m}{\epsilon^M} - 1\right] \cdot \left[1 + \frac{\rho}{2} \cdot (1-\tau)\right]$$

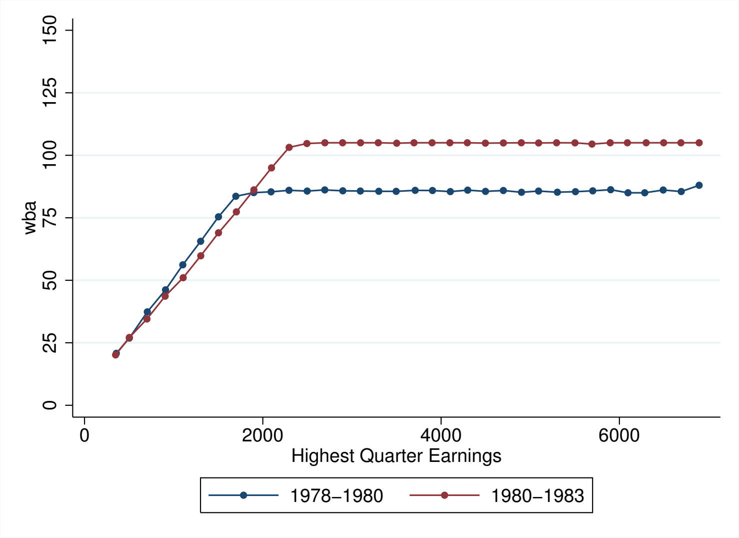
Return

Unemployment Rates in CWBH



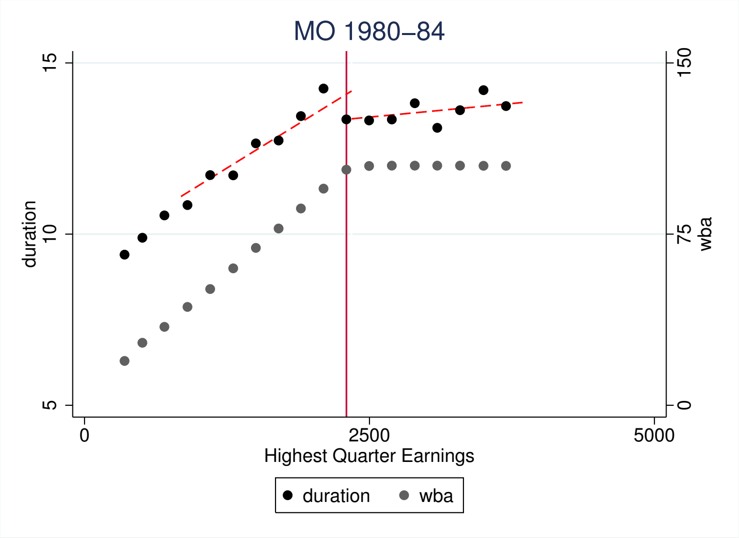
Return

Weekly UI Benefits Schedule: Missouri



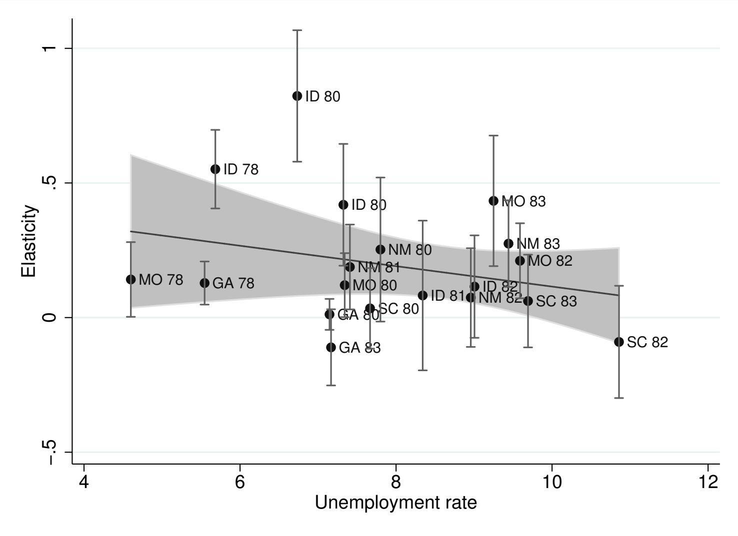
Return

RKD Design



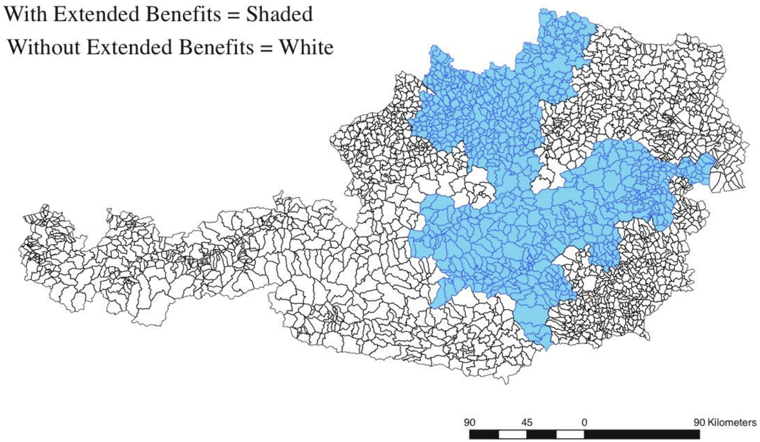
Return

Micro-Elasticity over the Business Cycle



Return

Regional Distribution of REBP



Return

Difference in Non-Employment Duration: Age 50-53

Return

Difference in Non-Employment Duration: Age 46-49

Return