Time-Varying Employment Risks, Consumption Composition, and Fiscal Policy

Kazufumi Yamana [1] Makoto Nirei [2] Sanjib Sarker [3]

[1]Hitotsubashi University

[2]Hitotsubashi University

[3]Utah State University

Summer Workshop on Economic Theory (SWET)
August 10, 2014

Motivation

- How does the household respond to a change in the **Unemployment Risk**?
- How is the **indirect effect** of a labor market policy?
  - Heckman, Lalonde, and Smith (1999)

Plan

- Consider labor market policies which affects unemployment risk environment.
- Construct a Krusell and Smith (1998)-type heterogeneous dynamic general equilibrium model to quantify the response.

Labor Market Policy

Passive Labor Market Policy (PLMP)

- Unemployment benefits (Unemployment insurance)

Active Labor Market Policy (ALMP)

1. Direct job creation (Ex. EU job programs for young people)
2. Employment incentives

Summary of results

When the unemployment risk decreases, the aggregate consumption increases.

- An **1.17%** drop in the unemployment rate increases the aggregate consumption level by **0.04 - 0.37%**.
- Much of the increment comes from the response to a decrease in the unemployment risk.
  - Not the composition effect.

Model

- Based on Krusell and Smith (1998)
  - Incomplete market ($\leftrightarrow$ Complete market)
  - Heterogeneous-agent model ($\leftrightarrow$ Representative-agent model)
  - Idiosyncratic shock + Aggregate shock ($\leftrightarrow$ Idiosyncratic shock ONLY)
- Modification
  - Unemployment rate follows aggregate policy regime.
- Solution algorithm
  - Euler equation based Policy function iteration with Endogenous grid method

Households

Each household i maximizes his/her utility:

$$\max_{c_{it},k_{it+1}} \mathrm{E}_0 \left[\sum_{t=0}^{\infty} \beta^t c_{it}^{1-\sigma}/(1-\sigma) \right]$$

$$\text{s.t.} \quad c_{it} + k_{it+1} = (r_t + 1 - \delta)k_{it} + \iota(h_{it})w_t - \tau(h_{it}, z_t), \quad \forall t$$

$$k_{it+1} \geq -\phi, \quad \forall t$$

where h_{it} denotes employment status (employed or unemployed), z_t denotes LMP regime (passive or active); both shocks follow exogenous stochastic process.

LMP regime

We consider 2 LMP regime: passive and active.

- In passive regime, the Government implements only a **passive** labor market policy.
- In active regime, the Government implements both **passive and active** labor market policies.

Exogenous stochastic process

- The LMP regime $z_t \in \{passive, active\}$ evolves according to the probabilities: $\pi_{zz'}$.
- The individual employment status $h_{it} \in \{unemployed, employed\}$ evolves according to the conditional probabilities: $\pi_{h'|hzz'}$.
- The unemployment rate follows the LMP regime: $u = u_z$
  - In order to achieve the targeted unemployment level, the Government or private firm employs the additional labor in the active regime.

Firms and the Government

- The firm has a Cobb-Douglas production function

$$Y_t = K_t^{\alpha} H_t^{1-\alpha}$$

and maximizes its profit in a competitive market.

$$\begin{aligned} r_t &= \alpha(K_t/H_t)^{\alpha-1} \\ w_t &= (1-\alpha)(K_t/H_t)^{\alpha}. \end{aligned}$$

- The Governmental budget is balanced each time.

Market equilibrium

$$K_t = \int k_{it} \mathrm{d}\Gamma_t(k_{it}, h_{it})$$

$$H_t = \int h_{it} \mathrm{d}\Gamma_t(k_{it}, h_{it})$$

where $\Gamma_t(k_{it}, h_{it})$ is a joint cross-sectional distribution of household i's asset k_{it} and labor supply h_{it}.

Equilibrium

An equilibrium is defined by

- Value function: $V(k, h, z, \Gamma)$
- Policy function: $F(k, h, z, \Gamma)$
- Transition function: $T(\Gamma, \Gamma')$

where T denotes the equilibrium transition function: $\Gamma' = T(\Gamma, z, z')$.

Calibration

We calibrate

- the unemployment rate in the passive regime: $u_{passive} = 6\%$
- the unemployment rate in the active regime: $u_{active} = 4.83\%$

We refer to the House/Shapiro (2006) estimate of the policy impact of the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA)[1] in 2003

[1] The Economic Growth and Tax Relief Reconciliation Act (EGTRRA) in 2001 and the JGTRRA are collectively called the Bush tax cuts.

Unemployment rate

Calibration

- Under the passive policy regime, the unemployed receive the unemployment insurance,

$$\iota(h_{it})w_t = \begin{cases} w_t & h_{it} = employed \\ 0.2w_t & h_{it} = unemployed \end{cases}$$

where 0.2 is the unemployment insurance replacement rate[2].

- The cost is financed by a contemporaneous lump-sum tax on the employed:

$$\tau(employed, passive) = 0.2w_t u_{passive}/(1 - u_{passive}).$$

[2]This is OECD summary measure of benefit entitlement, not close to the initial replacement ratio which the unemployed legally guaranteed, approximately $0.4 - 0.5$

Calibration

Under the active policy regime, the unemployed receive the passive unemployment insurance and an additional benefit, the opportunity to be employed at wage rate w_t up to the targeted unemployment rate u_{active}.

- By the government (Government employment as a Direct job creation)
- By the private firms (Corporate tax reduction as a Employment incentives)

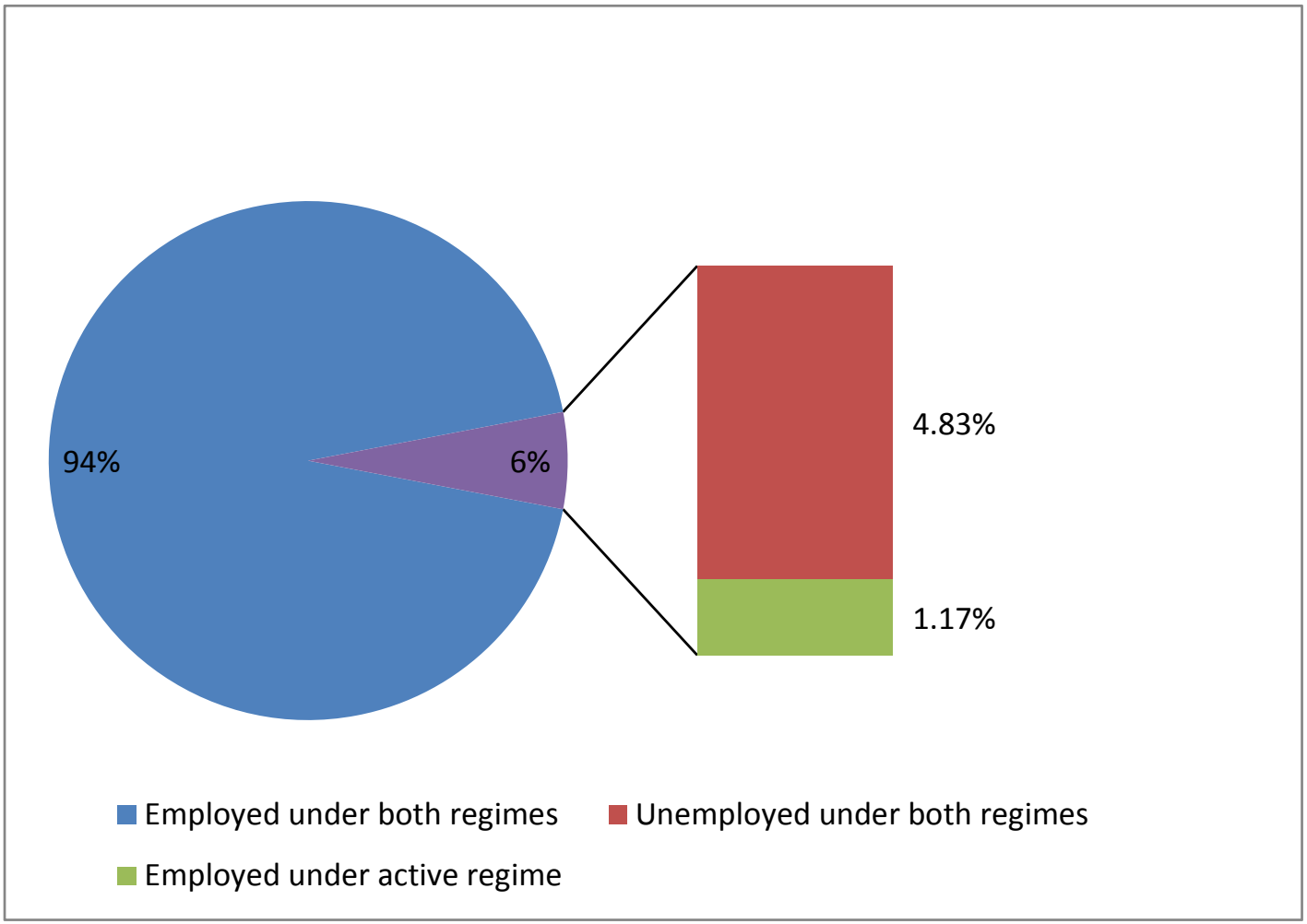
Calibration

The cost is financed by a contemporaneous lump-sum tax on the employed:

$$\tau(employed, active) = \underbrace{0.2 w_t u_{\textbf{active}}/(1 - u_{\textbf{active}})}_{\text{Unemployed insurance}} + \underbrace{w_t(u_{passive} - u_{active})/(1 - u_{active})}_{\text{Additional employment}}.$$

1. The cost for passive policy decreases:
   $0.2 w_t u_{\textbf{passive}}/(1 - u_{\textbf{passive}}) > 0.2 w_t u_{\textbf{active}}/(1 - u_{\textbf{active}})$
2. The cost for active policy increases:
   $0 < w_t(u_{passive} - u_{active})/(1 - u_{active})$
3. The total cost increases.

Job creation



Calibration

Benchmark parameters are as followed:

Description	Symbol	Value
Capital share	α	0.36
Discount factor	β	0.99
Depreciation rate	δ	0.025
Risk aversion	σ	1
Borrowing limit[3]	ϕ	3

[3] a quarterly wage

Exogenous Shock process

- Labor market policy regime changes following a 1st order Markov structure:

$$\pi = \begin{bmatrix} \pi_{pp} & \pi_{pa} \\ \pi_{ap} & \pi_{aa} \end{bmatrix} = \begin{bmatrix} 0.875 & 0.125 \\ 0.125 & 0.875 \end{bmatrix}.$$

  which is set such that the average policy duration is 8 quarters.
- Unemployment duration is 2.5 quarters under passive and 1.5 quarters under active LMP

Full transition

$$\Pi = \begin{bmatrix} \pi_{pp}\Pi_{pp} & \pi_{pa}\Pi_{pa} \\ \pi_{ap}\Pi_{ap} & \pi_{aa}\Pi_{aa} \end{bmatrix}$$

$$= \begin{bmatrix} 0.5250 & 0.3500 & 0.0313 & 0.0938 \\ 0.0223 & 0.8527 & 0.0044 & 0.1206 \\ 0.0938 & 0.0313 & 0.2917 & 0.5833 \\ 0.0031 & 0.1219 & 0.0296 & 0.8454 \end{bmatrix}$$

where

$$\Pi_{pp} = \begin{bmatrix} \pi_{uupp} & \pi_{uepp} \\ \pi_{eupp} & \pi_{eepp} \end{bmatrix} \quad \Pi_{pa} = \begin{bmatrix} \pi_{uupa} & \pi_{uepa} \\ \pi_{eupa} & \pi_{eepa} \end{bmatrix},$$

and

$$\Pi_{ap} = \begin{bmatrix} \pi_{uuap} & \pi_{euap} \\ \pi_{euap} & \pi_{eeap} \end{bmatrix} \quad \Pi_{aa} = \begin{bmatrix} \pi_{uuaa} & \pi_{ueaa} \\ \pi_{euaa} & \pi_{eeaa} \end{bmatrix}.$$

Summary of setups

- There are 2 states: employed and unemployed
- There are 2 regimes: active and passive LMP regime
- Unemployment rate depends on the regimes: 4.83% in active regime and 6% in passive regime.
- **The regime change from passive to active means a decrease in the unemployment risk.**
- Low unemployment can be achieved by additional employment.
- Public expenditure is financed by a contemporaneous lump-sum tax on the employed.

Difficulties in Krusell-Smith

- Since the aggregate shock exists, $\Gamma(k, h)$ does not have a stationary equilibrium distribution and evolves over time stochastically.
- We must consider the transition $\Gamma' = T(\Gamma, z, z')$
- The state variable is an infinite dimensional Γ, it's difficult to compute.

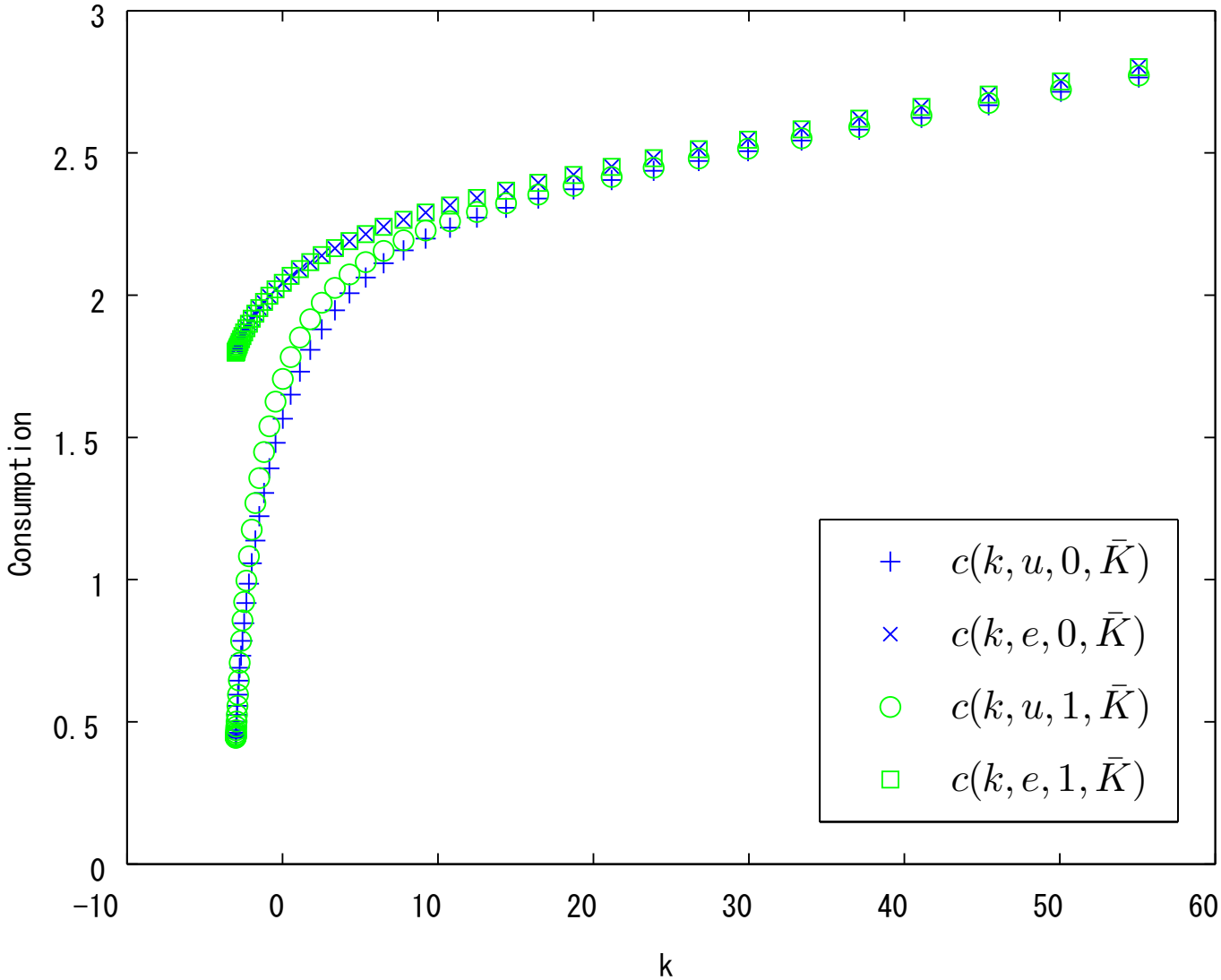
Numerical idea of Krusell-Smith

Since consumer's decisions depend on Γ only in a very limited way,

- Instead of using the entire distribution Γ, consider only the first moment, $\bar{k}$.
- Consider a simple linear forecasting rule:

$$\bar{k}' = \begin{cases} a_{active} + b_{active}\bar{k} & z = z_{active} \\ a_{passive} + b_{passive}\bar{k} & z = z_{passive} \end{cases}$$

Policy function



Value function iteration

We use $\bar{k}$ as a state variable.

1. Guess the LOM for $\bar{k}$ using least-square regression

$$\bar{k}' = \begin{cases} a_{active} + b_{active}\bar{k} & z = z_{active} \\ a_{passive} + b_{passive}\bar{k} & z = z_{passive} \end{cases}$$

2. solve the individual optimization problem given by

$$V(k, h, z, \bar{k}) = \max_{k'} u((r + 1 - \delta)k + \iota(h)w - \tau(h, z) - k') + \beta E[V(k', h', z', \bar{k}')|h, z]$$

3. simulate the economy using the derived policy function
4. compare the time series with the LOM we guess
5. revise the guess until we find the fixed point $(a^*_{active}, b^*_{active}, a^*_{passive}, b^*_{passive})$
6. find the REE

Euler equation based Policy function iteration with Endogenous grid method

Maliar, Maliar, and Valli (2010)'s specification

1. Guess the LOM for $\bar{k}$ using least-square regression
2. Solve the individual optimization problem using Endogenous grid method (EGM)
3. Simulate the economy using the derived policy function
4. Compare the time series with the LOM we guess
5. Revise the guess until we find the fixed point $(a^*_{active}, b^*_{active}, a^*_{passive}, b^*_{passive})$
6. Find the REE

EGM (skipped)

EGM proposed by Caroll (2005) and Barilas and Villaverde (2006)

1. Define $cah := c + k'$ where cah denotes "cash at hand"
2. Fix k and $\bar{k}$, compute $cah(k, \bar{k})$
3. Estimate $\bar{k}'$ on $\bar{k}$ by the guessed LOM
4. Guess the endogenous grid k'_{guess} and compute $cah'(k'_{guess}, \bar{k}')$
5. Use the relation $(k'_{guess}; k, \bar{k})$ and interpolate k'' on $(k'_{guess}, \bar{k}')$
6. Compute $c' = k'' - cah'$
7. Compute c by EEQ
8. Compute $k'_{new} = cah - c$
9. Stop if $||k'_{guess} - k'_{new}|| < \epsilon$; otherwise, update $k'_{guess} = k'_{new}$ and go back to 4

Then, get a policy function $c^*(k, \bar{k}) = cah - k^{*\prime}$

Result: Direct job creation

- The Government directly hires additional labor.
- Additional labors are non-productive.
- The tax burden on the employed increases from passive to active regime.

z	C_z^e	C_z^u	C_z
passive	2.5974	2.4682	2.5896
	(0.0001)	(0.0012)	(0.0001)
active	2.5942	2.5188	2.5905
	(0.0001)	(0.0008)	(0.0001))
log diff.	-0.0012	0.0199	0.0004
	(0.0000)	(0.0005)	(0.0000)

Decomposition

1. The unemployed participants increase the aggregate consumption level by 0.05%
2. The employed decrease the aggregate consumption level by 0.05%
3. The unemployed nonparticipants increase the aggregate consumption level by 0.02%

	$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$	Aggdiff	Simdiff
GE I	-0.0005	0.0002	0.0005	0.0001	0.0004
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GE II	0.0015	0.0003	0.0006	0.0024	0.0037
	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0002)

Implications

- Positive treatment effect.
  $(\log c^{e}_{active}/c^{u}_{passive} - \log c^{u}_{active}/c^{u}_{passive} = 0.0295)$
- Negative consumption response of the employed reflects a tax effect.
- Positive consumption response of the unemployed nonparticipants reflects the unemployment risk effect.
  - Since the expected future wage income increases, the demand for precautionary savings decreases and hence the consumption increases.

Alternative setup

The employed can receive a benefit of low unemployment risk. In order to disentangle the composite response of the employed, we include the constant tax burden across regimes to split off the tax effect.

z	C_z^e	C_z^u	C_z
passive	2.5699	2.3533	2.5569
	(0.0005)	(0.0065)	(0.0008)
active	2.5722	2.4494	2.5662
	(0.0006)	(0.0042)	(0.0007)
log diff.	0.0009	0.0400	0.0037
	(0.0002)	(0.0017)	(0.0002)

Decomposition

We can confirm that reducing unemployment risk affects not only the unemployed nonparticipants, but also the employed.

1. The unemployed participants increase the aggregate consumption level by 0.06%
2. The employed increases the aggregate consumption level by 0.15%
3. The unemployed nonparticipants increase the aggregate consumption level by 0.03%

	$(1-u_0)\log c_1^e/c_0^e$	$u_1 \log c_1^u/c_0^u$	$(u_0-u_1)\log c_1^e/c_0^u$	Aggdiff	Simdiff
GE I	-0.0005	0.0002	0.0005	0.0001	0.0004
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GE II	0.0015	0.0003	0.0006	0.0024	0.0037
	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0002)

Summary of the 1st experiment

- We can observe the positive treatment effect.
- A change in the unemployment risk can affect not only the unemployed, but also the employed.
- Aggregate consumption effect is rather limited ($+0.04\%$).
  - This may be because the supply cdn does not change (Additional labor assumed to be not productive).

Result: Employment incentives

- The Government induces private firms to hire additional labor by reducing the corporate tax.
- Additional labor are productive.
- Tax proceeds are rebated back to the households in a lump-sum manner.

z	C_z^e	C_z^u	C_z
passive	2.6010	2.4552	2.5923
	(0.0008)	(0.0023)	(0.0008)
active	2.6021	2.5161	2.5980
	(0.0009)	(0.0017)	(0.0009)
log diff.	0.0004	0.0245	0.0022
	(0.0002)	(0.0008)	(0.0002)

Decomposition

1. The unemployed participants increase the aggregate consumption level by 0.05%
2. The employed nonparticipants increase the aggregate consumption level by 0.10%
3. The unemployed nonparticipants increase the aggregate consumption level by 0.02%

	$(1-u_0)\log C_1^e/C_0^e$	$u_1 \log C_1^u/C_0^u$	$(u_0-u_1)\log C_1^e/C_0^u$	Aggdiff	Simdiff
Tax I	0.0010	0.0002	0.0005	0.0017	0.0022
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0002)
Tax II	0.0020	0.0003	0.0005	0.0028	0.0037
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0003)

Alternative setup

- Tax reduction means a decrease in transfer to households.
- Rebated tax proceeds contaminates the response (distortionary transfer from firms to households).
- Consider the case of No tax proceeds.

z	C_z^e	C_z^u	C_z
passive	2.5305	2.3876	2.5220
	(0.0048)	(0.0013)	(0.0015)
active	2.5353	2.4512	2.5312
	(0.0014)	(0.0034)	(0.0015)
log diff.	0.0019	0.0263	0.0037
	(0.0003)	(0.0010)	(0.0037)

Concluding remarks

What did we learn from this exercise?

- We can find the aggregate consumption increase in both experiments.
- The consumption response is interpreted as households' reaction to the unemployment risk.
- The quantitative difference in the responses comes from the goods supply condition.
  - The first policy is interpreted as a transfer policy to the unproductive labor.