The Effect of Elimination of Auxiliary Benefits on Sustainability of Social Security in Population Aging

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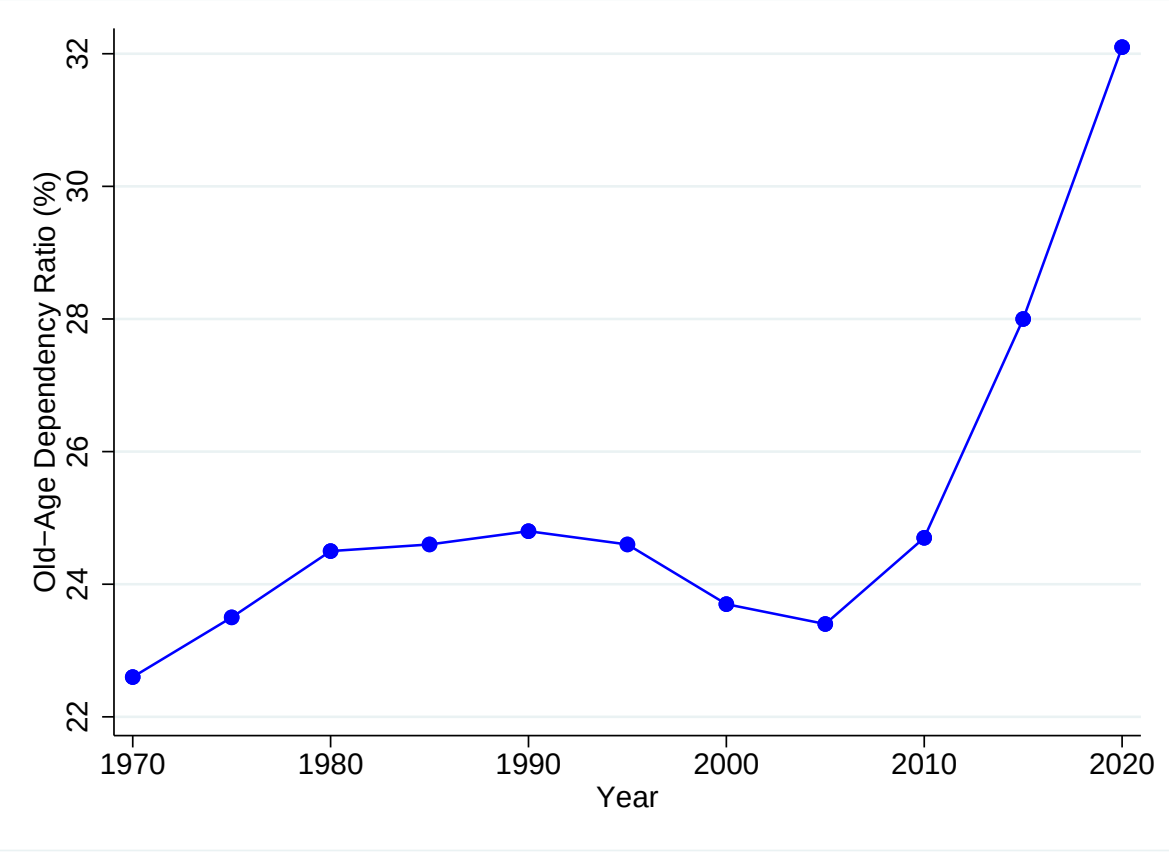
Motivation

- Population aging advances in the US.
  - **Would be more striking in the future**.
    - **Old-age dependency ratio in 2060: 46.7% (The United Nations)**.
- **Main issue: Increasing concerns for sustainability of Social Security**.

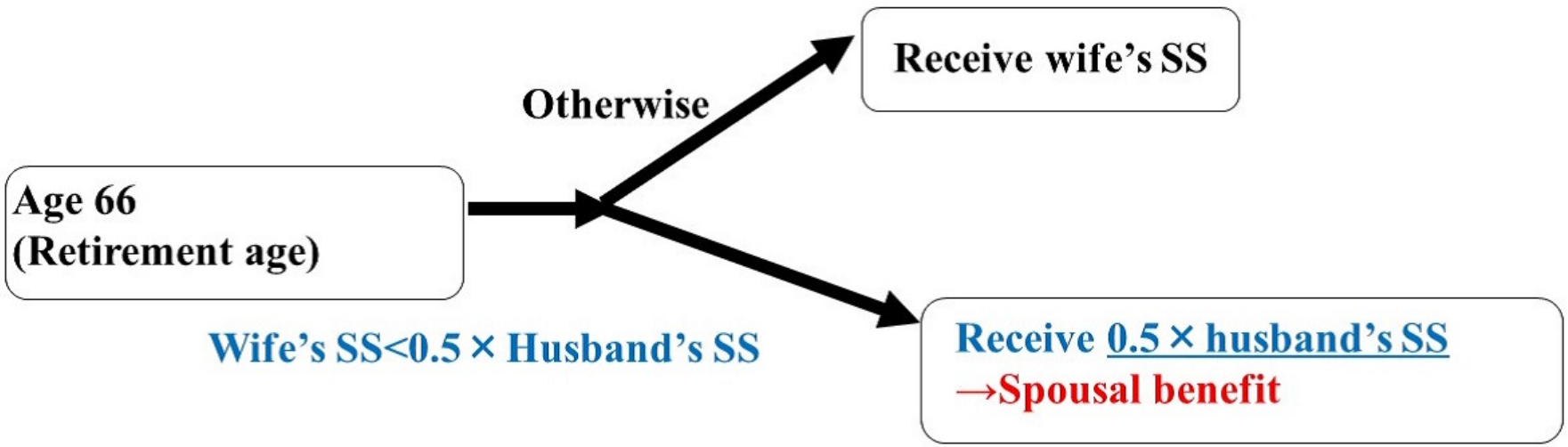


(Source: United Nations)

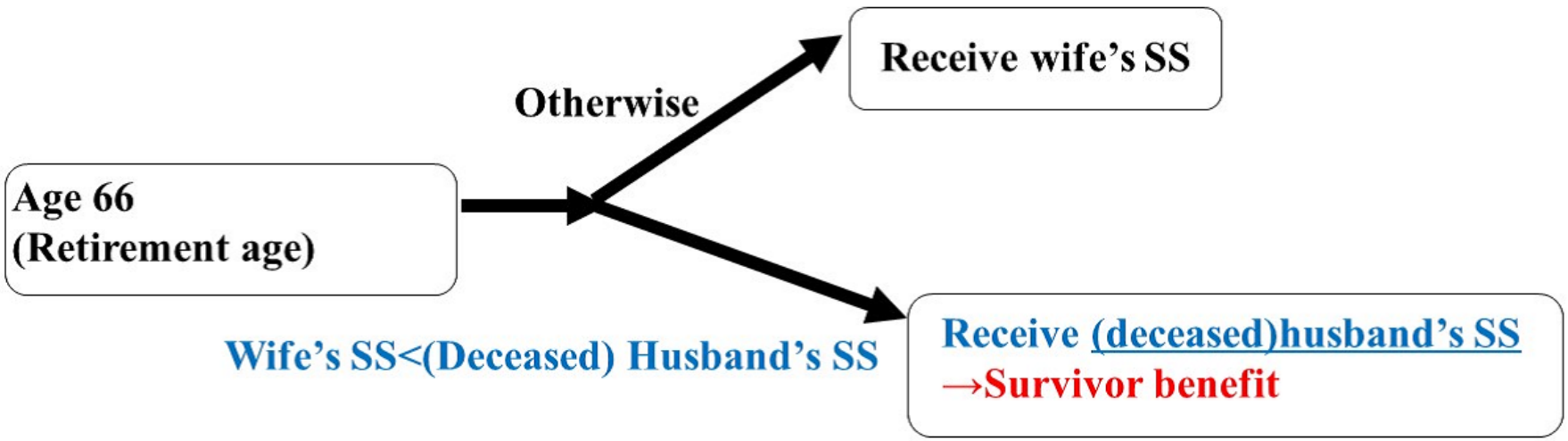
Focus of This Paper: Auxiliary Benefits

- **Literature abstracts from auxiliary benefits**.
- Auxiliary benefits: **Spousal and survivor benefits**.
  - Spousal benefit: For couples.
  - Survivor benefit: For widows and widowers.
  - **47.9**% of females aged 62 and older collect either of them (2010-2020).

Characteristic of Spousal Benefit



Characteristic of Survivor Benefit



Goal of This Paper

- **Answer two questions**:
  1. **What is the effect of elimination of the auxiliary benefits on the fiscal cost to sustaining the Social Security system?**
  2. **What are characteristics of this policy?**

What I do: Model

- Construct overlapping generations model with heterogeneous agents in a general equilibrium framework.

1. Household
   - **Couples and singles**.
   - Choose consumption, the working decision, and asset.
   - Collect Social Security calculated based on average life-time earnings.
     - **Couples can receive spouse or survivor benefits**.
2. Firm
   - Combine capital and labor according to a CRS production technology.
3. Government
   - Impose taxes to mainly finance Social Security benefits.

What I do: Calibration & Simulation

- Calibration target: The United States economy of year 2010.
- Simulation target: The United States economy of year 2060.
  - Higher old-age dependency ratio than the baseline economy.
  - Main question: How much additional tax does the government have to impose to sustain the Social Security system if
    1. **a government does not implement any policy for Social Security?**
    2. **the auxiliary benefits are eliminated?**
    3. **Social Security benefits are cut?**

Main Findings: The Effect of Elimination of Auxiliary Benefits

- **Reduce the fiscal cost strikingly**.
  - Equivalent to **when the replacement rate is cut by** 17.9%.
- **Have three characteristics**.
  1. **Labor supply for married females increases moderately**.
  2. **The welfare effect varies across couples**.
  3. **Increase the welfare for singles**.

Related Literature & Contribution

1. **Sustainability of Social Security with population aging.**
   - De Nardi et al. (1999); Kotlikoff et al. (2007); Diaz-Gimene and Diaz-Saavedra (2009); Imrohoroglu and Kitao (2012); Kitao (2014); McGrattan and Prescott (2017); Kotera (2020).

   ★**This paper**: **Investigate the effect of elimination of the auxiliary benefits**.

2. **Role of the auxiliary benefits on household behavior.**
   - Kaygusuz (2015); Sanchez-Marcos and Bethencourt (2018); Nishiyama (2019); Borella et al. (2021); Groneck and Wallenius (2021).

   ★**This paper**: **Explore the role on the sustainability of Social Security toward an aging economy**.

Roadmap

1. Introduction.
2. Model.
3. Calibration.
4. Simulations.
5. Conclusion.

Model Environment

- **A general equilibrium model of overlapping generations.**
- Households:
  - **Couples (Fraction ω).**
    - A husband m and a wife f who are the same age.
    - Married from the initial period.
    - No risk of divorce.
  - **Singles (Fraction $1-\omega$).**
    - Never married in their entire lives.
- The growth rate of a new cohort: n.
- The maximum age: J.
- Face mortality risk Φ_j^g where $g \in \{m, f\}$.
  - Become widowed if a husband or a wife dies.

Labor Earning

- Decompose into four elements:

$$e^g = w\eta_j^g \epsilon^g l^g.$$

  - w: Equilibrium wage.
  - η_j^g: Age- and gender-specific labor productivity.
  - ϵ^g: An idiosyncratic labor productivity shock.
  - l^g: Hours of work.

Consumption, Assets & Preference

- Can accumulate asset a (≥ 0) with the equilibrium interest rate r.
  - Assume no asset in the initial period.
- Utility function.
  - Couples: $u\left(c^m, c^f, l^m, l^f\right)$.
  - Singles: $u\left(c^g, l^g\right)$.
- Can leave a bequest when die.
  - Collected by the government and distributed as a lump-sum transfer tr^*.
  - Derive "warm-glow" utility $b\left(a'\right)$ from leaving bequests.
- Guarantee the minimum consumption level $c_{\min}$.
  - Receive a transfer benefit tr if total income plus assets are below $c_{\min}$.
  - Different level between couples and singles.

Social Security & Production Technology

- Pay-as-you-go pension system.
  - Start to receive Social Security benefits at j_R.
  - Calculate from average life-time earning $\bar{e}^g$.
  - **Couples can receive spousal or survivors benefits**.
- **Can work even after collecting Social Security**.
- Production function: $Y = F(K, L) = AK^{\alpha}L^{1-\alpha}$.
  - δ: Capital depreciation rate.

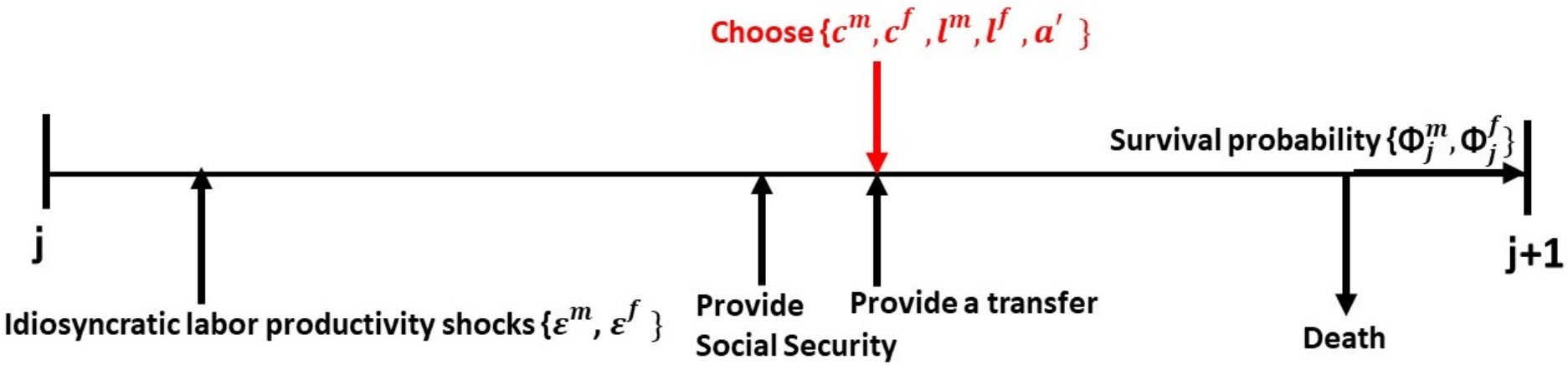
Fiscal Policy

- Government imposes
  - progressive tax on income: τ^I.
    - **The incomes of households are filed jointly**.
  - Social Security tax: τ^{ss}.
    - No additional tax is imposed if individuals' labor earnings are above the maximum amount of e^{ss}.
  - consumption tax: τ^c.

- To finance
  1. Social Security ss.
  2. transfer benefits from the government tr.
  3. the government expenditure G.
  4. the government debt issued in the previous period D.

Model Timing (Couples)

- Timing for singles is similar.



Couples' Problem

- $\mathbf{x} = \left(j, a, \overline{e}^m, \overline{e}^f, \epsilon^m, \epsilon^f\right)$.

$$V_c(\mathbf{x}) = \max_{\{c^m, c^f, l^m, l^f, a'\}} u\left(c^m, c^f, l^m, l^f\right) + \beta\left[\Phi_j^m \Phi_j^f \mathbb{E}\left[V_c(\mathbf{x}')\right] + \left(1 - \Phi_j^m\right)\Phi_j^f \mathbb{E}\left[V_s^f(\mathbf{x}')\right] + \Phi_j^m\left(1 - \Phi_j^f\right)\mathbb{E}\left[V_s^m(\mathbf{x}')\right] + \left(1 - \Phi_j^m\right)\left(1 - \Phi_j^f\right) b(a')\right],$$

subject to

$$(1 + \tau^c)\left(c^m + c^f\right) + a' = a(\mathbf{x}) + \tilde{y}(\mathbf{x}) + tr(\mathbf{x}) + 2 \times tr^*,$$

$$\tilde{y}(\mathbf{x}) = \left(1 - \tau^I\left[e^m(\mathbf{x}) + e^f(\mathbf{x}) + ra(\mathbf{x})\right]\right)\left(e^m(\mathbf{x}) + e^f(\mathbf{x}) + ra(\mathbf{x})\right) + ss^m(\mathbf{x}) + ss^f(\mathbf{x}) - \tau^{ss}\min\left\{e^m(\mathbf{x}), e^{ss}\right\} - \tau^{ss}\min\left\{e^f(\mathbf{x}), e^{ss}\right\},$$

$$tr = \max\left\{0, \left((1 + \tau^c)\, c_{\min,c} - \left(\tilde{y}(\mathbf{x}) + a(\mathbf{x})\right)\right)\right\}.$$

Singles' Problem

$$V_s^g(\mathbf{x}) = \max_{\{c^g, l^g, a'\}} u(c^g, l^g) + \beta\left[\Phi_j^g \mathbb{E}\left[V_s^g(\mathbf{x}')\right] + \left(1 - \Phi_j^g\right) b(a')\right],$$

subject to

$$(1+\tau^c)\, c^g + a' = a(\mathbf{x}) + \tilde{y}(\mathbf{x}) + tr(\mathbf{x}) + tr^*,$$

$$\tilde{y}(\mathbf{x}) = \left(1 - \tau^I\left[e^g(\mathbf{x}) + ra(\mathbf{x})\right]\right)\left(e^g(\mathbf{x}) + ra(\mathbf{x})\right) + ss^g(\mathbf{x}) - \tau^{ss}\min\left\{e^g(\mathbf{x}), e^{ss}\right\},$$

$$tr = \max\left\{0, \left(\left(1+\tau^c\right) c_{\min,s} - \left(\tilde{y}(\mathbf{x}) + a(\mathbf{x})\right)\right)\right\}.$$

▸ Stationary Equilibrium

Fixed Parameters: Demographics

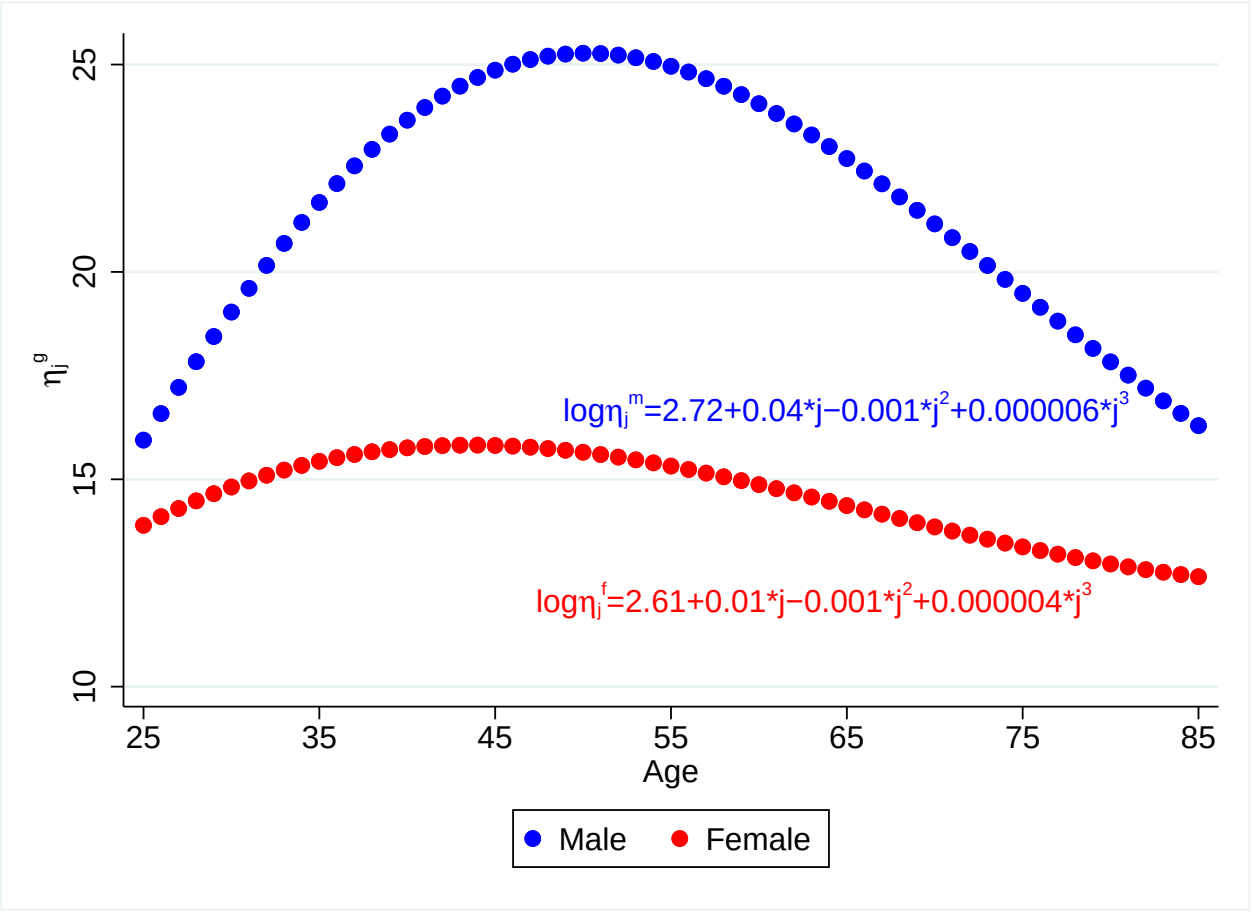
Parameter	Description	Values/Source
J	Maximum age	85 (Age 109)
ω	A fraction of couples	0.8429
Φ_j^g	Conditional survival probability	Bell and Miller (2005) ▸ Detail
n	Population growth rate	0.016

Fixed Parameters: Labor Productivity

- Employ the following regression.

$$log\eta_j^{g,data} = \alpha_0^g + \alpha_1^g j + \alpha_2^g j^2 + \alpha_3^g j^3.$$

- Assume that none of households works after age 86.



(Data Source: PSID)

Fixed Parameters: Idiosyncratic Labor Productivity Shock

- Specified as AR(1) process in log (Heathcoate et al. (2010)).
  - The value of a persistence parameter: 0.97.
  - The value of the variance of the white noise: 0.018.
  - The value of correlation: 0.13.
    - Assume that shocks for couples are correlated.
- **Make four grid points**.

Fixed Parameters: Preferences

- Utility function:

$$u\left(c^m, c^f, l^m, l^f\right) = \frac{\left(c^m\right)^{1-\sigma}}{1-\sigma} + \frac{\left(c^f\right)^{1-\sigma}}{1-\sigma} + \gamma^m \frac{\left(1 - l^m - \mathbf{1}_{l^m>0}\mathbf{1}_{j>21}\theta^m (j-21)^\kappa\right)^{1-\sigma}}{1-\sigma} + \gamma^f \frac{\left(1 - l^f - \mathbf{1}_{l^f>0}\mathbf{1}_{j>21}\theta^f (j-21)^\kappa\right)^{1-\sigma}}{1-\sigma}.$$

  - $\theta^g (j-21)^\kappa$: Time cost when work after $j = 21$ (Age 45).
  - Set $\sigma = 2.0$.

- Bequest motive:

$$b(a') = b_1 \frac{(b_2 + a')^{1-\sigma}}{1-\sigma}.$$

  - Set $b_2 = \$444{,}000$ (French and Jones (2011)).

Fixed Parameters: Social Security

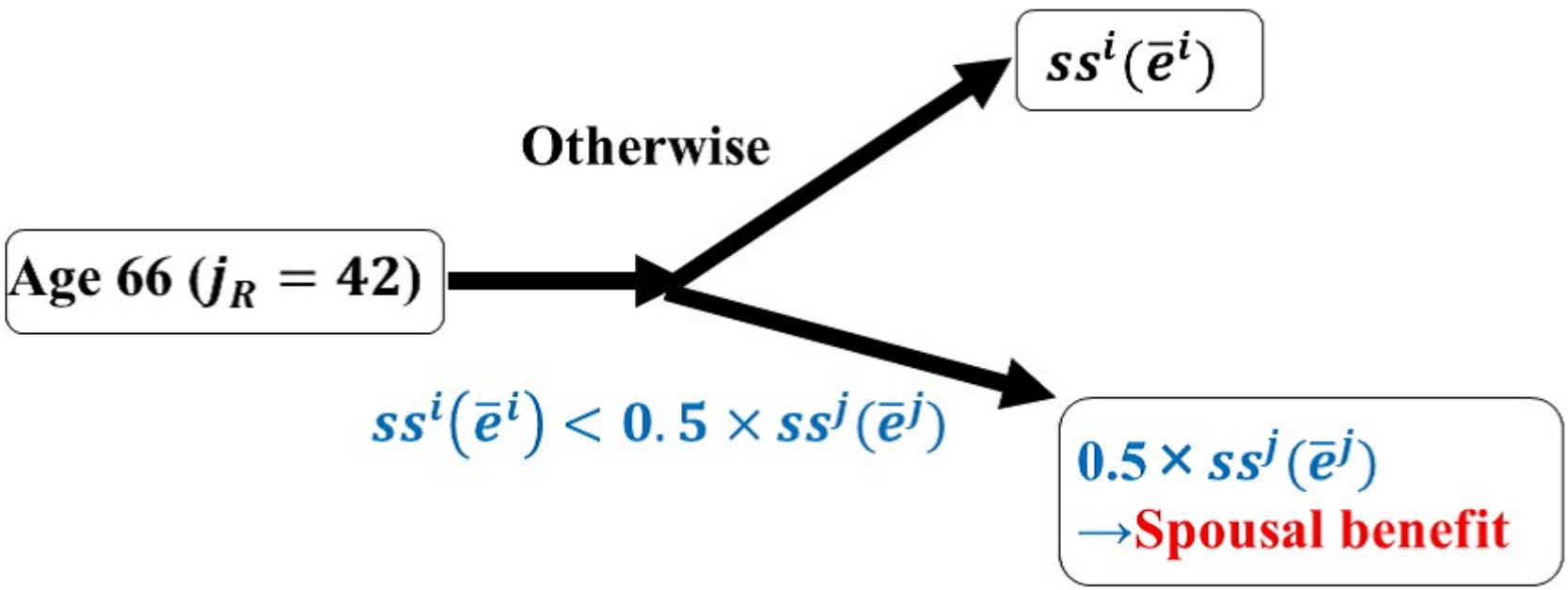
- $j_R = 42$ (Age 66).
- Calculate by the following formula:

$$ss(\overline{e}) = \begin{cases} 0.9 \times \overline{e} & \text{if } \overline{e} < \$9,132 \\ \$8,219 + 0.32 \times (\overline{e} - \$9,132) & \text{if } \$9,132 \leq \overline{e} < \$55,032 \\ \$23,199 + 0.15 \times (\overline{e} - \$55,032) & \text{if } \overline{e} \geq \$55,032. \end{cases}$$

$\overline{e}$: The average of the past 35 highest annual earnings.

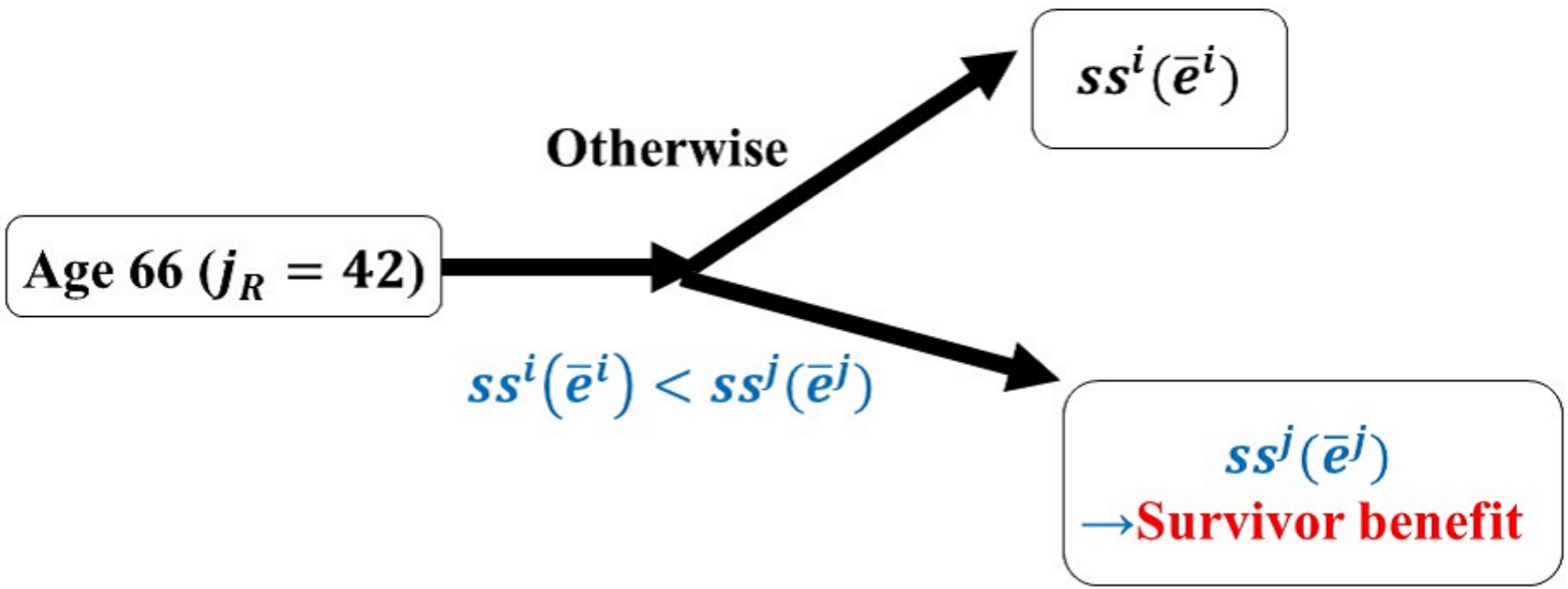
Fixed Parameters: Social Security System (Spousal Benefit)

- i's SS benefit: Determined based **on the comparison of** $ss^i\left(\bar{e}^i\right)$ **and** $0.5 \times ss^j\left(\bar{e}^j\right)$.



Fixed Parameters: Social Security System (Survivor Benefit)

- i's SS benefit: Determined based **on the comparison of** $ss\left(\bar{e}^i\right)$ **and** $ss^j\left(\bar{e}^j\right)$.



Fixed Parameters: Production Technology & Tax Scheme

- Production function: $Y = F(K, L) = AK^{\alpha}L^{1-\alpha}$.
- Income taxation: Employ a standard tax schedule (Gouveia and Strauss (1994)).

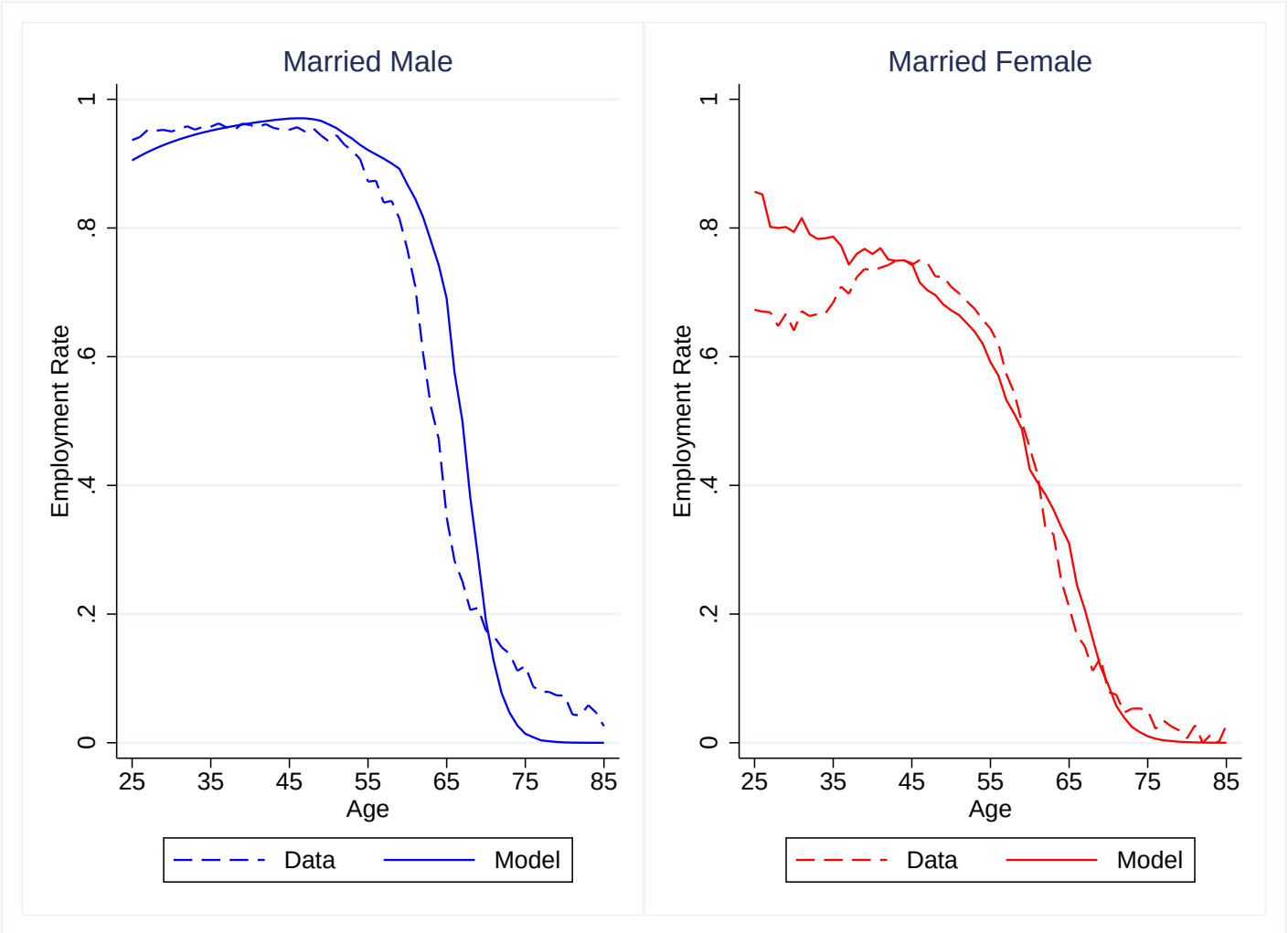
$$\tau^{I}\left[ra + e^{m} + e^{f}\right] = \lambda_0\left\{\left(ra + e^{m} + e^{f}\right) - \left(\left(ra + e^{m} + e^{f}\right)^{-\lambda_1} + \lambda_2\right)^{\frac{-1}{\lambda_1}}\right\}.$$

Parameter	Description	Values/Source
α	Capital share of output	0.36
δ	Capital depreciation rate	4.1%
τ^{ss}	Social Security tax	10.6%
e^{ss}	Maximum amount of labor earning	$\$106,800$
τ^{c}	Consumption tax	5.0%
$\{\lambda_0, \lambda_1\}$	Coefficients for income tax	$\{0.258, 0.768\}$
G	Government spending	20% of GDP
D	Government debt	40% of GDP
$\{c_{\min,c}, c_{\min,s}\}$	Consumption floor	$\{\$6,570, \$4,380\}$

Calibration Result

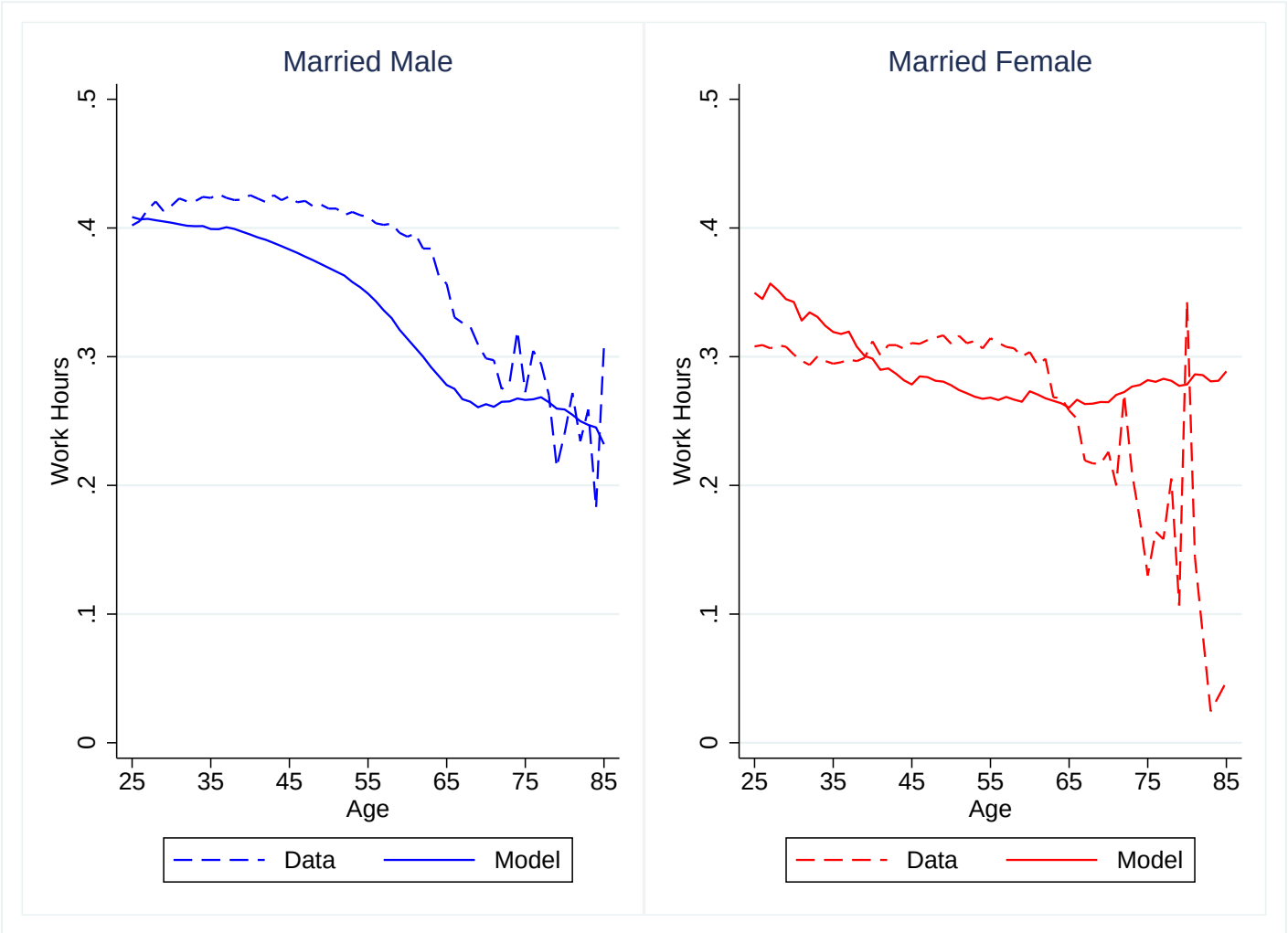
Parameter	Value	Target Moment	Data	Model
γ^m	0.901	Employment rate for married males at age 45	0.953	0.970
γ^f	1.021	Employment rate for married females at age 45	0.743	0.746
θ^m	0.0003	Employment rate for married males at age 70	0.174	0.189
θ^f	0.0002	Employment rate for married females at age 50	0.709	0.672
κ	2.048	Employment rate for married females at age 70	0.079	0.089
b_1	257	The ratio of the median value of asset at age 90 to age 80	0.810	0.857
β	0.970	Capital-output ratio for the US in 2010	3.63	3.69
λ_2	0.156	Balance the government budget constraint	–	–
A	1.145	Normalize the aggregate output to 1	–	–

Non-Targeted Moment: Labor Supply for Couples over the Life Cycle



(Data Source: PSID)

Non-Targeted Moment: Work Hours for Couples over the Life Cycle



(Data Source: PSID)

Non-Targeted Moment: A Fraction of Females Receiving Spouse or Survivor Benefit

	Data	Model
Spouse Benefit	19.7%	22.8%
Survivor Benefit	28.2%	22.0%
Total	47.9%	44.8%

(Data Source: SSA Annual Statistical Supplement for Retirement Statistics 2011-2021)

Setup for Simulation Analysis

- **Simulate the United States economy of year 2060**.
- Change two exogenous forces:
  1. **Survival probability**.
     - Projected survival probability by gender in 2060 (Bell and Miller (2005)). Detail
  2. **Population growth rate** $n = 0.001$.
     - The old-age dependency ratio in the simulation: 45%.
- **Add a proportional income tax to balance the government budget**.
- Conduct **three** simulations.
  1. **Simulation I: No policy for Social Security**.
  2. **Simulation II: Spouse and survivor benefits are eliminated**.
  3. **Simulation III: The replacement rate is cut by** 17.9%.

Result of Simulation I

	2010	2060
	Baseline	Simulation I
Capital per capita	–	−16.5%
Labor per capita	–	−11.6%
Average work hours	–	+1.22%
Consumption per capita	–	−9.93%
Equilibrium interest rate	5.66%	6.02%
Equilibrium wage rate	–	−2.17%
Employment rate for married males at ages 25-65	92.9%	93.4%
Employment rate for married males at ages 66-85	16.0%	19.8%
Employment rate for married females at ages 25-65	69.7%	69.0%
Employment rate for married females at ages 66-85	6.53%	8.69%
Benefit spending per capita	–	+48.0%
Additional tax on income	–	13.3%

▸ Employment Rates and Work Hours for Couples (Simulation I)

Result of Simulation II

	2010	2060	
	Baseline	Simulation I	Simulation II
Capital per capita	–	−16.5%	+12.3%
Labor per capita	–	−11.6%	+0.03%
Average work hours	–	+1.22%	−2.66%
Consumption per capita	–	−9.93%	+3.45%
Equilibrium interest rate	5.66%	6.02%	5.30%
Equilibrium wage rate	–	−2.17%	+4.32%
Employment rate for married males at ages 25-65	92.9%	93.4%	94.0%
Employment rate for married males at ages 66-85	16.0%	19.8%	21.5%
Employment rate for married females at ages 25-65	69.7%	69.0%	73.1%
Employment rate for married females at ages 66-85	6.53%	8.69%	9.56%
Benefit spending per capita	–	+48.0%	−16.0%
Additional tax on income	–	13.3%	9.02%
Average welfare effect		–	5.46%

Average Life-Time Labor Earning by Initial ϵ

Couples	ϵ_1	ϵ_2	ϵ_3	ϵ_4
ϵ_1 (the lowest)	1.00	1.12	1.26	1.47
ϵ_2	1.19	1.28	1.41	1.59
ϵ_3	1.45	1.51	1.61	1.76
ϵ_4 (the highest)	1.82	1.86	1.92	2.01

Singles	
ϵ_1	0.56
ϵ_2	0.72
ϵ_3	0.91
ϵ_4	1.15

Fraction of Married Females Receiving Auxiliary Benefits by Initial ϵ

Couples	ϵ_1	ϵ_2	ϵ_3	ϵ_4
ϵ_1	46.5%	29.8%	14.7%	5.26%
ϵ_2	66.3%	48.6%	28.5%	12.0%
ϵ_3	85.2%	72.8%	52.6%	28.3%
ϵ_4	94.7%	90.3%	81.6%	62.8%

Singles	
ϵ_1	0.00%
ϵ_2	0.00%
ϵ_3	0.00%
ϵ_4	0.00%

Result of Simulation II: Welfare Effect by Initial ϵ

Couples				
Male/Female	ϵ_1	ϵ_2	ϵ_3	ϵ_4
ϵ_1	5.26%	5.55%	5.70%	5.47%
ϵ_2	5.01%	5.43%	5.79%	5.84%
ϵ_3	4.53%	4.98%	5.54%	5.96%
ϵ_4	3.87%	4.19%	4.67%	5.42%

Singles	
ϵ_1	6.47%
ϵ_2	6.32%
ϵ_3	6.16%
ϵ_4	6.19%

Results: Simulation II vs III

	Simulation I	Simulation II	Simulation III
Capital per capita	–	+12.3%	+10.5%
Labor per capita	–	+0.03%	−0.11%
Average work hours	–	−2.66%	−0.96%
Consumption per capita	–	+3.45%	+4.88%
Equilibrium interest rate	6.02%	5.30%	5.39%
Equilibrium wage rate	–	+4.32%	+3.73%
Employment rate for married males at ages 25-65	93.4%	94.0%	93.5%
Employment rate for married males at ages 66-85	19.8%	21.5%	21.8%
Employment rate for married females at ages 25-65	69.0%	73.1%	69.4%
Employment rate for married females at ages 66-85	8.69%	9.56%	9.82%
Benefit spending per capita	+48.0%	−16.0%	−17.5%
Additional tax on income	13.3%	9.02%	9.02%
Average welfare effect	–	5.46%	5.29%

Welfare Effect by Initial ϵ: Simulation II vs III

5.17%	Simulation II			
Male/Female	ϵ_1	ϵ_2	ϵ_3	ϵ_4
ϵ_1	5.26%	5.55%	5.70%	5.47%
ϵ_2	5.01%	5.43%	5.79%	5.84%
ϵ_3	4.53%	4.98%	5.54%	5.96%
ϵ_4	3.87%	4.19%	4.67%	5.42%

5.25%	Simulation III			
	ϵ_1	ϵ_2	ϵ_3	ϵ_4
ϵ_1	5.10%	5.16%	5.23%	5.25%
ϵ_2	5.19%	5.20%	5.27%	5.31%
ϵ_3	5.33%	5.28%	5.30%	5.37%
ϵ_4	5.26%	5.26%	5.29%	5.37%

6.25%	Simulation II
ϵ_1	6.31%
ϵ_2	6.31%
ϵ_3	6.18%
ϵ_4	6.23%

5.37%	Simulation III
ϵ_1	5.41%
ϵ_2	5.41%
ϵ_3	5.32%
ϵ_4	5.39%

The Effect of Elimination of the Auxiliary Benefits: Summary

1. **The fiscal cost to sustaining SS reduces significantly (13.3% →9.02%).**
2. **Employment rates for married females increase moderately.**
   - Between ages 25 and 65: **+4.19%** (vs +0.40%).
   - **Mechanism: SS benefits become dependent only on average life-time earnings.**
3. **The gap of welfare effect is large across couples.**
   - Welfare gap: **2.09%** (vs 0.27%).
   - **Mechanism: The smaller a fraction of receiving the auxiliary benefits is, the larger their welfare gain becomes.**
     - **Decrease the welfare for households who are eligible for the auxiliary benefits.**
4. **Singles' welfare increases.**
   - The average welfare effect: **6.25%** (vs 5.37%).
   - **Mechanism: Singles' Social Security remains the same.**

Conclusion

- **Study the effect of elimination of the auxiliary benefits on sustainability of Social Security in population aging**.
- Construct a general equilibrium model of overlapping generations.
- Main findings: Elimination of the auxiliary benefits
  - **reduces the fiscal cost strikingly**.
  - **has three characteristics**:
    1. **Labor supply for married females increases moderately**.
    2. **There is a considerable variation in welfare effect across couples**.
    3. **Singles increae their welfare**.
- **Future work: Compute the transition dynamics**.

Definition of Stationary Equilibrium

- Households' allocation rule solves the recursive optimization problem.
- Factor prices: $w = (1-\alpha) A K^{\alpha} L^{-\alpha}$ and $r = \alpha A K^{\alpha-1} L^{1-\alpha} - \delta$.
- The labor and capital market clearing conditions are following.

$$L = \sum_{\mathbf{x}} \left(\eta_j^m \epsilon l^m(\mathbf{x}) + \eta_j^f \epsilon l^f(\mathbf{x}) \right) \mu(\mathbf{x}),$$

$$K = \sum_{\mathbf{x}} a(\mathbf{x}) \mu(\mathbf{x}) - D.$$

Definition of Stationary Equilibrium

- The lump-sum bequest transfer is equal to the sum of bequests:

$$tr^* = \sum_{\mathbf{x}} \left(1-\Phi^m\right)\left(1-\Phi^f\right) a'\left(\mathbf{x}\right)\mu_{mar}\left(\mathbf{x}\right) +$$

$$\left(1-\Phi^m\right)\Phi^f a'\left(\mathbf{x}\right)\mu^m_{wid}\left(\mathbf{x}\right) + \Phi^m\left(1-\Phi^f\right) a'\left(\mathbf{x}\right)\mu^f_{wid}\left(\mathbf{x}\right).$$

- The parameter in the income tax function satisfies the government budget constraint.

$$G + (1+r)D + \left[\sum_{\mathbf{x}}\left(ss^m\left(\mathbf{x}\right) + ss^f\left(\mathbf{x}\right)\right) + \sum_{\mathbf{x}} tr(\mathbf{x})\right]\mu(\mathbf{x}) =$$

$$\sum_{\mathbf{x}}\left[\tau^I\left[e^m\left(\mathbf{x}\right) + e^f\left(\mathbf{x}\right) + ra(\mathbf{x})\right]\left(e^m\left(\mathbf{x}\right) + e^f\left(\mathbf{x}\right) + ra(\mathbf{x})\right) +\right.$$

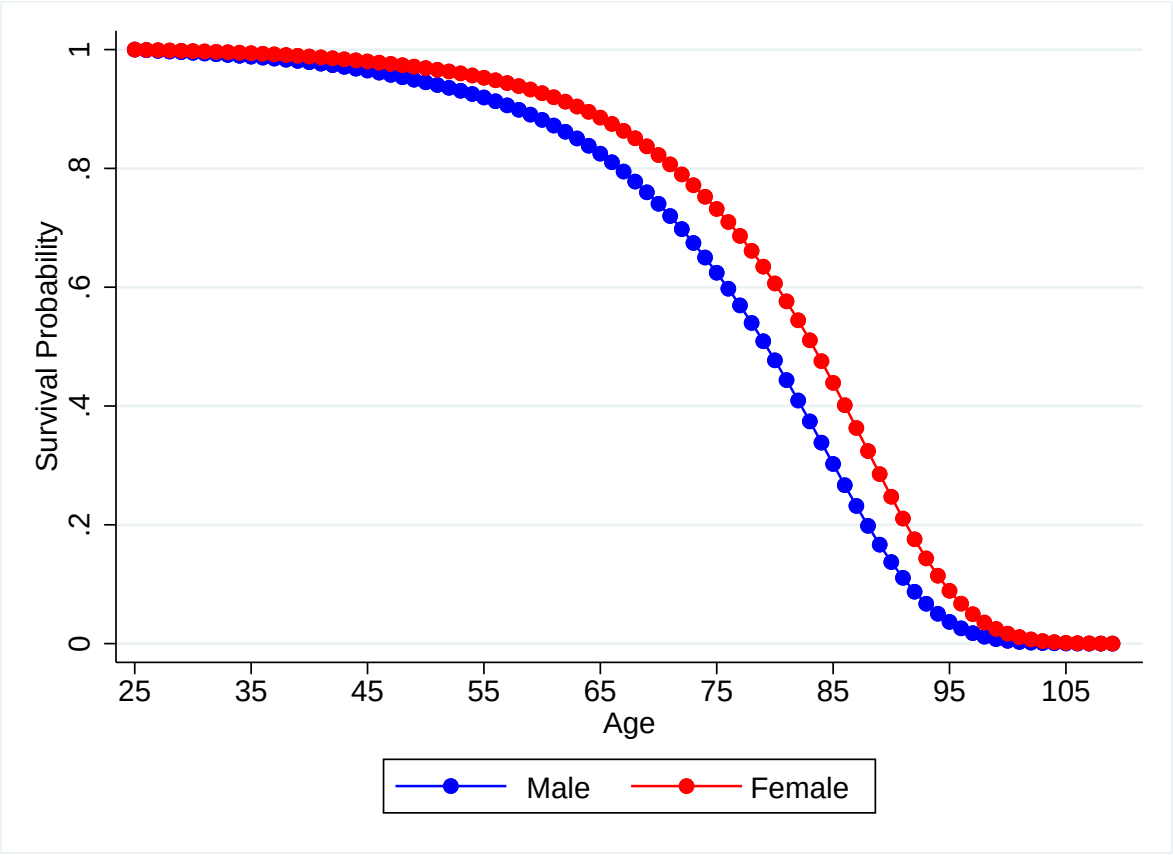
$$\left.\tau^{ss}\min\left\{e^m(\mathbf{x}), e^{ss}\right\} + \tau^{ss}\min\left\{e^f(\mathbf{x}), e^{ss}\right\} + \tau^c c(\mathbf{x})\right]\mu(\mathbf{x}) + D'.$$

In the stationary equilibrium, $D' = (1+n)D$ holds.

- The distribution of individuals across states $\mu\left(\mathbf{x}\right)$ is stationary.

Go Back

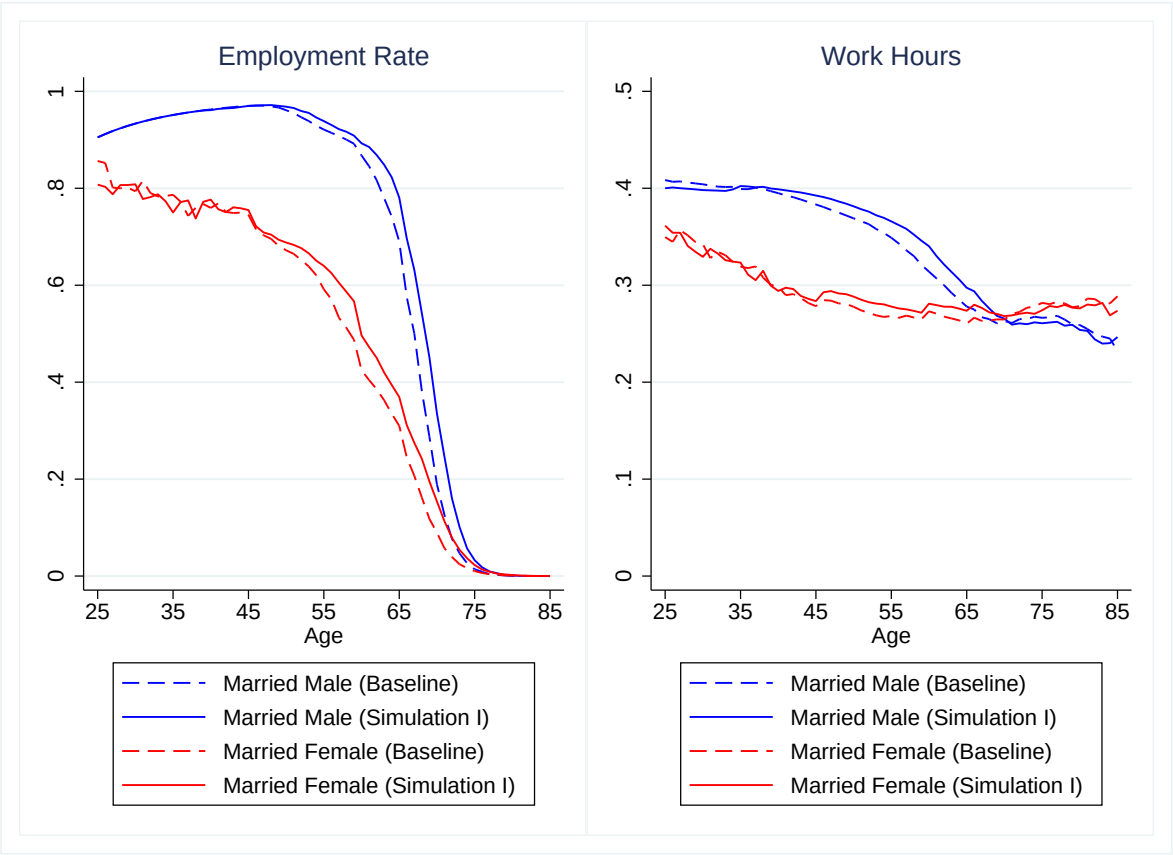
Unconditional Survival Probability at Age 25



(Data Source: Bell and Miller (2005))

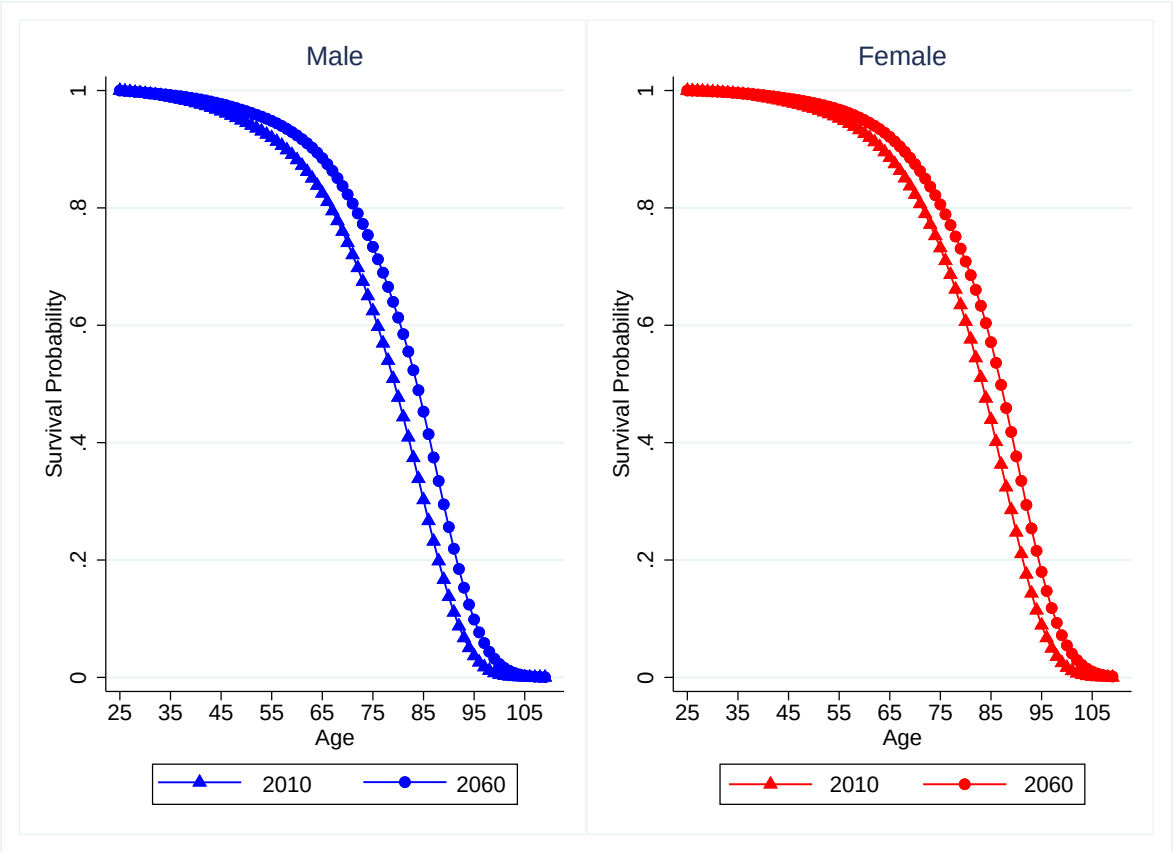
Go Back

Employment Rates and Work Hours for Couples in Simulation I



Go Back

Unconditional Survival Probability at Age 25 in 2010 and 2060



(Data Source: Bell and Miller (2005))

Go Back