Social Security, Life Insurance and Annuities for Families

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Motivation

- One rationale for Social Security is market failure such as the Absence of annuities: i.e. insurance against surviving
- There are many studies of the role of social security as a provider of annuities: Abel (1986), Hubbard and Judd (1987), Imrohoroğlu et al. (1995), and Conesa and Krueger (1999), always in a context of single agents with no concern over others.
- So all agents would always purchase annuities if available.
- However, many people hold life insurance (negative annuities..)
- We revisit the issue of the usefulness of social security with respect to the existence of life insurance and annuities.

Households as families

- We model households as families.

- This provides a rationale for the existence of life insurance and hence it provides for a much better modeling of the margins that may be of concern when facing death.

- Most people purchase life insurance which making it unlikely that they would also purchase annuities.

- Our structure also allows us to incorporate altruism towards dependents, providing a unified picture of the various risks associated to death.

In This Paper...

- We use a two-sex OLG model where agents are indexed by their marital status.
- We incorporate all important events in life: marriage, divorce, death, remarriage, dependents.
- We use our model to reevaluate the usefulness of social security.
- We look at the usefulness of Survivor benefits program within Social security.
- We explore the world where people live longer.
- The point of this paper is to see whether there is a quantitative rationale for annuities when we take into account the exact family position and concerns of most Americans.

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3. Social security acts as a deterrent to savings and lower welfare
4. There is some usefulness of the Survivor Benefits program within social security.
5. We find no differences in our answers in a world where people live longer.

Annuities

- Single agent without dependents with Survival probability γ
- Annuity

$$\text{invest } \gamma \text{ today} \longrightarrow \begin{cases} 1 & \text{if alive,} \\ 0 & \text{if dead.} \end{cases}$$

$$\begin{aligned} \max_{c,s,c' \geq 0} \quad & u(c) + \gamma\, u(c') \\ \text{s.t.} \quad & c + \gamma\, s_1 + (1-\gamma)\, s_2 = y \\ & c' = s_1 \end{aligned}$$

the optimal choice is

$$c = c' = \frac{y}{1+\gamma}, \quad s_2 = 0$$

a rate of return is $\frac{1}{\gamma}$ if surviving. This allocation is Pareto optimum as it has complete markets.

No Annuities

- If there are no annuities..

$$\begin{aligned} \max_{c,s,c' \geq 0} \quad & u(c) + \gamma\, u(c') \\ \text{s.t.} \quad & c + s = y \\ & c' = s \end{aligned}$$

The FOC: $u_c(c) = \gamma\, u_c(c')$.
With standard preferences, $c' < c$ and

$$c + c' = y < \frac{2y}{1+\gamma}$$

Social Security

- How social security can help in the absence of annuities?

$$\begin{aligned} \max_{c,s,c' \geq 0} \quad & u(c) + \gamma\, u(c') \\ \text{s.t.} \quad & c + s = y\,(1-\tau) \\ & c' = s + Tr \\ & Tr = \frac{\tau\, y}{\gamma} \end{aligned}$$

Where τ is the social security tax rate and Tr is the transfer.

$$c + c' = y + y\,\tau\,\frac{1-\gamma}{\gamma} \geq y$$

The allocation may be better than that without annuities because the choice set is larger.

Life insurance and annuities

- Agents with dependents or with spouses

$$\begin{aligned} \max_{c,c',b\geq 0} \quad & u(c) + \gamma\, u(c') + (1-\gamma)\, \chi(d) \\ \text{s.t.} \quad & c + \gamma\, s_1 + (1-\gamma)\, s_2 = y \\ & c' = s_1 \\ & d = s_2 \end{aligned}$$

the optimal choices: $c = c'$ and by $u_c(c) = \chi_b(d)$.

Life insurance and annuities..cont..

- Is annuity always useful? Not always.
- World without annuity but with life insurance.

$$\begin{aligned} \max_{c,c',b\geq 0} \quad & u(c) + \gamma\, u(c') + (1-\gamma)\, \chi(d) \\ \text{s.t.} \quad & c + s + (1-\gamma)\, b = y \\ & c' = s \\ & d = s + b \end{aligned}$$

if in the optimal allocation $d > c'$, this can be implemented:

- with an unconditional savings of c'
- and with a life insurance purchase of $b = (d - c')$

- The inexistence of annuities only matters in some circumstances, i.e., $d < c'$.

The Model: 1. Environment

The overlapping generation model of multiperson households.
Agents are indexed by

- Age $i \in \{1, 2, \cdots, I\}$. $i' = i + 1$
- Sex $g \in \{m, f\}$. Sex doesn't change $g' = g$.
- Marital Status $z \in \{S, M\} =$
  $\{n_o, n_w, d_o, d_w, w_o, w_w, 1_o, 1_w, 2_o, 2_w, \cdots, I_o, I_w\}$.
- Change in marital status - Transition $\pi_{i,g}(z'|z)$
- Assets $a \in \mathcal{A}$. Shared within household

The Model: 2. Demographics & Marriage

- Age-,sex- specific survival probability ($\gamma_{i,g}$)
- Population growth at a rate of λ_μ

$$\mu_{i+1,g,z'} = \sum_z \gamma_{i,g} \frac{\pi_{i,g}(z'|z)}{(1+\lambda_\mu)} \mu_{i,g,z}$$

- Internal consistency.

$$\mu_{i,m,j_o} = \mu_{j,f,i_o}$$

The Model: 3. Preferences and Endowments

Agents enjoy utilities from (1) consumption (2) leaving bequests.

- Stationary Demographics
- Households share consumption goods between members.
- Household type affects consumption (equivalence scales).

$$u_{i,g,z}(c) = u\left(\frac{c}{\eta_{i,g,z}}\right) \qquad \text{(no time allocation or fertility choices).}$$

- $\chi(a)$: Warm Glow Bequest
- Labor earnings endowment: $\varepsilon_{i,g,z}$.

The Model: 4. Agents' Problems

- Single Agents

$$v_{i,g,z}(a) = u_{i,g,z}(c) + \beta\, \gamma_{i,g}\; E\{v_{i+1,g,z'}(a')|z\} + \beta\;\; (1-\gamma_{i,g})\;\; \chi(a')$$

- Married Agents

$$\begin{aligned} v_{i,g,j}(a) = u_{i,g,j}(c) \quad &+ \quad \beta\, \gamma_{i,g}\; E\{v_{i+1,g,z'}(a')|z\} \\ &+ \quad \beta\;\; (1-\gamma_{i,g})\;\; (1-\gamma_{j,g^*})\;\; \chi(a') \\ &+ \quad \beta\;\; (1-\gamma_{i,g})\;\; \gamma_{j,g^*}\;\; E\{\Omega_{j+1,g^*,z'_{g^*}}(a'_{g^*})\} \end{aligned}$$

  - Ω represents the well being of the dependents when the spouse survives and they are under its supervision

The Model: 5. Markets and Legal System

- No insurance for changes in marital status.
- Life insurance against early death of spouse.
- There is Social Security.
- Spouses are constrained to enjoy equal consumption.
- Common property regime (all assets are shared).
- No borrowing possibilities.
- Married HH solve joint maximization problem (weights $\{\xi_{i,g,j}\}$).
- Upon divorce, assets are divided (shares $\{\psi_{i,g,j}\}$).
- Upon death, surviving spouse receives a death benefit from life insurance.

Problem of Single Agents

without dependents

$$
\begin{aligned}
v_{i,g,z}(a) &= \max_{c\geq 0, y\in\mathcal{A}} u_{i,g,z}(c) + \beta\,\gamma_{i,g}\,E\{v_{i+1,g,z'}(a')|z\} \text{ s.t.} \\
c + y &= (1+r)\,a + (1-\tau)\,w\,\varepsilon_{i,g,z} + T_{i,g,z} \\
a' &= y + L_{i,g,z} \qquad \text{if } z' \in S \equiv \{n_w, n_o, d_w, \cdots, w_o\} \\
a' &= y + L_{i,g,z} + A_{z',g^*} \qquad \text{if } z' \in M \equiv \{1_w, 1_o, .., I_o\}
\end{aligned}
$$

- $L_{i,g,z}$: Lump sum transfer to survivors
- A_{z',g^*} : Assets spouse brings into marriage. (Random variable).
- Agent must know asset distribution of prospective partners.

Problem of Single Agents

with dependents

$$v_{i,g,z}(a) = \max_{c\geq 0, b\geq 0, y\in A} u_{i,g,z}(c) + \beta\gamma_{i,g}\, E\{v_{i+1,g,z'}(a')|z\} + \beta\left(1-\gamma_{i,g}\right)\chi(y+b) \quad \text{s.t.}$$

$$c + y + (1-\gamma_{i,g})b = (1+r)\,a + (1-\tau)w\,\varepsilon_{i,g,z} + T_{i,g,z}$$

$$a' = \begin{cases} y & \text{if } z' \in S \\ y + A_{z',g^*} & \text{if } z' \in M, \end{cases}$$

$$a' \geq 0,$$

$$y + b \geq 0.$$

Problem of Married Couples

- We need to specify a bunch of family details:
  1. Spouses are constrained to enjoy equal consumption.
  2. Common property regime (all assets are shared).
  3. The household solves a joint maximization problem with weights: $\xi_{i,m,j} = 1 - \xi_{j,f,i}$.
  4. Upon divorce, assets are divided.
     - $\psi_{i,g,j}$: fraction of assets to $\{i, g, j\}$
     - $\psi_{j,g^*,i}$: fraction of assets to spouse.
  5. Upon the death of spouse, remaining spouse receives a death benefit from life insurance.

Problem of Married Couples

without dependents

$$\max_{c\geq 0, b_g \geq 0, b_{g^*} \geq 0, y \in \mathcal{A}} \quad \xi_{i,g,j}\left[u_{i,g,j}(c) + \beta\,\gamma_{i,g} E\{v_{i+1,g,z'_g}(a'_g)|j\}\right]$$

$$+ \quad \xi_{j,g^*,i}\left[u_{j,g^*,i}(c) + \beta\,\gamma_{j,g^*}\, E\{v_{j+1,g^*,z'_{g^*}}(a'_{g^*})|i\}\right]$$

$$\text{s.t.} \quad c + y + (1-\gamma_{i,g})b_g + (1-\gamma_{j,g^*})b_{g^*}$$

$$= \quad (1+r)\,a + (1-\tau)\,w(\varepsilon_{i,g,j} + \varepsilon_{j,g^*,i}) + T_{i,g,j}$$

Problem of Married Couples

Cont..

- if same marriage:

$$a'_g = a'_{g^*} = y + L_{i,g,j}$$

- if divorce and no remarriage {remarriage}:

$$\begin{aligned} a'_g &= \psi_{i,g,j} \ (y + L_{i,g,j}) + \{A_{z'_g,g^*}\}, \\ a'_{g^*} &= \psi_{j,g^*,i} \ (y + L_{i,g,j}) + \{A_{z'_{g^*},g}\}. \end{aligned}$$

- if agent widowed and no remarriage {remarriage}:

$$a'_g = y + L_{i,g,j} + b_{g^*} + \{A_{z'_g,g^*}\}.$$

- if spouse widowed and no remarriage {remarriage}:

$$a'_{g^*} = y + L_{i,g,j} + b_g + \{A_{z'_{g^*},g}\}.$$

Equilibrium

- We look at stationary equilibria. An equilibrium is a probability measure on assets, $x_{i,g,z}$, such that

i) Factor prices are consistent with x.

ii) Agents solve their problem given factor prices and the distribution of wealth x, (need to know properties of prospective spouses).

iii) Distribution x is indeed generated by agents actions:

$$x_{i+1,g,z'}(B) = \sum_{z \in Z} \pi_{i,g}(z'|z) \int_{a \in \mathcal{A}} \chi_{a'_{i,g,z}(a) \in B} \; x_{i,g,z}(da)$$

where χ is the indicator function.

iv) There are zero profits in the insurance industry.

Market Structures

- The benchmark: Social security, no annuities and rebates and life insurance
- The Pharaoh: Social security, no annuities and no rebates and life insurance
- Annuities: Social security, annuities and life insurance
- No contingencies: Social security, no annuities and rebates and no life insurance

Welfare Comparison

- Consumption equivalent variation measure: how much additional consumption is needed in every nodes of event tree in the old steady state so that their welfare equals welfare of newborn in the new economy.
  - C^s : steady states
  - C^b : new born under a new policy but with the bequests of the benchmark model
- Externality : Distribution of asset from prospective spouses.

We calculate the steady state welfare by

$$W^s = \int v_{1,g,z}(a)\, d\mu_{1,g,z}$$

Average of value function of newborn with asset a.

Mapping the Model to Data. I. Demographics

- Age groups: 15-85.
- Survival Probabilities: 1999 (U.S. Vital Statistics Mortality Survey).
- Population growth 1.2%.
- Family Transitions: From the PSID between 1994 and 1999

Mapping the Model to Data. II. Other features from the marriage.

- Equal share of assets upon divorce: $(\psi_{\cdot,m,\cdot} = \psi_{\cdot,f,\cdot} = 0.5)$.
- Family Size. From CPS.
- Endowments. CPS earnings 1989-1991 distinguished by age, sex, and marital status (7 groups): $\{M, n_o, n_w, d_o, d_w, w_o, w_w\}$).
- Adjust for divorced. We add age-specific alimony and child support income to the earnings of divorced women on a per capita basis.

III. Preferences, Endowments and Technology

- Habits from marriage.
  $u_{*,g,n_o}(c) = u(c), \qquad u_{*,g,d_o}(c) = u_{*,g,w_o}(c) = u\left(\frac{c}{1+\theta^g_{dw}}\right).$
- Increasing Returns to Consumption $u_{*,g,m_o}(c) = u\left(\frac{c}{1+\theta}\right)$.
- Singles with dependents (adults or children), cost and utility. We distinguish the costs by sex of the of household head.

$$u_{*,g,n_w}(c) = \kappa \; u\left(\frac{c}{1+\theta^g\{\theta_c \#_c + \theta_a \#_a\}}\right)$$

Utility Parameters

Parameter Values Estimated by Hong and Ríos-Rull (2004)

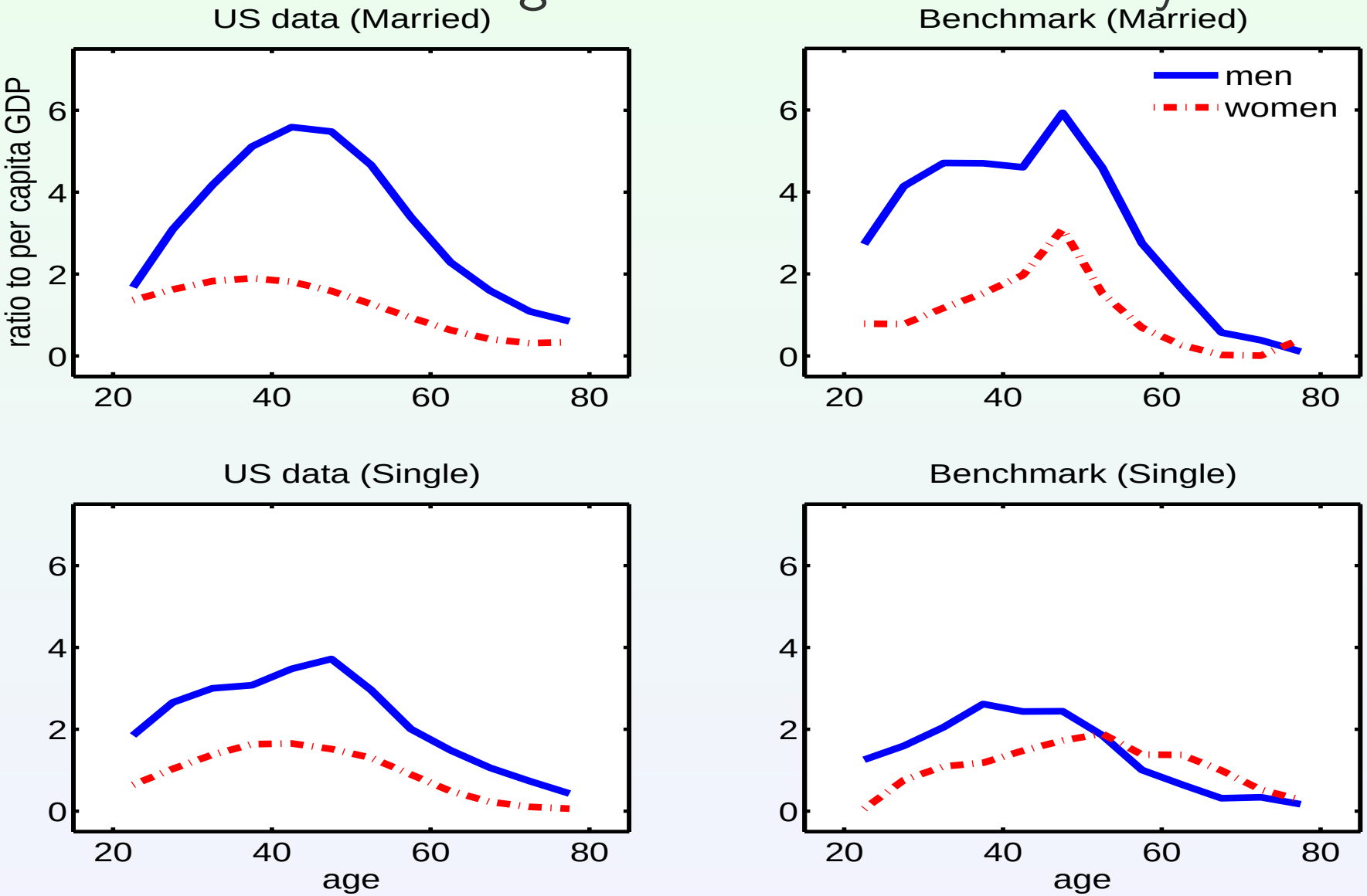
θ	θ_c	θ_a	θ^m_{dw}	θ^f_{dw}	θ^m	χ_a	χ_b	κ	ξ_m
.11	2.54	.00	.00	1.77	1.28	0.29	5.93	1.00	.87

- Marriage generates strong economies of scale.
- Marriage generates habits for women.
- Children are very costly for males.
- Children are less costly for females than for males.
- Agents care a lot for their dependents.

Social Security

- Social Security tax (τ): 11%
- Retirement age: 65
- Benefit is adjust by sex and marital status.
  - $T_m : T_f : T_M = 1 : .76 : 1.5$
  - $T^w = \max\{T_m, T_f\}$ survivor's benefit for a widow

Life insurance holdings in Benchmark Economy



Economies with Social Security

	Benchmark	Pharaoh	Annuities	No Contingent
Wealth	229.03	235.31	230.06	279.48
Earnings	71.73	71.73	71.73	71.73
Consumption	81.81	81.18	81.94	83.67
Life Insurance	127.45	132.77	121.16	0
Annuity	0	0	124.69	0
Social Security Tax	7.88	7.88	7.88	7.88
Survivors' Benefits	0.32	0.32	0.32	0.32
Output	100.00	100.78	100.13	106.23
Bequest	0.81	0.83	0.75	0.84
Assets that Disappear	-	0.77	-	-
CE C^s		0.009%	-0.047%	-0.541%
CE C^b		0.005%	-0.006%	-0.551%
CE $\widehat{C}^b$		-0.004%	0.000%	-0.648%

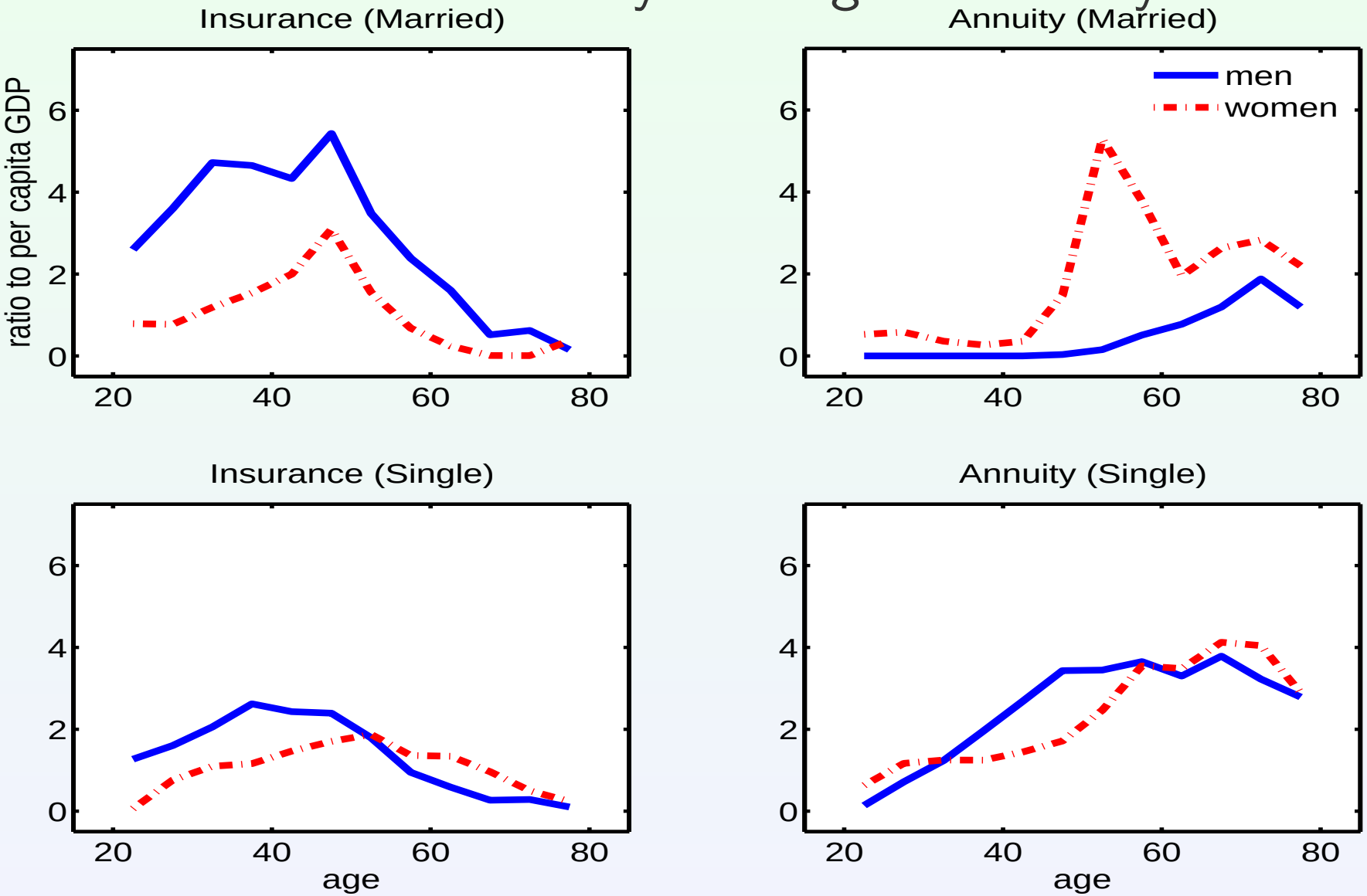
Pharaoh Economy with Social Security

- Social Security, Life Insurance, no Annuities, no Rebates
- Agents save more and consume less
- They purchase a lot more life insurance.
- The welfare costs of the asset destruction are not very large.

Annuity Economy with Social Security

- The Economy with Social Security, Life Insurance and Annuities
- Middle-age married women use annuities the most.
- Why?? Women outlive men and have higher incentive to save more
- Our utility specification : habit from previous marriages for women
- More life insurance against their husband's life
- Annuities for themselves.

Life insurance and annuity holdings in Annuity Economy



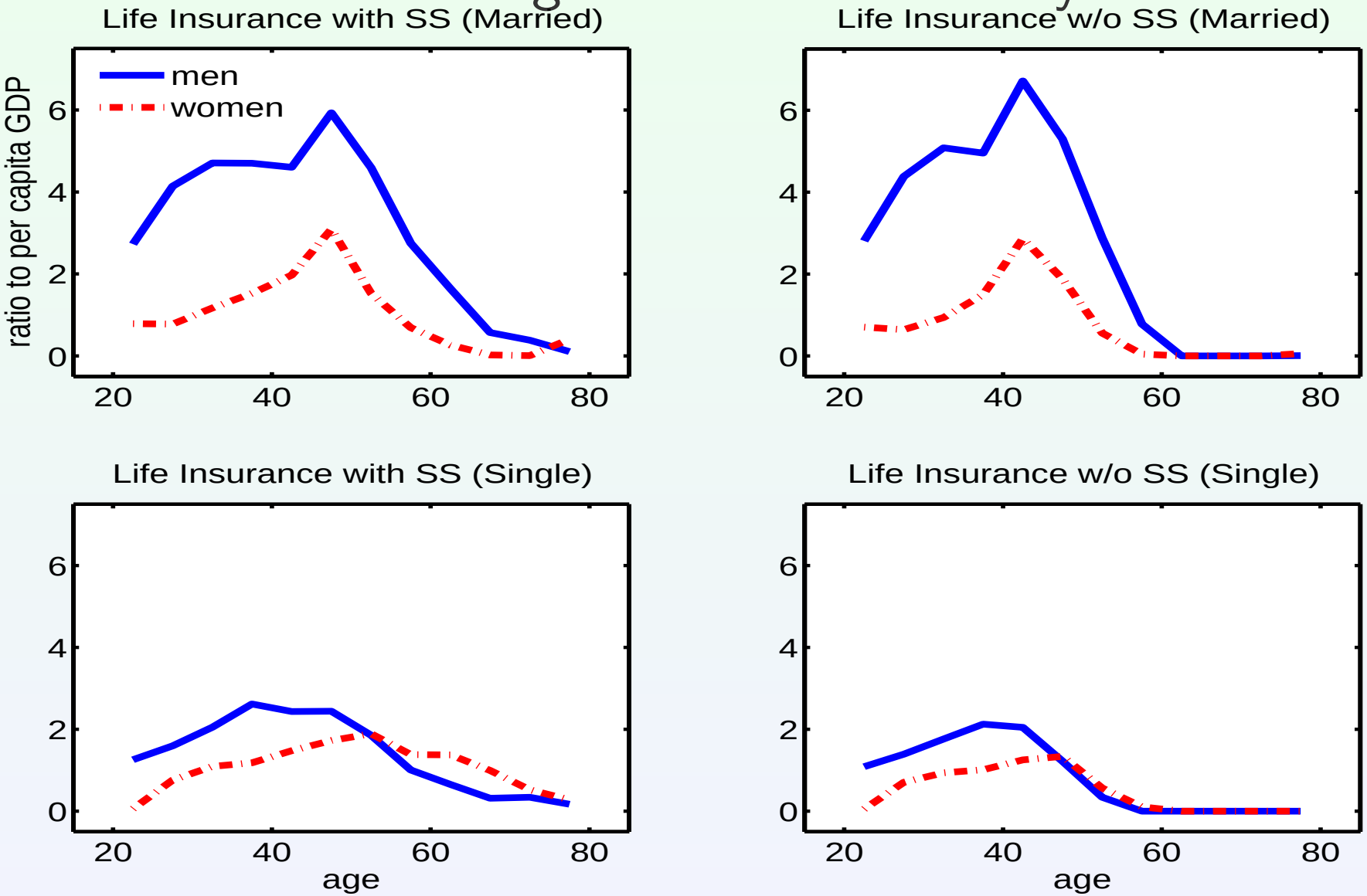
No contingent claim economy with Social Security

- Economy with Social Security and without Annuities and Life Insurance
- Without life insurance, they make up for it by increasing their savings.
- The amount of assets is 22 percent higher than in the benchmark economy.
- Higher asset by increasing savings throughout the lifetime, especially when young
- The lack of life insurance seriously hampers the ability of people to cover against early death in the families and the welfare losses are quite large both if we do adjust for different amounts of bequests or not.

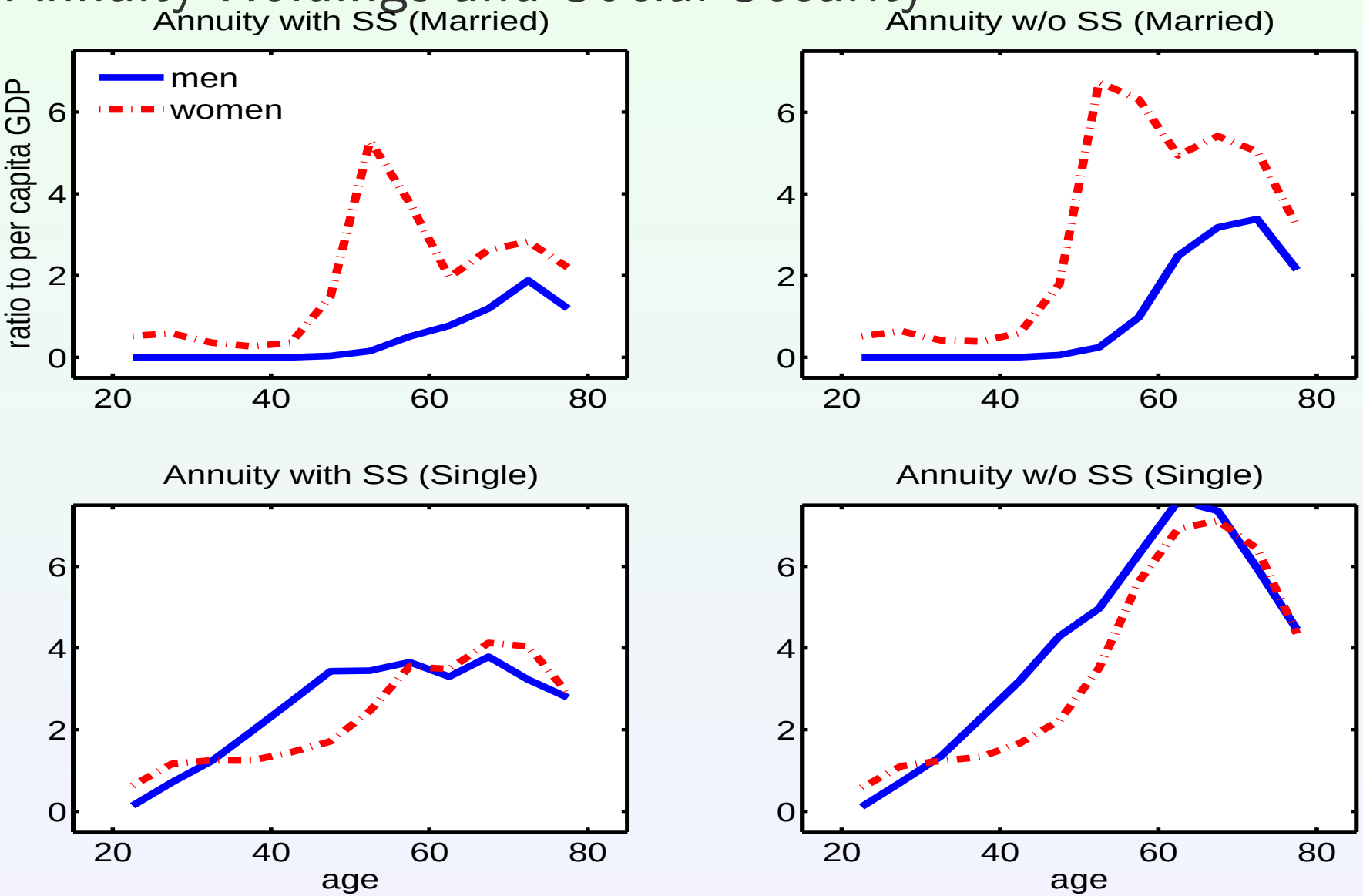
Abolishing Social Security

	Benchmark	Pharaoh	Annuities	No Contingent
Wealth	374.00	390.02	364.27	416.76
(with SS)	229.03	235.31	230.06	279.48
Consumption	87.97	87.06	87.76	89.54
	81.81	81.18	81.94	83.67
Life Insurance	129.96	133.21	125.27	0
	127.45	132.77	121.16	0
Annuity	0	0	225.65	0
	0	0	124.69	0
Output	117.90	119.87	116.69	123.17
	100.00	100.78	100.13	106.23
Bequest	1.05	1.08	0.77	1.08
	0.81	0.83	0.75	0.84
Assets that Disappear	-	1.38	-	-
	-	0.77	-	-
CE C^s	12.245%	12.330%	12.125%	11.745%
CE C^b	12.134%	12.215%	12.104%	11.633%

Life Insurance Holdings and Social Security



Annuity Holdings and Social Security



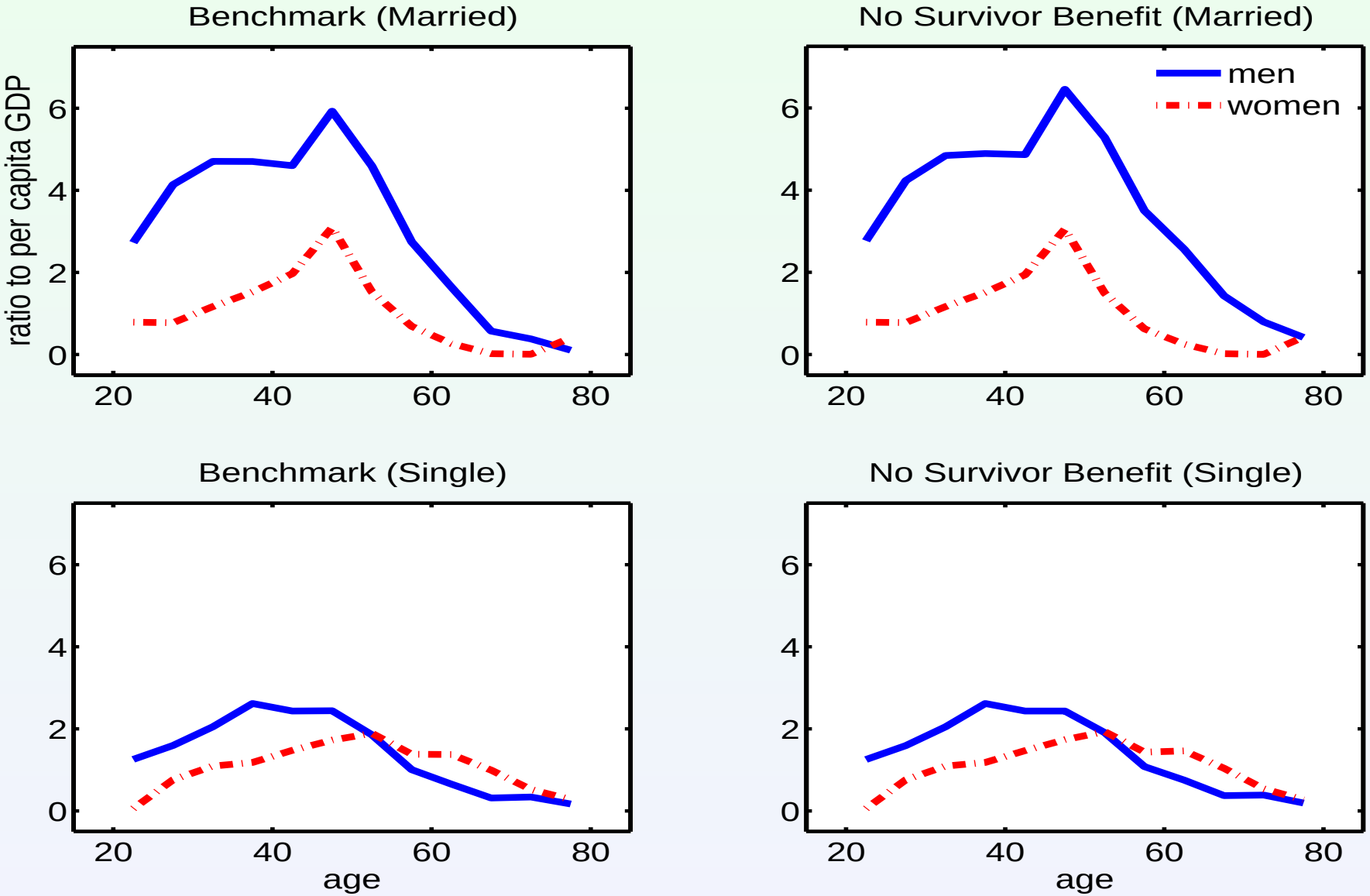
What is going on?

- Effect of social security
  - the standard effect as a deterrent to savings
  - Social annuity provides an implicit annuity to a single beneficiary
  - A partial life insurance component in the form of survivor's benefits.
- Huge welfare effects of eliminating Social Security
- Big drop in life insurance holdings of elderly.
- Increase in annuity holdings for all groups.

Abolishing Survivor's Benefits

	Benchmark	Pharaoh	Annuities	No Contingent
Wealth (without SS)	229.60	236.42	230.52	281.16
(with SS)	229.03	235.31	230.06	279.48
Consumption	81.85	81.26	81.98	83.75
	81.81	81.18	81.94	83.67
Life Insurance	137.18	143.99	129.18	0
	127.45	132.77	121.16	0
Annuity	0	0	123.48	0
	0	0	124.69	0
Survivors' Benefits	.0	.0	.0	.0
	0.32	0.32	0.32	0.32
Output	100.07	100.91	100.18	106.44
	100.00	100.78	100.13	106.23
Bequest	0.82	0.83	0.75	0.84
	0.81	0.83	0.75	0.84
Assets that Disappear	-	0.79	-	-
	-	0.77	-	-
CE C^s	-0.028%	-0.019%	-0.029%	-0.015%
CE C^b	-0.032%	-0.022%	-0.032%	-0.016%

Life Insurance without Survivor Benefits

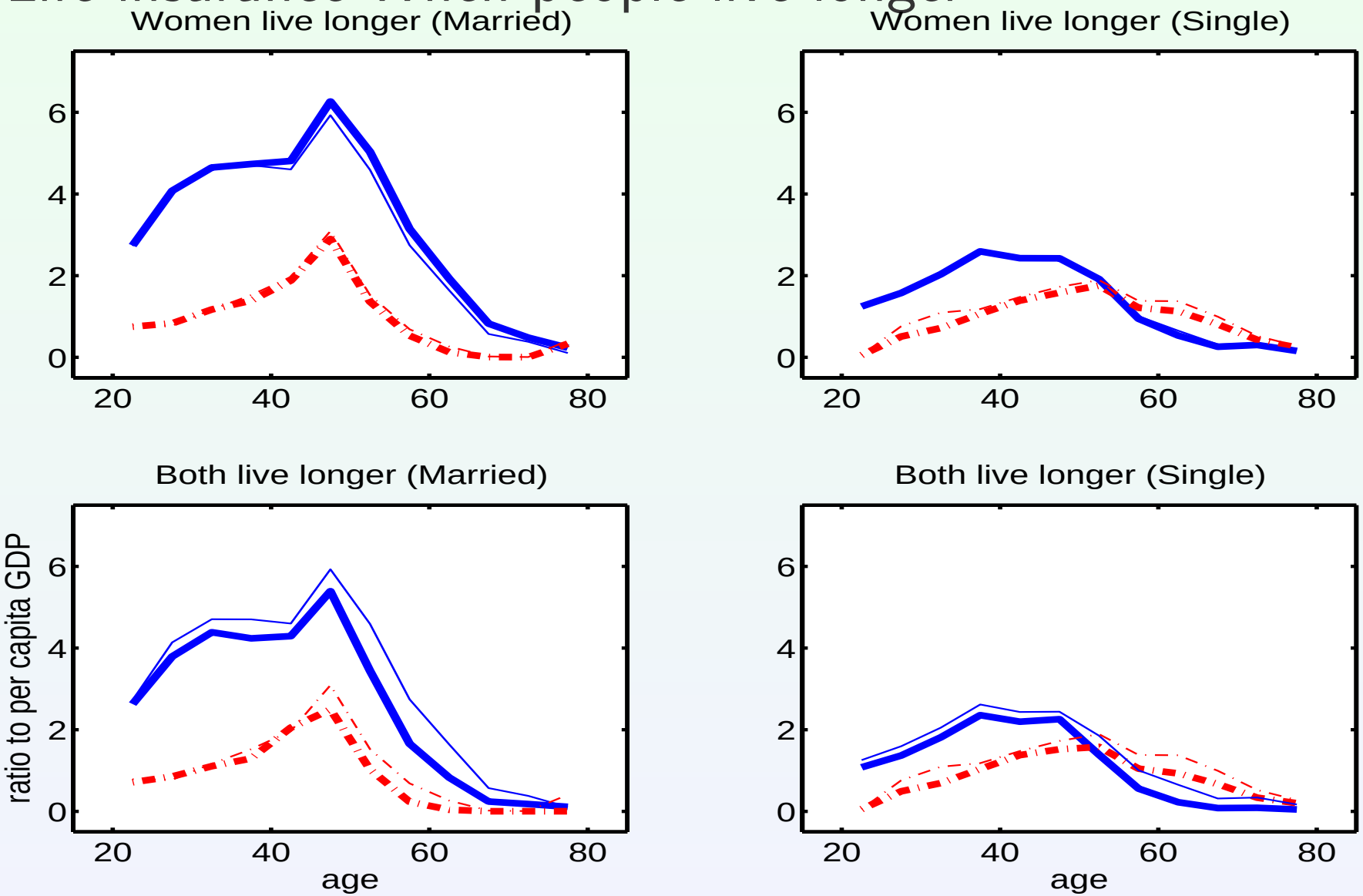


Economies with increased longevity

- With fixed payroll tax rate, average benefit amount is reduced.
- Relative size of Social Security is smaller.

	Both live longer	No survivors Benefits	Women live longer	No survivors Benefits
Wealth	260.10	260.23	237.89	238.49
Earnings	67.89	67.89	70.63	70.63
Consumption	79.09	79.11	81.12	81.17
Life Insurance	105.16	112.84	127.41	138.18
Annuity	0	0	0	0
SS Tax	7.46	7.46	7.76	7.76
Survivors Benefits	0.17	0	0.35	0
Output	100.00	100.02	100.00	100.07
Bequest	0.74	0.74	0.69	0.70
CE C^s		-0.0038%		-0.0081%
CE C^b		-0.0041%		-0.0092%

Life insurance When people live longer



Conclusion

- The usefulness of social security should be looked at in the context of **family** because annuities, life insurance, and social security are related to the risks of people's death.
- We use the OLG model of family to understand the role of annuity and welfare implication of current social security system.
- We find that
  - life insurance is important in enhancing welfare of agents
  - annuity does not improve welfare when there is strong bequest motives.
  - Social security acts as a deterrent to savings and lower welfare
  - We do find some support for maintaining the Survivor Benefits program within social security.
  - No differences in our answers in the world where people live longer.

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