Life Insurance and Household Consumption

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Introduction: A few questions

- How do preferences change over the life cycle?
- How to model *households* as different from individuals?
- What are the events (shocks) that shape people's lives?
- How do these issues translate into building heterogeneous agents macroeconomic models?

Introduction: Insight

- An insight from the work of Chiappori (et al.) is that

  - with information about both private (for individual members of the household) and public (shared by all household members) and
  - with the assumption that the allocations are on the contract curve

we can learn about individual preferences and the decision making process.

Introduction: Our paper

- Life insurance holdings conditional on the death of a specific person is a very clear case of a purely private good.

- The life cycle and in general demographics generates a lot of systematic variation of the usefulness of life insurance.

- The use of a fully articulated general equilibrium macroeconomic model provides an ideal tool to learn about preferences and the within household decision making process.

We put these notions to work

- We use an OLG model with agents differing in age, sex, marital and parental status, and wealth where households are formed and destroyed via marriages, divorces and deaths and where agents consume and save and purchase life insurance.

- Our model with life insurance is a standard macro model in the sense that it looks like the U.S. economy in other dimensions as well.

- We estimate the (very rich) model and we match the data (very) well. The estimates say a lot about how preferences vary across household types, about the degree of altruism for the progenie and about the weights of a bargaining process. These estimates give a very different picture than the pervasive equivalence scales.

- We show how abstracting from some of the features that we pose yields very bad estimates.

- We explore the implications of two Social Security reforms.

Chambers, Schlagenhauf and Young (2003)

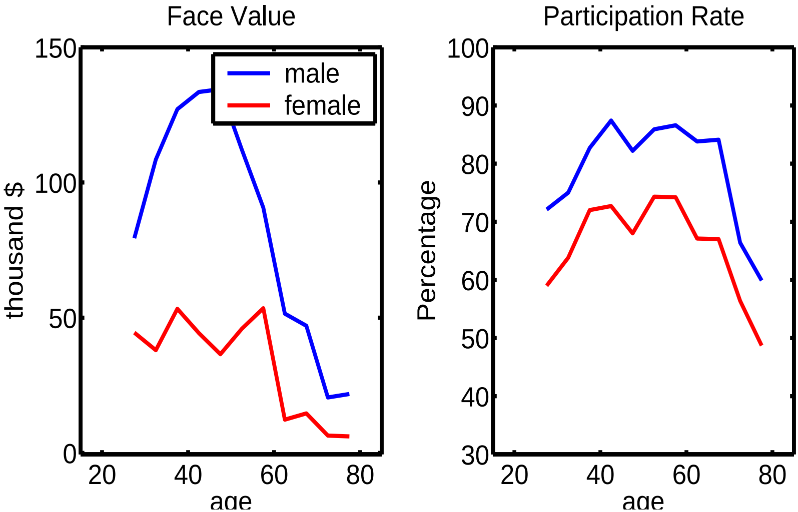
- They find puzzling the pattern of life insurance holdings. They do not (cannot) distinguish by sex.

Data: Life Insurance holdings of U.S. households

- More men (76.0%) own life insurance than women (62.8%).
- Ownership is more common for middle-aged people.
- A lot more if men die ($80,374) than if women ($28,110) die.
- More for married people than singles:
  - Married men ($85,350), married women ($32,197)
  - Single men($54,930), Single women($18,718)

- Data: From SRI International Survey of Consumers Financial Decisions, 1990 .

Life Insurance Holdings According to the SRI DATA



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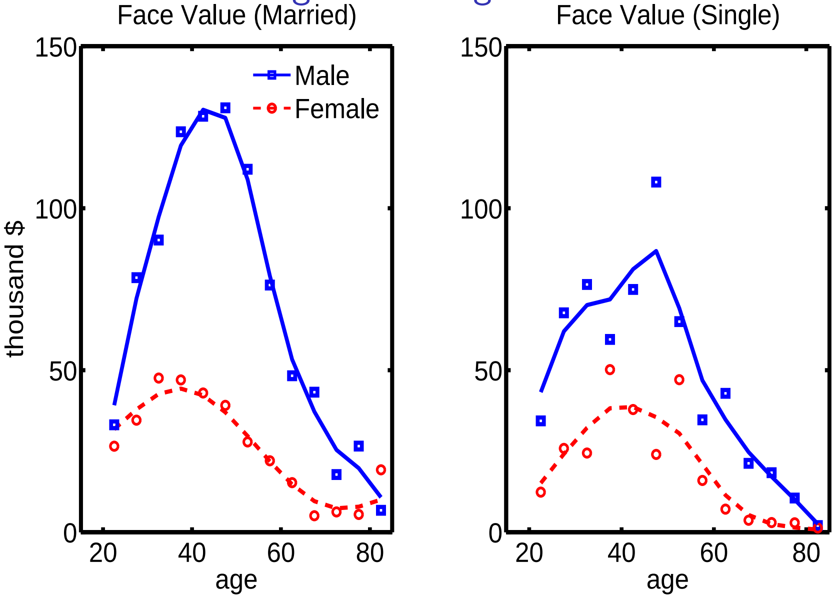
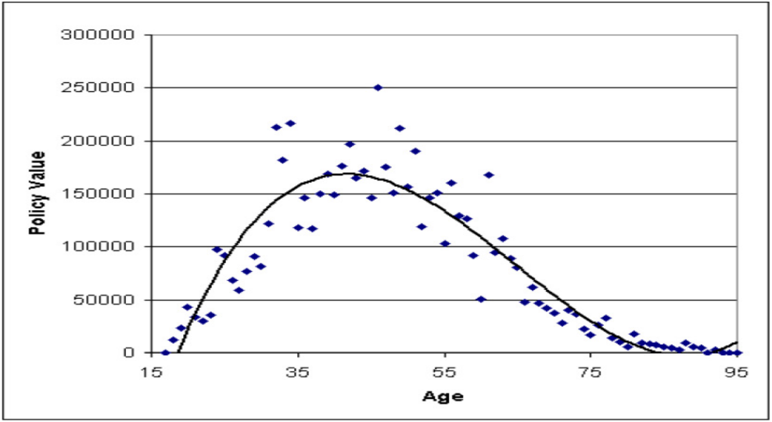


Life Insurance Holdings According to the SCF

Figure 2: Average Life Insurance Holdings by Age



Source: Chambers, Schlagenhauf and Young (2003).

Term Insurance vs. Whole Life Insurance

- Term Insurance

  1. Protect a policyholder's life until its expiration date.
  2. Renew the contract with new (increased) premium when expired.
  3. Purely for protection against death.

- Whole Life Insurance

  1. No expiration date.
  2. Premium remains constant.
  3. Insurance purpose + *Saving purpose*

- We only consider the term insurance because whole-life insurance can be treated as an asset. Even in term insurance there may be some front loading (LT10, LT20, LT5, A. Lizzeri).

The logic: 1. Life insurance and altruism

- Consider a single agent with dependents. With prob γ the agent may live another period. Its preferences are given by utility function $\mathbf{u}(\cdot)$ if alive, which includes care for the dependents. If the agent is dead, $\chi(\cdot)$ is an altruistic concern for its dependents. With access to insurance the problem agent is:

$$\max_{\mathbf{c},\mathbf{a}',\mathbf{b}} \quad \mathbf{u}(\mathbf{c}) + \gamma\, \mathbf{u}(\mathbf{a}') + (1-\gamma)\, \chi\big(\mathbf{a}' + \mathbf{b}\big)$$

$$\text{s.t.} \quad \mathbf{c} + \mathbf{a}' + (1-\gamma)\, \mathbf{b} = \mathbf{y}$$

where $\mathbf{b}$ is the life insurance purchase. The foc implies $\mathbf{c} = \mathbf{a}'$ and

$$\mathbf{u}_{\mathbf{c}}(\mathbf{c}) = \chi_{\mathbf{b}}(\mathbf{a}' + \mathbf{b}).$$

With data on consumption and life insurance holdings for many households we could recover the relation of $\mathbf{u}$ and χ.

The logic: 2. Utility when married versus when single

- Consider now a married couple where one of them is the sole decision-maker and she lives for two periods. The other agent may live a second period with prob γ. Let $\mathbf{u^m(c)}$, ($\mathbf{c}$ public), be the utility of the decision-maker when married while $\mathbf{u^w(c)}$ is the utility when she is a widow. With fair insurance markets and zero interest rate, her problem is:

$$\max_{\mathbf{c^m, a', b}} \quad \mathbf{u^m(c^m)} + \gamma\, \mathbf{u^m(a')} + (1-\gamma)\, \mathbf{u^w\big(a' + b\big)}$$

$$\text{s.t.} \quad \mathbf{c^m} + \mathbf{a'} + (1-\gamma)\, \mathbf{b} = \mathbf{y}$$

The foc are $\mathbf{c^m = a'}$ and $\mathbf{u^m_c(c^m) = u^w_c(a' + b)}$. This can also be estimated.

The (Baseline) Model

We use an Overlapping Generations Model. Agents are indexed by:

- **Age:** $\mathbf{i} \in \{\mathbf{1}, \mathbf{2}, \cdots, \mathbf{I}\}$. Time ages people: $\mathbf{i}' = \mathbf{i} + \mathbf{1}$.

- **Sex:** $\mathbf{g} \in \{\mathbf{m}, \mathbf{f}\}$, ($\mathbf{g}^*$ is spouse's gender). Sex of agents does not change: $\mathbf{g}' = \mathbf{g}$.

- **Marital Status:** $\mathbf{z} \in \{\mathbf{n_c}, \mathbf{n_o}, \mathbf{n_w}, \mathbf{d_c}, \cdots, \mathbf{w_c}, \cdots, \mathbf{1_c}, \mathbf{1_o}, \mathbf{2_c}, \cdots, \mathbf{I_o}\}$,: never married, divorced, widows, with children, other dependents or alone and married (specifying the spouse's age) with and without children. This we think of a shock: with $\pi_{\mathbf{i},\mathbf{g}}(\mathbf{z}'|\mathbf{z})$ being the probability of moving to state $\mathbf{z}'$, conditional on being in state $\mathbf{z}$.

- **Assets:** $\mathbf{a} \in \mathcal{A}$. These assets are attached to the household and it varies because of savings, because of receiving life insurance benefit and because of changes in the composition of the household.

Stationary Demographics

- Population grows at a rate λ_μ, Age- and Sex- specific mortality risk $\gamma_{i,g}$(Survival probability of age $\mathbf{i}$ and sex $\mathbf{j}$ person)

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

  - $\mu_{i,g,z}$ **:** Measure of people of type $\{i, g, z\}$.

- Consistency of demographic conditions (measure age $\mathbf{i}$ males married to age $\mathbf{j}$ females equals measure age $\mathbf{j}$ females married to age $\mathbf{i}$ males).

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

Preferences

- Preferences of a single without dependents {with}

$$\mathbf{v}_{i,g,z}(a) = \mathbf{u}_{i,g,z}(c) + \beta\, \gamma_{i,g}\, \mathbf{E}\{v_{i+1,g,z'}(a')|z\} + \{\, \beta\, (1-\gamma_{i,g})\, \chi(a')\}$$

- A married household is more complicated (there is utility from the dependents' consumption while under the care of the former spouse)

$$\mathbf{v}_{i,g,j}(a) = \mathbf{u}_{i,g,j}(c) + \beta\, \gamma_{i,g}\, \mathbf{E}\{v_{i+1,g,z'}(a')|z\} + \beta\, (1-\gamma_{i,g})\, (1-\gamma_{j,g^*})$$

$$\chi(a') + \beta\, (1-\gamma_{i,g})\, \gamma_{j,g^*}\, \mathbf{E}\left\{\Omega_{j+1,g^*,z'_{g*}}(a'_{g^*})\right\}$$

$$\Omega_{i,g,z}(a) = \widehat{u}_{i,g,z}(c) + \beta\, \gamma_{i,g}\, \mathbf{E}\{\Omega_{i+1,g,z'}(a'|z)\} + \beta\, (1-\gamma_{i,g})\, \chi(a')$$

Equivalence Scales and Endowments

- Hhold type affects consumption

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

- Labor earnings endowment: $\varepsilon_{\mathbf{i,g,z}}$.
  - It allows for women going to the labor market upon separation.
  - It incorporates alimony and child support.
  - It does not deal with the selection of males properly.

Markets

- No insurance for changes in marital status.
- Life insurance against early death of spouse.
- Annuities markets insure against the death of singles and joint death of married couples both without dependents. Internal consistency (not very important).
- No borrowing possibilities (not very important).
- There is Social Security.

Marital Property Status

- We assume common property of all household assets, no memory of who brought what to the household.

- This is not necessarily the law of all countries but it is the de facto system for most people, those with few assets, or those with small differences in assets at the time of marriage.

- An important question is the extent to which property can be protected (e.g. young people save mostly in the form of human capital that is typically non–transferable).

Single Agent's Problem:

$$
\begin{aligned}
v_{i,g,z}(a) &= \max_{c \geq 0, y \in \mathcal{A}} u_{i,g,z}(c) \; + \beta \, \gamma_{i,g} \, E\{v_{i+1,g,z'}(a') | z\} \text{ s.t.} \\
c + y &= (1 + r)\, a + (1 - \tau) \; w \; \varepsilon_{i,g,z} + T_{i,g,z} \\
a' &= \frac{y}{\gamma_{i,g}} \qquad\qquad\qquad \text{if } \; z' \in \{n_c, n_o, n_w, d_c, \cdots, w_w\} \\
a' &= \frac{y}{\gamma_{i,g}} + A_{z',g^*} \qquad \text{if } \; z' \in \{1_c, 1_o, .., l_o\}
\end{aligned}
$$

- A_{z',g^*} **:** Assets spouse brings into marriage. (Random variable).
- Agent must know asset distribution of prospective partners.

Married Couple's Problem: $\mathbf{z} \in \{1, .., \mathbf{I}\}$

- 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: $\xi_{\mathbf{i,m,j}} = 1 - \xi_{\mathbf{j,f,i}}$.
4. Upon divorce, assets are divided.
   - $\psi_{\mathbf{i,g,j}}$: fraction of assets to $\{\mathbf{i}, \mathbf{g}, \mathbf{j}\}$
   - $\psi_{\mathbf{j,g^*,i}}$: fraction of assets to spouse.
5. Upon the death of spouse, remaining spouse receives a death benefit from life insurance.

Married Couple's Problem: $z \in \{1, .., I\}$ cont.

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

$$\text{s.t.} \quad c + y + b_g + b_{g*} \quad = \quad (1 + r)\, a + (1 - \tau)\, w(\varepsilon_{i,g,j} + \varepsilon_{j,g^*,i})$$
$$+ T_{i,g,j}$$

- if same marriage:

$$a'_g = a'_{g^*} = \frac{y}{\gamma_{i,g} + \gamma_{j,g^*} - \gamma_{i,g}\gamma_{j,g^*}} = \frac{y}{\Gamma}.$$

- if divorce and no remarriage {remarriage}:

$$a'_g = \psi_{i,g,j} \frac{y}{\Gamma} + \{A_{z'_g,g^*}\},$$

$$a'_{g^*} = \psi_{j,g^*,i} \frac{y}{\Gamma} + \{A_{z'_{g^*},g}\}.$$

- if agent widowed and no remarriage {remarriage}:

$$a'_g = \frac{y}{\Gamma} + \frac{b_{g^*}}{\gamma_{i,g}(1 - \gamma_{j,g^*})} + \{A_{z'_g,g^*}\}.$$

- if spouse widowed and no remarriage {remarriage}:

$$a'_{g^*} = \frac{y}{\Gamma} + \frac{b_g}{(1 - \gamma_{i,g})\gamma_{j,g^*}} + \{A_{z'_{g^*},g}\}.$$

Equilibrium

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

i) Factor prices are consistent with $\mathbf{x}$.

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

iii) Distribution $\mathbf{x}$ is indeed generated by agents actions:

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

where χ is the indicator function.

iv) There are zero profits in the insurance industry.

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
- The implied population structure is stationary.

II. Preferences, Endowments and Technology 1.

- Never married w/o depnts have CRRA, no altruism between couple.

1. Habits from marriage.

$$\mathbf{u}_{*,g,n_o}(\mathbf{c}) = \mathbf{u}(\mathbf{c}), \qquad \mathbf{u}_{*,g,d_o}(\mathbf{c}) = \mathbf{u}_{*,g,w_o}(\mathbf{c}) = \mathbf{u}\left(\frac{\mathbf{c}}{1+\theta^{g}_{dw}}\right).$$

2. Increasing Returns to Consumption $\mathbf{u}_{*,g,m_o}(\mathbf{c}) = \mathbf{u}\left(\frac{\mathbf{c}}{1+\theta}\right)$.
3. Singles with dependents (adults or children), cost and utility. We distinguish the costs by sex of the of household head.

$$\begin{aligned}
\mathbf{u}_{*,g,n_w}(\mathbf{c}) &= \kappa\ \mathbf{u}\left(\frac{\mathbf{c}}{1+\theta^{g}\{\theta_c\#_c+\theta_a\#_a\}}\right) \\
\mathbf{u}_{*,g,d_w}(\mathbf{c}) = \mathbf{u}_{*,g,w_w}(\mathbf{c}) &= \kappa\ \mathbf{u}\left(\frac{\mathbf{c}}{1+\theta^{g}_{dw}+\theta^{g}\{\theta_c\#_c+\theta_a\#_a\}}\right)
\end{aligned}$$

II. Preferences, Endowments and Technology 2.

4. Married with dependents is a combination of singles with dependents and married without dependents.

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

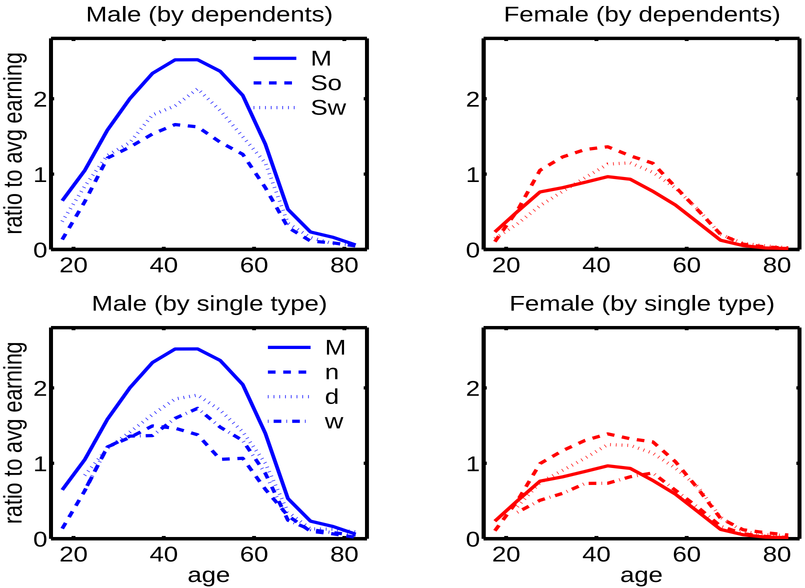
5. Altruism function χ to be a CRRA function, $\chi(x) = \chi_a \frac{x^{1-\chi_b}}{1-\chi_b}$. Two parameters control both average and derivative of altruism intensity.
6. Sex weights in joint maximization problem, $\xi_m + \xi_f = 1$.

- 12 parameters: $\{\beta, \xi_m, \sigma\}$ and parameters related to the multiperson household $\{\theta^m_{dw}, \theta^f_{dw}, \theta, \theta^m, \theta_c, \theta_a, \chi_a, \chi_b, \kappa\}$. We set the risk aversion parameter to 3, and we estimate all other parameters.

Other features from the marriage.

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

CPS earnings by age, sex, and marital status



Social Security

- Social Security tax (τ): 11%
- Retirement age: 67
- Benefit is adjust by sex and marital status.
  - $\mathbf{T_m : T_f : T_M = 1 : .76 : 1.5}$
  - $\mathbf{T^w = max\{T_m, T_f\}}$ survivor's benefit for a widow

Estimation of the Benchmark Economy (11 parameters)

- We choose parameters to minimize the sum of the square of the residuals of the age profile of life insurance holdings by sex and marital status, subject to the model economy's generating a wealth to earnings ratio of 3.2.

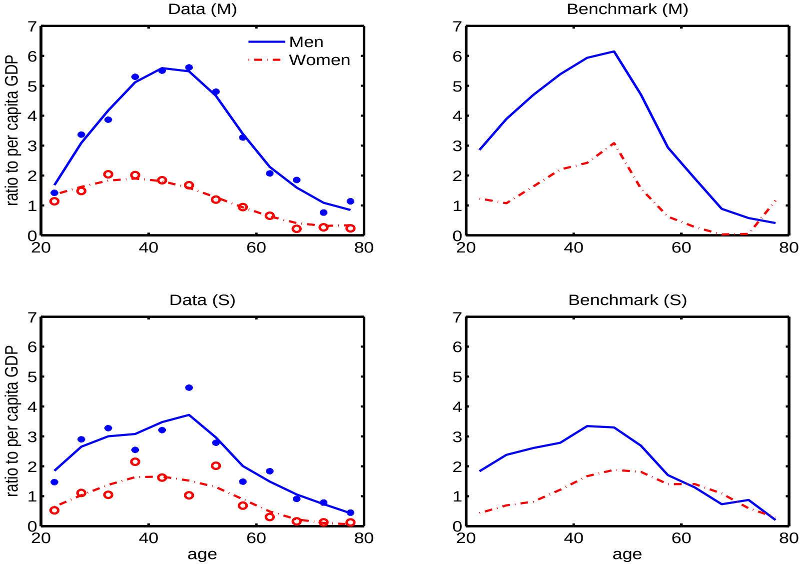
- We simultaneously search for parameters that provide the smallest possible residuals, that ensure that the economy is in equilibrium, and that guarantee that the government satisfies its budget constraint by minimizing a weighted sum of residuals where the equilibrium considerations are essentially required to be satisfied with equality.

θ	θ_c	θ_a	θ^m_{dw}	θ^f_{dw}	θ^m	χ_a	χ_b	κ	ξ_m	β	SSE
.48	3.79	.0	.00	2.56	1.50	4.71	2.84	1.00	.87	.975	11.1

Properties of the Benchmark

- Marriage generates strong economies of scale. Two people spend \$1.48 together to enjoy the same utility as one spending \$1.
- **Marriage generates habits for women.** A divorced/widowed woman spending \$3.56 has the utility of a 1\$ never married. Not men.
- **Children are very costly for males.** A single male with a child has to spend an additional \$3.79 to get the same utility he would get alone spending \$1. If the dependent is an adult, nothing.
- **Children are less costly for females than for males.** A dependent costs a single man 50 percent more than it costs single women or married couples. Females produce a lot of home goods.
- **Agents care a lot for their dependents.** The average single man of age **I** with dependents consumes .45 and gives .55 as a bequest.
- **Men have a higher weight in the joint-decision problem.**

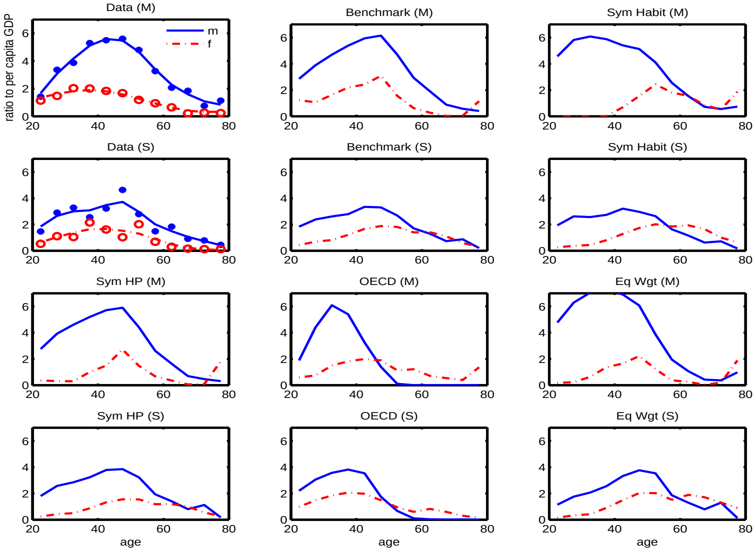
Benchmark model and U.S. life insurance holdings



Alternative Specifications

	θ	θ_c	θ_a	θ^m_{dw}	θ^f_{dw}	θ^m	χ_a	χ_b	κ	ξ_m	β	SSE
Bench	.48	3.79	.0	.00	2.56	1.50	4.71	2.84	1.00	.87	.975	11.1
sym hab	.00	5.44	.0	.25	.25	.59	3.80	2.65	1.00	.59	.970	41.2
sym HP	.43	3.78	.0	.00	2.55	1.00	6.35	2.26	1.00	.89	.979	16.3
OECD	.70	.50	.7	.00	.00	1.00	1.63	3.34	1.44	.85	.973	90.6
Eq weight	.24	2.75	.0	.00	.22	1.76	7.10	1.82	1.00	.50	.977	50.6

Table : Parameter Estimates and Residuals of Alternative Models


Data (M)
Benchmark (M)
Sym Habit (M)
Data (S)
Benchmark (S)
Sym Habit (S)
Sym HP (M)
OECD (M)
Eq Wgt (M)
Sym HP (S)
OECD (S)
Eq Wgt (S)
ratio to per capita GDP
m
f
age
0
2
4
6
20
40
60
80

Two Experiments: 1. No survivor's benefits

- In the benchmark, widows collect as a Social Security benefit the same amount that single men do in the form of a widow pension once they reach retirement age. Here we assume that widows get the same amount as never married women, (a 24% reduction).

- In this model, there are big habits. Consequently, the death of an elderly husband acts as a drawback, since it implies lower income but not lower consumption, and as a consequence, the household responds by increasing the amount of life insurance it purchases in case that the elderly male dies.

- Aggregate life insurance face value rises to 160 percent of GDP from 151 percent. In addition to this effect on life insurance holdings, there is a 0.3 percent increase in total assets held.

A (bad) the compensated variation measure of welfare

- The *ex post* discounted lifetime utility of all newborns and calculate what percentage change in consumption makes agents indifferent between living in the benchmark economy and in an economy without survivor's benefits.

- The measure is 0.999, and we find that survivor's benefits have no effect on welfare.

- Married men over age 50 increase their insurance holdings, but at the same time, their Social Security benefit increases (given that the government collects the same amount of Social Security taxes).

- Consistent with Chambers-Schlagenhauf-Young 2003, who found the effect of survivor benefits to be so small that aggregates are almost unaffected.

Two Experiments: 2. No Social Security

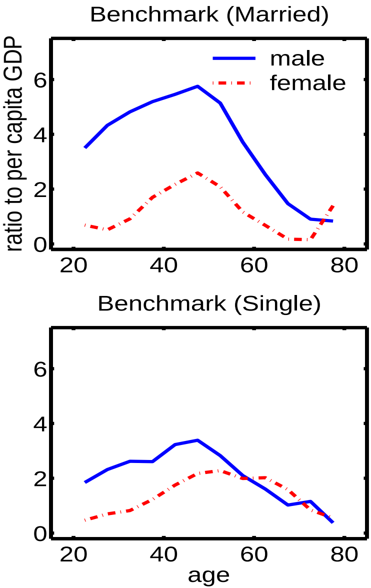
- A. A standard effect where Social Security acts as a deterrent to savings

- B. An effect associated with the implicit annuity Social Security provides.

- However, given our estimates, there is no important role played by Social Security. Two-person married households do not want to consume amounts very different from what they would consume if one spouse becomes a widow. Hence the elimination of Social Security reduces future income in case of the death of the beneficiary. The response of the household is to drastically reduce its life insurance purchases when reaching retirement age.

- The agents accumulate more assets because they will not have any income other than capital income when they retire. The compensated variation measure of welfare is large. Without Social Security, we need only 89.2 percent of its implied consumption to enjoy the same welfare as that in the benchmark economy.

Life insurance holdings without Social Security



Conclusion

• We have used the information on a private good (purchases of life insurance) to look into households. We have learned

1. That marriage induces habits type features in females but not males.
2. That children are quite expensive.
3. That females are much better at home production than males.

We assessed the effects of two Social Security policies:

- The loss of survivor's benefits can be accommodated via larger life insurance purchases in the case of the death of male.
- Social Security plays no important insurance role: there could be large benefits if it were eliminated.

Future Work

1. To show the important implications of our findings for standard macroeconomic questions of savings and response to fiscal policies.
2. The explicit modeling of time use, allowing for the possibility, not always exercised, of specialization in either market or home production activities.
3. The consideration of more interesting decision-making processes within the household that essentially will imply that the weights depend on outside opportunities that are time varying. This makes marital status endogenous.
4. The explicit consideration of the problem of agents that differ in types (which may shed light on what is behind the vast differences in the performance of single and married men). We are looking forward to seeing more work in these directions.