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Life Insurance and Household Consumption

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Abstract

In this paper, we use data of life insurance holdings by age, sex, and marital status to infer how individuals value consumption in different demographic stages. Essentially, we use revealed preference to estimate equivalence scales and altruism simultaneously in the context of a fully specified model with agents facing U.S. demographic features and with access to savings markets and life insurance markets. Our findings indicate that individuals are very caring for their dependents, that there are large economies of scale in consumption, that children are costly but wives with children produce a lot of goods in the home and that while females seem to have some form of habits created by marriage, men do not. These findings contrast sharply with the standard notions of equivalence scales.

Keywords: Life Insurance, Equivalence Scales, Life Cycle Model, Altruism

JEL Classifications: D12, D91, J10, D64

1 Introduction

Two central pieces of modern macroeconomic models are consumption and hours worked. In recent years there has been a lot of effort to construct models of the macroeconomy with a large number of agents[1] who choose how much to work and how much to consume. Still, the data are collected by posing hours worked by individuals and consumption of the household. This inconsistency of economic unit has to be resolved, and there is exciting new work that attempts to do so. Some of this work comes from the labor economics tradition and represents a household as a multiple-agent decision-making unit,[2] while the work in macroeconomics tries to use some form of equivalence scales to construct households.[3]

In this paper we address the issue of how to model an individual versus a household by using information on the changing nature of the composition of the household and on life insurance purchases by households. Life insurance is perhaps one of the cleanest cases of state contingent claims that exist: life insurance claims are widely held and the events that trigger the payments, the death of individuals, are very predictable, and, to a large extent, free of moral hazard problems. We use a two-sex OLG model where agents are indexed by their marital status, which includes never married, widowed, divorced, and married (specifying the age of the spouse) as well as whether the household has dependents. Agents change their marital status as often as people do in the U.S. In our environment, that is embedded in

[1]The list of papers is by now very large, but we can trace this line of research to İmrohoroğlu (1989) and Diaz-Gimenez, Prescott, Fitzgerald, and Alvarez (1992) as well as the theoretical developments of Huggett (1993) and Aiyagari (1994) and the technical developments of Krusell and Smith (1997).

[2]Chiappori (1988, 1992) developed the "collective" model where individuals in the household are characterized by their own preferences and Pareto-efficient outcomes are reached through collective decision-making processes among them. Browning, Bourguignon, Chiappori, and Lechene (1994) use the collective model to show that earnings differences between members have a significant effect on the couple's consumption distribution. Browning (2000) introduces a non-cooperative model of household decisions where the members of the household have different discount factors because of differences in life expectancy. Mazzocco (2003) extends the collective model to a multiperiod framework and analyzes household intertemporal choice. Lise and Seitz (2004) use the collective model to measure consumption inequality within the household.

[3]Attanasio and Browning (1985) show the importance of household size to explain the hump-shaped consumption profiles over the life cycle. In Cubeddu, Nakajima, and Ríos-Rull (2001) and Cubeddu and Ríos-Rull (2003), consumption expenditures are normalized with standard OECD equivalence scales. Greenwood, Guner, and Knowles (2003) use a functional form with equivalence scales which is an increasing and concave function in family size as does Chambers, Schlagenhauf, and Young (2003b). Attanasio, Low, and Sanchez-Marcos (2004) use the McClements scale (a childless couple is equivalent to 1.67 adults, a couple with one child is equivalent to 1.9 adults if the child is less than 3, to 2 adults if the child is between 3 and 7, to 2.07 adults if the child is between 8 and 12 and 2.2 adults if between 13 and 18). See Browning (1992) and Fernández-Villaverde and Krueger (2003) for a detailed survey on equivalence scales.

a standard macroeconomic growth model: individuals in a married household solve a joint maximization problem that takes into account that, in the future, the marriage may break up because of death or divorce.[4] Crucially, we use their choices of life insurance purchases as well as aggregate restrictions to identify how individuals assess their utilities in different demographic stages. This process allows us to estimate preferences across marital status jointly with altruism for dependents and also jointly with the weights of each spouse within the household. Perhaps a way to summarize our exercise is to use revealed preference via life insurance purchases to estimate a form of equivalence scales.

Life insurance can be held for various reasons. Standard life-cycle models, models that identify households with agents, predict that only death insurance, i.e., annuities will be willingly held. Life insurance arises only in the presence of bequest motives.[5] In two-person households, life insurance can also arise because of altruism, either for each other or for their descendents. But more interestingly, perhaps, life insurance can arise out of selfish concerns for lower resources in the absence of the spouse. The prevalence across space and time of marriage indicates that such form of organization is an efficient one, and losing its members because of the death can be very detrimental to the survivor. If this is the case, both spouses may want to hold a portfolio with higher yields in case one spouse dies. In our paper, we abstract from altruism between spouses, and we allow for altruism for dependents (there is a lot of information about this in the life insurance held by singles). In our model, the household composition affects the utility of agents, not only because of altruism toward descendents but also because it affects how consumption expenditures translate into consumption enjoyed (equivalence scales). Household composition also matters for earnings. The specificity with which the household composition affects agents changes over time, as the number of dependents evolves and as earnings vary. These changes translate into different amounts of life insurance being purchased, and these varying amounts contain a lot of information about how agents' utility changes. This is the effective information of the data that inform our findings.

Our estimates of how utility is affected by household composition have some interesting features: *i)* Individuals are very caring for their dependents. While there are no well-defined units to measure this issue, our estimates indicate that a single male in the last period of his life will choose to leave more than 50 percent of his resources as a bequest. *ii)* There are large economies of scale in consumption when a couple lives together. It costs $1.32 to provide

[4] In Greenwood, Guner, and Knowles (2003), the decisions of married household are made through Nash bargaining following Manser and Brown (1980) and McElroy and Horney (1981).

[5] See Fischer (1973), Lewis (1989), and Yaari (1965)

for two people living together what it costs each of them \$1 living apart. *iii)* Children are extremely expensive. A single man with one child has to spend more than \$6 to get the same marginal utility that he would have had alone. *iv)* Women are much better at providing for children than men. Children who live with either single women or married couples require 48 percent less expenditures to keep marginal utility constant than children who live with single men. *v)* Adult dependents seem to be costless. *vi)* Men have the upper hand in the marriage decision as the weight they carry in the household's maximization problem is higher. These findings contrast sharply with the standard notions of equivalence scales.

We use our estimates to explore two policy changes. In the first one, we eliminate survivor's benefits from the Social Security program. This policy change implies that a retired widow is entitled only to her Social Security and not to any component of her deceased husband's. This amounts to a 24 percent reduction in widow's pensions. We find that in our environment, widows want to spend an amount similar to that of couples, and hence upon the husband's death, income is reduced but not necessarily expenses. Married couples can easily cope with this change by purchasing additional life insurance, so this policy change has little effect. The other policy change we explore is the total elimination of Social Security. In this regard, our environment works very similarly to other environments that abstract from multiperson households. Social Security imposes a large negative effect on agents' income as the sum of population and productivity growth is much lower than the interest rate. In our environment, Social Security does not provide an important insurance mechanism, given the existence of life insurance.

There is an empirical literature on how life insurance ownership varies across different household types. Auerbach and Kotlikoff (1991) document life insurance purchases for middle-aged married couples, while Bernheim (1991) does so for elderly married and single individuals. Bernheim, Forni, Gokhale, and Kotlikoff (2003) use the Health and Retirement Study (HRS) to measure financial vulnerability for couples approaching retirement age. Of special relevance is the independent work of Chambers, Schlagenhauf, and Young (2003a), which carefully documents life insurance holding patterns from the Survey of Consumer Finances. Chambers, Schlagenhauf, and Young (2003b) use a dynamic OLG model of households to estimate life insurance holdings for the purpose of smoothing family consumption and conclude that the life insurance holding of households in their model is so large that it constitutes a puzzle.[6]

[6] They also introduce the innovative trick of having both agents in a household not know their own sex, which solves a few technical problems.

We proceed as follows. Section 2 reports U.S. data on life insurance ownership patterns in various respects. Section 3 illustrates the logic of how life insurance holdings may shed light on preferences across different demographic configurations of the household. Section 4 poses the model we use and describes it in detail. Section 5 describes the quantitative targets and the parameter restrictions we impose in our estimation. Section 6 carries the estimation and includes the main findings. In Section 7 we explore various alternative (and simpler) specifications and make the case for the choices we had made. Section 8 explores Social Security policy changes in our environment and Section 9 concludes. In various appendices we describe some details of life insurance in the U.S. and some details of the computation and estimation of the model.

2 Life Insurance Holdings of U.S. Households

Figure 1 shows the face value of life insurance (the amount that will be collected in the event of death) by age, sex, and marital status. The data are from Cubeddu (1995), who used a data set from Stanford Research Institute (SRI), a consulting company, called the International Survey of Consumer Financial Decisions for 1990. The main advantage of this data set relative to the Survey of Consumer Finances (SCF) data is that we have information on the division of life insurance between spouses (on whose death the payments are conditional). This is crucial because both the loss of income and the ability of the survivors to cope are very different when the husband dies than when the wife dies.

Some of the key features displayed in the figure are that the face value of life insurance is greater for males than for females for all ages and marital status. The ratio of face values for males relative to face values of females is 2.7. The face value reaches its peak at around age 45 for males, while it is about constant for females until age 55 and then decreases. The face value of life insurance for married males (females) is on average 1.5 (1.6) times greater than that of single head of household males (females). For all ages, a greater percentage of men (78.9 percent) own life insurance than women (66.4 percent). Ownership is less common for younger and older age groups than for middle-aged people. Married men and women are more likely to own life insurance than single men and women. The percentage of men owning life insurance is 80.1 percent, 85.9 percent, and 70.1 percent for married men, single men with dependents, and single men without dependents, respectively. The percentage of women owning life insurance is 67.1 percent, 66.7 percent, and 63.6 percent for married women, single women with dependents, and single women without dependents, respectively. We use these profiles to learn about how preferences depend on family structure.

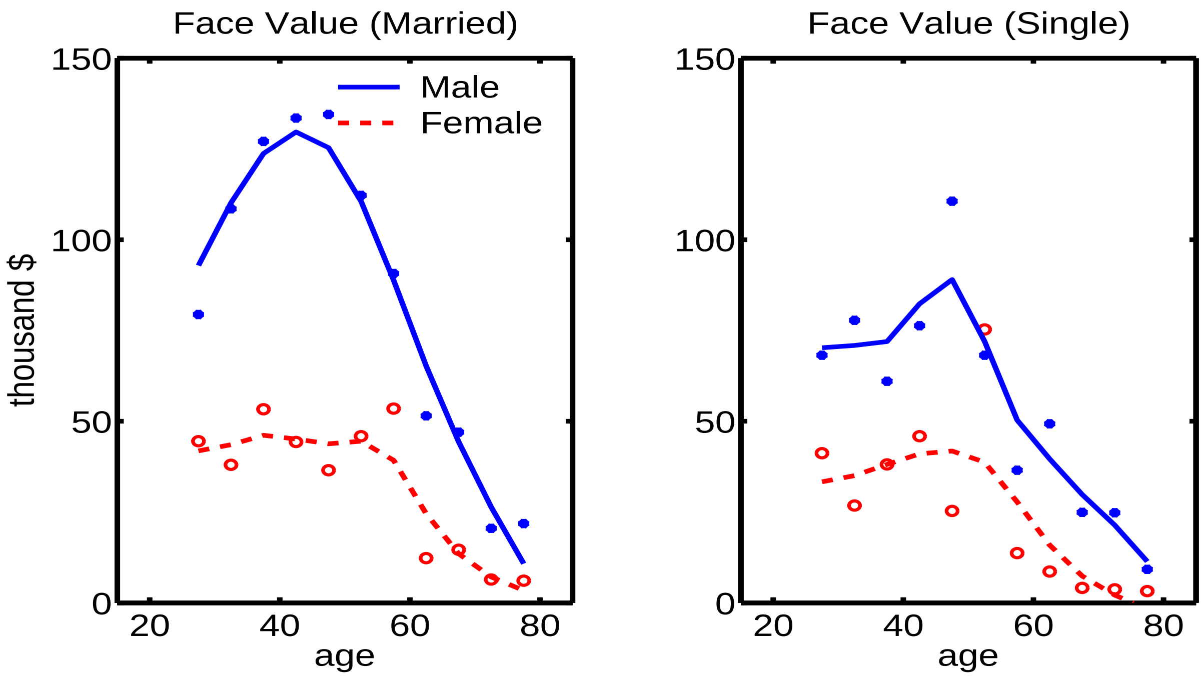

Figure 1: U.S. life insurance holdings by age, sex, and marital status

2.1 Data issues about life insurance

There are two issues about life insurance that we have to address: first, what type of life insurance products are we referring to (Section 2.1.1), and second, whether SRI data are consistent with other available sources, in particular, SCF data (Section 2.1.2).

2.1.1 Term insurance versus whole life insurance

There are different types of life insurance products, but they can be divided into two main categories: *term insurance* and *whole life insurance*. Term insurance protects a policyholder's life only until its expiration date, after which it expires. Renewal of the policy typically involves an increase in the premium because the policy-holder's mortality is increasing with age. Even the life insurance contracts labeled as term insurance may be have some front loading (see Hendel and Lizzeri (2003)).[7] Whole life insurance doesn't have any expiration date. When signing the contract, the insurance company and the policyholders agree to set a face value (amount of money benefit in case of death) and a premium (monthly payment).

[7]They compare annual renewable term insurance with level term contracts which offers premium increase only every n years. They found that premiums for level term policies have some front loading compared with annual renewable contract.

The annual premium remains constant throughout the life of the policy. Therefore, the premium charged in earlier years is higher than the actual cost of protection. This excess amount is reserved as the policy's *cash value*. When a policyholder decides to surrender the policy, she receives the cash value at the time of surrender. There are tax considerations to this type of insurance, since it can be used to reduce a tax bill. Since whole life insurance offers a combination of insurance and savings, we have to subtract this saving component from the face value to get the pure insurance amount.

2.1.2 Life insurance data in the SRI and in the SCF

The SRI data are not very explicit about what type of insurance it refers to. What we do is compare the 1990 SRI with the 1992 SCF. The SCF documents the face values of term insurance and whole insurance separately as well as their cash values, which allows us to compute the amount of pure insurance in each household. We compile the SCF data by subtracting the cash value from the sum of the face values of term insurance and whole life insurance by age, sex, and marital status of the head of household. Note that the SCF collects information on life insurance for the whole household and we cannot distinguish between life insurance for the husband or for the wife in a married couple. To see whether the amounts reported in the SRI are similar to those in the SCF, we combine the insurance face value for married men and for married women by age to get the face value of married households in the SRI.

Figure 2 shows life insurance face values by household types from the 1990 SRI and the 1992 SCF. The dots are the average face value in each age group, while the solid lines are profiles smoothed with splines. As we see, the amounts are extremely similar. Hence, we conclude that the SRI data are a good measure of the amount of pure life insurance held by American households.

3 Retrieving Information from Life Insurance Holdings

In this section we briefly describe how life insurance holdings carry information both about altruism or, more precisely, the joy of giving (Section 3.1) and about how consumption expenditures translate into utilities across different types of marital status (Section 3.2).

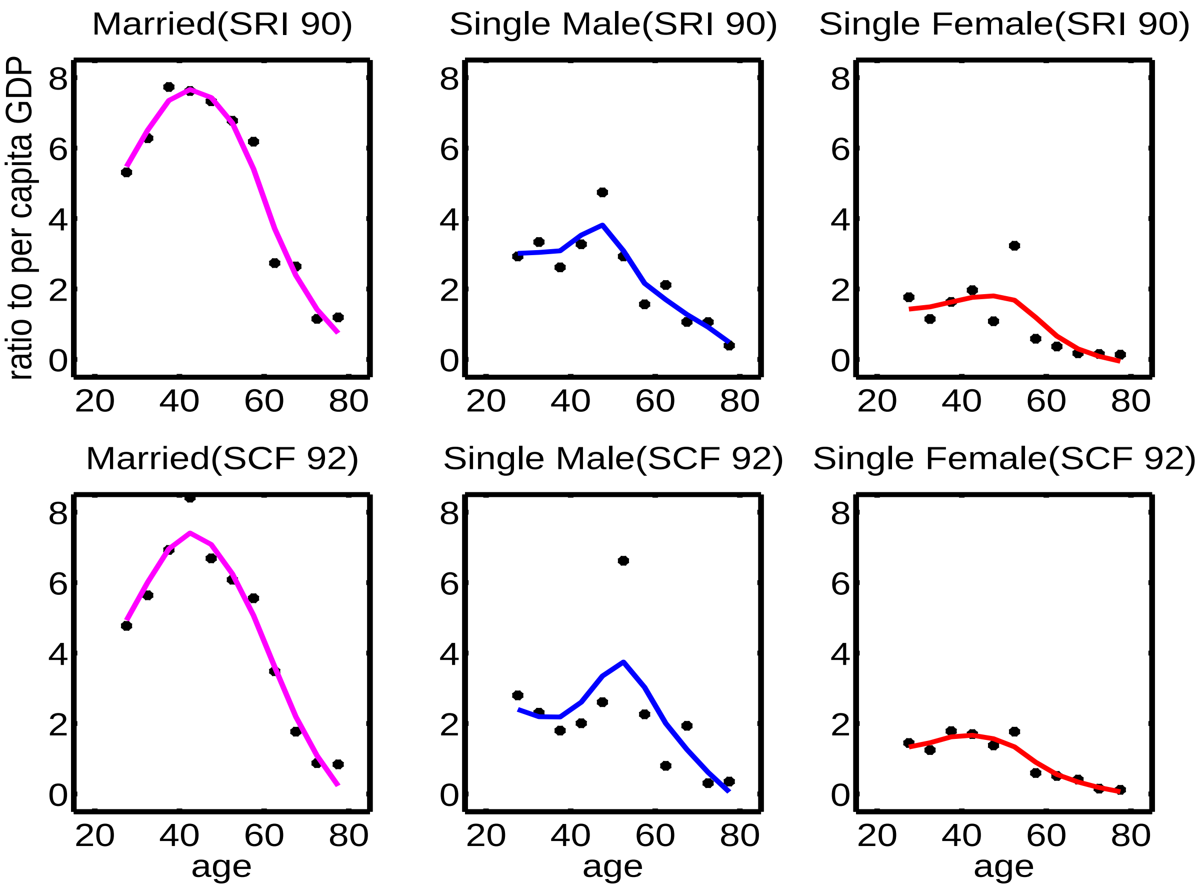

Figure 2: U.S. life insurance holdings: SRI vs. SCF

3.1 Life insurance and altruism

Consider a single agent with dependents. With probability γ the agent may live another period. Its preferences are given by utility function $u(\cdot)$ if alive, which includes care for the dependents. If the agent is dead, it has an altruistic concern for its dependents that is given by function $\chi(\cdot)$. Under perfectly fair insurance markets and zero interest rate, the agent could exchange $1-\gamma$ units of the good today for one unit of the good tomorrow if it dies and γ units today for one unit tomorrow if it survives. The problem of this agent is:

$$\max_{c,c',b} \quad u(c) \;+\; \gamma\, u(c') \;+\; (1-\gamma)\,\chi(b) \tag{1}$$

$$\text{s.t.} \qquad c + \gamma\, c' + (1-\gamma)\, b = y \tag{2}$$

where c and c' are current and future consumption, b is the life insurance purchase, and y is its income. The first-order conditions of this problem imply that $c = c'$ and

$$u_c(c) = \chi_b(b). \tag{3}$$

Notice that if we had data on consumption and life insurance holdings for many households we could recover the relation of the utility function u and the altruism function χ from the estimation of equation (3).

3.2 Life insurance and the differential utility while married and while single

Consider now a married couple where one of the agents is the sole decision-maker. In addition, this agent lives for two periods. The other agent may live a second period with probability γ. Let $u^m(c)$ be the utility of the decision-maker when consumption expenditures are c and when there are two persons in the household, while $u^w(c)$ is the utility when she is a widow and lives alone. Under fair insurance markets and zero interest rate, the problem is:

$$\max_{c^m, c'^m, c'^w} \quad u^m(c^m) \ + \ \gamma \, u^m(c'^m) \ + \ (1-\gamma) \, u^w(c'^w) \tag{4}$$

$$\text{s.t.} \qquad c^m \ + \gamma \, c'^m + (1-\gamma) \ c'^w = y \tag{5}$$

The first-order conditions of this problem are $c^m = c'^m$ and

$$u_c^m(c^m) = u_c^w(c'^w). \tag{6}$$

In this simple model, having data on both consumption of married couples c^m and of widows c^w could allow us to estimate equation (7), and consequently it would tell us how to compare utilities across marital status.

While life insurance is pervasive, death insurance[8] or annuities are very rare in the data. This does not matter, since if $c'^w > c'^m$ in this example, the same allocation can be achieved with uncontingent savings and life insurance by looking at the following problem:

$$\max_{c^m, a', b \geq 0} \quad u^m(c^m) \ + \ \gamma \, u^m(a') \ + \ (1-\gamma) \, u^w(a'+b) \qquad \text{s.t.} \tag{7}$$

$$c^m \ + a' + (1-\gamma) b = y \tag{8}$$

With first-order conditions given by $c^m = a'$ and $u_c^m(c^m) = u_c^w(a'+b)$. Here we see that life insurance holdings together with savings can be used to infer the relation between the utility

[8]What single-sex OLG models call for, as, for example, Ríos-Rull (1996).

functions that represent preferences when living alone with those that represent living in a two-period household.

Obviously, when confronting the data, things are much more complicated than these examples illustrate: agents live many periods, there is no dictator in marriages, both spouses can die, there are many possible family sizes, and there is divorce and remarriage, to name but a few. We next pose an OLG model with agents differing in age, sex, marital status, and asset holdings that can be confronted with the life insurance holdings data. The model is built around the structure of a growth model which allows us to use aggregate and individual variables when obtaining our estimates.

4 The Model

The economy is populated by overlapping generations of agents embedded into a standard neoclassical growth structure. At any point in time, its living agents are indexed by age, $i \in \{1, 2, \cdots, I\}$, sex, $g \in \{m, f\}$ (we also use g^* to denote the sex of the spouse if married), and marital status, $z \in \{S, M\} = \{n_o, n_w, d_o, d_w, w_o, w_w, 1_o, 1_w, 2_o, 2_w, \cdots, I_o, I_w\}$, which includes being single (never married, divorced, and widowed) without and with dependents and being married without and with dependents where the index denotes the age of the spouse. Agents are also indexed by the assets that belong to the household to which the agent belongs $a \in A$.

While agents that survive age deterministically, one period at a time, and they never change sex, their marital status evolves exogenously through marriage, divorce, widowhood, and the acquisition of dependents following a Markov process with transition $\pi_{i,g}$. If we denote next period's values with primes, we have $i' = i + 1$, $g' = g$, and the probability of an agent of type $\{i, g, z\}$ today moving to state z' is $\pi_{i,g}(z'|z)$. Assets vary both because of savings and because of changes in the composition of the household. Once a couple is married, all assets are shared, and agents do not keep any record of who brought which assets into the marriage. If a couple gets divorced, assets are divided. In the case of the early death of one spouse, the surviving spouse gets to keep all assets and to collect the life insurance death benefits of the deceased (if any). We look at economies only in steady state, which implies stationarity of all aggregates. We next go over the details.

Demographics. While agents live up to a maximum of I periods, they face mortality risk. Survival probabilities depend only on age and sex. The probability of surviving between age i and age $i + 1$, for an agent of gender g is $\gamma_{i,g}$, and the unconditional probability of being alive at age i can be written $\gamma_g^i = \Pi_{j=1}^{i-1}\gamma_{j,g}$. Population grows at an exogenous rate λ_μ. We use $\mu_{i,g,z}$ to denote the measure of type $\{i, g, z\}$ individuals. Therefore, the measure of the different types satisfies the following relation:

$$\mu_{i+1,g,z'} = \sum_z \gamma_{i,g} \frac{\pi_{i,g}(z'|z)}{(1+\lambda_\mu)} \mu_{i,g,z} \tag{9}$$

There is an important additional restriction on the matrices $\{\pi_{i,g}\}$ that has to be satisfied for internal consistency: the measure of age i males married to age j females equals the measure of age j females married to age i males, $\mu_{i,m,j_o} = \mu_{j,f,i_o}$ and $\mu_{i,m,j_w} = \mu_{j,f,i_w}$.

Preferences. We index preferences over per period household consumption expenditures by age, sex, and marital status $u_{i,g,z}(c)$. We also consider a form of altruism. Upon death, a single agent with dependents gets utility from a warm glow motive from leaving its dependents with a certain amount of resources $\chi(b)$. A married agent with dependents that dies gets expected utility from the consumption of the dependents while they stay in the household of her spouse. Upon the death of the spouse, the bequest motive becomes operational again. If we denote with $v_{i,g,z}(a)$ the value function of a single agent and if we (temporarily) ignore the choice problem and the budget constraints, in the case where the agent has dependents we have the following relation:

$$v_{i,g,z}(a) = u_{i,g,z}(c) + \beta\ \gamma_{i,g}\ E\{v_{i+1,g,z'}(a')|z\} + \ \beta\ \ (1-\gamma_{i,g})\ \ \chi(a') \tag{10}$$

while if the agent does not have dependents, the last term is absent.

The case of a married household is slightly more complicated because of the additional term that represents the utility obtained from the dependents' consumption while under the care of the former spouse. Again, using $v_{i,g,j}(a)$ to denote the value function of an age i agent of sex g married to a sex g^* of age j and ignoring the decision-making process and the budget constraints, we have the following relation:

$$\begin{aligned} v_{i,g,j}(a) = u_{i,g,j}(c) + \beta\ \gamma_{i,g}\ E\{v_{i+1,g,z'}(a')|z\} \\ +\ \beta\ \ (1-\gamma_{i,g})\ \ (1-\gamma_{j,g^*})\ \ \chi(a')\ + \\ \beta\ \ (1-\gamma_{i,g})\ \ \gamma_{j,g^*}\ \ E\{\Omega_{j+1,g^*,z'_{g^*}}(a'_{g^*})\} \end{aligned} \tag{11}$$

where the first and second terms of the right-hand side are standard, the third term represents the utility that the agent gets from the warm glow motive that happens if both members of the couple die, and where the fourth term with function Ω represents the well being of the dependents when the spouse survives and they are under its supervision. Function $\Omega_{i,g,z}$ is given by

$$\Omega_{i,g,z}(a) = \widehat{u}_{i,g,z}(c) + \beta\, \gamma_{i,g}\, E\{\Omega_{i+1,g,z'}(a'|z)\} + \beta\, (1-\gamma_{i,g})\, \chi(a') \tag{12}$$

where $\widehat{u}_{i,g,z}(c)$ is the utility obtained from dependents under the care of a former spouse that now has type $\{i, g, z\}$ and expenditures c. Note that function Ω does not involve decision-making. It does, however, involve the forecasting of what the former spouse will do.

Endowments. Every period, agents are endowed with $\varepsilon_{i,g,z}$ units of efficient labor. Note that in addition to age and sex, we are indexing this endowment by marital status, and this term includes labor earnings and also alimony and child support. All idiosyncratic uncertainty is thus related to marital status and survival.

Technology. There is an aggregate neoclassical production function that uses aggregate capital, the only form of wealth holding, and efficient units of labor. Capital depreciates geometrically.[9]

Markets. There are spot markets for labor and for capital with the price of an efficiency unit of labor denoted w and with the rate of return of capital denoted r, respectively. There are also markets to insure in the event of early death of the agents. While, for the most part, these markets are for standard life insurance policies that pay when an agent dies, in some cases (singles and couples without dependents), these markets can be used for payments in case agents survive, or annuities. We assume that the insurance industry operates at zero costs without cross-subsidization across age and sex.

We do not allow for the existence of insurance for marital risk other than death; that is, there are no insurance possibilities for divorce or for changes in the number of dependents. This assumption should not be controversial. These markets are not available in all likelihood for moral hazard considerations. We also do not allow agents to borrow.

[9]This is not really important, and it only plays the role of closing the model. What is important is to impose restrictions on the wealth to income ratio and on the labor income to capital income ratio of the agents, and we do this in the estimation stage.

Social Security. The model includes Social Security, which requires a slight modification of the household budget constraint:

$$
\begin{aligned}
c + y + b_g + b_{g^*} &= (1+r)\,a + (1-\tau)w(\varepsilon_{i,g,j} + \varepsilon_{j,g^*,i}) + T_{i,g,j,R} \\
T_{i,g,j,R} &= \begin{cases} T_g & \text{if agent is eligible} \\ T_{g^*} & \text{if only spouse is eligible} \\ T_M & \text{if both are of retirement age} \end{cases}
\end{aligned}
$$

where R is the retirement age, and T_g, T_{g^*} and T_M are the amounts of Social Security benefits for one-person and two-person households, respectively. We assume that this is the only role of government, which runs a period-by-period balanced budget.

Distribution of assets of prospective spouses. When agents consider getting married, they have to understand what type of spouse they may get. Transition matrices $\{\pi_{i,g}\}$ have information about the age distribution of prospective spouses according to age and existence of dependents, but this is not enough. Agents have to know also the probability distribution of assets by agents' types, an endogenous object that we denote by $\phi_{i,g,z}$. Taking this into account is a much taller order than that required in standard models with no marital status changes. Consequently, we have $\mu_{i,g,z}\ \phi_{i,g,z}(B)$ as the measure of agents of type $\{i, g, z\}$ with assets in Borel set $B \subset A = [0, \overline{a}]$, where $\overline{a}$ is a nonbinding upper bound on asset holdings. Conditional on getting married to an age $j + 1$ person that is currently single without dependents, the probability that an agent of age i, sex g who is single without dependents will receive assets that are less than or equal to $\widehat{a}$ from its new spouse is given by:

$$
\int_A 1_{y_{j,g^*,s_o}(a) \leq \widehat{a}} \quad \phi_{j,g^*,s_o}(da) \tag{13}
$$

where 1 is the indicator function and $y_{j,g^*,s_o}(a)$ is the savings of type $\{j, g^*, s_o\}$ with wealth a. If either of the two agents is currently married, the expression is more complicated because we have to distinguish the cases of keeping the same or changing spouse (see Cubeddu, Nakajima, and Ríos-Rull (2001) for details). This discussion gives an idea of the requirements needed to solve the agents' problem.

Bequest recipients. In the model economy there are many dependents that receive a bequest from their deceased parents. We assume that the bequests are received in the first period of their lives. The size and number of recipients are those implied by the deceased, their dependents, and their choices for bequests.

We are now ready to describe the decision-making process.

The problem of a single agent without dependents. The relevant types are $z \in S_o = \{n_o, d_o, w_o\}$, and we write the problem as:

$$v_{i,g,z}(a) = \max_{c \geq 0, y \in A} u_{i,g,z}(c) + \beta\gamma_{i,g} E\{v_{i+1,g,z'}(a')|z\} \qquad \text{s.t.} \tag{14}$$

$$c + y = (1+r)\, a + w\ \varepsilon_{i,g,z} \tag{15}$$

$$a' = \begin{cases} \frac{y}{\gamma_{i,g}} & \text{if } z' \in \{n_o, n_w, d_o, d_w, w_o, w_w\}, \\ \frac{y}{\gamma_{i,g}} + y_{z',g^*} & \text{if } z' \in \{1_o, 1_w, .., I_o, I_w\}. \end{cases} \tag{16}$$

There are several features to point out. Equation (15) is the budget constraint, and it includes consumption expenditures and savings as uses of funds and after-interest wealth and labor income as sources of funds. More interesting is equation (16), which shows the evolution of assets associated with this agent. First, if the agent remains single, its assets are its savings augmented by the fact that it set them up as annuities (they are augmented by the inverse of the survival probability). While annuities markets are not widely used, allowing agents to use them solves the problem of what to do with the assets of agents who die early. This is not, we think, an important feature. Second, if the agent marries, the assets associated with it include whatever the spouse brings to the marriage, and as we said above, this is a random variable.

The problem of a single agent with dependents. The relevant types are $z \in S_w = \{n_w, d_w, w_w\}$, and we write the problem as:

$$v_{i,g,z}(a) = \max_{c \geq 0, y \in A} u_{i,g,z}(c) + \beta\gamma_{i,g} E\{v_{i+1,g,z'}(a')|z\} + \beta\,(1-\gamma_{i,g})\ \chi(y+b) \tag{17}$$

$$\text{s.t.} \qquad c + y + (1-\gamma_{i,g})b = (1+r)\, a + w\ \varepsilon_{i,g,z} \tag{18}$$

$$a' = \begin{cases} y & \text{if } z' \in \{n_o, n_w, d_o, d_w, w_o, w_w\}, \\ y + y_{z',g^*} & \text{if } z' \in \{1_o, 1_w, .., I_o, I_w\}. \end{cases} \tag{19}$$

Note that here we decompose savings into uncontingent savings and life insurance that pays only in case of death and that goes straight to the dependents. The face value of the life insurance paid is b, and the premium of that insurance is $(1-\gamma_{i,g})b$.

The problem of a married couple without dependents. The household itself does not have preferences, yet it makes decisions. Note that there is no agreement between the two spouses, since they have different outlooks (in case of divorce, they have different future earnings, and their life horizons may be different). We make the following assumptions about the internal workings of a family:

1. Spouses are constrained to enjoy equal consumption.
2. The household solves a joint maximization problem with weights: $\xi_{i,m,j} = 1 - \xi_{j,f,i}$.
3. Upon divorce, assets are divided, a fraction, $\psi_{i,g,j}$, goes to the age i sex g agent and a fraction, $\psi_{j,g^*,i}$, goes to the spouse. These two fractions may add to less than 1 because of divorce costs.
4. Upon the death of a spouse, the remaining beneficiary receives a death benefit from the spouse's life insurance if the deceased held any life insurance.

With these assumptions, the problem solved by the household is:

$$v_{i,g,j}(a) = \max_{c \geq 0, b_g \geq 0, b_{g^*} \geq 0,, y \in A} u_{i,g,j}(c) + \xi_{i,g,j} \;\; \beta \, \gamma_{i,g} \, E\{v_{i+1,g,z'_g}(a'_g)|j\} + \xi_{j,g^*,i} \;\; \beta \, \gamma_{j,g^*} \;\; E\{v_{j+1,g^*,z'_{g^*}}(a'_{g^*})|i\} \quad (20)$$

$$\text{s.t.} \qquad c + y + (1 - \gamma_{i,g}) b_g + (1 - \gamma_{j,g^*}) b_{g^*} = (1 + r)\, a + w(\varepsilon_{i,g,j} + \varepsilon_{j,g^*,i}) \qquad (21)$$

$$\begin{array}{ll}
a'_g = a'_{g^*} = \frac{y}{\gamma_{i,j}}, & \text{if remain married } z' = j+1 \\
a'_g = \psi_{i,g,j} \; \frac{y}{\gamma_{i,j}}, & \\
a'_{g^*} = \psi_{j,g^*,i} \; \frac{y}{\gamma_{i,j}}, & \text{if divorced and no remarriage, } z' \in S \\
a'_g = \psi_{i,g,j} \; \frac{y}{\gamma_{i,j}} + y_{z'_g,g^*}, & \\
a'_{g^*} = \psi_{j,g^*,i} \; \frac{y}{\gamma_{i,j}} + y_{z'_{g^*},g}, & \text{if divorced and remarriage, } z' \in M \\
a'_g = \frac{y}{\gamma_{i,j}} + \frac{b_{g^*}}{\gamma_{i,g}}, & \\
a'_{g^*} = \frac{y}{\gamma_{i,j}} + \frac{b_g}{\gamma_{j,g^*}}, & \text{if widowed and no remarriage } z' \in S \\
a'_g = \frac{y}{\gamma_{i,j}} + \frac{b_{g^*}}{\gamma_{i,g}} + y_{z'_g,g^*}, & \\
a'_{g^*} = \frac{y}{\gamma_{i,j}} + \frac{b_g}{\gamma_{j,g^*}} + y_{z'_{g^*},g}. & \text{if widowed and remarriage, } z' \in M
\end{array} \qquad (22)$$

where $\gamma_{i,j} = \gamma_{i,g} + \gamma_{j,g^*} - \gamma_{i,g}\gamma_{j,g^*}$ is the probability that both spouses die at the same time. We assume that savings are annuatized for this contingency. Note that the household may purchase different amounts of life insurance, depending on who dies. Equation (22) describes the evolution of assets for both household members under different scenarios of future marital status.

The problem of a married couple with dependents. The problem of a married couple with dependents is slightly more complicated, since it involves altruistic concerns. The main change is the objective function:

$$v_{i,g,j}(a) = \max_{c\geq 0, b_g\geq 0, b_{g^*}\geq 0, y\in A} u_{i,g,j}(c) \ + \beta\ (1-\gamma_{i,g})\ (1-\gamma_{j,g^*})\ \chi(y+b_g+b_{g^*}) +$$

$$\xi_{i,g,j}\ \ \beta\left\{\gamma_{i,g}\, E\{v_{i+1,g,z'_g}(a'_g)|j\} \ + \ (1-\gamma_{i,g})\ \gamma_{j,g^*}\ \Omega_{j+1,g^*,z'}\,(y+b_g)\right\} +$$

$$\xi_{j,g^*,i}\ \ \beta\ \left\{\gamma_{j,g^*}\ E\{v_{j+1,g^*,z'_{g^*}}(a'_{g^*})|i\} + \ (1-\gamma_{j,g^*})\ \gamma_{i,g}\ \Omega_{i+1,g,z'}\left(y+b^*_g\right)\right\} \quad (23)$$

The budget constraint is as in equation (21). The law of motion of assets is as in equations (22) except that there is no use of annuities, which means there is no division by $\gamma_{i,j}$. Note also how the weights do not enter either the current utility or the utility obtained via the bequest motive if both spouses die, since both spouses agree over these terms. As stated above, functions Ω do not involve decisions, but they do involve forecasting the former spouse's future consumption decisions.

These problems yield solutions $\{y_{i,g,j}(a)[= y_{j,g^*,i}(a)], b_{i,g,j}(a), b_{j,g^*,i}(a)\}$. These solutions and the distribution of prospective spouses yield the distribution of next period assets $a'_{i+1,g,z}$, and next period value functions, $v_{i+1,g,z'}(a')$.

Equilibrium. In a steady-state equilibrium, the following conditions have to hold:

1. Factor prices r and w are consistent with the aggregate quantities of capital and labor and the production function.

2. There is consistency between the wealth distribution that agents use to assess prospective spouses and individual behavior. Furthermore, such wealth distribution is stationary.

$$\phi_{i+1,g,z'}(B) = \sum_{z\in Z}\pi_{i,g}(z'|z)\int_{a\in\ A} 1_{a'_{i,g,z}(a)\in B}\ \ \phi_{i,g,z}(da), \quad (24)$$

   where again 1 is the indicator function.

3. The government balances its budget, and dependents are born with the bequests chosen by their parents.

5 Quantitative Specification of the Model

We now restrict the model quantitatively.

Demographics. The length of the period is 5 years. Agents are born at age 15 and can live up to age 85. The annual rate of population growth λ_μ is 1.2 percent, which approximately corresponds to the average U.S. rate over the past three decades. Age- and sex-specific survival probabilities, $\gamma_{i,g}$, are taken from the 1999 United States Vital Statistics Mortality Survey.

We use the Panel Study of Income Dynamics (PSID) to obtain the transition probabilities across marital status $\pi_{i,g}$. We follow agents over a 5-year period, between 1994 and 1999, to evaluate changes in their marital status. Appendix A describes how we constructed this matrix.

Preferences. For a never married agent without dependents, we pose a standard CRRA per period utility function with a risk avesrion parameter σ, which we denote by $u(c)$. We assume no altruism between the members of the couple. There are a variety of features that enrich the preference structure, which that we list in order of simplicity of exposition and not necessarily of importance.

1. Habits from marriage. A divorcee or widow may have a higher marginal utility of consumption than a never married person. Think of getting used to living in a large house or having conversation at dinner time. We allow habits to differ by sex but not by age. We write this as:

$$u_{*,g,n_o}(c) = u\left(c\right), \qquad u_{*,g,d_o}(c) = u_{*,g,w_o}(c) = u\left(\frac{c}{1+\theta^g_{dw}}\right). \tag{25}$$

2. A married couple without dependents does not have concerns over other agents or each other, but it takes advantage of the increasing returns to scale that are associated with a multiperson household. We model the utility function as:

$$u_{*,g,m_o}(c) = u\left(\frac{c}{1+\theta}\right). \tag{26}$$

   where θ is the parameter that governs the increasing returns of the second adult in the household.

3. Singles with dependents. Dependents can be either adults or children, and they both add to the cost (in the sense that it takes larger expenditures to enjoy the same consumption) and provide more utility because of altruism. We also distinguish the implied costs of having dependents according to the sex of the head of household. The

implied per period utility function is:

$$u_{*,g,n_w}(c) = \kappa \ u\left(\frac{c}{1+\theta^g\{\theta_c\#_c+\theta_a\#_a\}}\right) \tag{27}$$

$$u_{*,g,d_w}(c) = u_{*,g,w_w}(c) = \kappa \ u\left(\frac{c}{1+\theta^g_{dw}+\theta^g\{\theta_c\#_c+\theta_a\#_a\}}\right) \tag{28}$$

where κ is the parameter that increases utility because there exist dependents while the number of children and adult dependents increases the cost in a linear but differential way. We denote by $\#_c$ and $\#_a$ the number of children and of adults, respectively, in the household. Note that there is an identification problem with our specification. Parameters $\{\theta^g, \theta_c, \theta_a\}$ yield the same preferences as $\left\{1, \frac{\theta_c}{\theta^g}, \frac{\theta_a}{\theta^g}\right\}$. We write preferences this way because these same parameters also enter in the specification of married couples with dependents, which allows us to identify them. We normalize θ^f to 1 and we impose that single males and single females (and married couples) have the same relative cost of having adults and children as dependents.

4. Finally, married with dependents is a combination of singles with dependents and married without dependents. The utility is then

$$u_{*,g,m_w}(c) = \kappa \ u\left(\frac{c}{1+\theta+\{\theta_c\#_c+\theta_a\#_a\}}\right) \tag{29}$$

   Note that we are implicitly assuming that the costs of having dependents are the same for a married couple and a single female. We allowed these costs to vary, and it turned out that the estimates are very similar and the gain in accuracy quite small so we imposed these costs to be identical as long as there is a female in the household.

We pose the altruism function χ to be a CRRA function, $\chi(x) = \chi_a \frac{x^{1-\chi_b}}{1-\chi_b}$. Note that two parameters are needed to control both the average and the derivative of the altruism intensity. In addition, we assume that the spouses may have different weights when solving their joint maximization problem, $\xi_m + \xi_f = 1$. Note that this weight is constant regardless of the age of each spouse.[10]

With all of this, we have 12 parameters: the discount rate β, the weight of the male in the married household maximization problem, ξ_m, the coefficient of risk aversion σ and

[10] Lundberg, Startz, and Stillman (2003) show that the relative weight shifts in favor of the wife as couples get older when women live longer than men. This weight also could depend on the relative income of each member of the couple, which in our model is a function of age of each spouse and marital status. (See also Browning and Chiappori (1998) and Mazzocco (2003))

those 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. We still have to specify other features from the marriage. With respect to the partition of assets upon divorce, we assume equal share[11] ($\psi_{\cdot,m,\cdot} = \psi_{\cdot,f,\cdot} = 0.5$). For married couples and singles with dependents, the number of dependents in each household matters because they increase the cost of achieving each utility level. We use the Current Population Survey (CPS) of 1989-91 to get the average number of child and adult dependents for each age, sex, and marital status. For married couples, we compute the average number of dependents based on the wife's age. Female singles have more dependents than male singles, and widows/widowers tend to have more dependents than any other single group. The number of children peaks at age 30-35 for both sexes, while the number of adult dependents peaks at age 55-60 or 60-65.

Endowments and technology. To compute the earnings of agents, we use the Current Population Survey (CPS) March files for 1989-1991. Labor earnings for different years are adjusted using the 1990 GDP deflator. Labor earnings, $\varepsilon_{i,g,z}$, are distinguished by age, sex, and marital status. We split the sample into 7 different marital statuses $\{M, n_o, n_w, d_o, d_w, w_o, w_w\}$.[12] Single men with dependents have higher earnings than those without dependents. This pattern, however, is reversed for single women. For single women, those never married have the highest earnings, followed by the ones divorced and then the widowed. But for single men, those divorced are the ones with highest earnings, followed by widowed and never married.

To account for the fact that most women who divorce receive custody of their children, we also collect alimony and child support income of divorced women from the same CPS data. We add age-specific alimony and child support income to the earnings of divorced women on a per capita basis. We reduce the earnings of divorced men in a similar fashion. Note that we cannot keep track of those married men who pay child support from previous marriages. Figure 3 shows the earnings profile by each sex and marital status excluding alimony and child support.

The Social Security tax rate τ is set to be 11 percent to account for the fact that there is

[11] Unlike Cubeddu, Nakajima, and Ríos-Rull (2001) and Cubeddu and Ríos-Rull (2003), we account explicitly for child support and alimony in our specification of earnings, which makes it unnecessary to use the asset partition as an indirect way of modeling transfers between former spouses.

[12] This is a compromise for not having hours worked. Married men have higher earnings than single men, while the opposite is true for women.

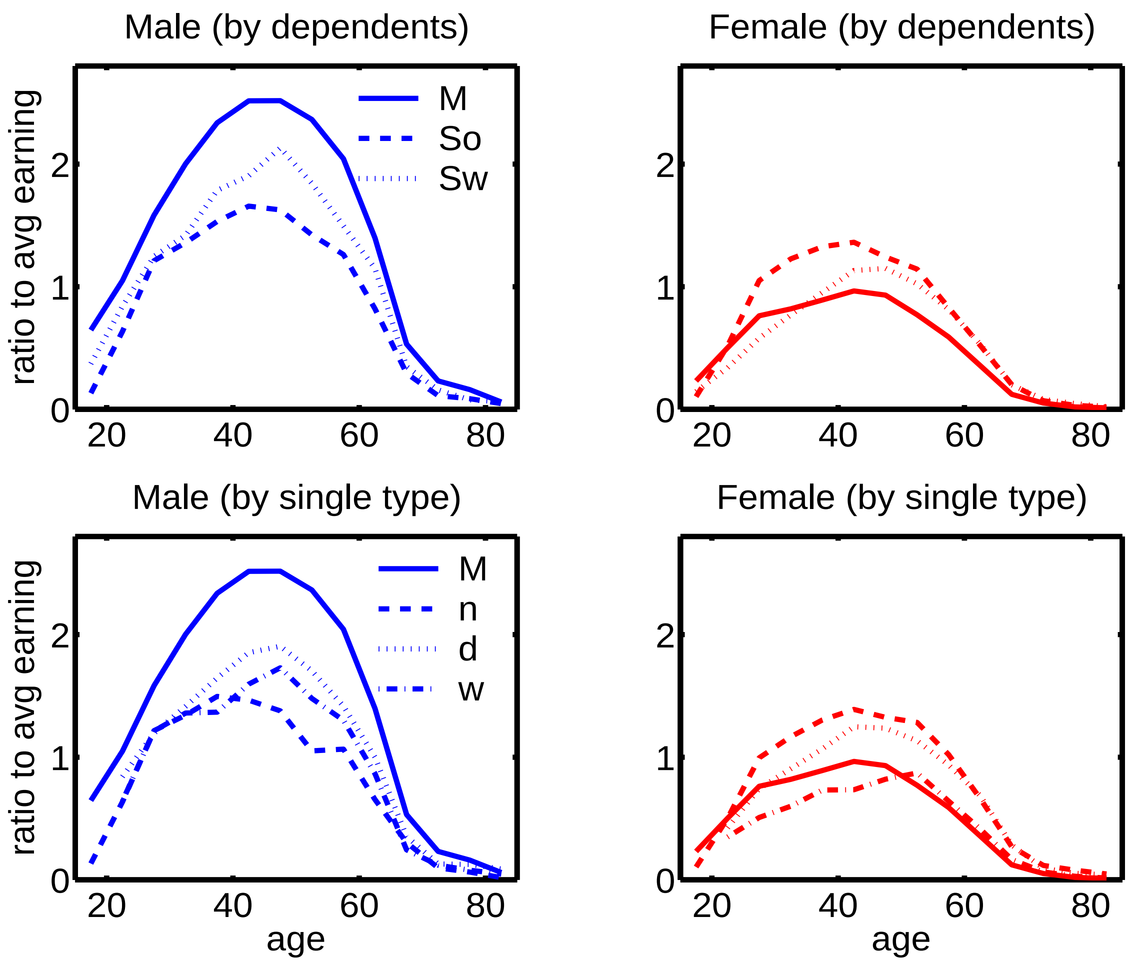

Figure 3: CPS earnings by age, sex, and marital status

an upper limit for Social Security payments. Agents are eligible to collect benefits starting at age 67. We use 1991 Social Security beneficiary data to compute average benefits per household. We break eligible households into 3 groups: single retired male workers, single retired female workers, and couples. Single females' benefit is 76 percent of the average benefit of single males because women's contribution is smaller than men's. When both spouses in a married couple are eligible, they receive 150 percent of the benefit of a single man. To account for the survivor benefits of Social Security, we assume that a widow can collect the benefits of a single man instead of those of a single woman upon her retirement, $T_f^w = \max\{T_m, T_f\}$.

We also assume a Cobb-Douglas production function where the capital share is 0.36. We set annual depreciation to be 8 percent.

	θ	θ_c	θ_a	θ_{dw}^m	θ_{dw}^f	θ^m	χ_a	χ_b	κ	ξ_m	β	SSE
Benchmark	.32	5.57	.06	.00	1.69	1.48	4.69	3.47	1.00	.78	.964	12.9

Table 1: Parameter Estimates and Residuals of of the Benchmark Model

6 Estimation

The benchmark model economy has 11 parameters to estimate. The strategy we follow is to choose those parameters so that we 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.[13] As a practical matter, we simultaneously search for suitable 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. This is a very cumbersome process, since it essentially involves a minimization over 13 variables of a function that is very expensive to evaluate. In addition, this function is imprecisely evaluated owing to both sampling and approximation errors, which prevents the use of fast minimization algorithms that use gradients. We have pushed computational capacity by using various Beowulf clusters with up to 26 processors.

As a measure of the goodness of fit of the estimation, we provide the size of the residuals of the function we are minimizing. We also provide the pictures of the U.S. life insurance holdings data and the model life insurance holdings by age, sex, and marital status. Table 1 shows the results of the estimation and the sum of squared errors (SSE) that we use as our measure of fit. The findings are very interesting and can be summarized by:

- **Marriage generates strong economies of scale.** When two adults get married, they spend a total of $1.32 together to enjoy the same utility they could get as singles by spending $1 each.
- **Marriage generates habits for women.** The divorcee or widow is different from a never married female. A divorced/widowed woman has to spend an additional $1.69

[13]While the actual number in the U.S. is higher, we choose this target as a way of dealing with the enormous wealth concentration in the U.S., which this paper does not attempt to account for and which makes median wealth so much lower than mean wealth.

to enjoy the same utility of a never married woman who spends \$1. This is not the case for males. We say that marriage generates strong habits for females.

- **Children are very costly for males.** A single male with a dependent child has to spend an additional \$5.57 to get the same utility he would get if he did not have dependents and spent \$1. This contrasts with the fact that if the dependent is an adult, there is almost no additional cost.

- **Children are less costly for females than for males.** A dependent costs a single man 48 percent more than it costs single women or married couples. This indicates that females produce a lot of home goods.[14]

- **Agents care a lot for their dependents.** Our estimates imply that the average single man of age I with dependents consumes 45 cents and gives 55 cents as a bequest. The estimates for single women range from consuming 37 cents for never married to 54 cents for a widow.[15]

- **Men have a higher weight in the joint-decision problem.**

Figure 4 shows the results of the estimation by putting next to each other the values of life insurance holdings by age, sex, and marital status, both in the model and in the data. Note that while the match is not perfect, the model replicates all the main features of the data that we described in Section 2.

7 Alternative Specifications

We now turn to exploring the validity of our specification by postulating a variety of alternative models that ignore some of the features we have included in our benchmark model. This will give us an idea of the role played by the features we have included. We report the estimates in Table 2, and we plot the predicted life insurance holdings in Figure 5.

[14]When we allowed the costs of child dependents to be different for married couples and single females, we obtain that the estimate for a married couple is 2 percent lower than for a single female, with small changes in the other parameters, and the gains in terms of accuracy to be around 10 percent (11.8 instead of 12.9). Consequently, to avoid having too many parameters, we set the costs of dependents to be equal for married couples and for single females.

[15]This large variation is due to the possible presence of marriage habits.

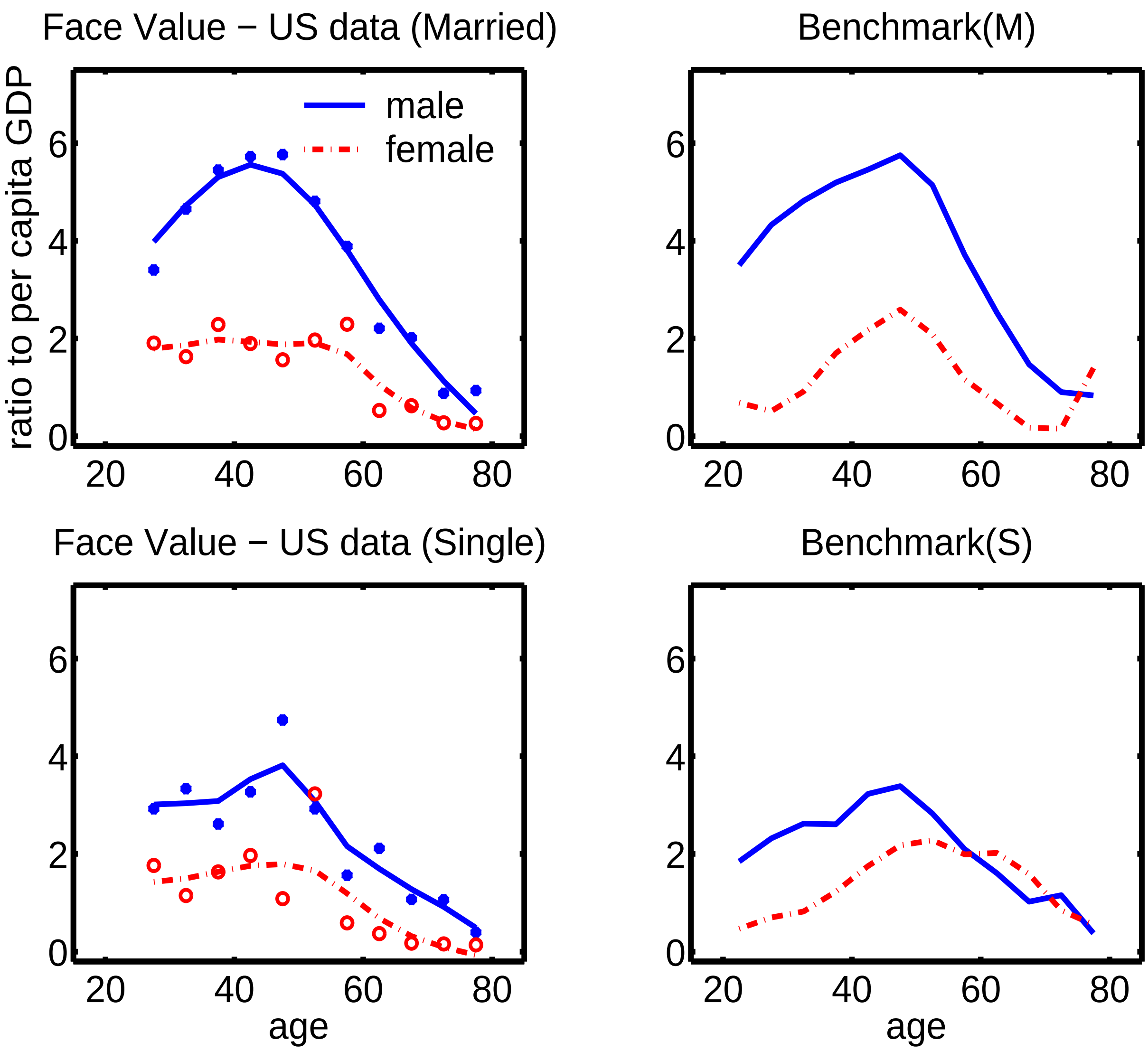

Figure 4: Benchmark model and U.S. life insurance holdings by age, sex, and marital status

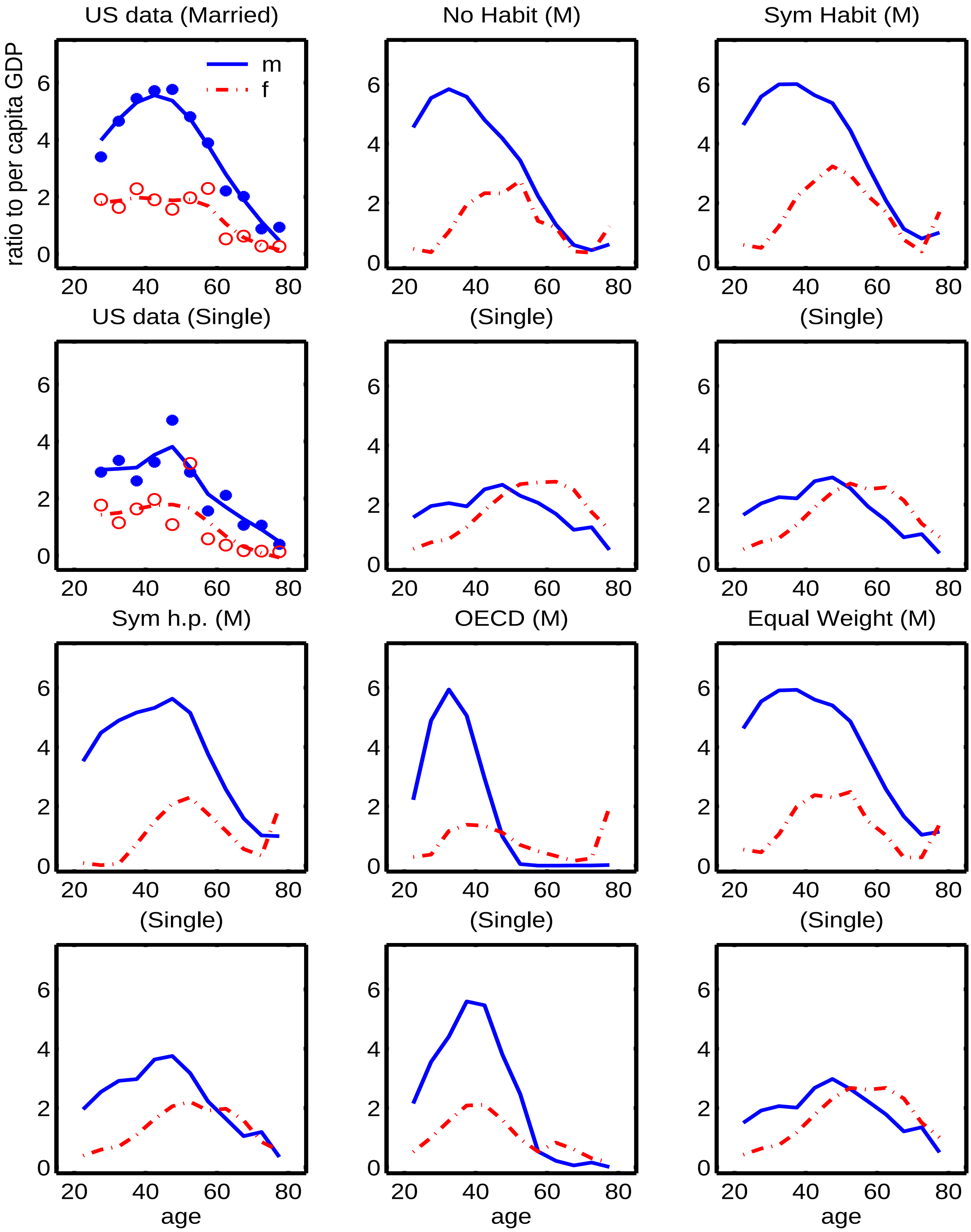

Figure 5: Face value of alternative models by sex and marital status

	θ	θ_c	θ_a	θ^m_{dw}	θ^f_{dw}	θ^m	χ_a	χ_b	κ	ξ_m	β	SSE
Benchmark	.32	5.57	.06	.00	1.69	1.48	4.69	3.47	1.00	.78	.964	12.9
No Habit	.02	6.23	.04	.00	.00	1.94	3.94	3.61	1.16	.47	.952	43.9
Sym Habit	.07	5.33	.00	.33	.33	1.92	4.89	3.27	1.00	.51	.961	33.2
Sym HP	.16	5.96	.29	.00	1.49	1.00	5.38	3.01	1.00	.78	.963	18.3
OECD	.70	.50	.70	.00	.00	1.00	6.12	1.98	1.19	.76	.972	106.0
Equal Weight	.12	6.41	.00	.00	.50	2.02	5.98	3.17	1.00	.50	.953	29.3

Table 2: Parameter Estimates and Residuals of Alternative Models

7.1 Marriage does not generate habits

We start asking about the relevance of habits in marriages by setting $\theta^m_{dw} = \theta^f_{dw} = 0$, which implies that those who are divorced/widowed are not different from those who never married. All singles enjoy the same utility for a dollar spent. Compared with the benchmark model where women acquire strong habits while in a marriage, this no-habit model generates too little life insurance holdings late, especially in the case of a male's death, relative to the data. This shows that given the rest of the estimates, something is needed to account for the large purchases of life insurance that occur late in life after most earnings have been made. In fact, the estimated model attempts to tilt consumption toward married females by choosing a much lower weight for the male than does the benchmark model. The quality of the estimates as measured by the SSE is notoriously worse than the benchmark's.

7.2 Marital habits are symmetric between men and women

We also impose a symmetric structure in the habits created by marriage, $\theta^m_{dw} = \theta^f_{dw}$. This is an intermediate case between the previous two. Still, the quality of the estimation is not so great, generating holdings of life insurance in the case of the death of older males that are too low. We conclude that it is hard to avoid the use of some form of habits to account for the purchases of older males.

7.3 Men and women are equally good at home production

In the benchmark model, it costs men 48 percent more than it costs women to take care of dependents, which we interpret as indicating that women are better at home production in the presence of dependents. We then assume that men and women are equally good at home production, that is, $\theta^m = \theta^f = 1$. The model predicts purchases of life insurance in the case of death of young married females that are too low (this is the group for which the assumption matters most, since this group has a large number of dependents). Still, the fit of this model is quite good; it is the best among the alternative specifications.

7.4 The OECD equivalence scales

For the sake of comparison with a very standard measure of what a household is, we re-estimated the model imposing the OECD equivalence scales. Under the OECD view,[16] each additional adult in a household requires an expenditure of 70 cents in order to enjoy one dollar of consumption, while each child requires 50 cents. The OECD assumes also that there are no habits or differences between males and females. To implement these ideas, we re-estimate the patience and altruism parameters as well as the weights in the joint maximization problem. As we can see, the quality of the fit is terrible. The model predicts that insurance is held in different circumstances from those in which people in the U.S. hold insurance. The model underpredicts the holdings of married couples, especially late in life and conditional on the death of females. Notice that among the estimates, the curvature of the bequest function is much lower, which is the way this model increases insurance holdings, by bumping up altruism.

7.5 Equal weights in the joint maximization process

We also impose equal weights in the joint maximization problem, solved by a married couple, to see if this margin matters. It does. The fit of the estimation is worse. The model tries to account for what would be holdings of life insurance that are too low in the case where the wife dies by increasing men's disadvantage at home production dramatically (102 percent versus 48 percent).

Our main conclusion from this brief assessment of alternative models is that doing without any of the features of the benchmark model, we obtain a much worse fit of the model with the data. (We have explored many other versions that do not match the data well, but we do not report them, to avoid boring the reader.) We also have shown that the OECD equivalence scales do a very bad job in accounting for the life insurance holding patterns.

[16] OECD (1982)

8 Policy Experiments

We now proceed to look at two different policy changes that directly affect the nature of income streams depending on agents' demographic circumstances. They have to do with Social Security, the largest U.S. social program. We start abolishing the survivor's benefits that typically pay widows when their own Social Security entitlement is lower than that of their deceased spouse. We then proceed to the even more radical policy change of completely abolishing Social Security.

8.1 No survivor's benefits

In the benchmark model, the widow collects as a Social Security benefit the same amount that a single man does in the form of a widow pension once she reaches retirement age. This was a simplification of current survivor's benefits under the U.S. Social Security system. Here we assume that widows get as Social Security benefits the same amount as never married women, which amounts to a 24 percent reduction of her benefits.

In this model, female widows consume almost the same amount as married couples owing to the larger number of habits women acquire in marriage. 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. Figure 6 compares the insurance face values in the benchmark model and under the new policy. It is easy to see that married men over age 50 hold more insurance. 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.[17]

We also compute the compensated variation measure of welfare.[18] Specifically, we compute 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 compensated variation 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

[17]This is under the small open economy assumption with constant interest rates.

[18]This is not, strictly speaking, a welfare measure because it ignores the transition. However, we find it interesting because it concentrates on the role of Social Security as provider of insurance and not as a redistributor of resources.

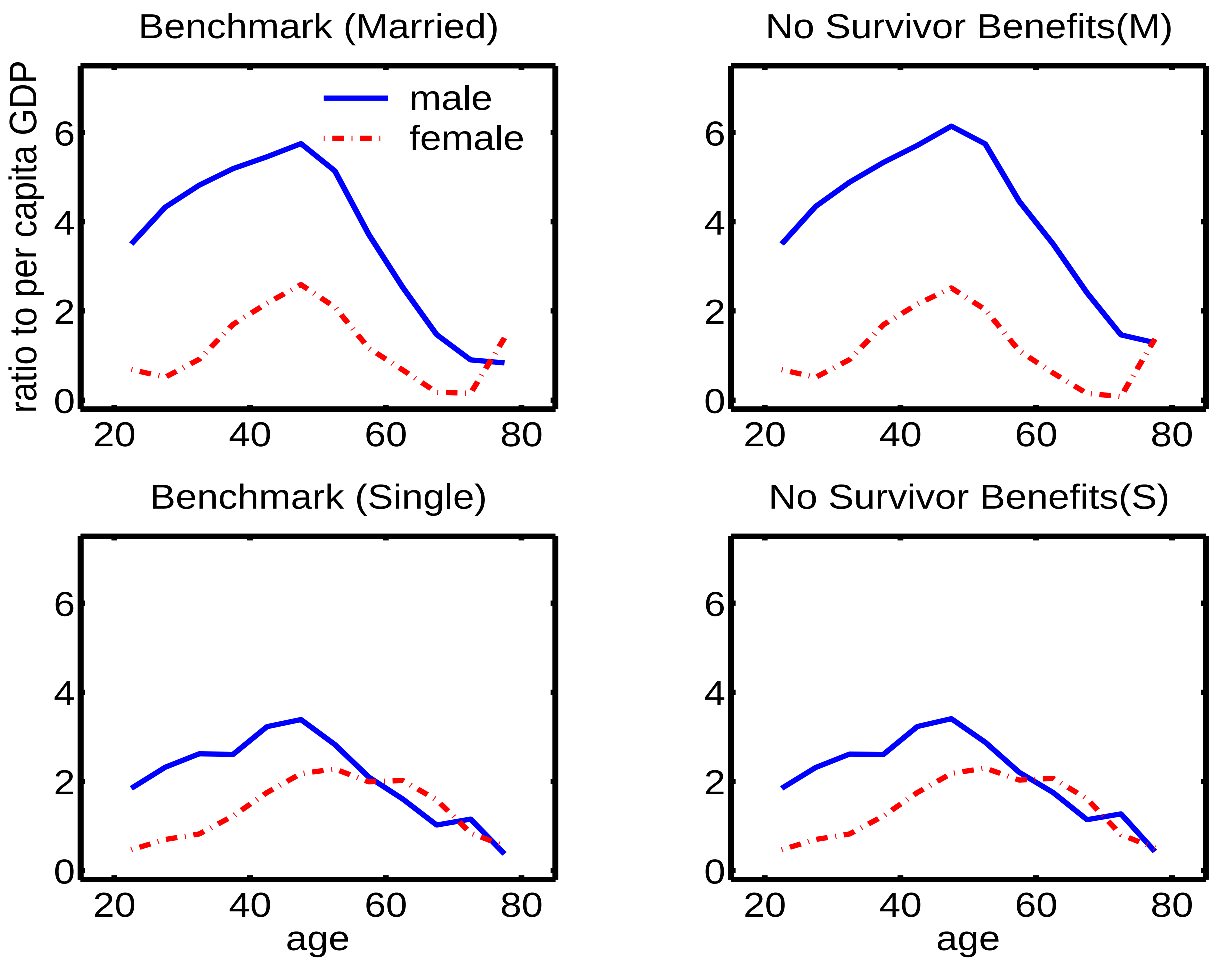

Figure 6: Life insurance holdings by age, sex, and marital status without widow's pension

(given that the government collects the same amount of Social Security taxes). These two effects are canceled out, and there is no significant change in welfare. This is consistent with Chambers, Schlagenhauf, and Young (2003b), who found the effect of survivor benefits to be so small that aggregates are almost unaffected.

8.2 No Social Security

The other experiment is to abolish Social Security completely. This policy induces two types of effects in this model: the standard effect where Social Security acts as a deterrent to savings, which is described in most of the literature on Social Security, and the 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. As a consequence, all that eliminating Social Security does is to reduce 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, as Figure 7 shows. Total wealth in this economy is 50 percent higher than that of the benchmark economy. 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.[19]

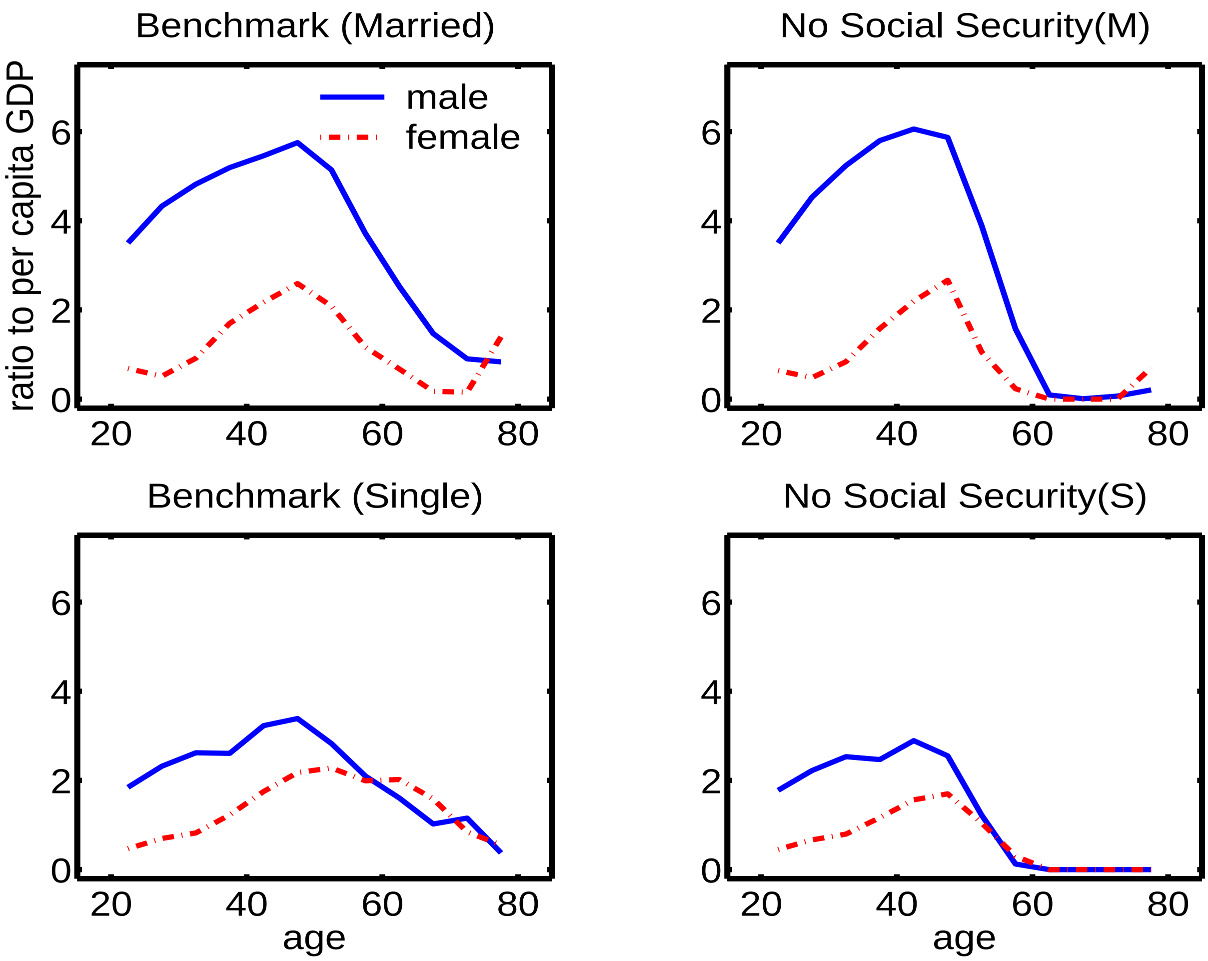

Figure 7: Life insurance holdings by age, sex, and marital status without Social Security

[19] Note that some of our results are due to the fact that agents without dependents have access to annuities. In the absence of annuities, Social Security may be a welfare-enhancing program.

9 Conclusion

In this paper we have explored how life insurance purchases indicate how people assess consumption across different marital statuses. We have learned that marriage increases marginal utility of consumption for females when they are no longer married. We also saw that children are quite expensive and that females are much better at home production than males. We have used our estimates of the utility function to assess the effects of some Social Security policies, and we found that the loss of survivor's benefits can be accommodated via larger life insurance purchases in the case of the death of male. We also found that there are no important insurance roles played by Social Security itself and that there could be large benefits if it were eliminated.

Needless to say, this type of research has three immediate directions that call for more work: *i)* the explicit modeling of time use, allowing for the possibility, not always exercised, of specialization in either market or home production activities; *ii)* 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, and finally *iii)* 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.

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Appendix

A Construction of Marital Status Transition Matrix

We now describe briefly how we constructed the transition matrix π, and which criteria we used to ensure that the number of men and women married are the same.

1. We calculate from the PSID the followings;
   - Probability of remarrying: $q_{i,g}$ - couples who change spouses over couples who reported being married in both interviews.
   - Transitions from singles: $\hat{\pi}_{i,g}(j|s), \hat{\pi}_{i,g}(s_o|s), \hat{\pi}_{i,g}(s_w|s)$
   - Transitions from married: $\hat{\pi}_{i,g}(M|M), \hat{\pi}_{i,g}(s_o|M), \hat{\pi}_{i,g}(s_w|M)$
   - Switching between two dependents status: $p_{i,g}(d'|d)$

2. We use the fact that transition from one spouse to another involves a spell of being single. We construct transitions from married to married distinguishing by age, by using information on transitions from single to married. Specifically, we construct the following statistics:

$$\pi^*_{i,g}(\ell|j) \;=\; q_{i,g}\hat{\pi}_{i,g}(M|M)\left(\frac{\hat{\pi}_{i,g}(s_o|M)}{\hat{\pi}_{i,g}(S|M)}\frac{\hat{\pi}_{i,g}(\ell|s_o)}{\hat{\pi}_{i,g}(M|s_o)} + \frac{\hat{\pi}_{i,g}(s_w|M)}{\hat{\pi}_{i,g}(S|M)}\frac{\hat{\pi}_{i,g}(\ell|s_w)}{\hat{\pi}_{i,g}(M|s_w)}\right) \tag{30}$$

   for $k = j+1$, and then add the probability of not remarrying:

$$\pi^*_{i,g}(k|j) \;=\; \pi^*_{i,g}(j+1|j) \,+\, (1-q_{i,g})\hat{\pi}_{i,g}(M|M) \tag{31}$$

   To account for change in couples' dependent status:

$$\pi^*_{i,g}(\ell_{d'}|j_d) = p_{i,g}(d'|d)\pi^*_{i,g}(\ell|j) \tag{32}$$

3. We have to account for mortality, and the PSID does not allow us to do so, since we cannot disentangle those who died from those who left the sample. To properly account for mortality, we use the following steps:

   (a) We compute the complement of those who stay married to the same spouse, $\hat{x}_{i,g}(j)$:

$$\hat{x}_{i,g}(j) \;=\; 1 \,-\, (1-q_{i,g})\pi^*_{i,g}(M|j). \tag{33}$$

   (b) We define the probability of marital dissolution as the maximum value of $\hat{x}_{i,g}(j)$ and the probability of spousal death:

$$x_{i,g}(j) \;=\; \max\ \{\hat{x}_{i,g}(j),\, (1-\gamma_{j,g^*})\}. \tag{34}$$

(c) Then we redefine the transition probabilities and account for the agent's own probability of death as follows:

$$\frac{\pi_{i,g}(z|j)}{\gamma_{i,g}} = \begin{cases} \frac{\hat{\pi}_{i,g}(z|M)}{\hat{x}_{i,g}(j)} x_{i,g}(j) & \text{for } \ z \in S \\ \frac{\pi^*_{i,g}(z|j)}{\hat{x}_{i,g}(j)} x_{i,g}(j) & \text{for } z \in M \ \text{ and } z \neq j+1 \\ (1 - x_{i,g}(j)) + \frac{\pi^*_{i,g}(z|j)}{\hat{x}_{i,g}(j)} x_{i,g}(j) - & \\ \qquad (1 - q_{i,g}) \frac{\pi^*_{i,g}(M|j)}{\hat{x}_{i,g}(j)} x_{i,g}(j) & \text{for } z \in M \text{ and } z = j+1 \end{cases} \tag{35}$$

4. We make the transitions of males and females consistent with each other. (Recall that $\mu_{i,m,j} = \mu_{j,f,i}$ for all $i, j \in \mathcal{I}$.) We impose that the male's transition has to adjust to match the number of females of each type. We do this by scaling the rows of $\pi_{i,m,j}$ appropriately while conserving the ratios generated by the original matrix between single males with and without dependents, and between the transition from and to marriage across the different age groups of the wives. The transformation also requires that the new matrix be a Markov matrix; that is, 1) no element is either negative or above 1; and 2) each row has to sum to 1. This requires some additional rules when this property is violated. The rules are designed so that the new male transition matrix inherits as many properties as possible from the original.

5. We partition singles into three different groups $\{n, d, w\}$. We use the following facts:[20]

   - $\pi_{i,g}(n|j) = 0$
   - $\pi_{i,g}(S|j) = \pi_{i,g}(d|j) + \pi_{i,g}(w|j)$
   - $\pi_{i,g}(w|j) = \min\{\pi_{i,g}(S|j), (1 - \gamma_{j,g^*})\}$

B Tables of Interest

A few tables that we have used to carry out our work and that may be of interest can be found at `http://www.ssc.upenn.edu/~vr0j/papers/tablesjayins.pdf` and they include:

1. Number of Children (CPS 1989-1991) by Age, Sex, and Marital Status.

2. Earnings by Age, Sex, and Marital Status (CPS March 1989-1991).

3. Alimony and Child Support (CPS March 1989-1991) as percentage of earnings.

[20] While studies reveal that the probability of remarriage, controlling for age and sex, is slightly higher after divorce than after the death of a spouse, we assume they are equal.