Abstract

Marriage is an institution that also helps insure shocks. Despite this and the prevalence of marriage, very little is known on how effectively marriage insures households against income or health risks and how being married affects labor supply and savings. We develop a framework with both single and married people, in which single people meet partners and everyone experiences labor productivity shocks, medical costs shocks, life span risk, and married people also experience divorce risk. People can self-insure by saving and by choosing their labor supply. We also allow for reversibility of social security and pension payments to the surviving spouse in case of death of one of the spouses and for differential tax treatment of married and single people. In this framework, we study the insurance benefits of marriage, both at the individual and at the aggregate level.
1 Introduction

Marriage is an institution that also helps insure shocks. Despite this and the prevalence of marriage, very little is known on how effectively marriage insures households against income or health risks and how being married affects labor supply and savings. We develop a framework with both single and married people, in which single people meet partners and everyone experiences labor productivity shocks, medical costs shocks, life span risk, and married people also experience divorce risk. People can self-insure by saving and by choosing their labor supply. We also allow for reversibility of social security and pension payments to the surviving spouse in case of death of one of the spouses and for differential tax treatment of married and single people. In this framework, we study the insurance benefits of marriage, both at the individual and at the aggregate level.

2 Related Literature

The most closely related work to ours is by Ortigueira and Siassi (2011), that studies the effects of unemployment spells in an environment with infinitely lived agents and compares two economies, one with single agents, and one with couples, that share risk and optimally choose consumption and labor supply. Compared with Ortigueira and Siassi, we explicitly model both singles and married couples jointly, the life cycle, labor productivity shocks, medical expenses shocks, divorce shocks, and important elements that affect the value of being married, such as the reversibility of social security and differential taxation of couples and singles.

More in general, our paper is related to the literature that studies family decisions, such as female labor supply. Attanasio et al. (2008) build a model in which a unitary family makes consumption, saving and female labor supply decisions and show that the increase over time in female labor supply in the US is largely explained by the observed reduction of child care costs and the increase in women’s wages. Gemici and Laufer (2012) study how cohabitation affect women’s decisions to work. They abstract from saving. Gumer, Kaygusuz and Ventura (2012) quantify the aggregate effects of income tax reform in an OLG model with married and single households and with an extensive margin in labor supply. Kaygusuz (2012) and Nishiyama (2012) study the aggregate effects of Social Security reform in a model with married and single households and with an extensive margin in labor supply. Love (2010) quantifies how marital status and children affect life-cycle saving and portfolio decisions. Hong and Rios-Rull (forthcoming) study how changes in family status affect the demand for life insurance.

Our work is also related to the literature on incomplete markets models with partial insurance coming from different channels such as female labor supply, parental transfers, labor supply, and savings. Low (2005) and Pijoan-Mas (2006) study the role of labor supply as insurance against income shocks. Attanasio et al. (2005)
examine the insurance role of female labor supply when permanent labor earnings risk increases. They find that the welfare cost of an increase in the risk of permanent labor earnings is higher if saving and borrowing are limited. Kaplan (2012) investigates the co-residence with parents as an insurance against labor risk and shows that co-residence leads to smaller consumption responses to job loss, higher labor elasticities of the young, lower savings rates, and higher long-term earnings growth. The effect is smaller for the young from richer families, who tend to receive monetary transfers. Heathcote, Storesletten, and Violante (2010) study the quantitative and welfare implications of rising of college premium, narrowing of gender gap, and increasing of wage volatility observed in the US.

Although we allow for endogenous labor supply, we take the maximum retirement age to be exogenous. Our work complements and builds on interesting work on the joint retirement behavior of couples by Blau (1998), Blau and Gilletskie (2006), van der Klaauwa and Wolpin (2008), and Casanova (2012).


3 The Model

Our model period is one year. We explicitly model the working and retirement stages of the life cycle.

During their working stage, people are alive for sure, face shocks to their labor productivity, might get married if they are single, and risk divorce if they are married. Each period, each household, whether single or married chooses how much to save and how much to work, with married people choosing the labor supply of both partners together. As in French (2005), we introduce a fixed time cost of working for each person, which implies that, consistently with the observed data, most people will not choose to work just a few hours.\footnote{This fixed time cost of working includes commuting time, time spent getting ready for work, and so on.}

After retirement, the only control variable is savings and each person faces medical costs shocks and an exogenous probability of death.

We use the superscript $i$ to denote gender, with $i = 1$ being male and $i = 2$ being female. We allow several key elements to differ by gender: the survival probability, the fixed cost of working, the earnings processes, and the medical expense shocks.

3.1 The single people

First, consider the case of a young person who might get married with an exogenous probability, which depends on his age and other state variables. Let $t$ be
age $\in \{t_0, t_1, ..., t_r, ..., t_d\}$, with $t_r$ being retirement time and $t_d$ being the maximum possible lifespan.

Each single individual has preferences over consumption and leisure, and the period flow of utility is given by

$$v(c_t, l_t)$$

where $c_t$ is consumption, and $l_t$ is leisure, which is given by

$$l_t = 1 - n_t - \phi^i I_n,$$

that is, total time endowment less $n_t$, that is hours worked on the labor market less the fixed time cost of working. $I_n$ is an indicator function which equals 1 when hours worked are positive and zero otherwise. The term $\phi^i$ represents the fixed time cost of working, which might differ between males and females, partly because of differences in child rearing and home production.\(^2\)

Let $w$ be the market wage per unit of efficient labor. Let $e^i_t$ be a deterministic age-efficiency profile, which is a function of the individuals’ age and gender. Let $\epsilon^i_t$ be a persistent earnings shock that follows a Markov process. The product of $e^i_t$ and $\epsilon^i_t$ determines an agent’s units of effective labor per hours worked during the period.

$$\ln \epsilon^i_{t+1} = \rho^i \ln \epsilon^i_t + \nu^i_t, \quad \nu^i_t \sim N(0, \sigma^2_{\nu}).$$

Government taxes labor income at rate $\tau_{SS}$ to finance old-age Social Security. We use $\bar{y}_t$ to denote average lifetime labor earnings as of age $t$, which we use to determine old age social security and defined benefit pensions.

In taxing income, we adopt Gouveia and Strauss’ [11] functional form. The average federal tax $\tau(Y, j)$ on total income $Y$ depends on the family structure, with $j = 1$ indicating a single person and $j = 2$ indicating a married couple.

$$\tau(Y, j) = \left( b^j - b^i (s^i Y + 1)^{-\frac{1}{p^i}} \right) Y.$$  

Gouveia and Strauss [11] have shown that this functional form is flexible enough to approximate well the effective average tax rate.

Let $a_t$ be assets. For a currently single person with a given set of characteristics, we denote the probability of getting married at the beginning of next period with a partner $p$ with $\xi_{t+1}(\cdot) = \xi_{t+1}(e^i_{t+1}, e^p_{t+1}, i)$. Allowing this probability to depend on the ability of both partners generates assortative mating.

From the first period of working age and until retirement, the recursive problem

\(^2\)Our paper is not about the home production of children for singles and couples and we thus chose to simplify this aspect to keep the model tractable and yet rich along the aspects that are the focus of our analysis.
of the single person can be written as

\[
V_t(a_t, \epsilon_{i_t}^t, \bar{y}_t, i) = \max_{c_t, a_{t+1}, n_t} \left( v(c_t, 1 - n_t - \phi I_{n_t}) + \beta E_t(1 - \xi_{t+1}(\cdot)) V_{t+1}(a_{t+1}, \epsilon_{t+1}^i, \bar{y}_{t+1}, i) + \beta E_t \xi_{t+1}(\cdot) \hat{W}_{t+1}(a_{t+1} + \epsilon_{t+1}^p, a_{t+1}, \epsilon_{t+1}^i, \bar{y}_{t+1}, i) \right)
\]

(5)

\[
\xi_{t+1}(\cdot) = \xi_{t+1}(\epsilon_{t+1}^i, \epsilon_{t+1}^p, i)
\]

(6)

\[
Y_t = w e_t \epsilon_{i_t}^t n_t
\]

(7)

\[
c_t + a_{t+1} = (1 + r)a_t + (1 - \tau_{SS})Y_t - \tau(ra_t + Y_t, j)
\]

(8)

\[
\bar{y}_{t+1} = \bar{y}_t + (w e_t \epsilon_{i_t}^t n_t)/(t_r - t_0)
\]

(9)

\[
a_t \geq 0, \quad n_t \geq 0, \quad \forall t
\]

(10)

The expectation operator is taken with respect of the distribution of \( \epsilon_{t+1}^i \) conditional on \( \epsilon_i^t \) and with respect to the probability distribution of the partner’s characteristics for people getting married \( \xi_{t+1}(\cdot) \).

The value function \( \hat{W}_{t+1}^i \) is the discounted present value of the utility for the same individual, once he or she is in a married relationship with someone with given state variables, not the value function of the married couple, which counts the utility of both individuals in the relationship.

After retirement, single individuals don’t get married anymore and face health and death shocks.

Let \( m^i(t, \psi_i^t) \) be the medical health shock (which translates in medical monetary costs that have to be covered), which is a function of age and an AR(1) shock \( \psi_i^t \):

\[
\psi_{t+1}^i = p_{\psi} \psi_t^i + \mu_t, \quad \mu_t \sim N(0, \sigma_{\mu}^2)
\]

(11)

The retired individual’s recursive problem can be written as:

\[
V_t(a_t, \psi_t^i, \bar{y}_r, i) = \max_{c_t, a_{t+1}} \left( v(c_t, 1) + \beta s_t^i E_t V_{t+1}(a_{t+1}, \psi_{t+1}^i, \bar{y}_r, i) \right)
\]

(12)

\[
Y_t = SS(\bar{y}_r)
\]

(13)

\[
B(a_t, Y_t, \psi_t^i, \underline{c}(j)) = \max \left\{ 0, \underline{c}(j) - \left\{ (1 + r)a_t + Y_t - m(t, \psi_t^i) \right\} \right\}
\]

(14)

\[
\hat{Y}_t = ra_t + Y_t + B(a_t, Y_t, \psi_t^i, \underline{c}(j))
\]

(15)
\[ c_t + a_{t+1} = \left( (1 + r)a_t + Y_t + B(a_t, Y_t, \psi_t, \zeta(j)) - m(t, \psi_t^i) \right) \]
\[ -\tau \left( \hat{Y}_t - \max(0, m(t, \psi_t^i) - \kappa Y_t^i), j \right) \]  
\[ \text{Eq. (16)} \]

The term \( SS(\tilde{y}_r) \) includes social security and defined benefit plans, which for the single individual is a function of the income earned during their work life, \( \tilde{y}_r \), while \( s_t \) is the survival probability as a function of age. The function \( B(a_t, Y_t^i, \psi_t^i, \zeta(j)) \) represents old age means-tested government transfers such as Medicaid and SSI, which ensure a minimum consumption floor \( \zeta(j) \) in case of little resources and/or large medical costs. \( \hat{Y}_t \) is the gross taxable income. As in Kopecki and Koreshova (2010), we allow medical expenses that exceed \( \kappa \) fraction of gross taxable income to be deducted.

### 3.2 The Married Couples

We assume that couples maximize their joint utility function. Married couples derive utility from total consumption and from the leisure of each household member.\(^3\)

\[ w(c_t, l^1_t, l^2_t) \]  
\[ \text{Eq. (18)} \]

To solve for optimal labor supply of each household member and for savings, we solve for the household’s optimizations problem. Later on, to compute the insurance value of being married, we also compute the discounted present value of utility of a male and female in a marriage by using the appropriate policy functions of the couple that the person belongs to.

During the working period each of the spouses is affected by a labor productivity shock at the beginning of the period, and the couple can be hit by a divorce shock \( \zeta_t \) at the end of the period. If the couple divorces, the ex-partners split the assets and each of the individuals moves on with those assets, and their own productivity and social security contributions.

As for singles, the superscript \( i = 1 \) refers to males, while the superscript \( i = 2 \) refers to females. Spouses differ in their earnings and health processes and in their initial conditions.

\(^3\)An alternative specification is to use collective model and solve the Pareto-efficiency intro-household allocation along the line of, for example, Chiappori (1988, 1992), and Browning and Chiappori (1998)).
The recursive problem for the married couple until \( t_r \) can be written as

\[
W_t(a_t, \epsilon_t, \epsilon_t^1, \epsilon_t^2, \tilde{y}_t^1, \tilde{y}_t^2) = \max_{c_t, n_{t+1}, n_t^1, n_t^2} \left( w(c_t, 1 - n_t^1 - \phi I_{n_t^1}, 1 - n_t^2 - \phi I_{n_t^2}) + \right.
\]

\[
(1 - \zeta_t(\cdot)) \beta E_t W_{t+1}(a_{t+1}, \epsilon_{t+1}, \epsilon_{t+1}^1, \epsilon_{t+1}^2, \tilde{y}_{t+1}^1, \tilde{y}_{t+1}^2) + \left. \right)
\]

\[
\zeta_t(\cdot) \beta \sum_{i=1}^{2} \left( E_t V_{t+1}(a_{t+1}^i/2, \epsilon_{t+1}^i, \tilde{y}_{t+1}^i, i) \right)
\]

\[
\zeta_t(\cdot) = \zeta_t(a_t, \epsilon_t, \epsilon_t^1, \epsilon_t^2, \tilde{y}_t^1, \tilde{y}_t^2)
\]

\[
Y_t = we_1 \epsilon_t n_t^1 + we_2 \epsilon_t n_t^2
\]

\[
c_t + a_{t+1} = (1 + r)a_t + (1 - \tau_{SS})Y_t - \tau(ra_t + Y_t, j)
\]

\[
\tilde{y}_{t+1}^i = \tilde{y}_t^i + (we_1 \epsilon_t n_t^i) / (t_r - t_0), \quad i = 1, 2
\]

\[
a_t \geq 0, \quad n_t^1, n_t^2 \geq 0, \quad \forall t
\]

The expected value of the couple’s value function is taken with respect to the conditional probabilities of the two \( \epsilon_{t+1} \)s given the current values of the \( \epsilon_t \)s for each of the spouses (we assume independent draws). The expected values for the newly divorced people are taken using the appropriate conditional distribution for their own labor productivity shocks.

During retirement, that is from age \( t_r \) on, each of the spouses is hit with a medical cost shock \( \psi_t^i \) and a realization of the survival shock \( s_t^i \). For simplicity, we assume that there is no divorce after retirement. Symmetrically with the other shocks, \( s_t^1 \) is the after retirement survival probability of male spouse, while \( s_t^2 \) is the survival probability of the female spouse, and the deaths of the each spouse is independent of the other. In that period, the married couple’s recursive problem can be written as:

\[
W_t(a_t, \psi_t^1, \psi_t^2, \tilde{y}_r^1, \tilde{y}_r^2) = \max_{c_t, a_{t+1}} \left( w(c_t, 1, 1) + \beta s_t^1 s_t^2 E_t W_{t+1}(a_{t+1}, \psi_{t+1}^1, \psi_{t+1}^2, \tilde{y}_{t+1}^1, \tilde{y}_{t+1}^2) + \right.
\]

\[
\beta s_t^1 (1 - s_t^2) E_t V_{t+1}(a_{t+1}, \psi_{t+1}^1, \tilde{y}_{t+1}^1, 1) + \beta s_t^2 (1 - s_t^1) E_t V_{t+1}(a_{t+1}, \psi_{t+1}^2, \tilde{y}_{t+1}^2, 2)
\]

\[
Y_t = \max \left\{ (SS(\tilde{y}_r^1) + SS(\tilde{y}_r^2), \frac{3}{2} \max(SS(\tilde{y}_r^1), SS(\tilde{y}_r^2)) \right\}
\]

\[
\tilde{y}_r^1 = \max(\tilde{y}_r^1, \tilde{y}_r^2)
\]

\[
\tilde{y}_r^2 = \max(\tilde{y}_r^1, \tilde{y}_r^2)
\]

\[\text{Divorce rates among individuals over the age of 65 are low. For example, in 1990, the number of divorces per 1000 married individuals aged 65 and above was 7 for men and 5 for women. (Source: Monthly Vital Statistics Reports, Vol 43 No 9(S), March 1995).}\]
\[
B(a_t, Y_t, \psi^1_t, \psi^2_t, c(j)) = \max\left\{0, c(j) - (1 + r)a_t + Y_t - m^1(t, \psi^1_t) - m^2(t, \psi^2_t)\right\}
\] (29)

\[
\hat{Y}_t = r a_t + Y_t + B(a_t, Y_t, \psi^1_t, \psi^2_t, c(j))
\] (30)

\[
c_t + a_{t+1} = \left((1 + r)a_t + Y_t + B(a_t, Y_t, \psi^1_t, \psi^2_t, c(j)) - m^1_t - m^2_t\right)
\]
\[
- \tau \left(\hat{Y}_t - \max(0, m^1_t + m^2_t - \kappa \hat{Y}_t), j\right)
\] (31)

\[
a_t \geq 0 \quad \forall t
\] (32)

The evolution of variable \(Y_t\) mimics the spousal benefit from Social Security and pension which gives a married person the right to collect the higher of own benefit entitlement and half of the spouse’s entitlement. The evolution of variables \(\hat{y}_j, i = 1, 2\) represents survivorship benefits from Social Security and pension in case of death of one of the spouses. The survivor has the right to collect the higher of own benefit entitlement and the deceased spouse’s entitlement.

### 3.3 The Individual’s Discounted Present Value of Being in a Marriage

When explicitly modeling couples, some interesting issues come up. One needs to compute the joint value function of the couple when married to appropriately compute joint labor supply and savings under the married couples’ available resources. However, that value function, refer to the total utility of both people in the relationship, while when computing the value of getting married for a single person, or when computing the insurance value of marriage, the relevant object is the discounted present value of utility for a single person in the marriage, using the optimal policy functions for labor supply and savings for people in the couple that individual belongs to.

We define this object for person \(i\) in a marriage during the working period, and with given state variables as

\[
\hat{W}_t(a_t, \epsilon^1_t, \epsilon^2_t, \hat{y}^1_t, \hat{y}^2_t, i) = v(\hat{c}(\cdot), 1 - \hat{n}_t(\cdot) - \phi I_{n_t}^i) + \\
\beta (1 - \zeta(\cdot)) E_t \hat{W}_{t+1}(\hat{a}_{t+1}(\cdot), \epsilon^1_{t+1}, \epsilon^2_{t+1}, \hat{y}^1_{t+1}, \hat{y}^2_{t+1}, i) + \\
\zeta(\cdot) \beta E_t V_{t+1}(\hat{a}_{t+1}(\cdot)/2, \epsilon^i_{t+1}, \hat{y}^i_{t+1}, i)
\] (33)

where \(\hat{c}_t(\cdot)\) is the optimal consumption function, \(\hat{n}_t(\cdot)\) is the optimal labor supply for individual \(i\) in the couple, and \(\hat{a}_{t+1}(\cdot)\) is the optimal savings function for a married couple with the given state variables.
During the retirement period, we have
\[
\hat{W}_t(a_t, \psi_t^1, \psi_t^2, \tilde{y}_{t+1}, \tilde{y}_{t+2}, i) = v(\hat{c}_t(\cdot), 1) + \beta s_t^1 s_t^p E_t \hat{W}_{t+1}(a_{t+1}(\cdot), \psi_{t+1}^1, \psi_{t+1}^2, \tilde{y}_{t+1}, \tilde{y}_{t+2}, i) + \\
\beta s_t^1 (1 - s_t^p) E_t V_{t+1}(\hat{a}_{t+1}(\cdot), \psi_{t+1}^i, \tilde{y}_{t+1}^i, i).
\]
(34)

4 Sketch of the Solution Algorithm

We need to compute three sets of value functions by age. The value function of being single, the value function of the two people in the married couple, and the value function of each individual in the marriage.

During the retirement period, single people do not get married anymore, so their value function can be computed independently of the other value functions. The value function of the couples depends on their own future continuation value and the one of the singles, in case of death of a spouse. Then there is the value function of the single person being married in a couple, which depends on the optimal policy function of the couple, taking the appropriate expected values. This is thus how the solution is computed during retirement:

1. Compute the value function of the retired single person for all time periods after retirement, doing the usual backward iteration starting from the last period.
2. Compute the value function of the retired couple for all time periods after retirement, which uses the previous one in case of death of one of the spouses, doing the usual backward iteration starting from the last period.
3. Compute the value function of the single individual in a marriage for all time periods after retirement, adding up all of the discounted value of utility going backward, and computing the present value using the appropriate probabilities.

During the working age, the value functions are interconnected, so we need to solve for each of them at a given time \( t \). For each period, working backwards over the life cycle, we apply the following solution strategy:

1. For any given time period, take as given the value of being a single person in a married couple for next period, which has been previously computed. Compute the value function of being single.
2. Given the value function of being single, compute the value function of the couple for the same age.
3. Given the optimal policy function of the couple, solve for the discounted present value of utility for each of the spouses in a marriage.
4. Keep going back in time until the first period we solve for.
We assume a standard CRRA utility function in consumption and leisure for singles. For married couples, we generalize the singles’ utility function as in Casanova (2012).

\[ v(c_t, l_t) = \frac{(\omega t_l^{1-\omega} - 1)^{1-\gamma} - 1}{1-\gamma} \]  
\[ w(c_t, l_1^t, l_2^t) = \frac{((\omega t_1^{l_1^{1-\omega}} - 1)^{1-\gamma} - 1}{1-\gamma} + \frac{((\omega t_2^{l_2^{1-\omega}} - 1)^{1-\gamma} - 1}{1-\gamma} \]  

We set the risk aversion parameter, \( \gamma \), to be 1.5, from Attanasio et al. (1999), and Gourinchas and Parker (2002), who estimate it from consumption data. The economies of scale parameter \( \eta \) is set to 1.67 because, according to the McClements scale, a childless couple is equivalent to 1.64 adults (McClements (1977)).

We set \( \omega \) to match aggregate labor hours of .33.

* * *Eric estimates that the total labor endowment=4466, and consumption weight=0.578. But the weight needs to be adjusted to fit the normalization. Can you ask Eric what is his normalization? Yes, I can ask him when he comes back from his 3-weeks trip in Europe. This is week 2.

We choose the discount factor \( \beta \) to match the average assets to labor income ratio in middle age. The resulting value is 0.97.

To calibrate the survival probabilities \( s_1^t, s_2^t \), we take the mortality probabilities in 2000 for each gender from the Social Security Administration life tables.

The retirement benefit at age 66 is calculated to mimic the Old Age and Survivor Insurance component of the Social Security system:

\[ SS(\tilde{y}) = \begin{cases} 
0.9\tilde{y}, & \tilde{y} < 0.1115; \\
0.1004 + 0.32(\tilde{y} - 0.1115), & 0.1115 \leq \tilde{y} < 0.6725; \\
0.2799 + 0.15(\tilde{y} - 0.6725), & 0.6725 \leq \tilde{y} 
\end{cases} \]

The marginal rates and bend points, expressed as fractions of average household income, are from Social Security Bulletin (2000). Average household income in 2000 is $57,135 (from Census). For retired workers in 2000, the annual bend points are $6,372 and $38,424.

The deterministic age profile of the unconditional mean labor productivity for males, \( e_1^t \), is taken from French (2005). The resulting labor-efficiency profile is hump-shaped and peaks at age 50. We take the deterministic age profile of the unconditional mean labor productivity for females to be 70% of the male one, to reflect the gender wage gap.

Regarding the stochastic part of the earnings shock, we start by assuming that they coincide for males and females. The persistence $\rho_\varepsilon$ and variance $\sigma_\varepsilon^2$ of the stochastic productivity process are the same for both gender and are 0.977 and 0.014, respectively (French 2005). The initial distribution is chosen so that the variance of the initial distribution of productivity is 0.38 (Huggett 1996).

To capture positive assortative matching in marriage, we use the observed assortative mating on educational attainment for newlyweds in 1985-1987 reported by Mare (1991). The initial distribution of health for husbands and wives is assumed to independent of each other.

We choose the divorce rate calculated by Smith et al. (2007), who estimate the fraction of divorced females at each age by marital status in SIPP. The divorce rate is calculated as the increase of fraction of female who are divorced as a ratio of those who are married at the same age group using Figure 2-2.

$m^j(t,\psi^j_t)$ De Nardi, French and Jones (2010) estimate medical costs by age, permanent income, and health for single males and females starting from age 70. We use their estimates for the median permanent income.

Goda, Shoven and Slavov (2011) estimate monthly out-of-pocket medical and nursing homes spending by age, gender and marital status using the Health and Retirement Study (HRS), Waves 5-9, 2002-2008. They find that singles have higher out-of-pocket spending than married individuals of the same gender, and that women have higher out-of-pocket expenses than men of the same marital status. We calculate the health expenditure process for married individual, using the ratio provided there and the corresponding values for singles from De Nardi, et al. (2010). The AR(1) coefficient of health process and innovation of health process are taken from Kopecky and Koreskova (2010). The discretized process in section 5.

The minimum consumption for singles is set at $2,700 in 1998 dollar from De Nardi, et al. (2010). Scholz, Seshadri, and Khitatrakumin (2005) show that in 1992 the consumption floor was $8,159 for the one parent, two-child family. We set $c((j)$ accordingly.

The time participation cost $\phi^j$ is taken from French (2005), who estimates it for males.

The interest rate $r$ is set to 4%.

$\tau_{ss}$, Social Security tax, is set to 10.6% to be consistent with the actual one.

Guner et al. (2012) estimate tax function by marital status. We choose married and single without children. The resulting values for married couple without children are: $b^0 = 0.2338, s^0 = 0.0032, p^0 = 1.493$; Those for single without children are: $b^1 = 0.2462, s^1 = 0.0311, p^1 = 0.8969$. 

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Table 1. Calibration According to the Data and the Literature

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<td>$\rho_\varepsilon$</td>
<td>AR(1) coefficient of income process</td>
<td>0.977 French (2005)</td>
</tr>
<tr>
<td>$\sigma_\varepsilon^2$</td>
<td>innovation of income process</td>
<td>0.014 French (2005)</td>
</tr>
<tr>
<td><strong>Health shock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$m^j(t, \psi_t^i)$</td>
<td>AR(1) coefficient of health process</td>
<td>.901 Hubbard et al (1995)</td>
</tr>
<tr>
<td>$\rho_\psi$</td>
<td>AR(1) coefficient of health process</td>
<td>.901 Hubbard et al (1995)</td>
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<td>$\sigma_\psi^2$</td>
<td>innovation of health process</td>
<td>.156 Hubbard et al (1995)</td>
</tr>
<tr>
<td><strong>Government policy</strong></td>
<td></td>
<td></td>
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<tr>
<td>$b^j, s^j, p^j$</td>
<td>income tax</td>
<td>see text Guner et al. (2012)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>maximum medical deduction</td>
<td>7.5%</td>
</tr>
<tr>
<td>$SS(y)$</td>
<td>Social Security benefit</td>
<td>see text</td>
</tr>
<tr>
<td>$c(j)$</td>
<td>minimum consumption</td>
<td>see text</td>
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<tr>
<td><strong>Preferences</strong></td>
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</tr>
<tr>
<td>$\gamma$</td>
<td>risk aversion coefficient</td>
<td>1.5 Attanasio, et al. (1999), Gourinchas and Parker (2002)</td>
</tr>
<tr>
<td>$\phi^i$</td>
<td>participation cost</td>
<td>1292 French (2005)</td>
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<tr>
<td>$\eta$</td>
<td>equivalence scales</td>
<td>1.67 French (2005)</td>
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<tr>
<td>$\beta$</td>
<td>discount factor</td>
<td>0.97 French (2005)</td>
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</table>

6 Computation

To compute the steady state of our model, we first discretize the income process into 5 points and discretize the health process into 4 points. The state space for average lifetime earnings and asset holdings is discretized into unevenly spaced grids.

Following Kopecki and Koreshkova (2010), when the expected average annual earnings is normalized to one, the grid of realizations of health shock, $\log(\psi)$ is $[-5.83,-3.00,-1.70, 0.685]$, the initial distribution of non-nursing home entrants across medical expenses, is $[0.2205, 0.2177, 0.5209, 0.0409]$, and the probability transition matrix conditional on not entering a nursing home next period, is

$[0.6510 \ 0.2290 \ 0.1100 \ 0.0100 \ 0.1512 \ 0.7427 \ 0.0961 \ 0.0099 \ 0.0423 \ 0.1668 \ 0.7809 \ 0.0105 \ 0.1016 \ 0.3244 \ 0.4998 \ 0.0743]$. We use regular grid search to solve the model.
References


