Marrying for Money?

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February 2007

Ostensibly, people marry for love. In fact money may be the driving factor.

Marriage engenders economizing of resources, pooling risks and sharing wealth. How important are these factors? We provide an economic view of marriage and we determine what it is worth. Specifically, this paper is concerned with marriage as an implicit insurance contract against the risk of earning loss, of disability and of running out of consumption resources because of greater than average longevity. Our main finding is that, even though economies of shared living are the dominant factor in the financial gain from marriage, the risk-sharing opportunities provided by the family can play an important role.

Keywords: Risk; Insurance; Marriage

I am grateful to Laurence Kotlikoff and Francois Gourio for discussions and for comments motivating the direction of my research

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1 Introduction

Ostensively, people marry for love. In fact money may be the driving factor. Marriage engenders economizing of resources, pooling risks and sharing wealth. How important are these factors? Does it pay to get married? This paper provides an economic view of marriage and determines what it is worth.

Across many different countries, marriage has historically been viewed as a source of financial security, as noted by Waite and Gallagher(2000). The life uncertainties make it hard to decide how much to spend for the current consumption and how much to save against unpredictable events. Spouses' explicit agreement, as a part of their marriage vow, of mutual support against life's unforeseen events acts as a kind of insurance policy. Of course, people can buy insurance from private companies. However, since these companies have to cover the costs of running the business, the private insurance policies are much more expensive than the same level insurance that results from marriage. In addition, within the family, there exists a level of trust and information that alleviates the key problems associated with the provision of insurance by public markets. Among those, moral hazard, adverse selection and deception. Important risks for which the market "public" problems can be particularly severe are the risk of job loss or change in earnings and the risk of disability. In particular, the public market is not always able to determine the extent to which an individual actually suffered an earning loss or became disabled. The family's role in providing insurance to family members has been explicitly considered in Schulz(1974), Becker et al.(1977), Kotlikoff and Spivak(1981).

This paper is concerned with marriage as an implicit insurance contract against the risk of earning loss, of disability and of running out of consumption resources because of greater than average longevity. This contract is made ex-ante by completely selfish individuals who obtain utility only from their own consumption. Each individual works between age 30 and age 65 and then retires. We assume that each individual faces earning uncertainty in the working period and uncertain medical expenses after retirement. Along the entire life length, the date of death is uncertain. The labor income process, the medical expenditure process and the survival probabilities are ex-ante known. We calculate the spouses' gain from pooling their uninsurable risks of labor income, health expenditure and longevity through marriage. The prospect of bad realizations in future earnings, of out-of-pocket medical expenses, or of a longer life than average can influence the individuals' decisions about how fast to consume over time, about their wedding, and about their spouse. Throughout the paper, we simulate the gain from marriage as a result of the risk-sharing arrangements offered within the family. In the final paragraph we introduce the economies of shared living, to make our analysis more realistic. Our finding shows that even though the economies of shared living are the main determinant of the marriage gain, the risk-sharing arrangements play an important role. Focusing on risk sharing, we find that a 30-year-old representative spouse enjoys about a 15% higher consumption than if she stayed single. The marriage gain increases during the working period until age 45, mainly due to risk pooling opportunities against job loss risk, and then declines as the individual approaches retirement. After retirement, the gain from marriage increases again, reaching a peak at age 75, as families can self-insure against unexpected out-of-pocket medical expenses, nursing home costs and uncertain dates of death. We find that women experience higher marriage gain than men at each age. This reflects the fact that while both partners agree on equal consumption in an equally weighted marriage contract, the husband has lower survival probabilities and therefore is more likely to die and bequest first.

We compare the gain from marriage at different ages for both men and women with different education levels. We can explain the existing 'schooling homogamy' among highly educated people as a consequence of the behavior of rational individuals that at each age are likely to choose their spouse to maximize their expected lifetime utility and consumption. Love and affection can be important, but "there are fewer Cinderella marriages these days," as noted by Coontz(2005). "Men are less interested in rescuing a woman from poverty. They want to find someone who will pull her weight." From the vast literature on marriage and assortative mating, Mare(1991), Pencavel(1998), and Mancuso and Pencavel(1999) deal specifically with schooling homogamy. In our model, a 30-year-old male college graduate who marries a woman without high school faces a decrease in his consumption by about 4% than if he stayed single, while he can experience a consumption increase by about 7% from marrying a college graduate. For a 30-year-old female college graduate the marriage gain is about 7.5% and 21% respectively from marrying a man without high school and a college graduate. As noted before, the difference in male and female marriage gain reflects only the difference in survival probabilities for identical education levels.

The model cannot be solved analytically; therefore we develop a dynamic programming model in which single individuals and families face longevity, earning, and health uncertainty. The simulation analysis is conducted in partial equilibrium, and factor prices (wages and interest rates) are assumed constant over time. Partial equilibrium analyses can overstate the associated general equilibrium results but can give a first impression of the gain from marriage when individuals face multiple uncertainties.

The paper is organized as follows.

Section 1 introduces our life-cycle model for a single individual and for a couple. Section 2 describes the gain from marriage calculation. Section 3 discusses the numerical solution and Section 4 the calibration. Section 5 presents the simulation results. Section 6 concludes.

2 A Life-Cycle Model

2.1 The Individual's Consumption Plan

We consider a representative individual that faces earning, life span and health expenditure uncertainty. Time is discrete and each period t corresponds to one year. The retirement age is set exogenously and equal to age 65. T is the maximum longevity and it is set equal to 95. For age $t = \{30, \ldots, 65\}$, the individual faces earning shocks $Y_t^i \in E_t^i = \{Y_t^{i,\min}, ..., Y_t^{i,\max}\}$. At the beginning of each period, before observing the current period earning shock , the representative individual chooses her consumption $\{C_t^i\}_{t=30}^{65}$. This choice is conditioned on her history, which includes her initial endowment of wealth and accumulated assets. At the end of each period, the individual observes the current period earning shock. For the age $t = \{66, \ldots, 95\}$ the individual faces longevity and health shocks. Her wealth is determined by the accumulated assets and the associated interests, less medical expenses The representative individual choice of her consumption $\{C_t^i\}_{t=66}^{95}$ is conditioned on her history, accumulated assets and medical expenses.

The individual i's choice problem is to decide on the path of her control variable $\{C_t^i\}_{t=30}^{95}$ in order to maximize the expected discounted sum of her current and future utility, which can be written as follows:

$$\max_{\{C_t^i\}_{t=30}^{95}} E \sum_{t=30}^{95} \beta^{t-30} \left(\prod_{j=0}^{t-2} Q_j^i \right) u(C_t^i) \tag{1}$$

where $\beta = 1/(1+\rho)$ is the rate of time preference and Q_t^i is individual i's probability of survival from period zero until period t. We assume that individual i's preferences are represented by a time-separable iso-elastic utility function:

$$u(C_t^i) = \frac{(C_t^i)^{1-\gamma}}{1-\gamma} \tag{2}$$

2.2 The Family's Consumption Plan

We consider a representative family, composed of two individuals who both work from the age of 30 until the age of 65, and then they retire.

For age $t = \{30, \ldots, 65\}$, each family member faces earning shocks $Y_t^{f_i} \in E_t^{f_i} = \{Y_t^{f_i,\min}, ..., Y_t^{f_i,\max}\}$, with $i = \{1, 2\}$, while for the age $t = \{66, \ldots, 95\}$ each family member faces health shocks. During their entire life, the individuals face longevity uncertainty. At the beginning of each period the representative family chooses her consumption $\{C_t^f\}_{t=30}^{95}$, which is the sum of both family member's consumption $\{C_t^{f_1}, C_t^{f_2}\}_{t=30}^{95}$. The choice is conditioned on the family's history, which includes each member's initial endowment of wealth and the accumulated assets. At the end of the period, each family member observes her current period earning shock. For age $t = \{66, \ldots, 95\}$ the family's wealth is determined by accumulated assets and associated interests, less medical expenses.

The family's choice problem is to decide on the path of her control variables $\{C_t^{f_1}, C_t^{f_2}\}_{t=30}^{95}$ in order to maximize the expected discounted weighted sum of each family member's current and future utility.

Both family members have the same iso-elastic utility function:

$$u(C_t^{f_i}) = \frac{(C_t^{f_i})^{1-\gamma}}{1-\gamma} \qquad for \qquad i = 1, 2 \tag{3}$$

The current period family's consumption choice problem is described as follows:

$$\max_{\{C_t^{f_1}, C_t^{f_2}\}} Q_t^{f_1} Q_t^{f_2} (u(C_t^{f_1}) + \theta u(C_t^{f_2})) + Q_t^{f_1}(1 - Q_t^{f_2}) u(C_t^{f_1}) + (1 - Q_t^{f_1}) Q_t^{f_2} u(C_t^{f_2}) \tag{4}$$

subject to:

$$C_t^f = C_t^{f_1} + C_t^{f_2} \tag{5}$$

where $Q_t^{f_1}$ and $Q_t^{f_2}$ are respectively the male and female survival probabilities. $C_t^{f_1}$ and $C_t^{f_2}$ are the husband's and the wife's consumptions. C_t^f is the family's consumption. θ is the differential weight applied to the wife's expected utility. Throughout the paper we assume that θ equals 1, that is an equal consumption (equal weighting) marriage contract.

We rewrite this problem as follows:

$$\max_{\{C_t^f\}} Q_t^{f_1} Q_t^{f_2} U(C_t^f) + Q_t^{f_1}(1 - Q_t^{f_2}) u(C_t^f) + (1 - Q_t^{f_1}) Q_t^{f_2} u(C_t^f) \tag{6}$$

given that:

$$U(C_t^f) = \max_{\{C_t^{f_1}, C_t^{f_2}\}} (u(C_t^{f_1}) + \theta u(C_t^{f_2})) \qquad \textit{subject to} \qquad C_t^f = C_t^{f_1} + C_t^{f_2} \tag{7}$$

The FOCs associated with (7) are:

$$C_t^{f_1} = \frac{C_t^f}{1 + \theta^{1/\gamma}} \qquad \textit{and} \qquad C_t^{f_2} = \frac{C_t^f \theta^{1/\gamma}}{1 + \theta^{1/\gamma}} \tag{8}$$

It follows that:

$$U(C_t^f) = \frac{(C_t^f)^{1-\gamma}}{1-\gamma} (1 + \theta^{1/\gamma})^{\gamma} \tag{9}$$

2.3 The Labor Income Process

We consider the labor income process, as described in Cocco et al.(2005).

Before retirement ($t < 65$), age-t labor income is exogenously given by the sum of a deterministic component and two random components. The deterministic component $f(t)$ is a function of age and is calibrated to capture the hump shape of income over the life cycle. The random components are one permanent v_t^i and one transitory ε_t^i.

$$\log(Y_t^i) = f(t) + v_t^i + \varepsilon_t^i \tag{10}$$

The process for the permanent random component v_t^i is a random walk, as described by the following equation[1]:

[1] Caroll (1997), Gourinchas and Parker (2002) used the same assumption about the permanent random component. Hubbard, Skinner and Zeldes (1995) estimate a general first-order

$$v_t^i = v_{t-1}^i + u_t^i \tag{11}$$

The permanent shock u_t^i and is distributed as $N(0, \sigma_u^2)$ and is uncorrelated with ε_t^i. We assume that the transitory shock is distributed as $N(0, \sigma_\varepsilon^2)$.

A more realistic labor income process should take into account also catastrophic shocks, as described in Gomes et al.(2006), according to which the transitory shock is distributed as:

$$\begin{cases} N(0, \sigma_\varepsilon^2) & \text{with probability } (1-\pi) \\ Ln(0.1) & \text{with probability } \pi \end{cases} \tag{12}$$

Assuming this process for the transitory shock, we include in the model the probability of a large negative income shock as in Heaton and Lucas(1997), Caroll(1992), Deaton(1991).

2.4 Medical Expenses

We assume that medical expenses include both out-of-pocket health care expenditures $G(t, Z_t^i)$ and potential nursing home costs $D(t, Z_t^i)$.

$$M_t = G(t, Z_t^i) + s_t^i D(t, Z_t^i) \tag{13}$$

The process for out-of-pocket health care expenses for the retired individual is taken from Scholz et al.(2006)

$$\begin{aligned} G(t, Z_t^i) &= \beta_0 + \beta_1 Age_t + \beta_2 Age_t^2 + \eta_t \\ \eta_t &= \rho \eta_{t-1} + \zeta_t \\ \zeta_t &\sim N(0, \sigma_\zeta^2) \end{aligned} \tag{14}$$

where Age_t is the age of the individual at time t, η_t is an AR(1) error term and ζ_t is white noise.

The process for potential nursing home costs is taken from Luo(2006). Each period the representative individual has a certain probability of incurring nursing home admission. s_t^i denotes if the individual is under nursing home services.

autoregressive process for three categories of education of the family head: less than twelve years of schooling (no high school degree), between twelve and fifteen years (with high school degree) and sixteen years or more (college degree). They find a value for the autocorrelation coefficient close to one.

Let $s_t^i \in \{0,1\}$ be a binary variable which takes value 1 in the case of nursing home admission at time t.

$$s_t^i = \begin{cases} 1, & \textit{with probability } \delta(t, h_t^i, Z_t^i) \\ 0, & \textit{with probability } (1 - \delta(t, h_t^i, Z_t^i)) \end{cases} \tag{15}$$

where h_t^i is a discrete variable which represents the individual's health status. $h_t^i \in \{good, fair, poor\}$ follows a Markov process.

The probability of nursing home admission is assumed to be a function of the individual's age, health status and personal characteristics, and subject to the logistic distribution:

$$prob(s_t^i = 1) = \frac{\exp(\vartheta' x_t^i)}{1 + \exp(\vartheta' x_t^i)} \tag{16}$$

Where $prob(s_t^i = 1)$ is $\delta(t, h_t^i, Z_t^i)$, ϑ is a vector of estimated coefficients and x_t^i is the vector of independent variables.

Luo(2006) runs a regression to calibrate nursing home cost $D(t, Z_t^i)$. She finds that the lenght of nursing home stay conditional on entry does not depend on age, health status or personal characteristics. Following Luo(2006), we assume that a nursing home admission implies an expected cost based on the average length of stay in a year, which is 6.37 months. This cost is then calculated following Palumbo(1999):

$$D = (1-n)n(c^{ac} + c^{nh}) + n\left(\frac{n}{2}\right)(c^{ac} + c^{nh}) - Medicare\,Benefit \tag{17}$$

Where D is the total cost sustained in year t, n denotes the fraction of the year spent in a nursing home, c^{ac} is the average cost of one year of acute care received in a nursing home, c^{nh} is the average cost of one year of nursing home care. We assume that the individuals do not receive $MedicareBenefit$.

2.5 The Individual's Optimization Problem

In order to take into account the different sources of uncertainty, we split the individual's economic problem into three time periods: the after retirement period $t = \{66, \ldots, 95\}$, the last working year $t = 65$ and the working period $t = \{30, \ldots, 64\}$. We solve it recursively, under the assumption that $A_{96} = 0$.

For the age $t = \{66, \ldots, 95\}$, the individual faces longevity and health uncertainty. The individual's recursive problem can be written as:

$$V_t^i(A_t^i, \eta_{t-1}^i, h_{t-1}^i) = \max_{C_t^i} \left\{ u(C_t^i) + \beta Q_{t+1}^i E_t V_{t+1}^i(A_{t+1}^i, \eta_t^i, h_t^i) \right\} \tag{18}$$

subject to

$$A_{t+1}^i = (1+r) * (A_t^i - C_t^i - M_t^i) \tag{19}$$

$$0 \leq C_t^i \leq A_t^i \qquad and \qquad A_{96}^i = 0 \tag{20}$$

where $V_t^i(A_t^i, \eta_{t-1}^i, h_{t-1}^i)$ is period t maximum expected utility for individual i. The state variables h_{t-1}^i and η_{t-1}^i are respectively individual i's period $(t-1)$ health status and period $(t-1)$ out-of-pocket shock. $A_t^i \in \{A^{i,\min}, ..., A^{i,\max}\}$ is period t individual beginning-of-period wealth. M_t^i is the current period medical expenses. $Q_{t+1}^i$is the probability of survival from period zero until period $(t+1)$ and r is the interest rate. We impose a non-borrowing constraint, according to which the individual's current consumption cannot exceed the current available wealth.

In the last working year $t = 65$ there are no medical expenses. We assume that after retirement income does not depend on earnings in the last working year. Therefore, the permanent component of the labor income does not affect the value function in the next period. The level of assets is the only state variable

$$V_t^i(A_t^i) = \max_{C_t^i} \left\{ u(C_t^i) + \beta Q_{t+1}^i E_t V_{t+1}^i(A_{t+1}^i, \eta_t^i, h_t^i) \right\} \tag{21}$$

subject to

$$A_{t+1}^i = (1+r) * (A_t^i - C_t^i) \tag{22}$$

$$0 \leq C_t^i \leq A_t^i \tag{23}$$

For $t = \{30, \ldots, 64\}$, the individual faces longevity and earning uncertainty. The state variables are A_t^i and v_{t-1}^i, where v_{t-1}^i is period $(t-1)$ permanent random component of the individual's labor earning.

The Bellman equation for the dynamic problem associated with the individual's choice problem is given by:

$$V_t^i(A_t^i, v_{t-1}^i) = \max_{C_t^i} \left\{u(C_t^i) + \beta Q_{t+1}^i E_t V_{t+1}^i(A_{t+1}^i, v_t^i)\right\} \tag{24}$$

subject to

$$A_{t+1}^i = (1+r) * (A_t^i - C_t^i) + Y_t^i \tag{25}$$

$$0 \leq C_t^i \leq A_t^i \tag{26}$$

2.6 The Family's Optimization Problem

We split the family's economic problem into three time periods: after retirement $t = \{66, \ldots, 95\}$, the last working year $t = 65$ and the working period $t = \{30, \ldots, 64\}$. We solve it recursively, under the assumption that $A_{96} = 0$.

For the age $t = \{66, \ldots, 95\}$, the family's recursive problem can be written as:

$$\begin{aligned} V_t^f(A_t^f, \eta_{t-1}^{f_1}, \eta_{t-1}^{f_2}, h_{t-1}^{f_1}, h_{t-1}^{f_2}) = \max_{C_t^i} \{ & u(\phi C_t^i) \\ & + \beta Q_{t+1}^{f_1} Q_{t+1}^{f_2} E_t V_{t+1}^f(A_{t+1}^f, \eta_t^{f_1}, \eta_t^{f_2}, h_t^{f_1}, h_t^{f_2}) \\ & + \beta Q_{t+1}^{f_1}(1 - Q_{t+1}^{f_2}) E_t V_{t+1}^{f_1}(A_{t+1}^f, \eta_t^{f_1}, h_t^{f_1}) \\ & + \theta \beta Q_{t+1}^{f_2}(1 - Q_{t+1}^{f_1}) E_t V_{t+1}^{f_2}(A_{t+1}^f, \eta_t^{f_2}, h_t^{f_2}) \} \end{aligned} \tag{27}$$

subject to

$$A_{t+1}^f = (1+r) * (A_t^f - C_t^f - M_t^{f_1} - M_t^{f_2}) \tag{28}$$

$$0 \leq C_t^f \leq A_t^f \qquad and \qquad A_{96}^f = 0 \tag{29}$$

where $V_t^f(A_t^f, \eta_{t-1}^{f_1}, \eta_{t-1}^{f_2}, h_{t-1}^{f_1}, h_{t-1}^{f_2})$ is the period t maximum expected weighted utility of the two family members and $V_t^{f_i}(A_t^f, \eta_{t-1}^{f_i}, h_{t-1}^{f_i})$ for $i = 1, 2$ is the maximum expected utility of family member i if he or she survives alone until period t and is obtained from equation (3). We introduce the parameter ϕ in order to take into account the economies of shared living.

In the last working year $t = 65$ there are no medical expenses and the permanent component of the labor income does not affect the value function in the next period. Therefore the level of assets is the only state variable.

$$
\begin{aligned}
V_t^f(A_t^f) = \max_{C_t^i}\{ & u(\phi C_t^i) \\
& +\beta Q_{t+1}^{f_1} Q_{t+1}^{f_2} E_t V_{t+1}^f(A_{t+1}^f, \eta_t^{f_1}, \eta_t^{f_2}, h_t^{f_1}, h_t^{f_2}) \\
& +\beta Q_{t+1}^{f_1}(1 - Q_{t+1}^{f_2}) E_t V_{t+1}^{f_1}(A_{t+1}^f, \eta_t^{f_1}, h_t^{f_1}) \\
& +\theta\beta Q_{t+1}^{f_2}(1 - Q_{t+1}^{f_1}) E_t V_{t+1}^{f_2}(A_{t+1}^f, \eta_t^{f_2}, h_t^{f_2})\}
\end{aligned}
\tag{30}
$$

subject to

$$A_{t+1}^f = (1+r) * (A_t^f - C_t^f) \tag{31}$$

$$0 \leq C_t^f \leq A_t^f \tag{32}$$

For the age $t = \{30, \ldots, 64\}$, each family member faces life span and earning uncertainty. Let $S_t^f = (A_t^f, v_{t-1}^{f_1}, v_{t-1}^{f_2})$ denote the state vector of family f at age t, where $A_t^f \in \{A^{f,\min}, ..., A^{f,\max}\}$ is the family beginning-of-period wealth, $v_{t-1}^{f_i}$ for $i = \{1, 2\}$ period $(t-1)$ permanent random component of each family's member labor earning and period $(t-1)$ health shock.

The Bellman equation for the dynamic problem associated with the family's choice problem is given by:

$$
\begin{aligned}
V_t^f(A_t^f, v_{t-1}^{f_1}, v_{t-1}^{f_2}) = \max_{C_t^i}\{ & u(\phi C_t^i) \\
& +\beta Q_{t+1}^{f_1} Q_{t+1}^{f_2} E_t V_{t+1}^f(A_{t+1}^f, v_t^{f_1}, v_t^{f_2}) \\
& +\beta Q_{t+1}^{f_1}(1 - Q_{t+1}^{f_2}) E_t V_{t+1}^{f_1}(A_{t+1}^f, v_t^{f_1}) \\
& +\theta\beta Q_{t+1}^{f_2}(1 - Q_{t+1}^{f_1}) E_t V_{t+1}^{f_2}(A_{t+1}^f, v_t^{f_2})\}
\end{aligned}
\tag{33}
$$

subject to

$$A_{t+1}^f = (1+r) * (A_t^f - C_t^f) + Y_t^{f_1} + Y_t^{f_2} \tag{34}$$

$$0 \leq C_t^f \leq A_t^f \tag{35}$$

3 Gain From Marriage

The gain from marriage is measured as the percentage increase in the single individual's initial wealth that is required to make her as well off as if she were a member of a family. The welfare calculations are done in the form of consumption-equivalent variations: for each rule chosen respectively by the single individual and by the married individual we determine the constant consumption stream that makes the individual as well off in expected utility terms as the consumption stream that can be financed by the consumption rule.

For the single individual, we first solve the optimal consumption problem, denoting the optimal consumption stream by $\{C_t^R\}_{t=30}^{95}$. The subscript R indexes the individual optimal consumption rule followed. The expected lifetime utility from implementing $\{C_t^R\}_{t=30}^{95}$ is as follows:

$$V^R = E\sum_{t=30}^{95}\beta^{t-30}\left(\prod_{j=0}^{t-2}Q_j^i\right)\frac{(C_t^R)^{1-\gamma}}{1-\gamma} \tag{36}$$

V^R represents the maximal lifetime utility for an individual who uses the consumption rule $\{C_t^R\}_{t=30}^{95}$.throughout her life. We can then compute the equivalent consumption stream $EC^R \equiv \{\overline{C}^R\}_{t=30}^{95}$.that leaves the individual indifferent between EC^R and between the consumption stream attained from implementing the consumption rule $\{C_t^R\}_{t=30}^{95}$.

$$V^R = E\sum_{t=30}^{95}\beta^{t-30}\left(\prod_{j=0}^{t-2}Q_j^i\right)\frac{(\overline{C}^R)^{1-\gamma}}{1-\gamma} \tag{37}$$

By comparing the last two equations, we obtain:

$$\overline{C}^R = \left[\frac{(1-\gamma)V^R}{\sum_{t=30}^{95}\beta^{t-30}\left(\prod_{j=0}^{t-2}Q_j^i\right)}\right]^{\frac{1}{1-\gamma}} \tag{38}$$

We proceed analogously in the case of the family. We first calculate the optimal family consumption rule $\{C_t^{f,R}\}_{t=30}^{95}$ and the associated expected lifetime utility from implementing the rule. We then obtain the equivalent consumption stream $EC^{f,R} \equiv \{\overline{C}^{f,R}\}_{t=30}^{95}$ that leaves the married individual indifferent between $EC^{f,R}$ and the consumption stream attained from implementing the consumption rule $\{C_t^{f,R}\}_{t=30}^{95}$.

The gain from marriage for each individual i is computed as the percentage gain in equivalent consumption when choosing to get married and adopting the consumption rule $\{C_t^{f,R}\}_{t=30}^{95}$ rather than staying single and adopting the consumption rule $\{C_t^{R}\}_{t=30}^{95}$.

$$Gain\, from\, marriage = \frac{\overline{C}^{f,R} - \overline{C}^{R}}{\overline{C}^{R}} = \frac{(V^{f,R})^{\frac{1}{1-\gamma}} - (V^{R})^{\frac{1}{1-\gamma}}}{(V^{R})^{\frac{1}{1-\gamma}}} \tag{39}$$

4 Numerical Solution

The dynamic programming problem was solved by iterating on the value function. For the retired single individual, the state space is composed of four variables. These are age t, asset A, out-of-pocket medical expenses η, health status h. For the retired couple the state space involves six variables: age t, family asset A, each family member's out-of-pocket medical expenses η and health status h. We 'discretize' the state space. We construct an equally spaced 20-point grid for the assets, a 10-point grid for each individual's out-of-pocket medical expenses and a 3-point grid for each individual's health status. We approximate the density function for the innovation to the out-of-pocket medical expenditure using gaussian quadrature methods. The transition matrix for the health shock is taken from Luo (2006). For the working single individual the state space is composed by three variables: age t, asset A, permanent component of the labor income v. For the working couple the state space is composed of four variables: age t, family asset A and each family member's permanent component of the labor income v. The density function for both innovations to each individual's labor income process was approximated using gaussian quadrature to perform the numerical integration. We assume that husband and wife labor income shocks are uncorrelated. The model was solved using backward induction. We start at age T, assumed to be 95, and we compute the value function for the single individual $V_T^i(A_T^i, \eta_T^i, h_T^i)$ and for the couple $V_T^f(A_T^f, \eta_T^{f_1}, \eta_T^{f_2}, h_T^{f_1}, h_T^{f_2})$ associated with all the possible states in the discretized set. We move backward and solve for the decision rule for the assets, and hence for consumption, in all the periods, starting from age 30.

5 Calibration

5.1 Parameters

This section summarizes how we calibrate the model to the U.S. economy [2]

Table 1 shows the key parameters used in our experiments.

Discount factor	β	0.96
Coefficient of relative risk aversion	γ	2
Coefficient for economies of shared living	ϕ	1
Interest rate	r	0.065
Differential weight applied to family member f_2 utility	θ	1

Table 1: Parameters

5.2 Survival Probabilities

The survival probabilities are the male and female survival rates reported in the Social Security Administration Actuarial Study No.116 for the year 1999.

5.3 Labor Income Process

The labor income process analyzed is described in Gomes et al.(2006). Their analysis is based on Cocco et al.(2005), who estimate age profiles for three different education groups: households without high school education, household with high school education and college graduates. In our baseline simulations, we take the weighted average of the three. The values of σ_u^2 and σ_ε^2 are 10.95% and 13.89% respectively. In simulating the marriage gain for different education levels we use the three distinct processes described in Cocco et al. (2005). The probability of a large negative income shock π equals 2%.

5.4 Medical Expenses

The process for out-of-pocket medical expenses for the retired individual is taken from Scholz et al.(2006). They estimate age profiles for two different education groups, with and without college degree. In the baseline case we take the weighted average of the two. The values of ρ and σ_ϑ^2 are respectively 0.838 and 0.5635. In our simulations of the marriage gain by education level we use the

[2] Even though the product between β and $(1+r)$ is greater than 1, the Euler inequality $\beta(1+r)\frac{u'(c_{t+1})}{u'(c_t)} \leq 1$ is satisfied.

two distinct processes. The process for nursing home expenses is taken from Luo(2006). The probability of nursing home admission $\delta(t, h_t^i, Z_t^i)$ results from a logistic regression of nursing home admission. The health transition matrix is given by:

$$T_{k,j} = \begin{pmatrix} 0.823 & 0.142 & 0.035 \\ 0.327 & 0.486 & 0.187 \\ 0.13 & 0.296 & 0.574 \end{pmatrix}$$

Where $k = 1, 2, 3$ represents $h_{t-1}^i = good$, $h_{t-1}^i = fair$, $h_{t-1}^i = poor$ respectively and $j = 1, 2, 3$ represents $h_t^i = good$, $h_t^i = fair$, $h_t^i = poor$ respectively.

Rivlin and Wiener (1988) estimated the average daily nursing home costs and the average monthly acute care expenses and obtain c^{ac} and c^{nh} to be equal to \$14,381 and \$616.

6 Results

This section presents the results. Table 2 has six panels, each of which shows the marriage gain at different ages. In particular, Panel A reports the gain from marriage in the baseline scenario. In Panel B we assume that both family members have identical survival probabilities. Panel C and Panel D consider changes in the volatility to shocks respectively to permanent labor income and to out-of-pocket medical expenses. Panel E shows the marriage gain for women and men. Panel F presents the marriage gain when the wife is five years older than her husband.

Panel A presents the baseline results. The labor income process and the out-of-pocket medical expenditure process are a weighted average of the processes estimated respectively by Cocco et al.(2005) and Scholz et al.(2006).The single individual's survival probabilities Q_{t+1}^i in equations (18), (21), (24) are a weighted average of the male and female survival probabilities. The gain from marriage curve exhibits an inverted hump-shaped pattern, with two humps. Starting from a value equal to 14.49% at age 30, it grows until age 45, when it falls until age 65. It increases again and reaches a peak at age 75. The first hump reflects the risk-sharing opportunities provided by marriage against earning uncertainty, the second hump shows the risk-sharing opportunities offered against uncertain medical expenses. Along the entire length of life the individuals face longevity uncertainty and the death-risk-pooling opportunities can be quite important, especially at old ages. As a matter the fact, as one becomes older, the uncertainty about the date of death is much greater. The baseline analysis shows that for 45-year-old representative individual pooling risks through marriage is equivalent to about a 30% increase in her consumption than if stayed single. For a 75-year-old the marriage gain is equivalent to increasing one's consumption by about 20%.

Panel B reports the results when we assume that both family members have identical survival probabilities. The results are close to the baseline case; however the marriage gain is slightly higher when both family members have male survival probabilities than when they have female survival probabilities. The difference in the gains between these two cases is particularly relevant at the end of the individuals' life, given that male survival probabilities are lower than female.

Panel C shows the marriage gain as we vary the volatility to shocks to permanent income σ_u. With an increase in the volatility to these shocks, each period earning becomes more uncertain and therefore the risk-sharing opportunities provided by marriage are more relevant. A 45-year-old representative individual can increase her consumption by an amount equivalent to 41% than if she stayed single. This corresponds to about a 13% higher gain than in the baseline scenario.

Panel D shows the marriage gain when we vary the volatility of shocks to out-of-pocket medical expenses. Symmetrical to the previous case, an increase in the volatility of these shocks makes the after-retirement cash on hand more uncertain and increases the after-retirement marriage gain. In particular, a 75-year-old representative individual has a marriage gain equal to 26.94% when σ_ζ equals 0.865, which is about 6% higher than in the baseline case.

Gender is another relevant variable. Panel E reports the marriage gain respectively for men and women. We assume the baseline labor income and out-of-pocket medical expenses processes. However, the single survival probabilities Q^i_{t+1} for $t = 30, \ldots, 95$, in equations (18), (21), (24) are now the male survival probabilities in the former case and the female survival probabilities in the latter. Under our assumption of equal age family members, the wife has a marriage gain higher than the husband does at each age. As a matter the fact, marrying an individual with a higher survival rate (the wife) to one with a lower survival rate (the husband) and assuming an equal consumption (equal weighting) marriage contract, would leave the former slightly better off and the latter slightly worse off than in the baseline case. The difference between male and female marriage gain, even though present at young ages, is particularly important at the end of life, as the husband is much more likely to die and bequest first. The risk-pooling opportunities through marriage guarantee the 30-year-old wife a 20.96% increase and the 30-year-old husband a 7.32% increase of their respective consumption than if they stayed single. For a 75-year-old woman the marriage gain is 58.24%, while the husband faces a loss of 9.71%.

Panel F shows the marriage gain for each spouse under the assumption that the wife is five years older than the husband. We assume the baseline labor income and out-of-pocket medical expenses processes. In addition, we assume that both spouses work for 35 years and then they retire. In this case, the husband faces a positive and significant after-retirement marriage gain. The wife's marriage gain decreases with respect to the baseline female gain, but it is still positive. In addition, the two spouses' gains are closer to each other and therefore both spouses' incentive to leave the marriage contract declines.

	Age				
	30	**45**	**60**	**75**	**90**
A.Baseline	14.49%	28.68%	23.85%	20.77%	2.48%
B.Identical Survival Probabilities					
Male Survival Probabilities	14.55%	28.31%	22.66%	37.47%	12.57%
Female Survival Probabilities	12.49%	24.49%	19.12%%	19.08%	6.8%
C. Labor Shocks					
$\sigma_u = 13\%$	19.75%	41.55%	25.11%	17.4%	1.21%
$\sigma_u = 7\%$	10.54%	18.37%	22.87%	28.93%	5.12%
D. Health Shocks					
$\sigma^2_\zeta = 0.865$	15.08%	28.68%	24.1%	26.94%	2.85%
$\sigma^2_\zeta = 0.26$	14.49%	28.67%	23.72%	15.64%	1.92%
E. Gender					
Female (Baseline)	20.96%	37.64%	37.92%	58.24%	29.11%
Male (Baseline)	7.32%	17.81%	7.19%	-9.71%	-25.62%
F. Different Age					
Female, 5 years older than her husband	16.04%	29%	25.41%	23.41%	3.22%
Male, 5 years younger than his wife	10.17%	21.88%	14.79%	16.17%	11.35%

Table 2: Gain From Marriage for the Representative Individual

6.1 The Gain From Marriage by Gender and Education

Our model allows us to calculate the gain from marriage according to the spouse's gender and education. In simulating the marriage gain for different education groups, we use the labor income and the out-of-pocket medical expenses processes as estimated respectively by Cocco et al. (2005) and by Scholz et al. (2006). When the gender is taken into consideration, we use distinct survival probabilities in equations (18), (21), and (24).

Our results can be useful in explaining the existing schooling homogamy among college graduates (i.e., the correlation between the wife's and the husband's schooling), even though for each individual, regardless of her education level and gender, the best partner is a college graduate. In fact, college graduates have the highest potential earnings and lowest potential medical expenditure. There is a vast literature on marriage and assertive mating, but we limit the review to two recent papers that deal specifically with schooling homogamy. U.S. Census and Current Population Survey (CPS) data are exploited in both of them. Mare (1991) analyzes the probability that spouse education levels differ at various education levels using a "crossing model". He finds that between the 1930s and the 1970s the association between spouses' schooling grew, while in the 1980s it was stable or decreased He motivated this trend as a consequence of the time gap between marriage and schooling. During the period 1930-1960, the gap decreased following a decline in age for first marriage and an increase in educational attainment. On the other side, it increased in the 1970s and 1980s because of an increase in age at marriage. Mare observes that highly educated individuals are likely to marry individuals with the same schooling level. Unlike Mare, Pencavel (1998) finds an increase in schooling homogamy during the period 1960-1990. He explains this different result considering the availability of data from the 1990 Census. He attributes his finding to the increase in labor force participation of wives. In an assortative mating framework, this could lead to an increased emphasis placed by the husband on the wife's potential earnings, and therefore on her education.

In particular, we find that each individual, regardless of her educational level and gender, obtains a higher marriage gain from marrying a more educated individual and a lower marriage gain from marrying a less educated individual than in the baseline case. The greater the difference in the level of education of the two spouses, the greater the marriage gain for the less educated spouse while the lower the gain for the more educated one. On the other side, by marrying an 'educationally homogamous' individual, one obtains a gain close to the baseline gain. As follows, we report two examples. The first considers a marriage between a female without high school education and a college graduate. The second considers the marriage between a female college graduate and a male without high school education. Our results show that in both cases the college graduate would be better off from marring an 'educationally homogomous' individual.

A 30-year-old female without high school education has a marriage gain of 43.71% by marrying a college graduate. On the other side, a 30-year-old male college graduate faces a loss of about 4% by marrying a woman without high-school education. Therefore, the 30-year-old male college graduate is likely to look for a wife with the same education level, which guarantees him an increase in his consumption by about 7% than if he stayed single.

A 30-year-old man without high school education has a marriage gain of about 30% from marrying a college graduate, which is 22% higher than the male baseline gain. However a female college graduate has a marriage gain of 8.51%, which is 12% lower than the baseline female gain. The woman is significantly better off when marrying a college graduate, in which case the marriage gain is about 21%.

We also find that, at young ages, the gap between the lowest marriage gain, which the spouse obtains from marrying a less educated person, and the highest gain, which is obtained from marrying a more educated one, is quite relevant. In particular, at age 30, it is in the range 10-20% for both men and women and reflects the expectations of the spouse's future earnings. However, as individuals age, the gap decreases significantly and for 75-year-old individuals is in the range between 5 and 10%.

Table 3 shows that women experience the highest marriage gain at the end of their life. It is about 55%, 50% and 40% respectively for a 75-year-old without high school education, with high-school education and with college education. This important marriage gain for a female reflects, not just the risk-sharing opportunities against uncertain medical expenses, but mostly the death-risk-sharing opportunities. The husband's promise to leave his possessions to the wife together with the two spouses' shared accumulated assets act as a kind of insurance policy. In particular, the agreement to share until death and bequeath future support acts as an annuity. This allows the wife to increase her consumption than if she stayed single. On the other side, for 75-old-year men without college education the marriage gain is close to zero, while male college graduates face a loss of about 20%, regardless of their wives' education level. Every 90-year-old man faces a marriage loss. Given the expectation of dying before his partner, the man would be better off to consume at a faster rate at the end of his life. However, when participating in an equal weighted marriage contract the man is forced to consume at a slower rate than the optimal one and this decreases his end-of-life utility.

	Age				
	30	**45**	**60**	**75**	**90**
Female without High School					
Husband without High School	25.95%	39.07%	37.23%	61.73%	30.58%
Husband with High School	30.31%	43.35%	39.1%	62.43%	30.93%
Husband with College	43.71%	52.77%	45.84	87.78%	53.94%
Female with High School					
Husband without High School	18.26%	31.47%	35.00%	60.16%	29.06%
Husband with High School	22.11%	35.3%	36.80%	60.85%	29.47%
Husband with College	34.38%	43.94%	43.01%	68.92	30.70%
Female with College					
Husband without High School	8.51%	26.25%	29.19%	44.45%	24.17%
Husband without High School	11.76%	29.70%	31.12%	44.96%	24.52%
Husband with College	20.78%	37.63%	36.44%	49.71%	25.54%

Table 3: Gain for Women for Different Education Level

	Age				
	30	**45**	**60**	**75**	**90**
Male without High School					
Wife without High School	12.85%	19.61%	6.87%	-3.67%	-23.44
Wife with High School	16.82%	23.42%	8.42%	-1.18%	-23.19%
Wife with College	29.2%	31.83%	13.71%	1.85%	-22.48%
Male with High School					
Wife without High School	6%	12.4%	2.32%	-11.5%	-27.44%
Wife with High School	9.49%	15.86%	6.29%	-4.66%	-23.92%
Wife with College	20.85%	23.54%	11.39%	0.29%	-23.20%
Male with College					
Wife without High School	-4.02%	7.81%	0.47%	-22.39%	-30.89%
Wife with High School	-1%	10.87%	1.81%	-22.12%	-30.7%
Wife with College	7.10%	17.89%	6.43	-20.21%	-30.64%

Table 4: Gain for Men for Different Education Levels

6.2 The Economies of Shared Living

The needs of a household grow with each additional member, but, because of economies of scale in consumption, not in a proportional way. Needs for electricity, housing space, etc. will not be two times as high for a family with two members as for a single person. Equivalence scales are used to assign each household type in the population a value in proportion to its needs. The most commonly used scales are the following. The *OECD equivalence scale* assigns a value of 1 to the first household member, of 0.7 to each additional adult, and 0.5 to each child. The *OECD-modified equivalence scale* assigns a value of 1 to the head of the household, of 0.5 to each additional adult member, and 0.3 to each child. The *Square root scale* divides household income by the square root of the household size. There is no generally accepted method for determining equivalence scales and the choice of a particular equivalence scale is a function of technical assumptions about economies of scale in consumption. In our model, the economies of shared living are introduced by multiplying the two family members' joint consumption by the parameter ϕ. In the baseline scenario, ϕ equals 1, which implies that the needs of a household grows with each additional members in a proportional way. That is, two family members have double the needs of a single individual. At the other extreme, if two people can live as cheap as one individual, then the parameter ϕ takes value 2. Since there is no generally accepted equivalence scale, we consider the marriage gain when the parameter ϕ takes the intermediate values 1.25, 1.4, 1.5, and 1.75. All the other variables are as in the baseline scenario.

Table 5 reports the marriage gain for different values of ϕ. As ϕ increases, the marriage gain increases proportionally.

			Age		
	30	**45**	**60**	**75**	**90**
ϕ.=1.25	39.80%	55.72%	47.61%	33.17%	17.83%
ϕ.=1.4	54.34%	70.65%	69.43%	38.13%	26.99%
ϕ.=1.5	63.98%	81.1%	69.31%	43.75%	32.81%
ϕ.=1.75	87.14%	104%	88.62%	52.39%	49.78%

Table 5:Gain From Marriage and Economies of Shared Living

7 Conclusion

This paper provides a quantitative analysis of the economic gain from marriage. We present the family as an institution which provides risk-pooling opportunities against three main uninsurable risks: the risk of death, the risk of job loss, and the risk of health expenditure. We show that the risk-sharing advantage from marriage is associated with the specific characteristics of the spouse. The opportunity of pooling risks through marriage acts not only as a kind of insurance policy but also as an incentive for college graduates to marry 'schooling homogamous' individuals. In general, any individual, regardless of her gender and education, obtains the highest increase in her consumption from marrying a highly educated individual. This results from the fact that the education level significantly affects the labor income process and the medical expenses process and, therefore, indirectly affects the marriage gain. We assume that the two family members' labor income processes are uncorrelated. A more realistic model should take into account the possibility of correlation between the spouses' permanent labor income shocks.

Our main goal is to simulate the marriage gain as a result of the risk-sharing opportunities provided by the institution of the family. Therefore, in our study we do not take into account the economies of shared living until the last paragraph. Our main finding is that risk-sharing opportunities can be quite important, even though the economies of shared living are the dominant factors in determining the gain from marriage.

Our model presents two main limitations. Firstly, it simulates the marriage gain in absence of private and public insurance markets. The Social Security System, Medicare, other welfare programs, and private insurance markets can significantly reduce the economic incentive for family formation. Secondly, we abstract from the study of the effect of the US different tax treatment toward married and single individuals on the gain from marriage. Tax bonuses, calculated as the difference between the income tax that a couple pays and the amount that the single individual pays, undoubtedly increase the marriage gain. Both of these mechanisms are left to further research. Even with these limitations, this paper provides strong support for the life-cycle model as a good tool for the simulation of the marriage gain at different ages. More importantly, it shows that family insurance is particularly significant, even in small families.

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